

UNDERSTANDING THE EFFECTS ON STUDENTS AND STUDENT LEARNING
THROUGH TEACHING MATHEMATICS AND SCIENCE IN AN EXPERIENTIAL
ALL-OUTDOOR CLASSROOM

by

Michael John Haiderer

A professional paper submitted in partial fulfillment
of the requirements for the degree

of

Master of Science

in

Science Education

MONTANA STATE UNIVERSITY
Bozeman, Montana

July 2015

©COPYRIGHT

by

Michael John Haiderer

2015

All Rights Reserved

TABLE OF CONTENTS

1. INTRODUCTION AND BACKGROUND1

2. CONCEPTUAL FRAMEWORK3

3. METHODOLOGY12

4. DATA AND ANALYSIS17

5. INTERPRETATION AND CONCLUSION23

6. VALUE25

REFERENCES CITED.....30

APPENDICES32

 APPENDIX A: Institutional Review Board Exemption.....33

 APPENDIX B: Freshwater Ecology Handout35

 APPENDIX C: Survival Skills Handout.....47

 APPENDIX D: Land Navigation Handout57

 APPENDIX E: Alpine Ecology Handout70

 APPENDIX F: Standards List77

 APPENDIX G: Freshwater Ecology Pre and Posttest81

 APPENDIX H: Survival Skills Pre and Posttest.....88

 APPENDIX I: Land Navigation Pre and Posttest.....99

 APPENDIX J: Alpine Ecology Pre and Posttest111

 APPENDIX K: Pre and Posttest Outdoor Classroom Interview116

 APPENDIX L: Pre and Posttest Outdoor Classroom Survey119

LIST OF TABLES

1. Data Collection Matrix15

LIST OF FIGURES

1. Normalized Gains for Water Ecology Trip.....	17
2. Normalized Gains for Survival Skills Trip.....	18
3. Normalized Gains for Land Navigation Trip.....	19
4. Normalized Gains for Alpine Ecology Trip.....	19
5. Average Normalized Gains from All Trips	20
6. Listing of All Student Pretest and Posttest Scores.....	21

ABSTRACT

Outdoor education has been on the decline over the past few decades as funding for education has been reduced and the importance of standardized tests has increased. I wanted to see if I could teach the same math and science standards that students would learn in a traditional school setting in the context of outdoor education. This study tested the effects on student learning and students themselves through their participation in an experiential all-outdoor classroom. Outdoor education is a teaching method, not a subject. I took students on four daylong trips to learn math and science standards through experiential learning in the outdoors. The triangulation method was used to answer my purpose of study question. Pre and posttest were used to determine how each student learned. Pre and post interviews and surveys were used to gather students' thoughts about their participation in the outdoor classroom. The results showed that students experienced high levels of learning through participation in an all-outdoor classroom. Additionally, the outdoor classroom was a positive learning experience, and all students interviewed expressed interest in attending in the future.

INTRODUCTION AND BACKGROUND

In the summer of 2013, I took a graduate class called Alpine Ecology through the Master of Science in Science Education (MSSE) program at Montana State University. The entire week was spent at Jack Creek Preserve and the surrounding areas of Big Sky, Montana. This class was unlike any other class I ever attended in my 20 years of formal education, mainly because this class was not taught inside a school building. Every day we hiked into the alpine zone, upwards of 13 miles round trip, to study different aspects of the unique plants and animals, as well as the numerous abiotic factors that make an alpine ecosystem unique. Aside from a few evening lectures and class presentations, the entire class was taught outside, with all of the learning done on the mountain through observation and discovery. This was not my first time learning outside a traditional classroom during the school day.

I remember taking field trips in grade school where we might go out into nature for the day. In the 6th grade I even got to go to a nature center for a week. These field trips were fun and I learned many things, but current educational processes make these types of activities the exception, not the rule. While hiking up a mountain in Alpine Ecology, I thought about what it would be like to teach or attend a school like this. A school where students engage in learning through their interaction with nature. What would it take to make this type of learning experience an everyday occurrence? Why does learning need to be done inside the walls of a school? In my short five years of being a professional educator, I have taught at three different schools in three different countries on two different continents. I have had six different principals and four assistant

principals. I know teachers from nearly all 50 states and eight countries in Europe and Asia. Everywhere I look I see educational systems set up in a similar fashion. Students congregate in a building, at the convenience of the system, to learn. These stone walls of a school, by nature, are void from all real world application, yet students are expected to understand how they will use math, science, language arts, etc. in their daily lives. I think that learning is best done in a real life context, and that the walls of a classroom actually deter true learning. I believe that outdoor education can provide this real life context. Used correctly, outdoor education is a teaching method, not a subject (Bunting, 2006).

The standards that I taught were all from the high school math and science courses from the Department of Defense Dependent Schools. In order to teach a complete unit at each outdoor location, I carefully selected standards from many different grade levels and subjects. The locations dictated which standards could be taught because the location needed to have a suitable area for hands-on learning. I decided that the best way to teach the standards and monitor students' experiences was during daylong Saturday trips. To form my study group, I asked for student volunteers in the community that were interested in participating in an all-outdoor classroom using experiential learning.

The students in my study were a mix of homeschooled and traditional schooled children stationed at Vicenza Army post in Vicenza, Italy. The study included seven students. Three were homeschooled and four attended a traditional middle school. The students consisted of three boys and four girls. The ethnicities of the students were mixed. Four students classified themselves as Caucasian, two classified themselves as Hispanic, and one classified as Pacific Islander.

My focus statement for this study was, *What are the effects on students and student learning through teaching mathematics and science in an experiential all-outdoor classroom?*

CONCEPTUAL FRAMEWORK

Research shows numerous benefits of outdoor education as well as benefits for simply being in the outdoors or experiencing green space. Bunting (2006) defines it as, “Outdoor education is education in, for, about, and through the outdoors” (p. 4). Outdoor education is composed of three parts: extensions, content, and teaching method. The act of extension is taking the learning activity out of the traditional classroom and into a natural environment. Content is the information being presented to the students. This can consist of traditional state or national standards as well as typical outdoor skills like archery and fire starting. The final part is the teaching method, which is solely outdoor education. “Outdoor education as a teaching method links the cognitive, affective, and psychomotor domains of learning” (Bunting, 2006, p. 4). The proper application of outdoor education uses outdoor activities to initiate and deliver the study of standard curriculum materials.

Outdoor education is a great alternative teaching method. Similar to traditional classroom education, the mental self is active through thinking and questioning. Unlike the traditional classroom however, the physical self is active and moving as well. The emotional self is also feeling and engaging due to the body and mind being active. Outdoor education has four fundamental principles. First, it needs to be experiential learning. Likewise, there needs to be some connection with the natural environment.

Third is that time needs to be set aside for reflection, generalization, and application.

Finally, it should be taught interdisciplinary (Bunting, 2006).

Outdoor education lends itself to the idea of experiential learning. The Association for Experiential Education's definition is, "Experiential education is a philosophy and methodology in which educators purposefully engage with learners in direct experience and focused reflection in order to increase knowledge, develop skills, and clarify values" (Bunting, 2006, p. 5). Experiential learning consists of a four-step cycle. Experiencing is the first step, where students are directly engaged in an experience, usually physically active. Reflecting is the second step, where the students reflect on the experience through questions and prompts from the teacher. Generalizing is the third step, where students consider what meaning the activity had and how that meaning might relate to other areas of life not directly relating to the experience. Applying is the fourth step, where students apply what they realize in the generalization step. The application can be another experience and the entire process can continue, creating a cycle of learning (Bunting, 2006).

During experiential learning, learning comes from reflecting on the experience and the debriefing process. The experience cannot be self-standing. Time needs to be planned into the lesson for reflecting, generalizing, and applying, but extra planning needs to be given to plan the outdoor part of the lesson. Proper planning by the teacher must be done to ensure the success of the experience (Bunting, 2006).

Science education traditionally occurs in three locations: classrooms, labs, and the outdoors. The outdoors is the least utilized place of learning. This is due, in part, to the

large amounts of time, required to organize and plan a fieldtrip or any other educational experience outside of the classroom. Student learning and achievement can be maximized through proper planning. For example, students are more comfortable in familiar locations. To help students become familiar with a location, the teacher can show maps and pictures in class to help students become familiar with the location before arriving (Orion, 1994). Visual aids are also extremely useful to help students make the connections the teacher had planned (Bunting, 2006).

Even if students are familiar with a location, the outdoors can provide factors that reduce a student's comfort level. These factors include weather and difficult terrain. Difficult terrain would cause students to physically exert themselves more than they usually do, making them more uncomfortable. Weather can also put a damper on student's attitude if it is too hot or cold. Proper planning and communication by the teacher can help students prepare for inclement weather and difficult terrain. Interestingly enough, the attractiveness of the environment can actually distract students from physical stressors (Orion, 1994).

The use of groups is almost a necessity because of the nature of some of the outdoor activities. Group problem solving is typically a goal of outdoor education. When students are placed in situations where they have little background knowledge, they will need to work together to solve the problem. When the entire group makes the decision, it will most likely be better than one made by individuals. The focus is not on the outdoors or the survival scenario, but the group problem solving that can result from a successful outdoor experience (Keller, 2005).

Different factors must be considered and addressed by the teacher for field trips to be most effective. For students to see the relevance, a field trip needs to be an integral part of the curriculum rather than a standalone activity. The placement in the unit also plays a critical role in student achievement. By placing the trip early in the unit, student interest will be sparked early on and potentially show students an application of the topic at hand. Another variable that influences student learning is students' previous psychological ideas of the purpose of field trips. Interviewed students categorize field trips to be either adventure/recreation or learning/educational. The students who thought the purpose of field trips was adventure/recreation were not in the right frame of mind to learn if they showed up on a field trip geared toward learning. Proper communication ahead of time from the teacher can help prepare students to have the best learning experience possible (Orion, 1994). The teacher also has to prepare him or herself to be a teacher of outdoor education rather than a traditional classroom teacher.

During the outdoor experience, the teacher has to refrain from being a provider of knowledge, and instead, become a facilitator. Characteristics of an effective facilitator are to know the larger picture of why the students are doing what they are doing, anticipate how to use student failures in a positive way, and provide time after each activity for reflection on the activity. An effective facilitator should also take the focus off of him or herself and put it onto the students and end each activity on a high note (Bunting, 2006).

The importance and benefits of outdoor education are numerous as indicated by the growth of freshman experience programs by numerous universities and colleges all over the country. Torsney (2008), an employee of West Virginia University, took

incoming freshman out into Allegheny National Forest for five days. She found that without modern day distractions and in between the outdoor activities, students bonded and formed support groups. Students found the support system they needed for the upcoming semester through the bonding opportunities brought forth by the outdoor program. Torsney said, “they came out of the woods stronger people and more serious about their education” (p. 27). Studies found that students who participate in this type of program before beginning their freshman year have a higher retention rate from their first year to their second.

The concept of outdoor education and experiential learning is not new. In 1967, Kingsley L. Greene called for an increase of opportunities for outdoor education. People who do not appreciate the outdoors are far more willing to use it irresponsibly than people who do appreciate it. Two reasons exist behind this problem. First is an unconcerned attitude people have about nature, because when the true severity of the situation is realized they will not be around. Second is the general lack of concern for, and interest, in living things (Green, 1967). Experiential learning was around in the 18th century. Jean-Jacques Rousseau (1712-1788) and Johann Heinrich Pestalozzi (1746-1827) supported learning from direct experience rather than through traditional classroom means. John Dewey (1859-1952) thought problem solving was best done through direct experience (Blunting, 2006).

Outdoor education does not just benefit the academically minded students. Marlowe, Pearl, and Marlowe (2009) worked with the School of Urban Wilderness Survival. This school was designed to help reclaim troubled, challenged, and

unmanageable adolescents. Students, wilderness counselors, and a therapist spent approximately sixty days out in the wilderness with the goals of mastering wilderness and social-emotional skills. The students' journeys promote self-awareness and age appropriate goals. Throughout this program students experienced elements such as belonging, mastery, independence, and generosity that are essential for positive youth development.

These four elements are vital to the success of the School of Urban Wilderness Survival. All students need to be an integral part of the team, and therefore, students learn their actions, or lack thereof, have direct consequences for everyone involved. Natural consequences are also emphasized. Mother nature is cruel and swift in her punishments. If students fail to do a required task, they will soon realize their lack of preparedness and will have no one to blame but themselves. Over the course of the trip, the students are gradually given more responsibility and are required to demonstrate mastery of the wilderness and their social-emotional skills. When students leave the woods, they are ready to make a positive change in their lives (Marlowe, et. al, 2009).

Outward Bound schools produced similar results for at-risk adolescents. The use of the outdoors is a critical component of success. Several mechanisms exist that "respect the learning needs of the delinquent and virtually seduce him into achievement almost in spite of himself" (Golins, 1978, p. 26). In this program, the teaching was done through game-like methods. The use of games produced an atmosphere that was less threatening and easier in which to participate. Additionally, students were arranged in small peer groups, which allowed for strengths to be maximized and weaknesses to be minimized.

The problems were designed in a way that the students already possessed the capability to successfully solve them, but would experience stress in the process. The instructors were also of vital importance, because they were with the students all day and all night. If at any point a teachable moment arose they could capitalize on it.

D'Amato and Krasny (2011) list four elements that are important to positive personal growth gained by students through outdoor education. These elements are "living in pristine nature, experiencing a different lifestyle, being part of the course community, and dealing with intensity and challenges of the course" (p. 242). These results were found through 23 participant interviews after an outdoor adventure education experience. Participants experienced moments when they physically gave up. The environment of the course was so challenging, because of the high intensity and isolation, they could not continue. The participants that physically gave up then experienced psychological releases that allowed them to reveal their own personal strength when they were able to press on (D'Amato & Krasny, 2011).

Outdoor education also meets seven needs that are found in today's educational system. These include the need for effective learning, the need for basic concepts, the need for realism, the need for awareness, the need for appreciation of nature, the need for understanding the impact humans have on the environment, the need for improved physical fitness, and the need to relate to others (Bunting, 2006).

The outdoors offer benefits not just to students that take classes in the wilderness, but to those who simply spend time in green space. Some studies suggest that nature can be used to help treat Attention-deficit/ hyperactive disorder (ADHD). This is because

being close to nature helps boost a child's attention span. "New evidence suggests that the need for such medications is intensified by children's disconnection from nature" (Louv, 2008, p. 50). This disconnection from nature starts at a young age. In the time that has elapsed since today's parents were children, true nature has disappeared from many communities. Over this past generation, the drop in the level of outdoor play has been substantial. In a survey of today's mothers, 71% of them said they played outside everyday, while only 26% of them say their own children play outside at least once a day. The sad part is, children do not even know what they have not experienced due to their lack of exposure to nature, thus they never know and experience nature like previous generations (Louv, 2008).

Numerous studies performed all over the world have shown a link between children's physical and academic abilities and an increased amount of time spent in natural green spaces as opposed to manmade environments. In a Swedish study between two daycares, one urban and one rural, children in the rural daycare had better motor coordination and more ability to concentrate than children in the urban daycare. In a similar study in Norway and Sweden, results showed that children who played in natural areas, as opposed to manmade playgrounds, tested better in balance and agility (Louv, 2008).

Nature provides a powerful means to shape and change the moods of individuals. A Texas A&M study showed that within five minutes of looking at images of a natural landscape, a participant's muscle tension and pulse declined after experiencing a stressful experience. A University of Washington study suggests that humans' visual environment

strongly affects their physical and mental being. These findings all make sense when we look at the history of humans. For thousands of years, this visual environment has been nature. “Our brains are set up for an agrarian, nature-oriented existence, that came into focus five thousand years ago” (Louv, 2008, p. 103). In current times, hyperactive and energetic boys are put on Ritalin and other medications. In an agricultural society, one found less than 100 years ago, these same boys were prized for their strength, speed, and agility. Up until the 1950s most homes had some type of agricultural outlet for children to work. In less than 100 years, humans are attempting to undo what nature has had in place for thousands. Today’s children are paying the price for it (Louv, 2008).

Despite the success stories of outdoor education and the importance of nature, outdoor education has experienced a decline. Outdoor education provides opportunities for students to reunite with nature through use of meaningful and exciting experiences. However, outdoor education is not considered a part of the core curriculum. Due to this, it is the first thing to go if a school board needs to make a budget cut. Outdoor education is more important now than ever before because children are not getting as much outdoor exposure. For outdoor education to survive, it needs to become integrated and therefore considered a vital part of the school’s overall purpose, which is to educate children. It needs to be a method that can assist teachers with their teaching and enforce standards from the general classroom, not a standalone activity. As long as outdoor education is not deemed to be a part of or relating to the curriculum, it will be at risk of being cut. For outdoor education to survive it needs to become interdisciplinary (Glew, 1994).

Interdisciplinary is simply defined as pertaining to more than one subject. The lesson simply does not independently teach a math and a science objective, but the lesson needs to be designed in a way to show the connection between the two subjects. Outdoor education easily lends itself to the use of interdisciplinary instruction, but the teacher needs to plan it into the lesson. Connections are often missed if the teacher does not plan for the students to see the connection. Teachers need to plan the activity in a way that promotes students to apply the information to further themselves in the activity. Students will also be more likely to remember information when it is associated with a memorable activity. If a student views the information they are supposed to learn as just for the sake of learning something without a real world tie, it is usually forgotten (Bunting, 2006).

METHODOLOGY

My goal for this project was to determine the effects on students and their learning through teaching mathematics and science in an experiential all-outdoor classroom. Participation in this research was voluntary and did not affect a student's grade or class standing in any way, whether they participated or not. The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained (Appendix A).

All four trips to the outdoor classroom were day trips. Every trip had a learning packet (Appendices B-E) that allowed for students to write down the things they were studying. These also showed pictures of what we would be doing and included any necessary math equations for the activities. A total of 28 standards were taught through

the outdoor classroom. The complete listing of the standards and the related subject area is also included in the packet (Appendix F).

Large amounts of planning and preparation were done for each of the trips. I traveled to each trips location at least twice prior to taking students. The first trip was to scout out the area and see if it provided the necessary land features required for me to teach what I wanted to teach. Throughout the next week or so I planned out what I was going to teach the students and then made the learning packet and pre and posttest. The weekend prior to the trip I went back to the area to make sure nothing had changed. I then took photos of the area and made maps to give to the students to give them an idea of where we were going and what we were doing.

The trip to the outdoor classroom to study freshwater ecology was to a trout stream. Students first found the vertical cross-sectional area of a stream through use of the trapezoidal method. They then used oranges to find the velocity of the stream and then multiplied the velocities by the trapezoidal areas to find the discharge of the stream. They also investigated the importance of trout in a stream and studied a dead trout to learn about the adaptations trout acquired to live in fast flowing current. On this trip, students also learned about photosynthesis, found macro invertebrates in the water, and drew their own food chain to demonstrate energy flowing through the ecosystem. Prior to the trip, students built an underwater robot to investigate the benthic zone of a nearby lake. While building this robot, students were able to learn about AC and DC current. The trip to the outdoor classroom to study survival skills was a three fold investigation of building shelter, finding food, and cooking food. Students first read about the different

types of survival shelters from a survival book. They then gathered natural materials from the surrounding area. They designed and built small shelters in which a hot water bottle could be placed. Students measured the temperature of the water for one hour to see which type of shelter had the best insulating properties. After one hour students then graphed their results and compared theirs with the rest of the class's results. Students learned about projectile physics through shooting arrows from a bow and geometric probability by throwing tomahawks. Finally, they also had the opportunity to learn the anatomy of a chicken as they cleaned and prepared the chickens to eat.

The trip to the outdoor classroom to study land navigation was an investigation of how to navigate using only a compass and topographical map, and how to measure distance by counting steps. Students went to a piece of public forest that was pre-set with land navigational markers. First the students learned about the magnetic field of the Earth and the difference between true north and magnetic north. Next, students learned how to read the index lines of a topographical map and to understand scale factor. Following this, they learned how to find their exact location on a topographical map using the grid system as well as investigated the difference in accuracy between a six-digit coordinate and an eight-digit coordinate. Students were then given coordinates and had to determine their bearing and distance. Lastly, they learned that they were actually making vectors while they were walking. They were able to add the vectors together to navigate with more accuracy to the farther away points, using the closer points as checkpoints.

The trip to the outdoor classroom to study alpine ecology consisted of hiking 10 miles from an old growth forest to the nearly bald mountain peak. The overarching

question of this trip was, “What defines the alpine ecosystem.” Students studied the changes of abiotic and biotic factors on the hike up and graphed them. They viewed areas that had experienced avalanches in years past and learned about the process of ecological succession. Students also were able to investigate different samples of rocks that were experiencing mechanical and chemical weathering.

The triangulation method was used to answer my purpose of study statement (Table 1). My first data collection method was The Outdoor Classroom Pre and Posttest (Appendices G-J). Each standard addressed had a multi-point question on the pre and posttest. Due to each trip’s unique location, every trip had different pre and posttests associated with the different standards. The data from these tests were analyzed to show a decrease, increase, or no change in a student’s comprehension of the standards. A normalized gain statistical test was conducted to determine the changes in the scores.

Table 1
Data Collection Matrix

Research Question	Data Source 1	Data Source 2	Data Source 3
Is an outdoor school as effective as a traditional school?	The Outdoor Classroom Pre and Posttests	Outdoor Classroom Survey	Outdoor Classroom Interview

Student attitudes pertaining to education, both in a traditional classroom setting as well as the outdoor classroom, were assessed using two methods. The Outdoor Classroom Interview (Appendix K) was used to assess student attitudes towards education, both traditional schooling and outdoor classroom. These interview questions had more of a

focus on the feelings of learning math and science and spending time in the outdoors as opposed to the Outdoor Classroom Survey. Both of these instruments were used to compare students' before and after opinions of learning mathematics and science in the outdoor classroom. Student responses were categorized as positive, negative, or neutral. The results from the post interview were compared to the pre interview to see if a student's attitude towards learning math or science had changed. Two of the questions asked students about their best and worst outdoor science experience. These were strategically placed in the interview to see if one of the lessons of the outdoor classroom became one of the students best or worst outdoor experience. Before administering either test, I told students to tell me the truth of their experience of feelings, not what they thought I wanted to hear.

The Outdoor Classroom Survey (Appendix L) consisted of 10 questions using a Likert scale from 1 to 5 to assess students' feelings towards math and science education. The Likert scale was 1= *strongly disagree*, 2= *disagree*, 3 = *neutral*, 4 = *agree*, and 5 = *strongly agree*. Students put their names on the pre and post surveys. When it was time to analyze the data I matched the students' pre/post surveys up and then cut the names off in order to keep the student's identities unknown. Results were analyzed in two ways. For select questions, students' feelings on their post-survey were simply analyzed. These questions compared the outdoor classroom to the student's traditional means of going to school. Other questions attempted to document a change in students' feelings as a result of their participation in the outdoor classroom. Pre-survey results were compared to post-survey results for these particular questions. The changes from pre to post were measured

as being positive, neutral, or negative. Positive results had a higher post-survey rating than the pre-survey. Neutral results had the same rating on the pre/post survey. Negative results had a higher pre-survey rating than post-survey.

DATA AND ANALYSIS

This study yielded quantitative and qualitative data. The quantitative data consisted of the pretest and posttest from each trip to the outdoor classroom, four in total. These tests assessed the knowledge that the students learned as a direct result of attending the outdoor classroom. The normalized gains statistical test was performed on all the student pre/posttests. Normalized gain, G , is the change in the score divided by the maximum possible increase. $G = (\text{posttest \%} - \text{pretest \%}) / (100 - \text{pretest \%})$

All students scored higher on the Water Ecology Posttest compared to the Pretest (Figure 1). All students had a normalized gain of over 0.5. This trip yielded the highest individual normalized gain, 0.95, out of all the trips.

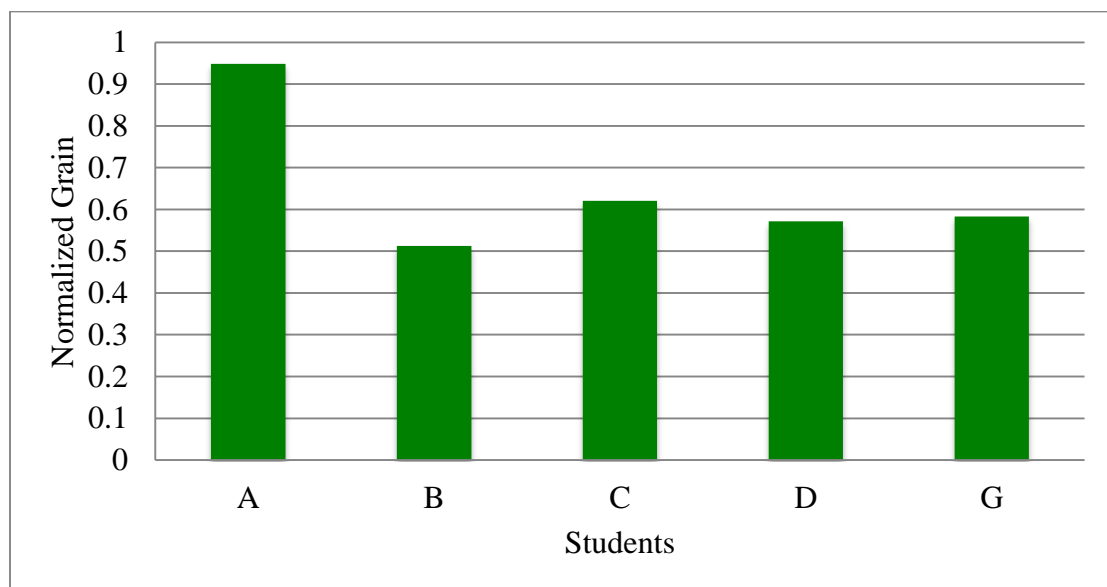


Figure 1. Normalized gains for water ecology trip, ($N=5$).

All students scored higher on the Survival Skills Posttest compared to the Pretest (Figure 2). The survival skills trip was the only trip where all seven students attended. All seven students had a normalized gain higher than 0.29. The average normalized gain was 0.56.

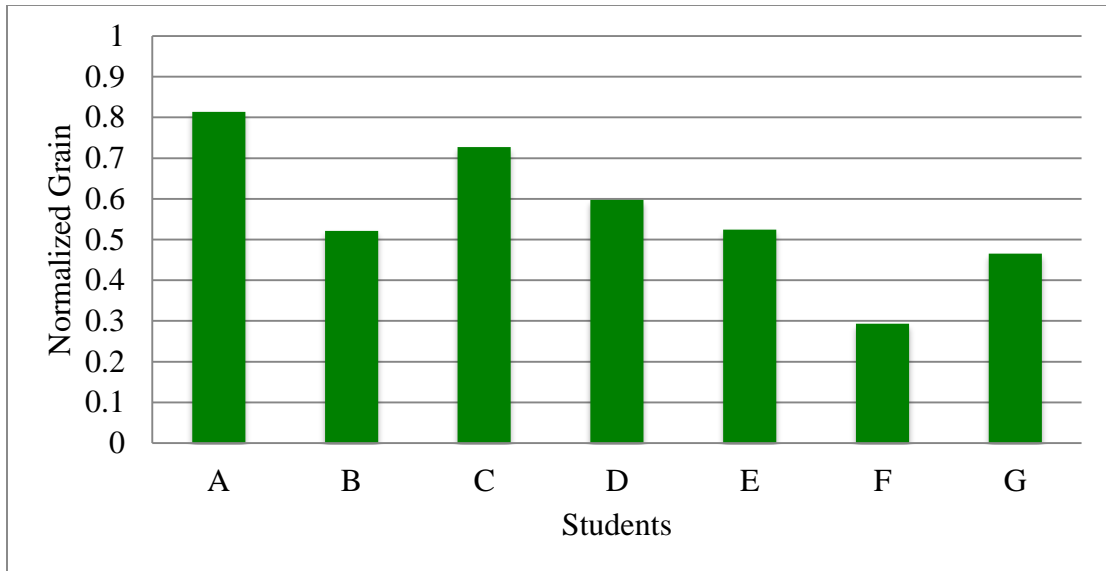


Figure 2. Normalized gains for survival skills trip, ($N=7$).

All students scored higher on the Land Navigation Posttest compared to the Pretest (Figure 3). All of the students had a normalized gain higher than 0.6. The average normalized gain was 0.78. This is the highest average out of all four trips.

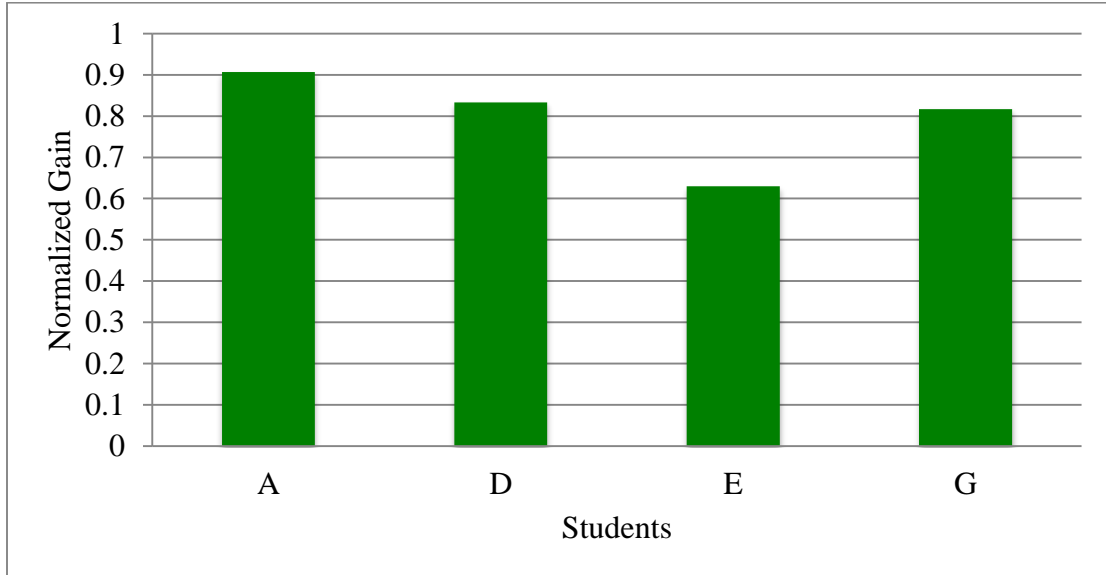


Figure 3. Normalized gains for land navigation trip, ($N=4$).

All students scored higher on Alpine Ecology Posttest compared to the Pretest (Figure 4). The average normalized gain was 0.63. All but one student had an individual normalized gain higher than 0.6. This trip yielded the lowest individual normalized gain, 0.12, out of all four trips.

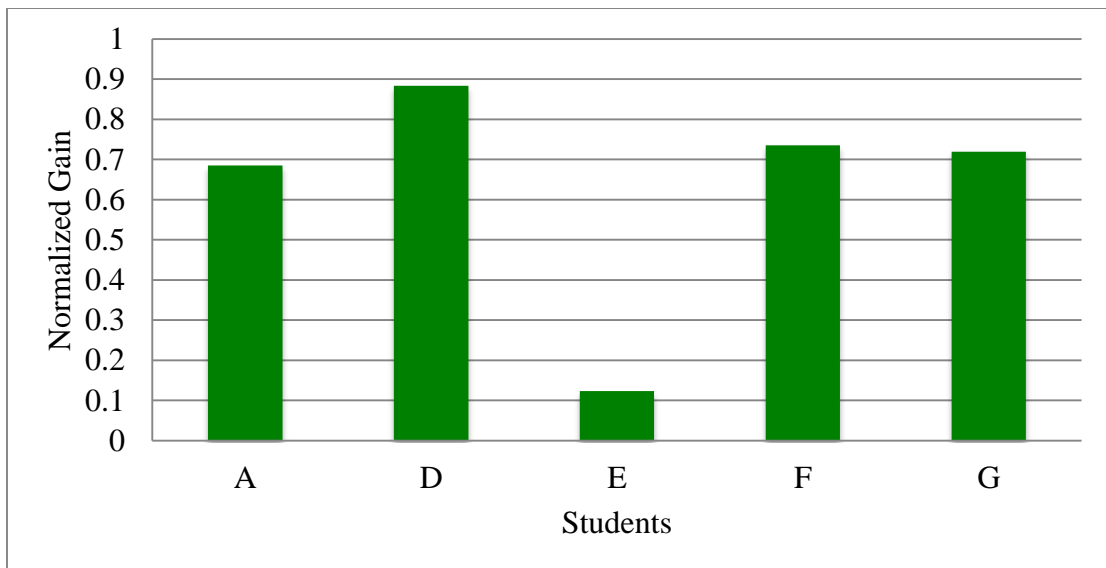


Figure 4. Normalized gains for alpine ecology trip, ($N=5$).

All trip averages yielded a positive normalized gain (Figure 5). A correlation exists as to how many students were present and how high the normalized gain results were. The highest gain was from the land navigation trip where only four students were present. The water and alpine ecology trips both had five students present and yielded relatively equal gains that were in the middle compared to the other two trips. The lowest gain was from the survival skills trip where seven students were present.

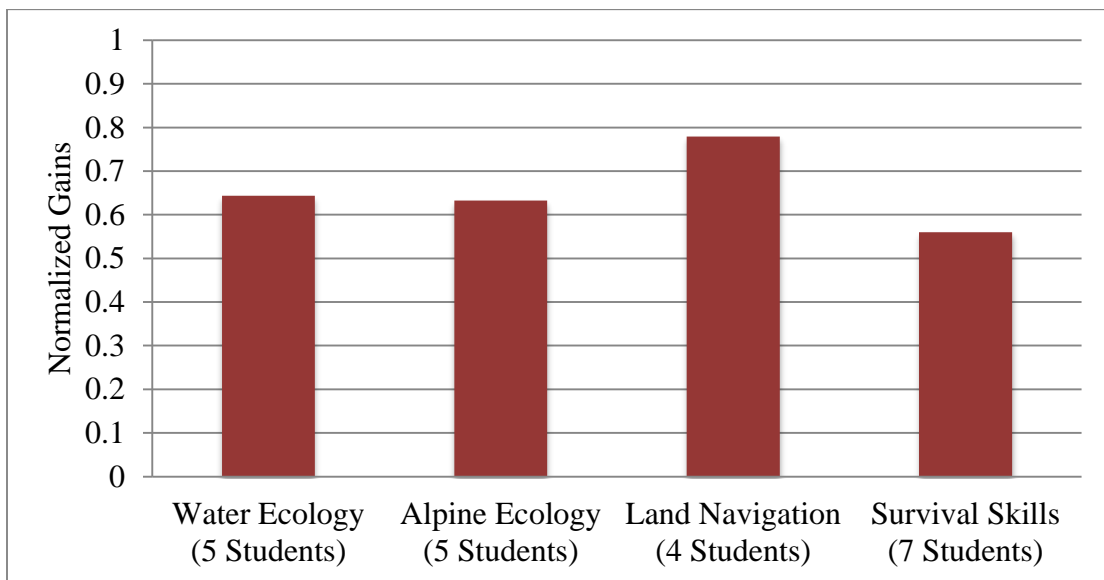


Figure 5. Average normalized gains from all trips, ($N=21$).

The straight percentage scores of the pre/posttests show a trend as well (Figure 6). Zero students passed the pretest using a traditional grading scale of 100-90%=A, 89-80%=B, 79-70%=C, etc. After participating in the outdoor classroom students earned a passing score that was higher than 60% on seventeen of the twenty-one tests. The four tests that were failed still had positive normalized gain scores (Figure 5). The same student did not produce all the failing grades. The failed tests were taken by four different students over the course of two outdoor classroom trips, alpine ecology and survival skills. While the posttest score was still below 60%, the normalized gains averaged 0.35.

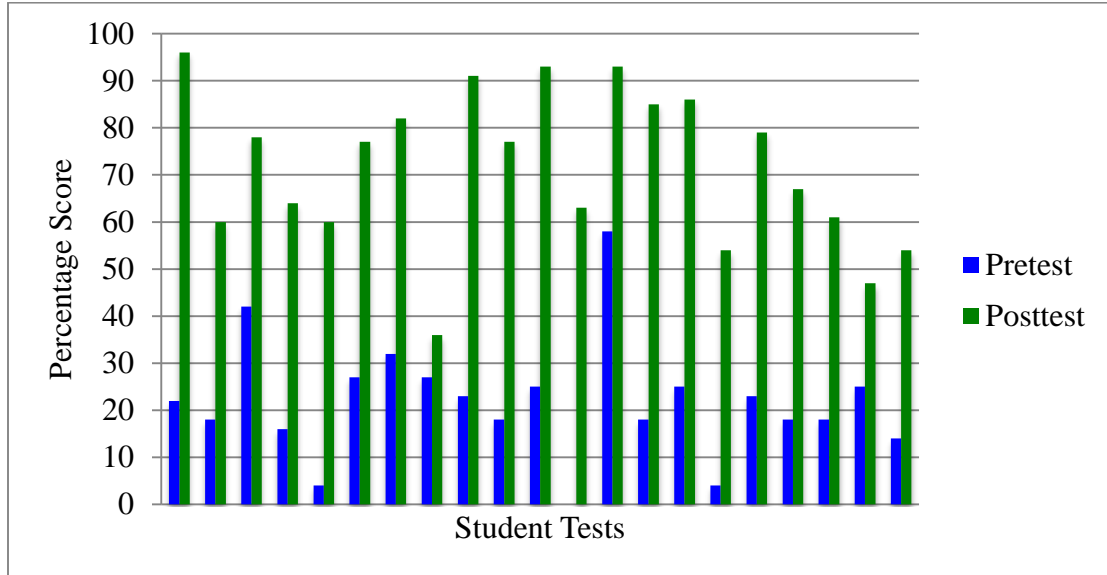


Figure 6. Listing of all student pretest and posttest scores, ($N=21$).

The qualitative data were collected from the Pre/Post Outdoor Classroom Interview questions ($n=5$) and the Outdoor Classroom Survey ($n=7$). All students that were interviewed had positive things to say about the outdoor classroom including, “I enjoyed it,” “it was fun,” and “I liked how we were exposed to nature straightforward.” When asked the question, “Would you like to attend a full-time outdoor classroom school,” all students stated an interest to attend on a regular basis, but never full time. No student wanted to attend the outdoor classroom five days a week, but all had their own ideal attendance schedule or application of the outdoor classroom to their regular schooling. Two students said they would prefer to attend the outdoor classroom one to three days per week out of a typical five-day school week. Attendance on the other days would be done in a traditional school building with traditional instruction. Four of the students replied that they would only want to learn math and science in the outdoor classroom only. They preferred to learn the other school subjects, like social studies,

reading, English, etc. in a traditional school building with traditional teacher directed instruction. When asked why they felt this way, the majority said they had difficulty concentrating in an outdoor setting due to the larger number of distractions outdoors compared to a traditional indoor classroom. One student replied that he didn't see how other subjects could be taught in an outdoor context, but if the teacher could figure out a way, he would be interested.

When asked on the post interview about the best outdoor science experience the students had, four students changed their favorite outdoor science experience to one of my outdoor classroom trips. When asked why, one student replied with, "when normally [learning science] in the classroom I'd be bored out of my mind, but I got to apply it in the outdoor classroom." When asked on the post interview about their worst outdoor science experience, only one student replied with an outdoor classroom trip. He said the land navigation trip was boring and he had difficulty learning the material. This same student, however, listed the survival skills trip as his favorite outdoor science experience.

The Outdoor Classroom Survey also yielded qualitative data. When students were asked if they enjoyed going to the outdoor classroom more than their traditional school, three students agreed, three were neutral, and one strongly disagreed. When asked if they found math and science lessons fun in the outdoor classroom one student strongly agreed, four agreed, one was neutral, and one disagreed. When asked if they saw a connection between the things they learned in the outdoor classroom to a real life application, five students agreed and two were neutral. This is an improvement from the pre-survey that questioned students if they saw a connection between the things they learned in their

traditional school setting to a real life application. On the pre-survey three students agreed, three were neutral, and one disagreed when asked if they saw a connection to the things they learned in school to a real life application.

When students were asked if they enjoyed learning math more in the outdoor classroom than in their traditional school setting, three agreed, two were neutral, and two disagreed. When asked if they enjoyed learning science more in the outdoor classroom than in their traditional school, four agreed, one was neutral, and two disagreed. The pre and post surveys both included the same question about the outdoors being a good place to learn math and science. The pre survey yielded one strongly agree, two agree, and four neutral. The post survey yielded two strongly agree, two agree, and three neutral. This is an improvement as one of the pre-survey agrees turned to strongly agree and one of the neutral turned to agree.

INTEPRETATION AND CONCLUSION

Through doing this action research-based project, I was able to find the effects on students and student learning though teaching in an experiential all-outdoor classroom. Of the 21 pre/posttest administered only four had a failing grade (Figure 6), which corresponded to a passing rate of 81%. I have taught mathematics and science at a traditional school for the past five years and I think that these results from the outdoor classroom compare similarly. I did not do a formal review during the outdoor classroom, as I typically do with my traditional schooled students. I feel a review would have helped improve the outdoor classroom results, especially with some of the topics that were taught earlier in the day that were not touched on again until students saw them on the

posttest. I was able to provide an answer to the question of what are the effects on student learning? The quantitative results show that high student learning of math and science can occur in an experiential all-outdoor classroom.

The qualitative data helps provide answers to understand what the effects on students were through participating in the outdoor classroom. Analysis of this data shows mixed trends among students. The Outdoor Classroom Survey showed about half of the students enjoyed attending the outdoor classroom more than their traditional school setting. It also revealed that about half enjoyed mathematics and science lessons more in the outdoor classroom than in their traditional school setting. When comparing before and after opinions regarding if the outdoors is a good place to learn math and science, only one of the four students who were neutral changed his/her mind that the outdoors is a good place to learn math and science.

The Outdoor Classroom Interview yielded more positive results than the Outdoor Classroom Survey. All the students interviewed expressed interest in continuing to supplement their education with attendance of the outdoor classroom. Additionally, they all had positive feelings about their participation. Some even offered suggestions on ways to make it better for next year. Of the students interviewed, four of the five students identified the outdoor classroom as their favorite outdoor science activity. I was able to provide an answer to the question, “what are the effects on students through their attendance of an all-outdoor classroom?” Not all the students enjoyed the outdoor classroom, but none of them absolutely hated it. In the end, I found that the outdoor

classroom was a positive learning experience for all the students in which all indicated they would willingly attend again in the future.

VALUE

Overall, this study was a success. The data showed that students could achieve a high standard of learning in an experiential all-outdoor classroom. The data also showed that some students enjoyed the outdoor classroom more than their traditional classroom and now believed the outdoors is a good place to learn math and science. The real gem of data is that every student interviewed expressed interest in continuing in the outdoor classroom for further studies.

I found it highly interesting that students actually preferred to be in a school building for part of the school week. It seemed as though students were out of their comfort zone in the outdoor classroom. It was a completely new type of schooling for them. Students have learned by listening and watching for so long that they are unaccustomed to that style and do not know what to do when asked to learn by doing. I think this shows the importance of learning for the purpose of real world application as opposed to learning for simply passing a test. In the event of a full time outdoor school becoming available, students should be taught how to make the most of their outdoor learning experience.

I always welcomed parents to participate if they wanted to attend. One parent who attended was a middle school math teacher. On the hour or so long drive back to the drop off point for the students, we started talking about how the outdoor classroom went. One negative thing that I pointed out was I had the students (driving time included) for six to

eight hours each Saturday, but was able to teach only five to seven math and science standards each day. Six to eight hours is the equivalent of two weeks of school. I questioned if I had students in a traditional classroom and taught math through drill and kill problem solving and lecture and labs for science, would I be able to produce the same results? Could students pass the same posttests with a higher score? I knew the answers were yes. The traditional classroom is a semi one-size-fits-all in which all students can learn, but it might not be ideal for all. My parent/teacher friend agreed whole heartedly but then brought up another question. That was, “who is a more well rounded student, an outdoor classroom participant or a traditionally schooled student?”

If the sole purpose of schooling is to produce high SAT and standardized test scores, then the outdoor classroom is not a best practice. The traditional classroom setting is far superior to the outdoor classroom for the purpose of raising test scores. However, if the test score is not of highest importance, rather the development of the student is emphasized, then the outdoor classroom is far superior to any traditional classroom. The outdoor classroom provides students with opportunities to develop and grow as an individual in ways the traditional classroom doesn't even come close to achieving.

Businesses in the 21st century are not looking for employees whose greatest asset is their intelligence. Intelligence is a valuable trait, but this is the information age. I possess a small piece of technology, iPhone 6, in my pocket with more computing power than NASA had to put a man on the moon that can search and find almost any piece of information I want in a matter of seconds. That has become a kind of equalizer for people without the best memory. With all this information readily available employers are

looking for employees that can use it effectively. Nowadays, proficiency in critical thinking, communication, collaboration, adaptability, and problem solving are just as valuable as a college diploma.

The outdoor classroom provided students with highly accurate and appropriate real-world opportunities to grow in these areas. The reality of my situation is that as a teacher, I am teaching students that will eventually take jobs that do not currently exist! My current students will use technology that has not yet been developed to solve problems that have not yet been identified. The traditional education system produces cookie-cutter students who will have a hard time succeeding in jobs like these. I think that the outdoor classroom does a much better job of producing students who will succeed in this ever changing world.

While I might not be able to turn my everyday classroom into the outdoor classroom, I can still take the things that I learned and make my classroom learning environment more meaningful, purposeful, and holistic. Throughout this action research project I came to realize that learning for a true end goal is what every student desires. They don't want the answer to "when will I use this?" to be "on the test." They want to know that what they are learning is meaningful and purposeful. I learned math and science in high school through plug and chug equations and rote memory. I was highly driven to earn good grades and I graduated with a 3.93, but I never did well on standardized tests.

I received a nineteen on the science portion of the ACT, which I think is pretty low for a science teacher. I would destroy the science portion of that test now! What

changed? I didn't see the big picture back then. The things I learned were simply to pass a test. It wasn't until after college that I started seeing the big picture and realized that the things I learned actually had usefulness outside of the classroom. It was this action research project that pushed me to investigate teaching math and science through the experiential teaching method. The outdoor classroom showed me that I don't need a projector and dry-erase boards to teach math and science.

Realistically, the implementation of the outdoor classroom is something I can't do on a daily basis at my job. However, on a regular basis I could present an application or real-world problem that needs to be solved using math and science. I can shift away from my traditional way of teaching where I teach the content and then show how to use it in a word problem. Instead, the math and science standards I am required to teach will be tools to solve this overarching problem. This will move the students away from the drill and kill method of teaching and give them more opportunities to develop the 21st century skills employers desire.

During my spring break, I traveled to Egypt for a scuba diving vacation. My plan was that when I wasn't diving, I would sit on the beach analyzing all of the data and writing the remainder of this paper. During one of the surface intervals between two scuba dives, I started talking with my instructor about the certifications he has in order to guide clients. I found out numerous classes exist to earn specialty certifications to safely do more things not covered under my basic certification. Upon further inquiry about what specifically I would learn in these classes, I found out that they are basically applied math and science courses. The overall goal is to get a certification in order to do something

more dangerous. Math and science concepts need to be taught and learned to stay safe. Furthermore, I feel our current school system is failing all non-college bound students by not offering trade programs anymore. What if students went to an outdoor school and in the process of earning certifications for scuba diving also learned typical math and science standards? Upon graduation students would have a skill for a job, such as a scuba instructor, that is in demand all over the world and would immediately be able to enter the workforce with a well paying job. If I were to continue to work on an advanced degree, my idea for a dissertation study might be to study the effects on students and student learning in an all-outdoor school that has the expressed goal of preparing students with life-skills, such as scuba or skydiving instructor, rock climbing or backpacking guide, captains license, etc.

REFERENCES CITED

- Bunting, Camille J. (2006). *Interdisciplinary Teaching Through Outdoor Education*. Champaign, IL. Versa Press.
- D'Amato, L. G. Krasny, M. E. (2011). Outdoor Adventure Education: Applying Transformative Learning Theory to Understanding Instrumental Learning and Personal Growth in Environmental Education. *The Journal of environmental education (0095-8964)*, 42 (4), p. 237.
- Greene, K. L. (1968). Outdoor education. *The American Biology Teacher*, Vol. 30, No. 4. pp. 285-287.
- Glew, F. (1994). Instincts for Survival in Outdoor Education. *Pathways (Hamilton) (0840-8114)*, 7 (1), p. 15.
- Golins, G. L. (1978). How Delinquents Succeed through Adventure Based Education. *The Journal of experiential education*, 1 (2), p. 26.
- Keller, G.M. (2005). Adventure in the Amazon, Leader's Manual by Lorraine L. Ukens; Arctic Expedition by Lorraine L. Ukens; Earthquake Survival Leader's Guide by Arlette C. Ballew; Marian K Prokop; Lost at Sea by Paul M. Nemiroff; William A Pasmore; Stranded in the Himalayas by Lorraine L. Ukens Wilderness Survival by Donald T. Simpson. *Academy of Management Learning & Education*, Vol. 4, No. 2. pp.250-251. <http://www.jstor.org/stable/40214299>.
- Louv, Richard. (2008) *Last Child in the Woods*. New York, New York. Algonquin Books of Chapel Hill.
- Marlowe, J. M. Pearl, N. L. Marlowe, M. J. (2009). School of urban wilderness survival and the circle of courage. *Reclaiming Children and Youth (1089-5701)*, 18 (3), p. 3.
- Orion, N. Hofstein, A. (1994). Factors that influence learning during a scientific field trip in a natural environment. *Journal of Research in Science Teaching (0022-4308)*, 32 (10), p. 0197.
- Torsney, C. B. (2008). The value of an outdoor education experience. *Peer review: Emerging Trends and Key Debates in Undergraduate Education (1541-1389)*, 10 (1), p.27.

APPENDICES

APPENDIX A
INSTITUTIONAL REVIEW BOARD EXEMPTION



INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 00000165

960 Technology Blvd. Room 127
 c/o Immunology & Infectious Diseases
 Montana State University
 Bozeman, MT 59718
 Telephone: 406-994-6783
 FAX: 406-994-4303
 E-mail: cherylj@montana.edu

Chair: Mark Quinn
 406-994-5721
 mqinn@montana.edu
Administrator:
 Cheryl Johnson
 406-994-6783
 cherylj@montana.edu

MEMORANDUM

TO: Michael Haiderer and John Graves
FROM: Mark Quinn, Chair *Mark Quinn CJ*
DATE: October 27, 2014
RE: "What Are the Effects on student Learning in Math and Science When Teaching in an All-outdoor School"
 [MH102714-EX]

The above research, described in your submission of October 27, 2014, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

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

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

APPENDIX B
FRESHWATER ECOLOGY HANDOUT

Freshwater Ecology Handout

At the Stream

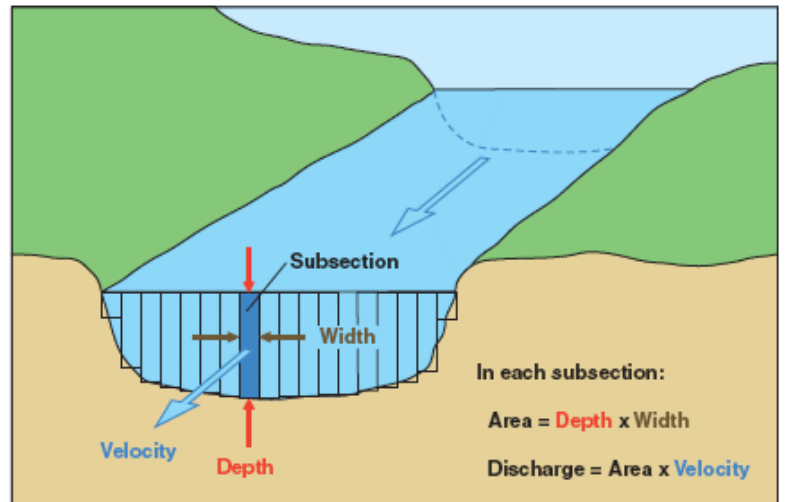
The student will use Riemann sums and the Trapezoidal Rule to approximate definite integrals of functions. (AP Calculus)

Goal: To find the volume of water passing through the stream at a given moment.

Step 1: Calculate the vertical area of the stream in cm squared.

Step 2: Calculate the velocity of the stream in cm per second

Step 3: Multiply the area and velocity to get the volume (discharge) in cubic cm per second.



Calculate the area

1: Mark off a string in 25 cm increments and span it across the stream horizontally. You are forming subsections.

2: Measure the depth of the stream at the edges of the 25 cm subsection.

3: Use the area of a trapezoid equation to figure out the area of all the individual trapezoidal subsections that span across the stream.

Trapezoid

$$\text{Area} = \frac{1}{2} h (b_1 + b_2)$$

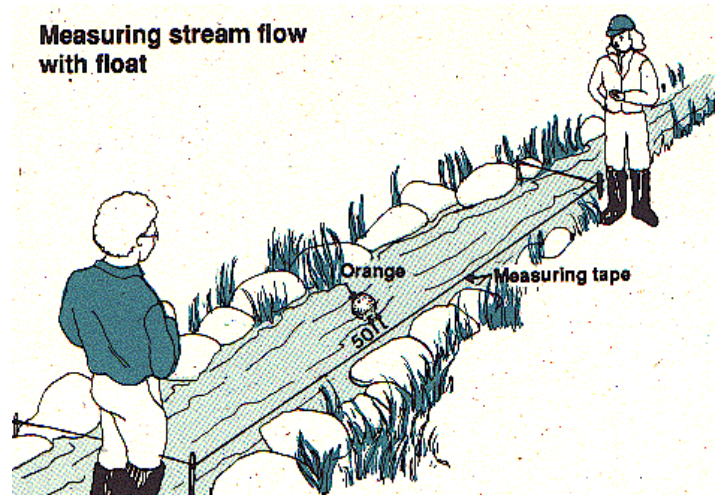


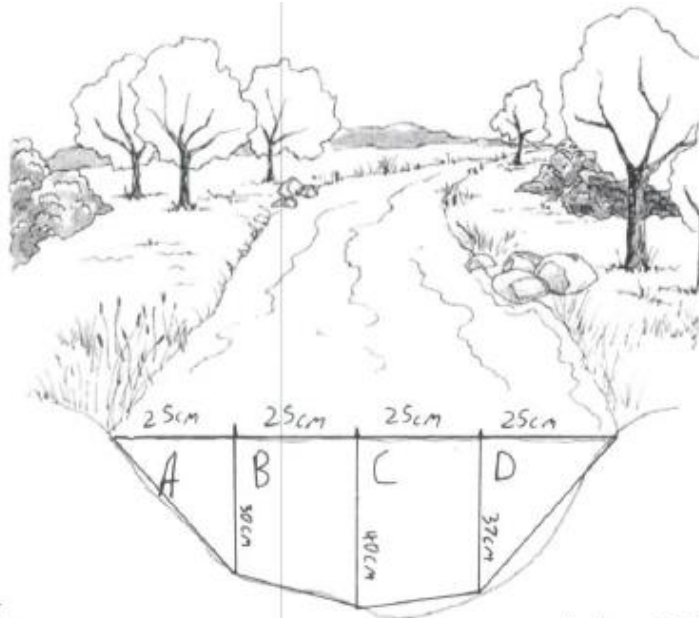
Calculate the velocity

- 1: Place another string similarly marked in 25 cm increments horizontally across the stream 2 meters above your initial string.
- 2: Place an orange in the water and time it as it floats down the stream. The orange must start and finish in the same subsection.

Calculate the volume

Take the individual area of a subsection and multiply it by the velocity of the water flowing through that subsection.
Hint: 1000 cubic centimeters equals 1 liter.





Areas

Trapezoid A: $A = \frac{1}{2} \cdot 25(\emptyset + 30) = 12.5(30) = 375 \text{ cm}^2$

Trapezoid B: $A = \frac{1}{2} \cdot 25(30 + 40) = 12.5(70) = 875 \text{ cm}^2$

Trapezoid C: $A = \frac{1}{2} \text{ — } (\text{ — } + \text{ — }) =$

Trapezoid D: $A =$

Velocities

Trapezoid A: 13 cm per second

Trapezoid B: 20 cm per second

Trapezoid C: 21 cm per second

Trapezoid D: 15 cm per second

Volume

Trapezoid A: $375 \text{ cm}^2 \times 13 \text{ cm/sec} = 4875 \text{ cm}^3 \text{ per second}$

Trapezoid B: $875 \text{ cm}^2 \times 20 \text{ cm/sec} = 17500 \text{ cm}^3 \text{ per second}$

Trapezoid C:

Trapezoid D:

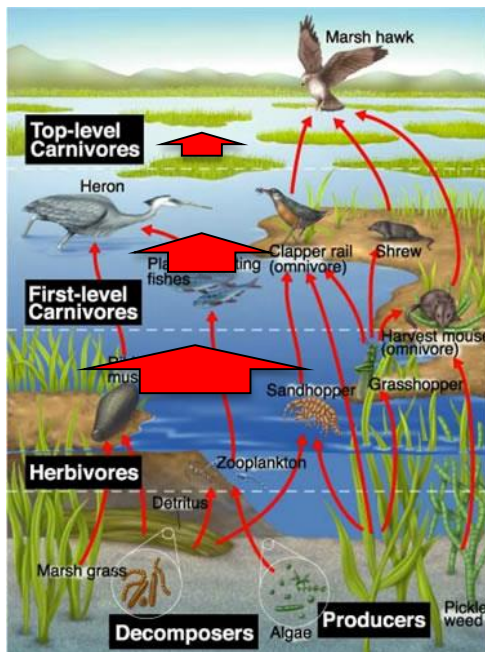
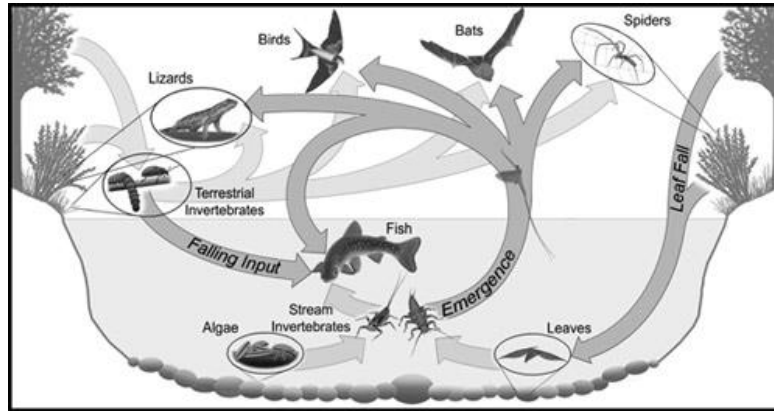
Illustrate the flow of energy through ecosystems. (Biology)

Food Chain: _____

Food Web: _____

Autotrophs: _____

Heterotrophs: _____



All the energy come from the _____

Quaternary Consumer

Tertiary Consumer

Secondary Consumer

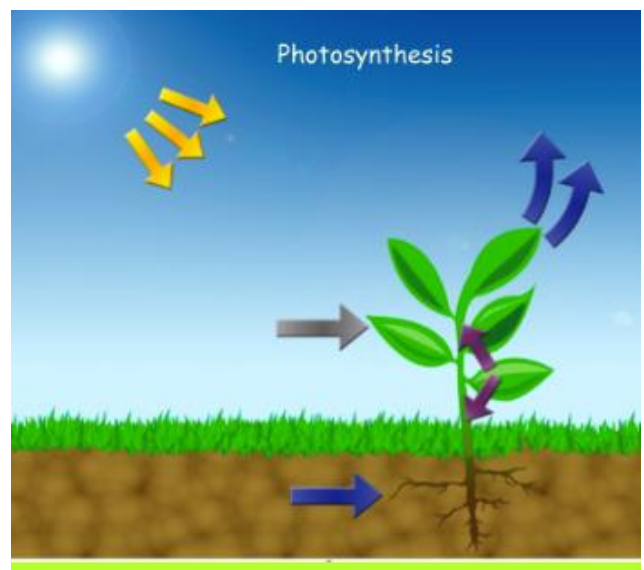
Primary Consumer

Energy

Primary Producer

You draw a food chain with the primary producers being grass, primary consumers are grasshoppers, secondary consumers are frogs, tertiary consumers are snakes, and quaternary consumers are eagles.

Summarize the overall process by which photosynthesis converts solar energy into chemical energy and interpret the chemical equation for the process. (Biology)



What do Plants Need	What do Plants Produce
------------------------	---------------------------

--	--

Let's put the process of photosynthesis into a sentence: _____

**Assess the potential value of a single species to a particular ecosystem.
(Environmental Science)**

Riparian Zone: _____

The 4 C's of a trout stream

C _____

C _____

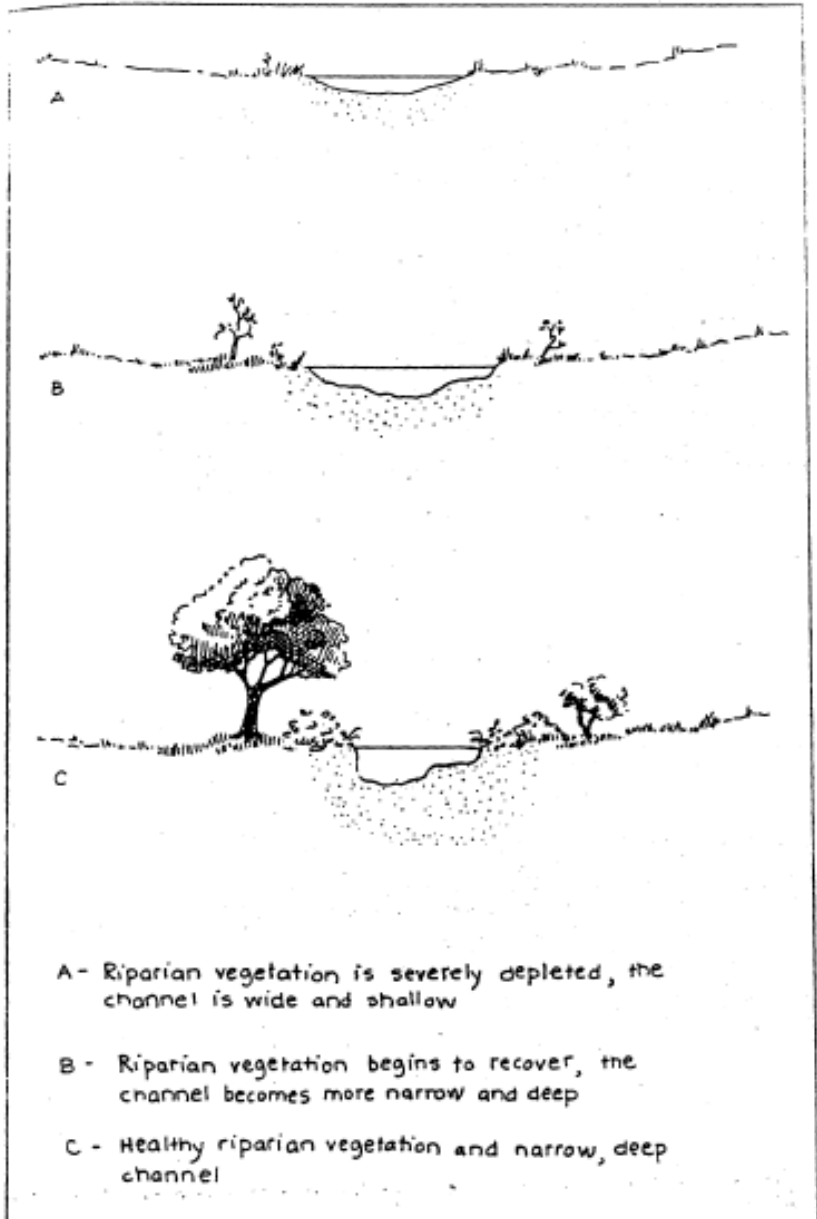
C _____

C _____

Trout in this stream?



Trout in this stream?



What do you think the importance of trout are to an ecosystem?

Explain how organisms are adapted to the environment in terms of ecological niches and natural selection. (Environmental Science)

Adaptation: _____

Niches: _____



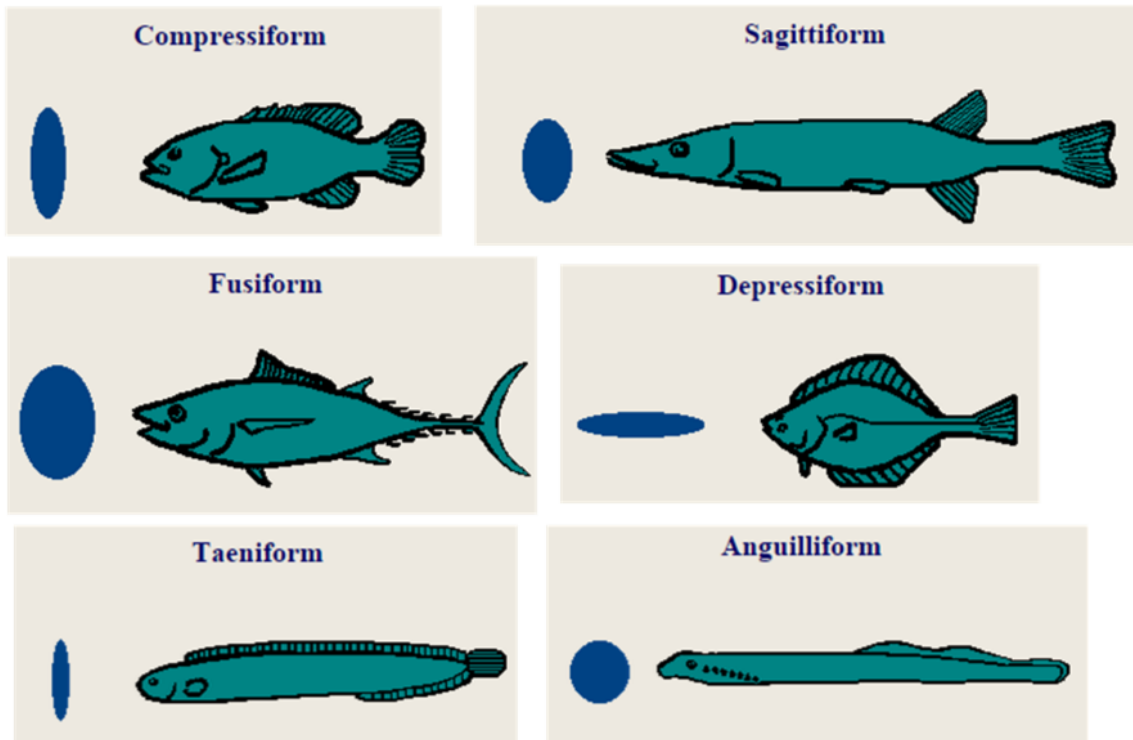
CAUDEL (TAIL) FIN

This fin is used to propel the fish through the water, pick up speed, and make turns.

- *Rounded caudal fin* – allows for effective acceleration and maneuvering but in general is found on fish that do not swim long distances because of large amounts of drag
- *Truncated caudal fin* – straight tipped tail; allows for quick turns and short burst of speed
- *Emarginated caudal fin* – has the least amount of drag; fin has two lobes
- *Forked caudal fin* - 2 lobes, helps reduce turbulence
- *Lunate caudal fin* - tend to be fastest fishes, maintain spe



Fish body shapes determine what environment they can live in. What benefit do you think fish with these different body types have?



Compressiform: _____

Sagittiform: _____

Fusiform: _____

Depressiform: _____

Taeniform: _____

Anguilliform: _____

**Analyze surface features of Earth in order to identify geologic processes that are likely to have been responsible for their formation.
(Environmental Science)**

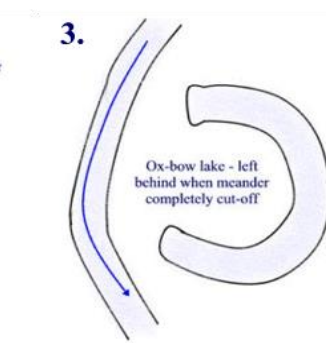
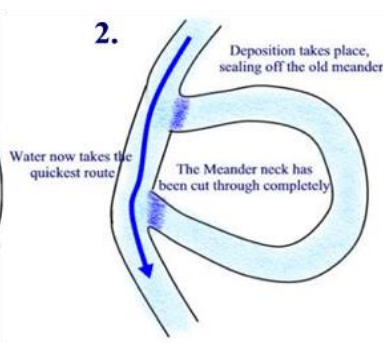
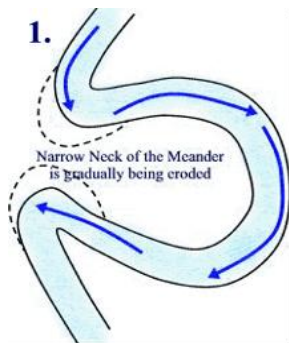
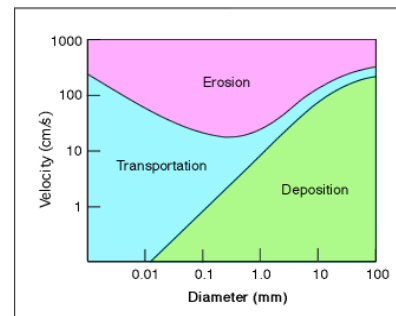
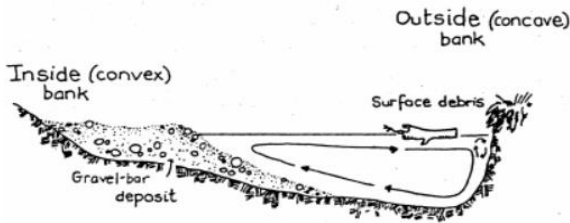
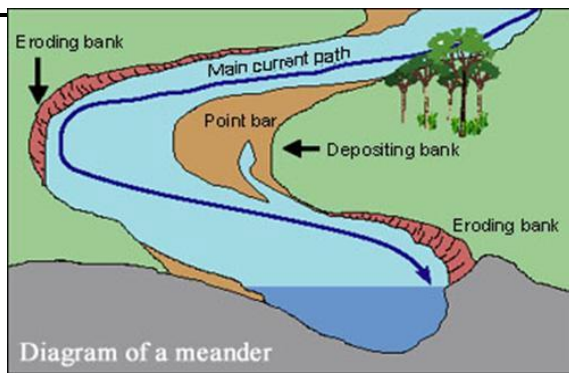
Erosion: _____

Deposition: _____

Cut Bank: _____

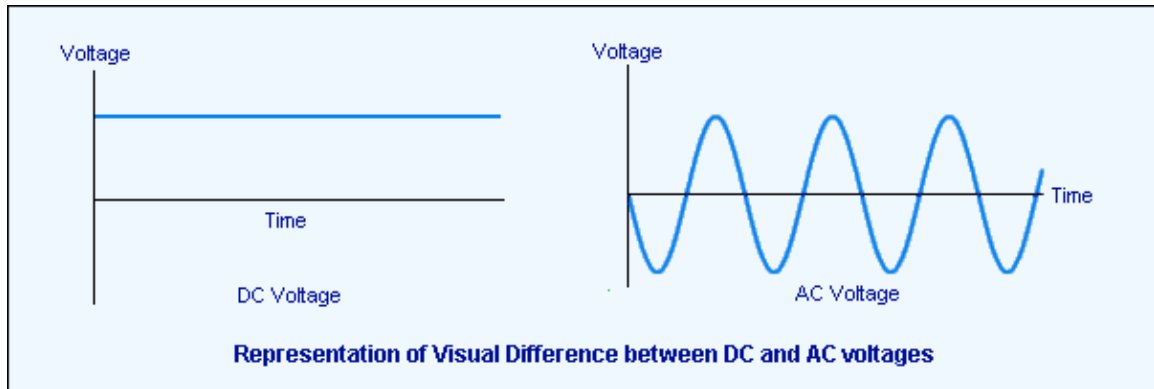
Point Bar: _____

Ox Bow Lake: _____



At the Lake

Differentiate between alternating current (AC) and direct current (DC) in electrical circuits. (Physics)



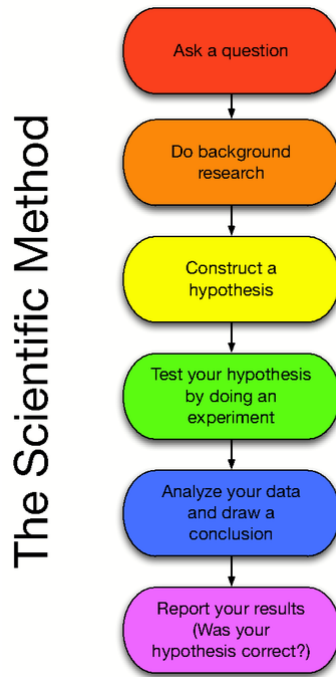
What is the difference between AC and DC electric currents?

APPENDIX C
SURVIVAL SKILLS HANDOUT

Survival Skills Handout

Building A Shelter

Design a scientific investigation with appropriate methods of control to test a hypothesis (including independent and dependent variables), and evaluate the designs of sample investigations. (Biology)



Independent Variable: _____

Dependent Variable: _____

Hypothesis: _____

Controls: _____

Control Experiment: _____

Different types of shelters? Chapter 2

Describe your experiment: _____

Organize and interpret the data from a controlled scientific investigation by using mathematics, graphs, models, and/or technology. (Biology)

Evaluate the results of a controlled scientific investigation in terms of whether they refute or verify the hypothesis. (Biology)

Describe your results: _____

Finding Food

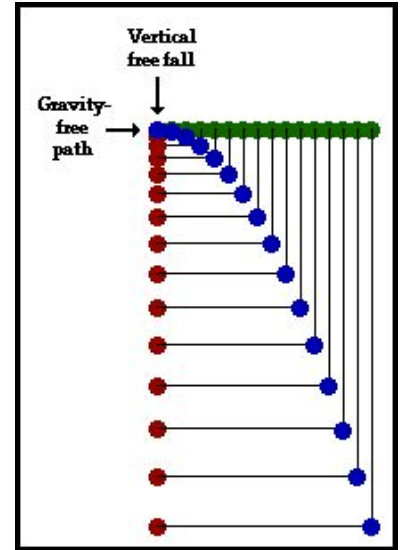
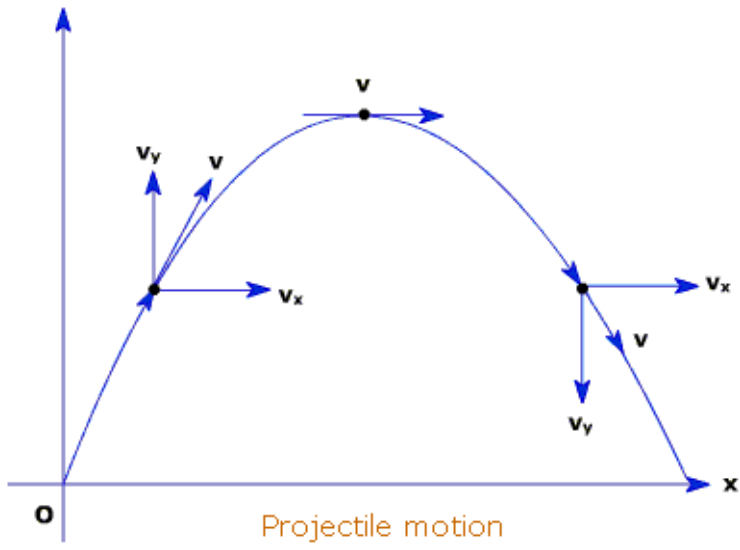
The Physics of Archery

Explain the factors that influence the dynamics of falling objects and projectiles. (Physics)

Velocity: _____

Acceleration: _____ 9.81 m/s/s

Time (sec)	Velocity (m/s)	Distance (m)
0	0	0
1	9.81	9.81
2		
3		
4		
5		



Apply formulas for velocity and acceleration to solve problems related to projectile motion. (Physics)

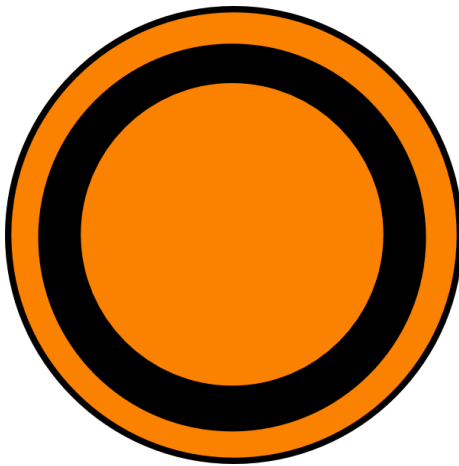
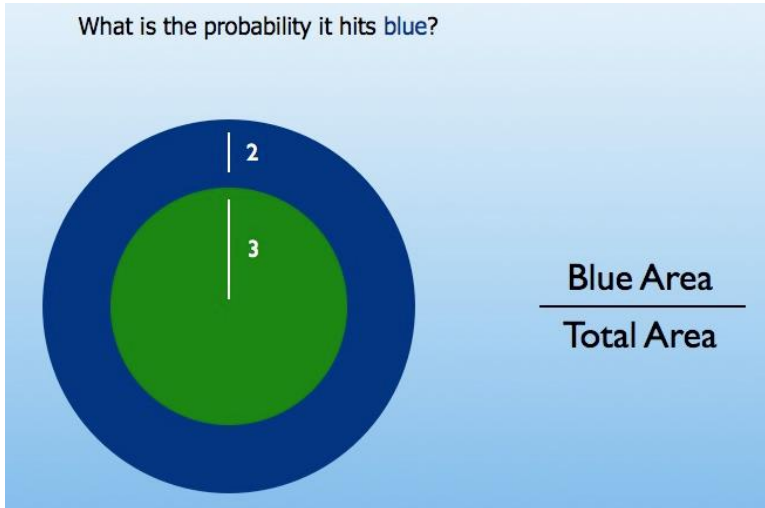
You are shooting a bow and arrow some distance (x). The velocity (V) of the arrow is able to be found. Use the following equation to find the angle θ of elevation of which you should shoot. Use 9.81m/s/s for the pull of gravity (g). $\theta = \frac{1}{2} \sin^{-1} (gx/V^2)$

We need to determine velocity by using the standard equation $(\text{rate})(\text{time}) = \text{distance}$

The use of photogates will tell us a super accurate time for when the projectile passes between them. We can measure the distance between them to figure our distance. We can modify this equation to get rate by itself by dividing by time to get $\text{rate} = (\text{distance}) / (\text{time})$



Describe, create, and analyze a sample space, then calculate the probability. (Geometry)



What is the area of the...

Center orange circle? _____

Black circle? _____

Outside orange circle? _____

Total shape? _____

Given that you will at least hit the target with a shot, find the probability of hitting the...

Black circle

Inner orange circle

Outer orange circle

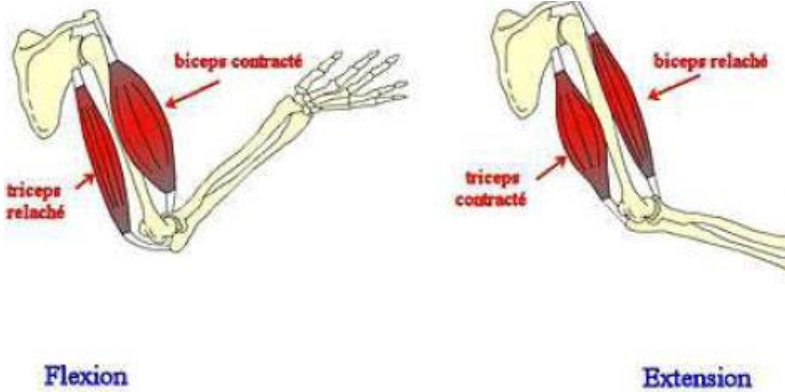
Any orange part of the circle

Cooking Food

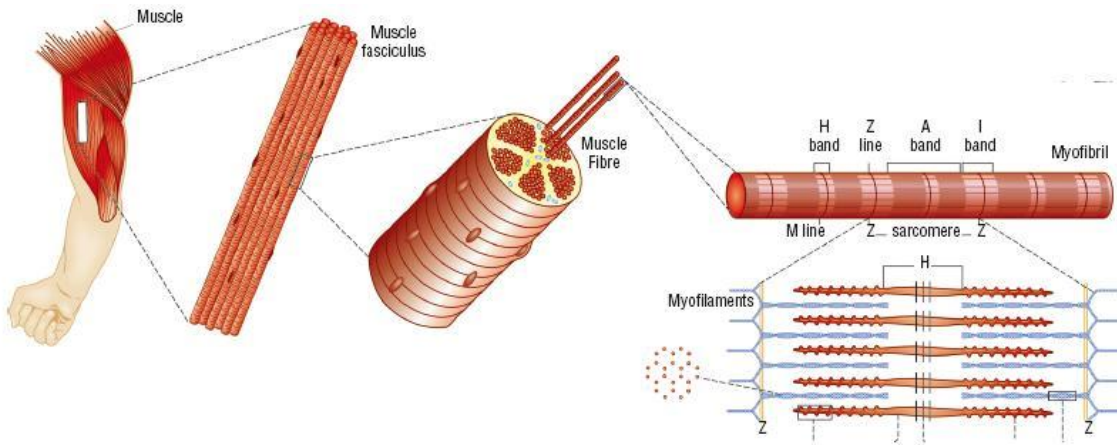
List the structural and functional characteristics of muscle tissues. (Human A&P)

Muscle tissue's only function is to _____

Antagonist: _____



Organ system → Organ → Tissue → Cells

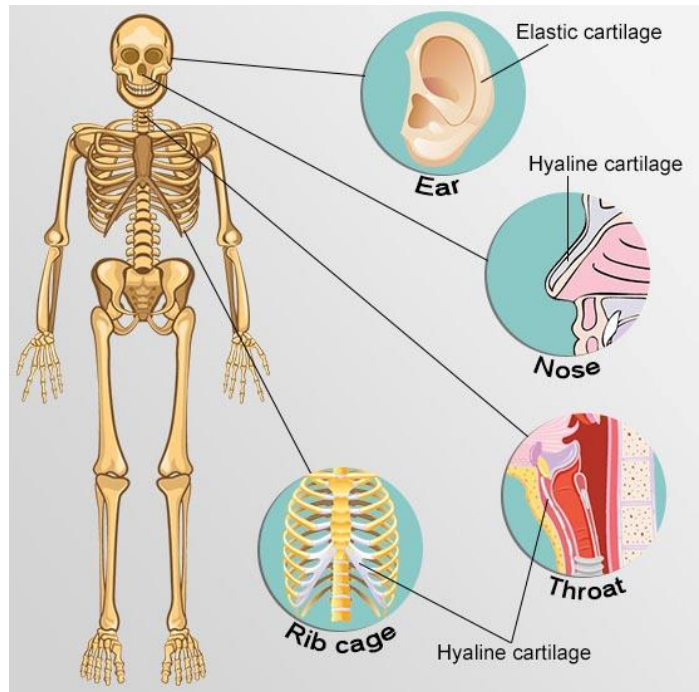
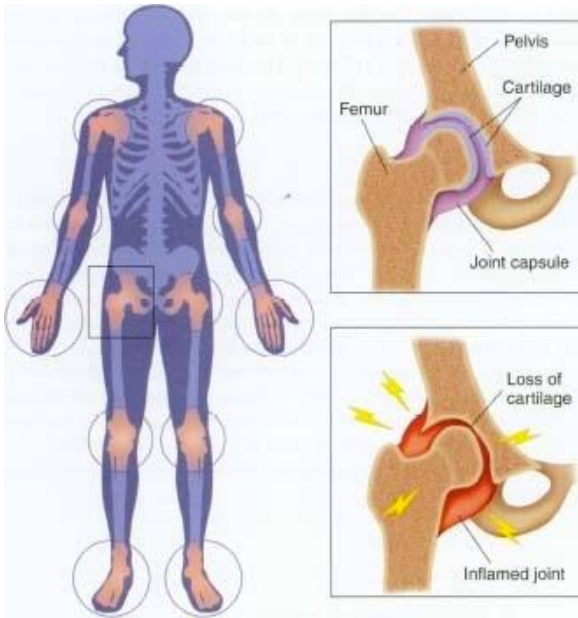


How is the muscle arranged?

Explain the location, characteristics, and functions of the major cartilage in the adult skeleton. (Human A&P)

Cartilage is _____ tissue.

Purposes: _____



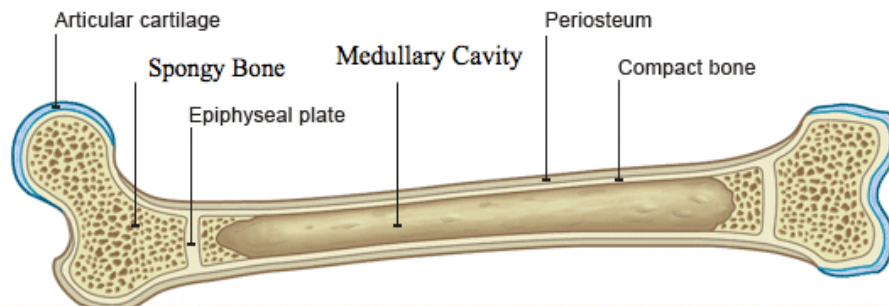
**Describe the gross anatomy of a typical long bone and flat bone.
(Human A&P)**

Compact bone: Dense and looks smooth and homogeneous.

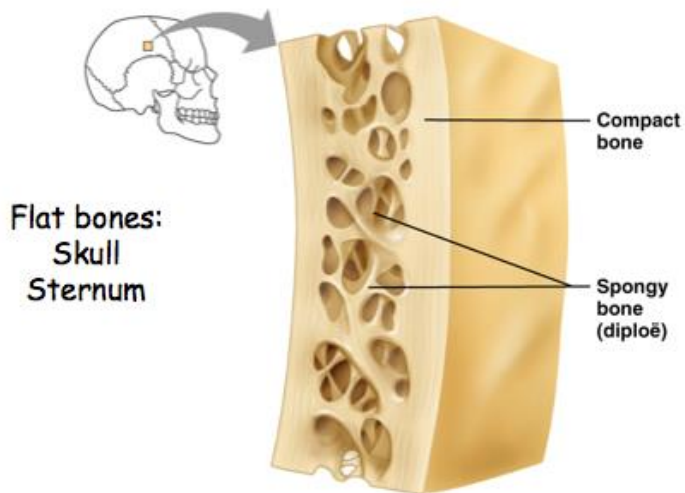
Spongy bone: is composed of small needlelike pieces of bone and lots of open space.

Periosteum: Covering on the outside of bones.

Long Bones: Long and narrow middle. Large heads on both end.



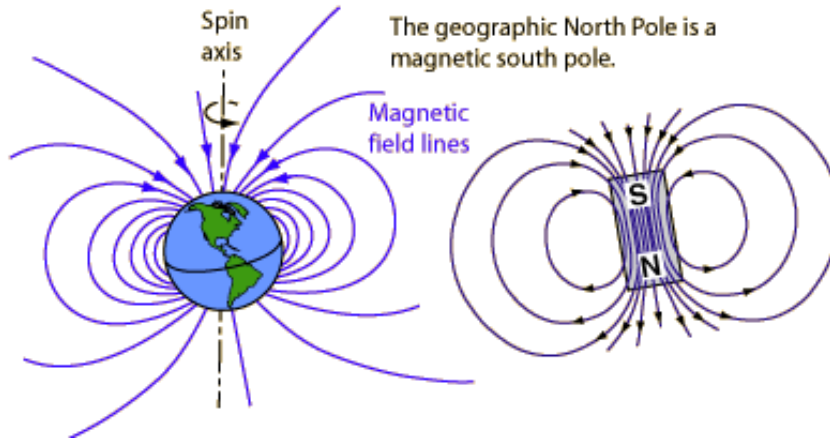
Structure of a Flat Bone



APPENDIX D
LAND NAVIGATION HANDOUT

Land Navigation Handout

Use diagrams to illustrate an electric field. (Physics)

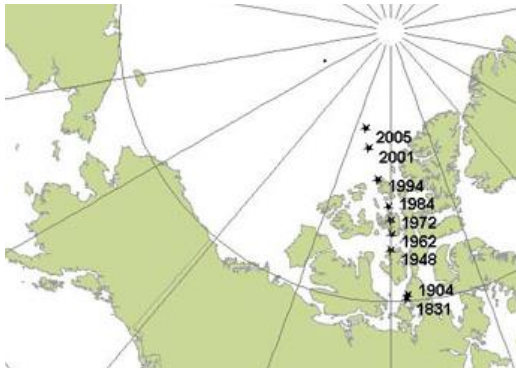


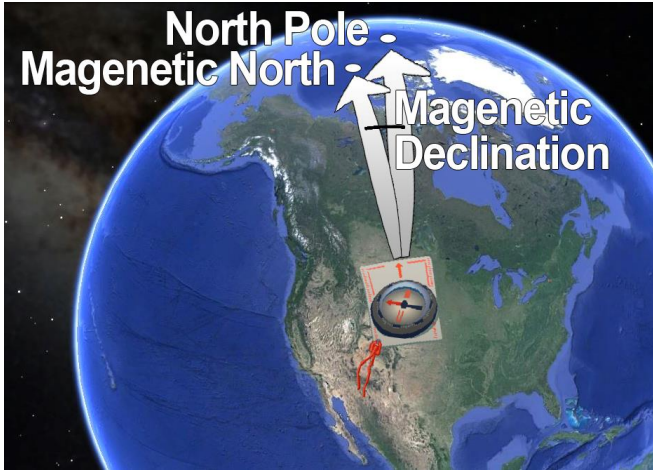
Draw your own magnetic field around this bar magnet



Opposites _____

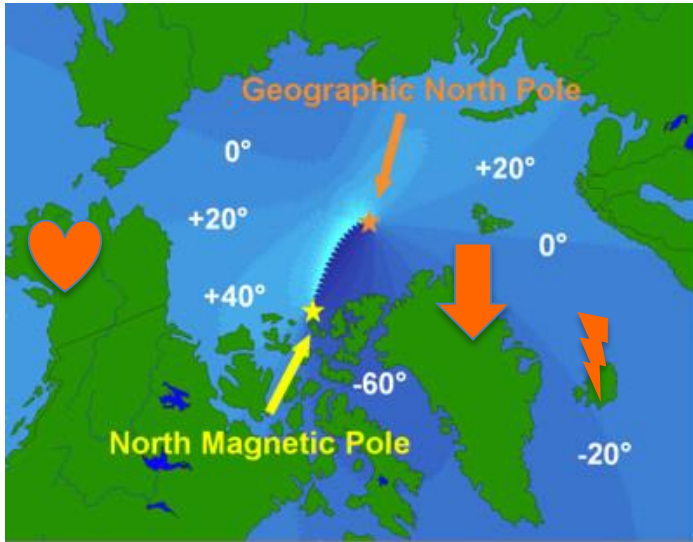
What appears to have happened in this photo?





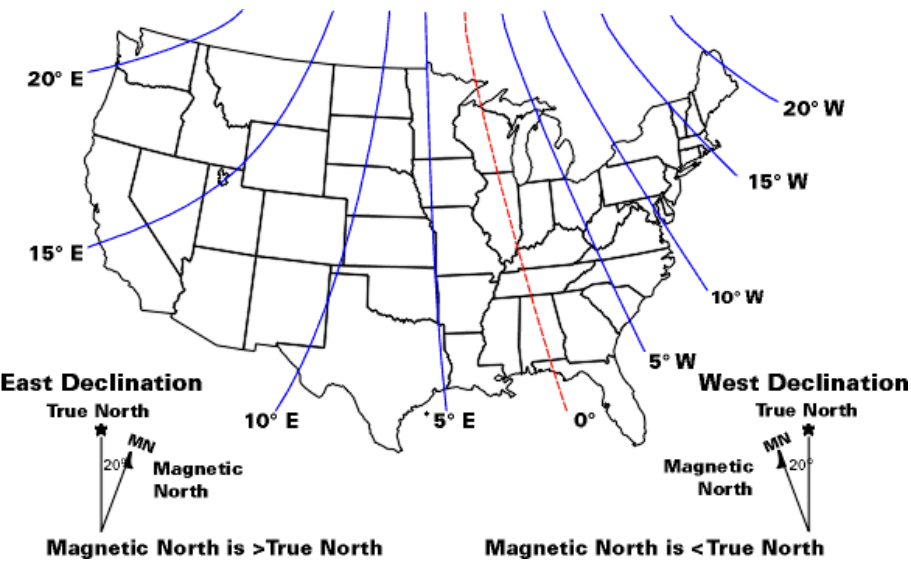
Magnetic Declination: _____

Lets calculate it!



What is the angle between the geographic north pole and the magnetic north pole if you are standing at the tip of the heart? At the tip of the arrow? At the tip of the lightening bolt?

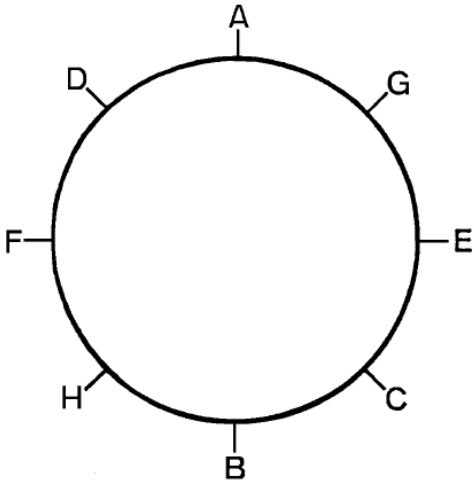
When comparing the arrow and lightening bolt, how does the angle change when getting farther away from the north pole?



Subtract for western declination.

Add for eastern declination

Directions: Use your compass to find the bearing/degree reading of the following points. You have a westward declination of 10 degrees. Direction is North, South, Northwest, etc.



	<u>Bearing/Degree Reading</u>	<u>Direction</u>
A.	_____	_____
B.	_____	_____
C.	_____	_____
D.	_____	_____
E.	_____	_____
F.	_____	_____
G.	_____	_____
H.	_____	_____

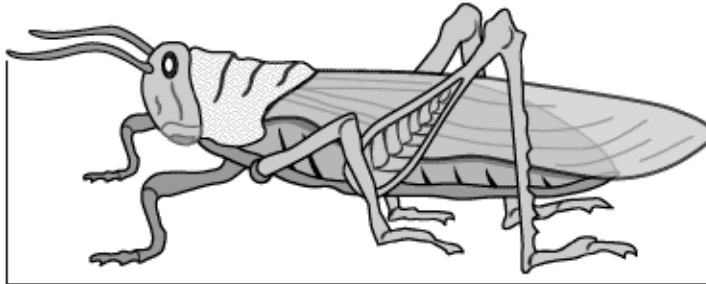
Explain the relationship between scale factors and their inverses and to apply scale factors to scale figures and drawings. (Geometry)



Scale of 1:1



Scale of 1:2



Scale of 2:1

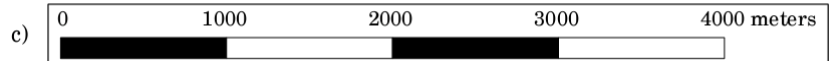
How do you represent the scale if the pre-image is larger than the image?
 How do you represent the scale if the pre-image is smaller than the image?

Scale factor on maps: Life size is (Bigger/Smaller) than the map. What means what?

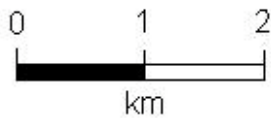
1:25,000

a) (1 centimeter represents 250 meters)

b) **1: 25 000**



One inch to one mile



Ways to measure distance on a map

- 1) _____
- 2) _____

Demonstrate an understanding of the relationship between geometric representation in a coordinate plane and algebraic models of lines and circles. (Geometry)

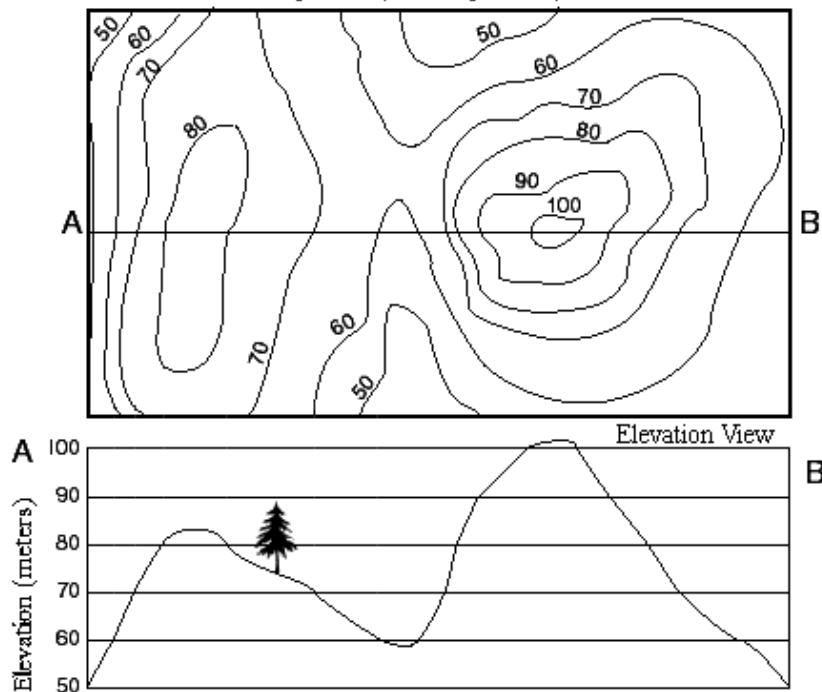
Topographic maps are from a _____ viewpoint

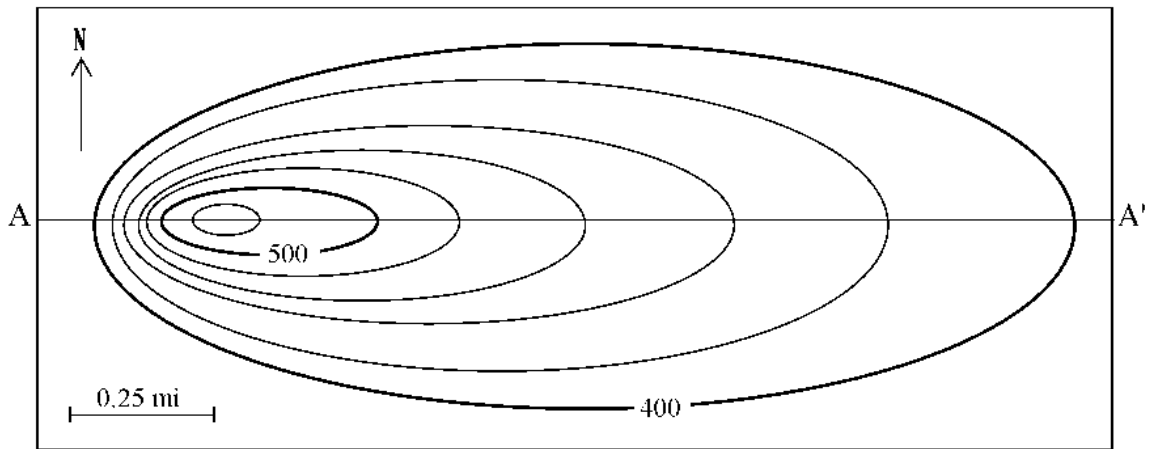
Contour Line: _____

Contour Interval: _____

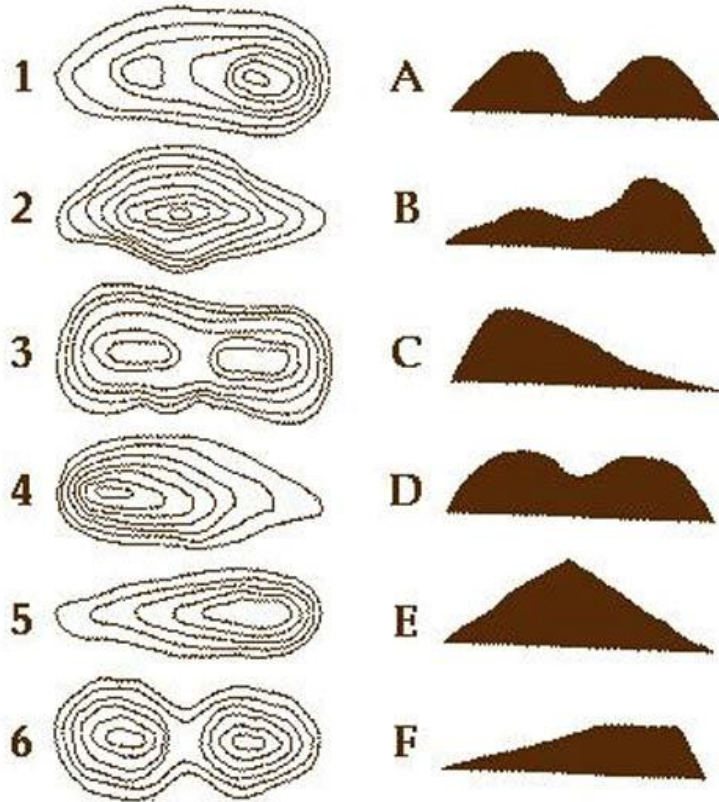
Creating a Topographic profile.

1. Draw a line across your terrain feature.
2. Label the topographic profile with the correct units of measure.
3. Draw a vertical line at each contour line from the map to the profile.
4. Connect the dots on the profile.





Match the following topographic images on the left to their topographic profile on the right



Use different degrees of precision in measurement, explain the reason for using a certain degree of precision, and apply estimation strategies to obtain reasonable measurements with appropriate precision for a given purpose. (Geometry)

“The goal of orientation is to determine that precise point on the surface of the earth where you now stand.”

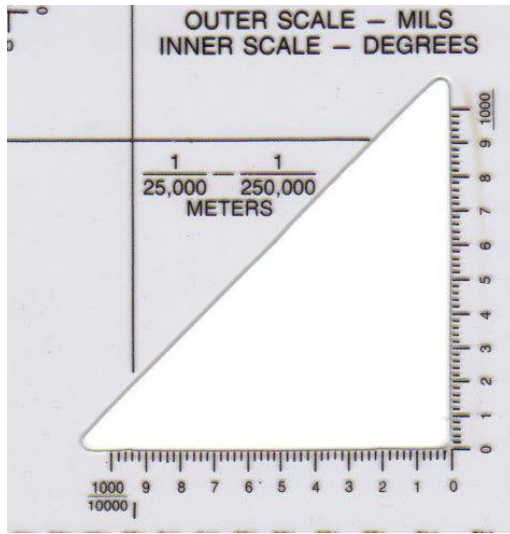
Six digit code vs. Eight digit code

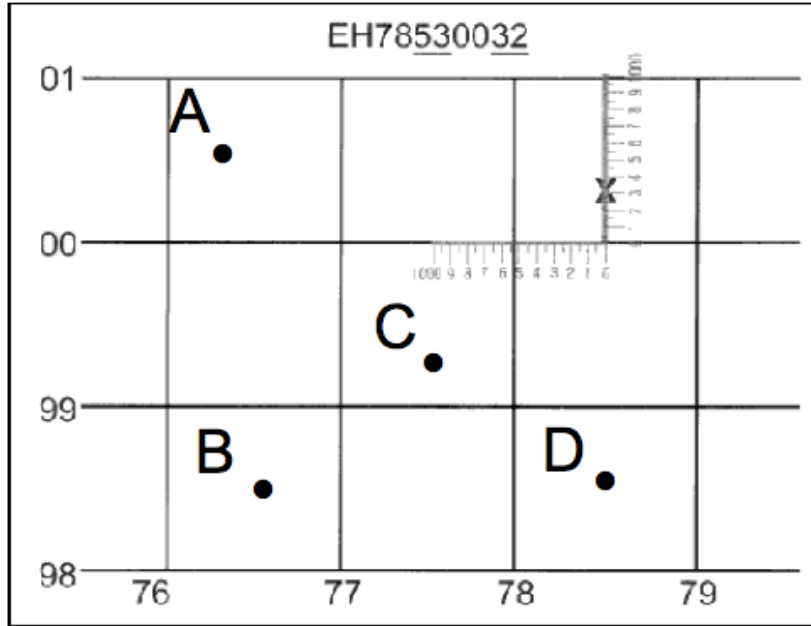
Similarities	Differences

What about a ten digit code?

1 km = 0.621371 miles what is 0.000371 of a mile? _____

It exists, but do we don't use it, why not?





00 ___ 78 ___

How to measure the exact location on a map

Always use the bottom number and the left number on the grid lines.

Slide the protractor left (horizontally) until the vertical numbers hit the point of interest.

Find the following 6 and 8 digit location for the following points.

- A _____
- B _____
- C _____
- D _____

- A _____
- B _____
- C _____
- D _____

Apply formulas for velocity or speed and acceleration to one and two-dimensional problems. (Physics)

Solve problems involving equations with algebraic fractions including direct, inverse, and joint variation. (Algebra)

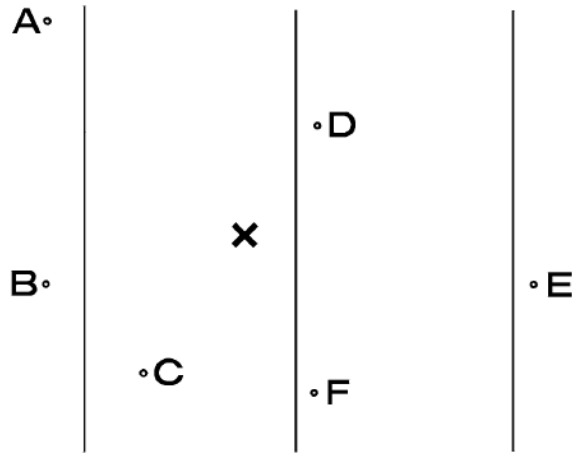
What is your dominant foot? _____

Walk normally for 100 meters and count how many times it touches the ground. Write that number here _____ steps per 100 meters

Represent vector quantities and use vector addition. (Physics)

Vector: a quantity having _____ as well as _____.

Measuring vectors



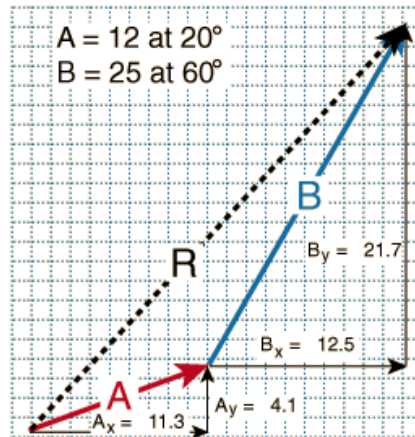
- _____ X to A
- _____ X to B
- _____ X to C

- _____ X to D
- _____ X to E
- _____ X to F

Coordinate vector addition

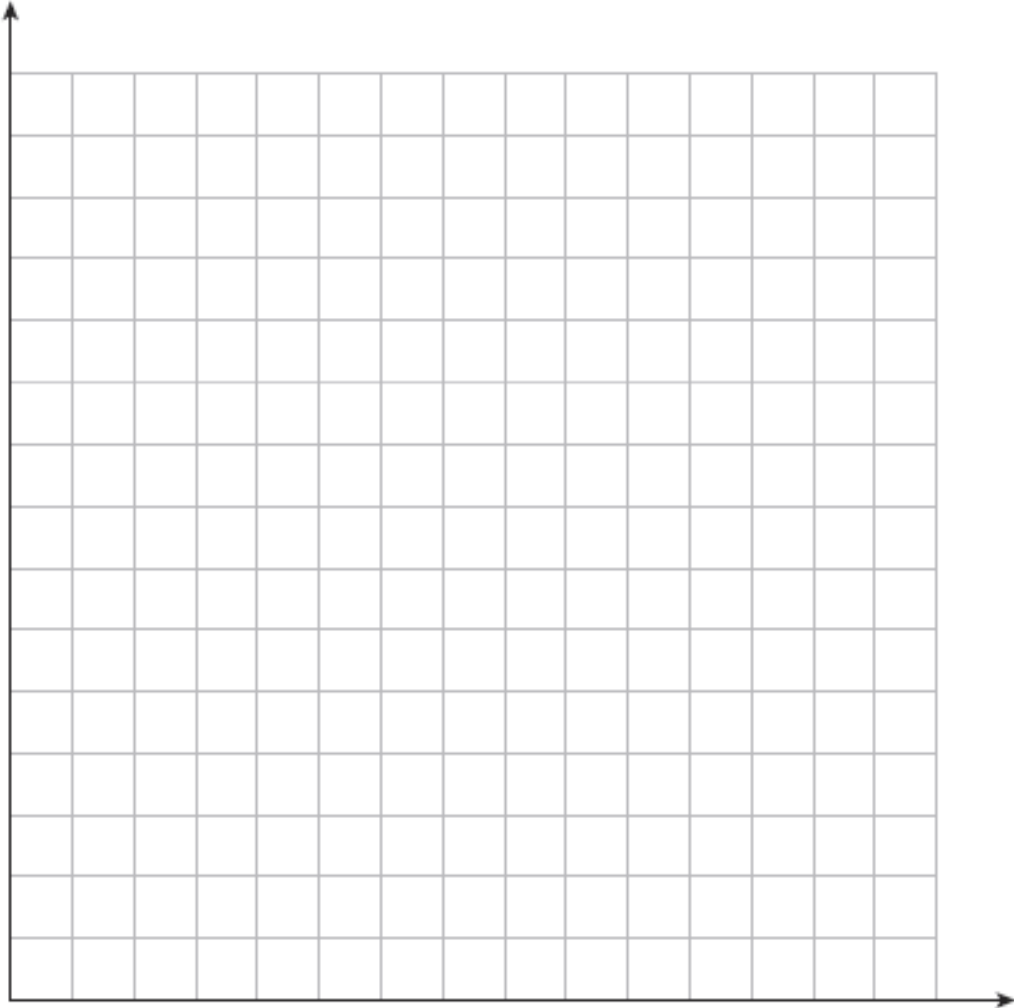
Steps

1. Graph out vectors in order.
 2. Draw a straight line to the starting point.
- Measure that angle.



You try.

You start at the origin and hike 8 cm at 280° . You stop for lunch and then hike 4 cm at 20° . You spend the night. The next morning you hike 6 cm at 300° . After lunch you need to head back. What is your vector.



APPENDIX E
ALPINE ECOLOGY HANDOUT

Alpine Ecology Handout

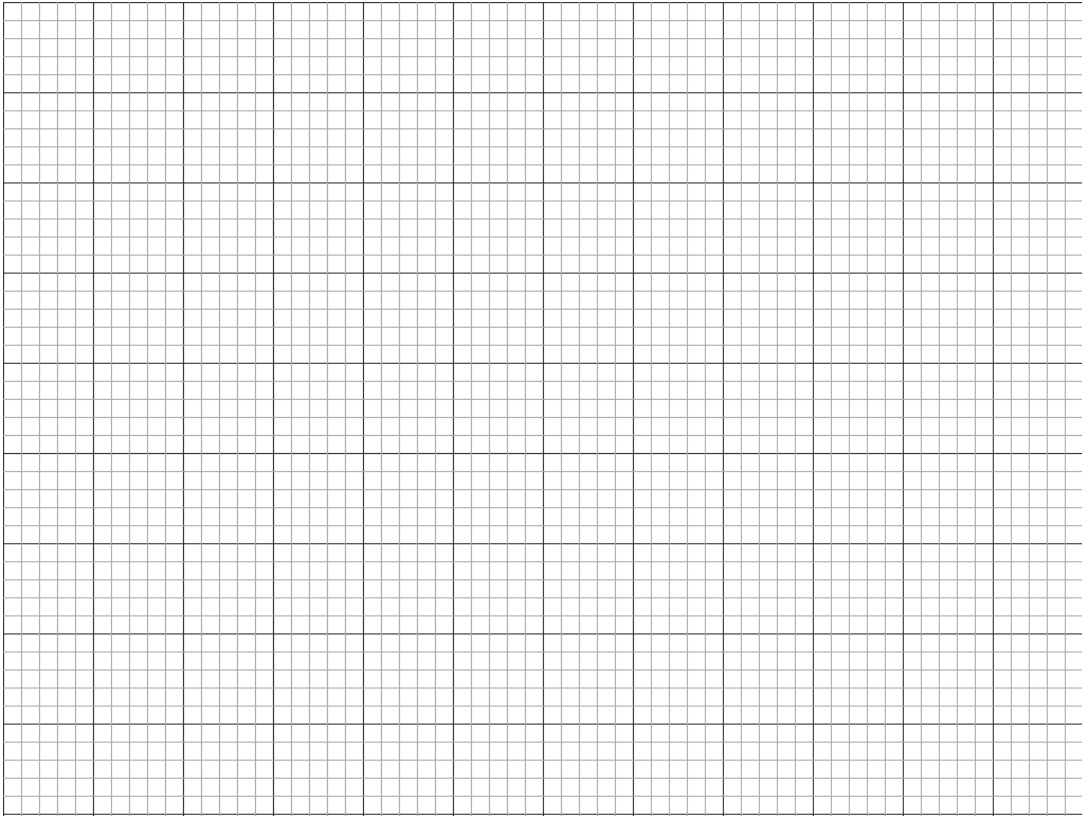
Explain how populations are affected by limiting factors (abiotic and biotic factors). (Biology)

“The biotic and abiotic factors work together to form the alpine tundra and keep the ecosystem working. When one of the factors in an ecosystem or biome changes, it impacts all of the system. Arctic and alpine tundra are areas where trees grow lightly because of the short growing season, low precipitation (rain, snow or hail fall), strong winds, and high altitude. Tundra is often found near long-lasting ice sheets where, during summer, the ice and snow drawback to uncover the ground and allow vegetation to grow. This can happen anywhere on earth.” <http://alpinetundrabiome.weebly.com/biotic-and-abiotic-factors.html>

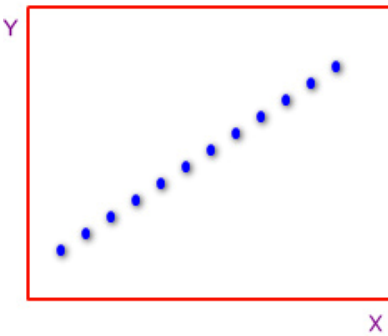
What is Alpine? _____

What are biotic factors? Please list an example of one.

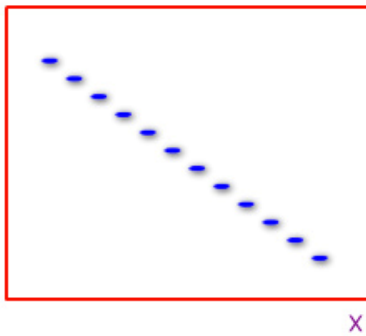
What are abiotic factors? Please list an example of one.



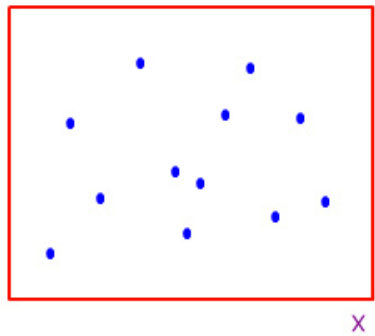
Perfect Positive Correlation



Perfect Negative Correlation



Zero Correlation



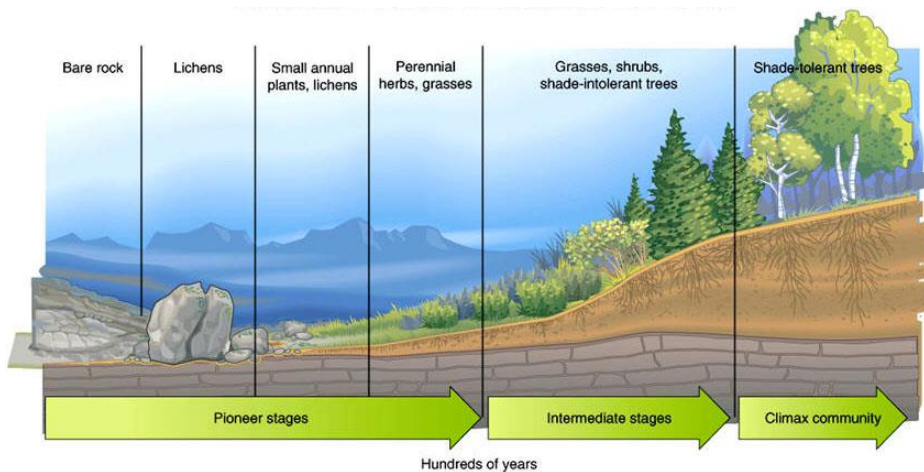
Illustrate the processes of succession in ecosystems. (Biology)

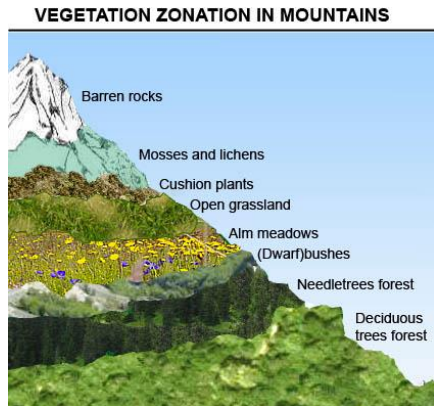
Primary succession occurs in an area that has not been previously occupied by a community. Places where primary succession occurs include newly exposed rock areas, sand dunes, and lava flows. Simple species that can tolerate the often harsh environment become established first. These organisms help enrich the soil by adding organic material. The added organic material allows for other species to become established that previously couldn't. The first organisms to appear in areas of primary succession are often mosses or lichens.

Secondary succession occurs in areas that have been disturbed. The causes of these disturbances may be natural or human-made. Secondary succession may occur in abandoned crop fields, clear-cut forests, areas damaged by wind storms, fire, or floods, etc. Soil typically remains and plants are able to grow much easier.

Primary Succession: _____

Secondary Succession: _____

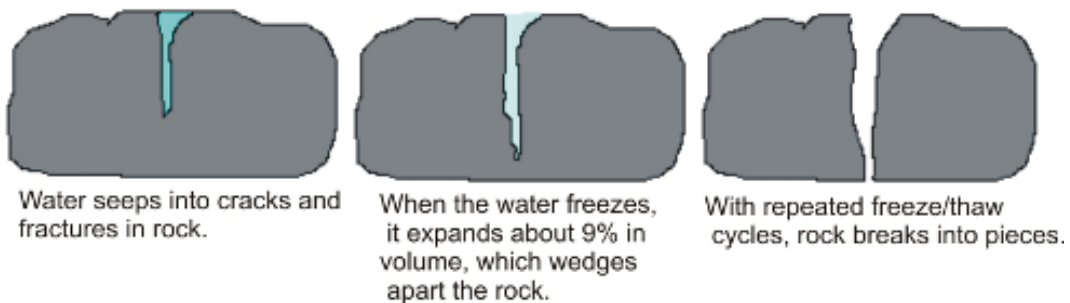


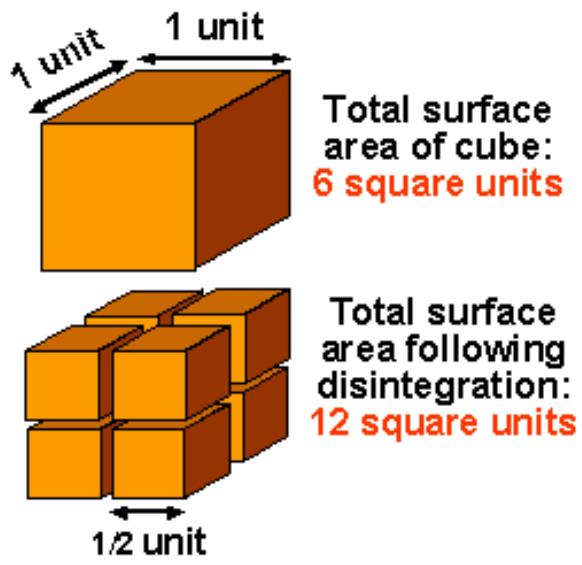


Analyze surface features of Earth in order to identify geologic processes (including weathering, erosion, deposition, and glaciation) that are likely to have been responsible for their formation. (Environmental Science)

Mechanical/physical weathering - physical disintegration of a rock into smaller fragments, each with the same properties as the original. Occurs mainly by temperature and pressure changes.

Chemical weathering - process by which the internal structure of a mineral is altered by the addition or removal of elements. Change in phase (mineral type) and composition are due to the action of chemical agents. Chemical weathering is dependent on available surface for reaction temperature and presence of chemically active fluids.





APPENDIX F
STANDARDS LIST

Outdoor Classroom Standards

Total Standards: 28

8 Biology

6 Physics

3 Human Anatomy and Physiology

2 Environmental Science

2 Earth Science

2 Algebra

4 Geometry

1 AP Calculus

Freshwater Ecology Standards

-Summarize the overall process by which photosynthesis converts solar energy into chemical energy and interpret the chemical equation for the process. (Biology)

-Illustrate the flow of energy through ecosystems (including food chains, food webs, energy pyramids, number. (Biology)

-Assess the potential value of a single species to a particular ecosystem.
(Environmental Science)

-Explain how organisms are adapted to the environment in terms of ecological niches and natural selection. (Environmental Science)

-Analyze surface features of Earth in order to identify geologic processes that are likely to have been responsible for their formation. (Earth Science)

-Differentiate between alternating current (AC) and direct current (DC) in electrical circuits. (Physics)

-The student will use Riemann sums and the Trapezoidal Rule to approximate definite integrals of functions. (Calculus)

Biology: 2

Physics: 1

Environmental Science: 2

Earth Science: 1

AP Calculus: 1

Survival Skills Standards

-Design a scientific investigation with appropriate methods of control to test a hypothesis (including independent and dependent variables), and evaluate the designs of sample investigations. (Biology)

-Organize and interpret the data from a controlled scientific investigation by using mathematics, graphs, models, and/or technology. (Biology)

-Evaluate the results of a controlled scientific investigation in terms of whether they refute or verify the hypothesis. (Biology)

- Explain the factors that influence the dynamics of falling objects and projectiles. (Physics)

- Apply formulas for velocity and acceleration to solve problems related to projectile motion. (Physics)

-Describe, create, and analyze a sample space, then calculate the probability. (Geometry)

-List the structural and functional characteristics of muscle tissues. (Human Anatomy)

-Describe the gross anatomy of a typical long bone and flat bone. (Human Anatomy)

-Explain the location, characteristics, and functions of the major cartilage in the adult skeleton. (Human Anatomy)

Biology: 3

Physics: 2

Human Anatomy: 3

Geometry: 1

Land Navigation Standards

- Represent vector quantities and use vector addition. (Physics)
 - Apply formulas for velocity or speed and acceleration to one and two-dimensional problems. (Physics)
 - Use diagrams to illustrate an electric field (Physics)
 - Explain the relationship between scale factors and their inverses and to apply scale factors to scale figures and drawings. (Geometry)
 - Demonstrate an understanding of the relationship between geometric representation in a coordinate plane and algebraic models of lines and circles (Geometry)
 - Use different degrees of precision in measurement, explain the reason for using a certain degree of precision, and apply estimation strategies to obtain reasonable measurements with appropriate precision for a given purpose. (Geometry)
- Solve problems involving equations with algebraic fractions including direct, inverse, and joint variation. (Algebra)

Physics: 3

Geometry: 3

Algebra: 1

Alpine Ecology Standards

- Organize and interpret the data from a controlled scientific investigation by using mathematics, graphs, models, and/or technology. (Biology)
- Illustrate the processes of succession in ecosystems. (Biology)
- Explain how populations are affected by limiting factors (including density-dependent, density-independent, abiotic, and biotic factors). (Biology)
- Analyze surface features of Earth in order to identify geologic processes (including weathering, erosion, deposition, and glaciation) that are likely to have been responsible for their formation. (Earth Science)
- Select, create, and interpret an appropriate graphical representation for a set of data. (Algebra)

Biology: 3

Earth Science: 1

Algebra: 1

APPENDIX G

FRESHWATER ECOLOGY PRE AND POST TEST

Freshwater Ecology Pretest

Summarize Photosynthesis

Draw a food chain where the primary producers are trees, primary consumers are detritivores, secondary consumers are nymphs, tertiary consumers are trout, and the quaternary consumers are ospreys. (you do not need to draw pictures of the organism)

Predict one reason why trout might not be in the stream. What do you think this effect would be on the food chain.

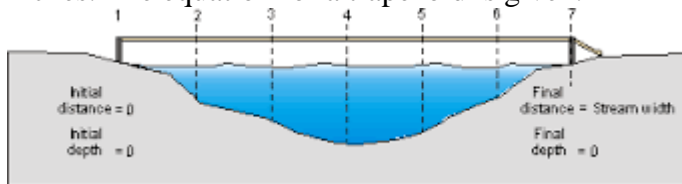
Predict which fish is adapted for living in fast flowing water. What is one adaptation that this fish has?



The stream on the left is good for fishing while the stream on the right is not. Predict one reason why.



Calculate the area of the stream between numbers 2 and 4. The distance between the numbers is 12 inches. The depths at number two is 8 inches, three is 13 inches, 4 is 15 inches. The equation for a trapezoid is given.



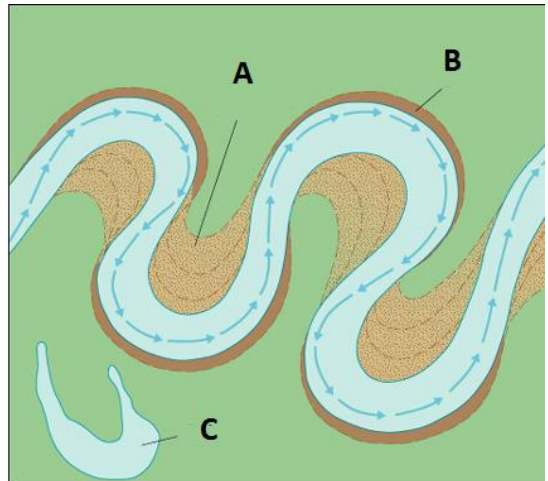
Trapezoid

$$\text{Area} = \frac{1}{2} h (b_1 + b_2)$$

A stream has a vertical area of 34.5 feet. The velocity of the stream is 5 cubic feet per second. What is the discharge?

What is the difference between AC and DC electrical current?

Geologic Processes are occurring in this picture. What 2 are occurring at A and B? What is the reason behind this? What is structure C called? How did it form?



Freshwater Ecology Posttest

Summarize Photosynthesis

Draw a food chain where the primary producers are trees, primary consumers are detritivores, secondary consumers are stoneflies, tertiary consumers are trout, and the quaternary consumers are ospreys. (you do not need to draw pictures of the organism)

Predict one reason why trout might not be in the stream. What do you think this effect would be on the food chain?

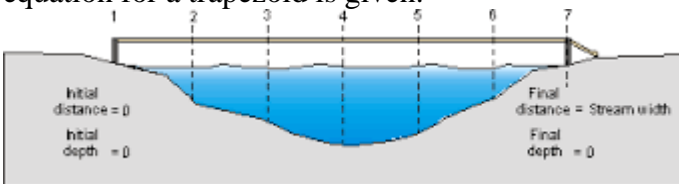
Predict which fish is adapted for living in fast flowing water. What is one adaptation that this fish has?



The stream on the left is good for fishing while the stream on the right is not. Predict one reason why.



Calculate the area of the stream between numbers 4 and 6. The distance between the numbers is 25 cm. The depths at number four is 12cm, five is 10cm, six is 7cm. The equation for a trapezoid is given.



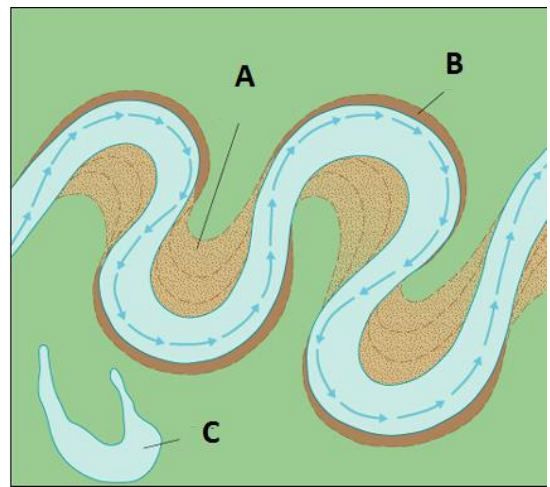
Trapezoid

$Area = \frac{1}{2} h (b_1 + b_2)$

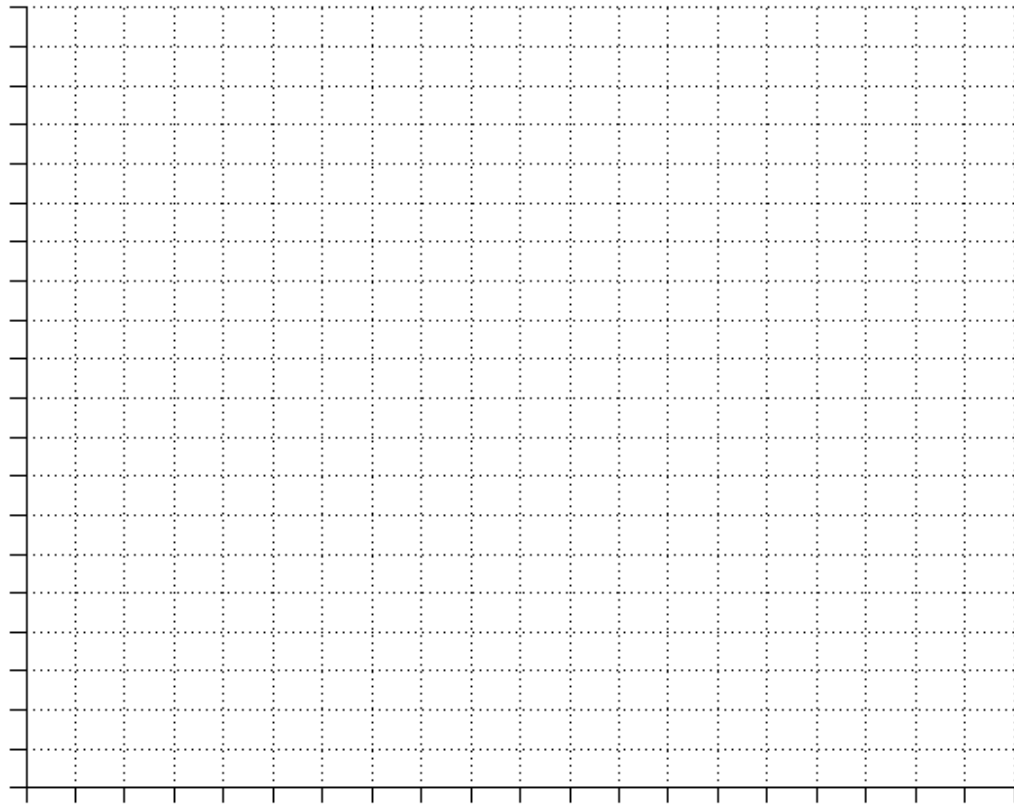
A stream has a vertical area of 125cm squared. The velocity of the stream is 4.5 cm per second. What is the discharge?

What is the difference between AC and DC electrical current?

Geologic Processes are occurring in this picture. What 2 are occurring at A and B? What is the reason behind this? What is structure C called? How did it form?

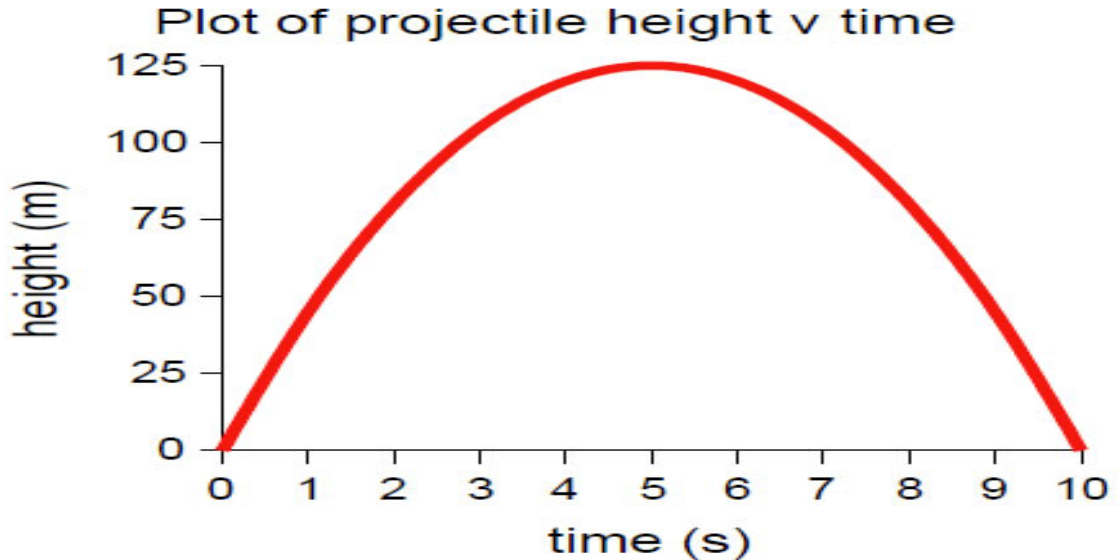


APPENDIX H
SURVIVAL SKILLS PRE AND POSTTEST



Amped Up' hypothesis is that their batteries last just as long and are brighter than comparable name brands. Looking at the data, explain if you can refute or verify the hypothesis.

This is a graph of a projectile fired through the air. The time it travels is compared to the height at that time. Draw in horizontal and vertical vectors that are proportional to the velocity and to the path of flight at 1, 3, 5, 7, and 9 seconds.



Two identical objects are placed at the same height. Object X is simple dropped while object Y is shot out in a horizontal direction. Which one will hit the ground first?

- A) X
- B) Y
- C) Both will hit at the same time

Define the following words:

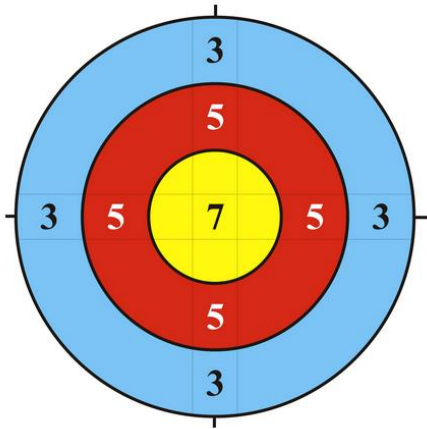
Velocity: _____

Acceleration: _____

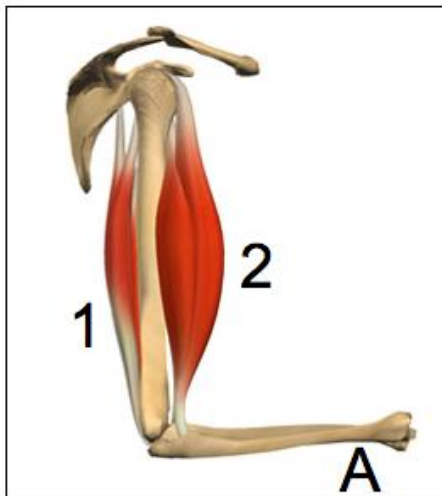
You are shooting a bow and arrow 20 meters (x). The velocity (V) of the arrow is 75 m/s. Use the following equation to find the angle Θ of elevation of which you should shoot.

Use 9.81m/s/s for the pull of gravity (g) $\Theta = \frac{1}{2} \sin^{-1} (gx/V^2)$

You are shooting a bow and arrow. You know you will at least hit the target. Calculate that probability that you will hit the bull's eye in yellow. The diameter of the entire target is 30cm and the diameter of the yellow bulls eye is 10cm.

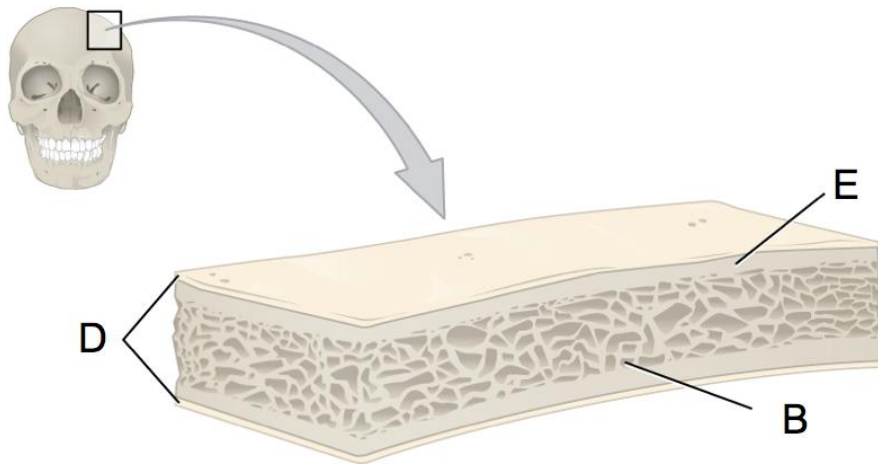
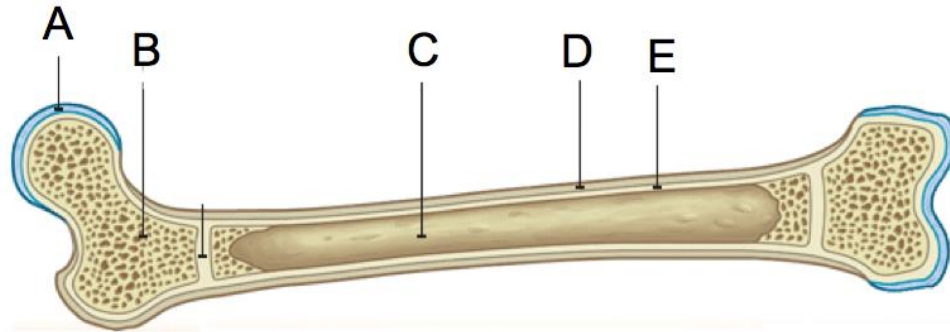


This is a picture of a human arm. Explain the function of muscle 1 (triceps) and muscle 2 (bicep) in relation to the bones with an A next to them (radius and ulna)



Describe the basic structure of a muscle.

Match the following structures with their proper name.



- ___ Articular Cartilage
- ___ Compact Bone
- ___ Medullar Cavity
- ___ Periosteum
- ___ Spongy Bone

What type of bone is the first one? _____

What type of bone is the second one? _____

Explain the location, characteristics, and functions of the major cartilage in the adult skeleton.

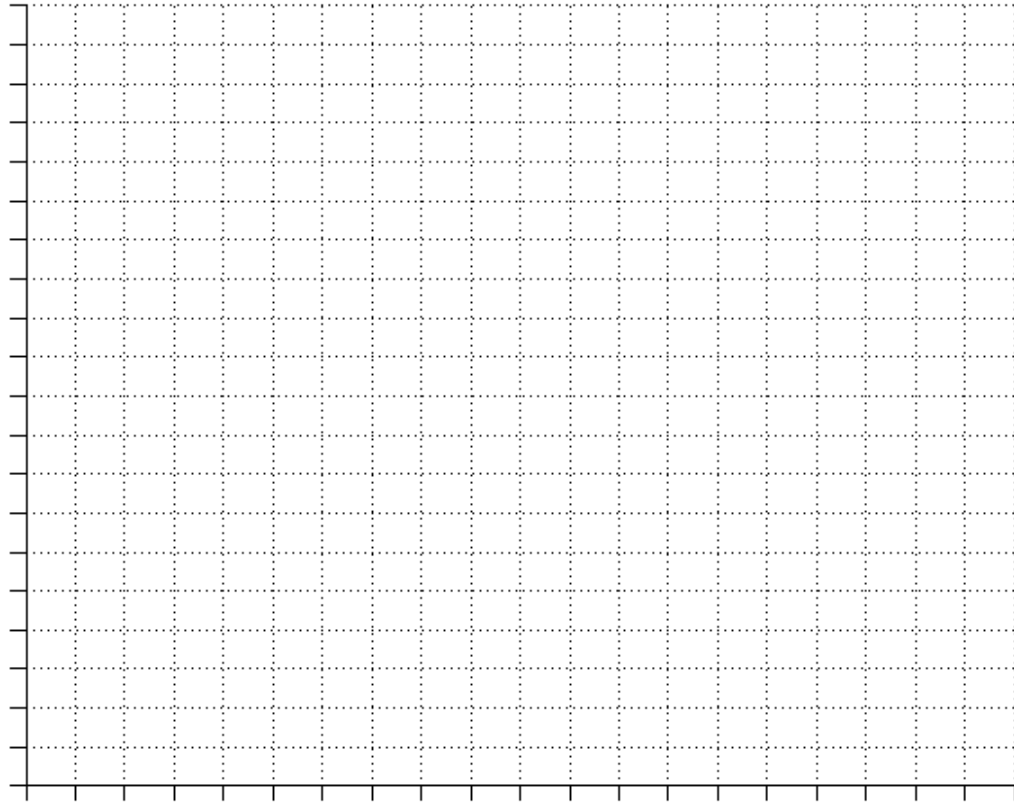
Survival Skills Pretest

You want to test if a specific brand of chicken feed is beneficial to the growth of a baby chick. Design an experiment as which to test the effect of this feed on the chicks. Be sure to include things like a hypothesis, control, independent variable and dependent variable.

The company “Amped Up” is testing their new brand of batteries compared to typical name brand batteries. Batteries were placed in flashlights and they were left on for 5 hours. Data is shown in the Lumens, which is the standard unit for measuring light intensity.

	1 hour	2 hours	3 hours	4 hours	5 hours
Amped Up	500	490	480	400	300
Energizer	500	490	475	455	430
Duracell	500	485	470	455	440

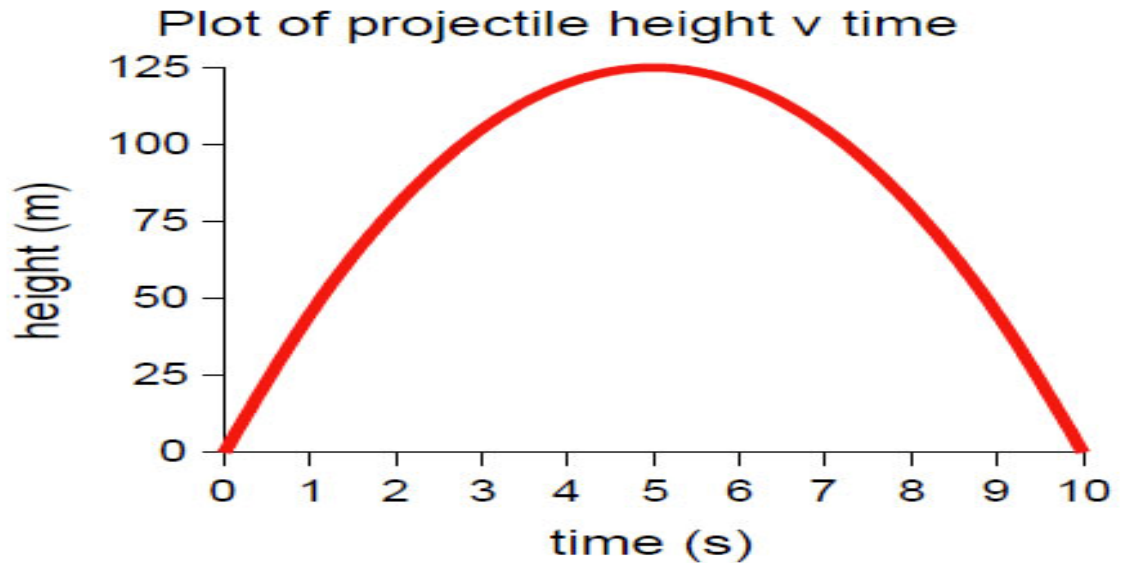
Make a graph of your choosing to display this data in a visual form.



Amped Up' hypothesis is that their batteries last just as long and are brighter than comparable name brands. Looking at the data, explain if you can refute or verify the hypothesis.

Finding Food

This is a graph of a projectile fired through the air. The time it travels is compared to the height at that time. Draw in horizontal and vertical vectors that are proportional to the velocity and to the path of flight at 1, 3, 5, 7, and 9 seconds.



Two identical objects are placed at the same height. Object X is simple dropped while object Y is shot out in a horizontal direction. Which one will hit the ground first?

- A) X
- B) Y
- C) Both will hit at the same time

Define the following words:

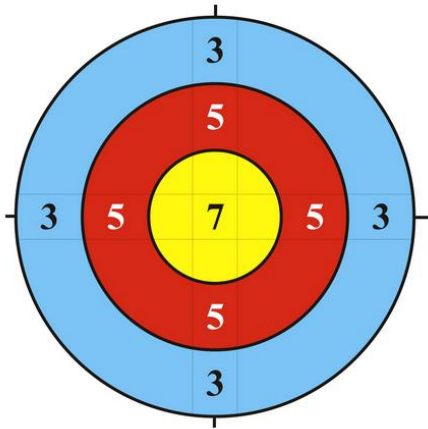
Velocity: _____

Acceleration: _____

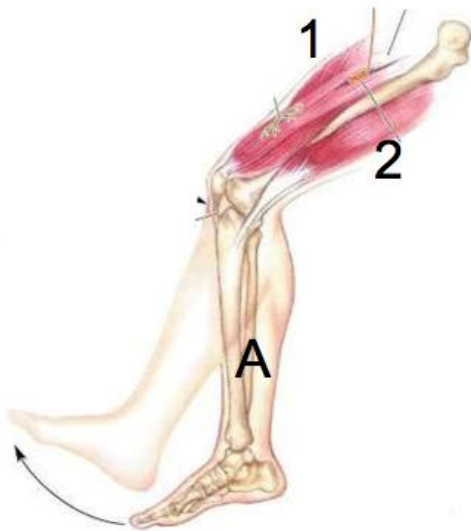
You are shooting a bow and arrow 10 meters (x). The velocity (V) of the arrow is 80 m/s. Use the following equation to find the angle θ of elevation of which you should shoot.

Use 9.81m/s/s for the pull of gravity (g) $\theta = \frac{1}{2} \sin^{-1} (gx/V^2)$

You are shooting a bow and arrow. You know you will at least hit the red or yellow area. Calculate that probability that you will hit the yellow area. The diameter of the red is 20cm and the diameter of the yellow circle is 10cm.

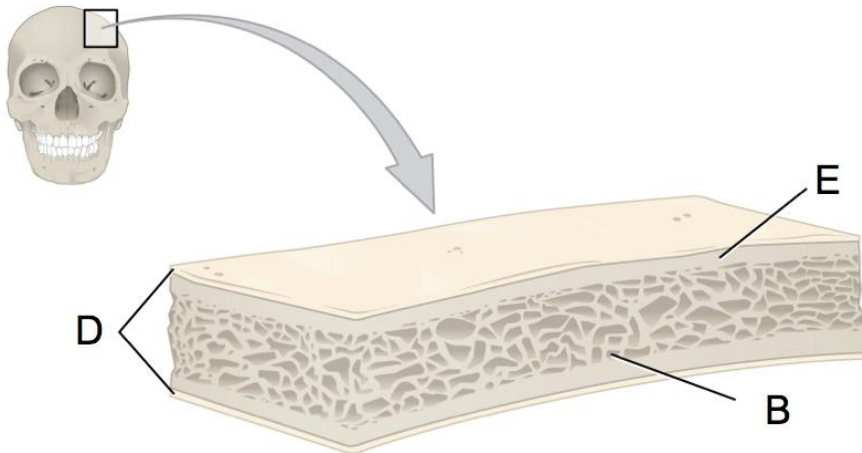
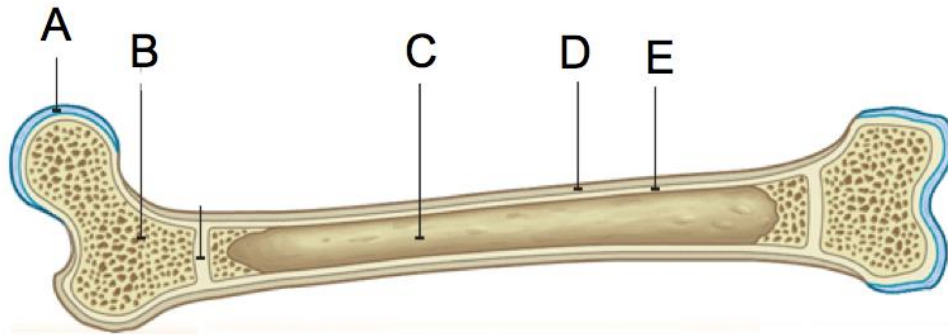


This is a picture of a human arm. Explain the function of muscle 1 (quadriceps) and muscle 2 (hamstring) in relation to the bones with an A next to them (tibia and fibula)



Describe the basic structure of a muscle.

Match the following structures with their proper name.



- ___ Articular Cartilage
- ___ Compact Bone
- ___ Medullar Cavity
- ___ Periosteum
- ___ Spongy Bone

What type of bone is the first one? _____

What type of bone is the second one? _____

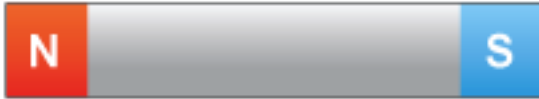
Explain the location, characteristics, and functions of the major cartilage in the adult skeleton.

APPENDIX I

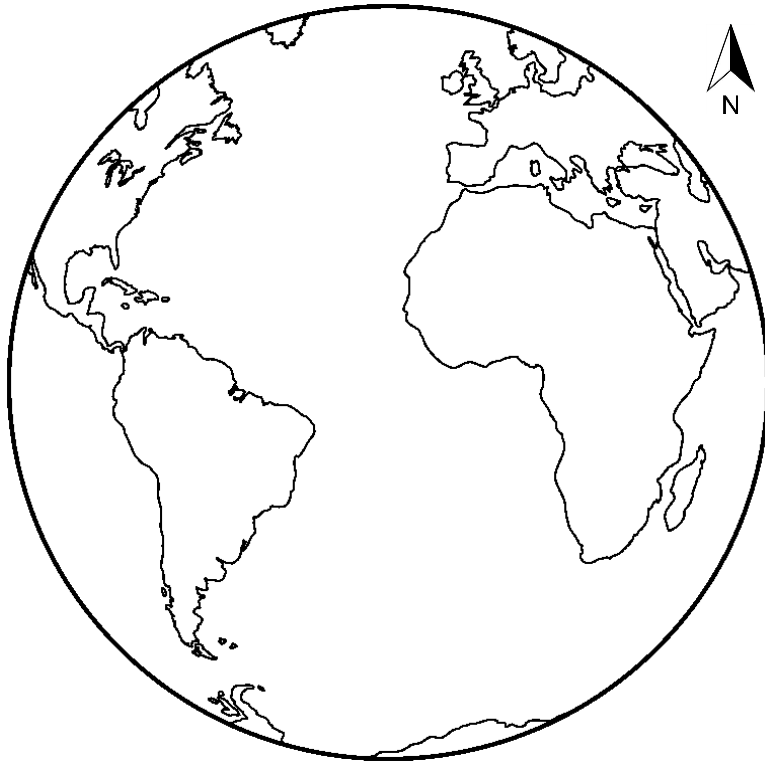
LAND NAVIGATION PRE AND POSTTEST

Land Navigation Pretest

Draw the magnetic field around this bar magnet.



Redraw this bar magnet on top of the globe so it is properly orientated in relation to the north and south pole.



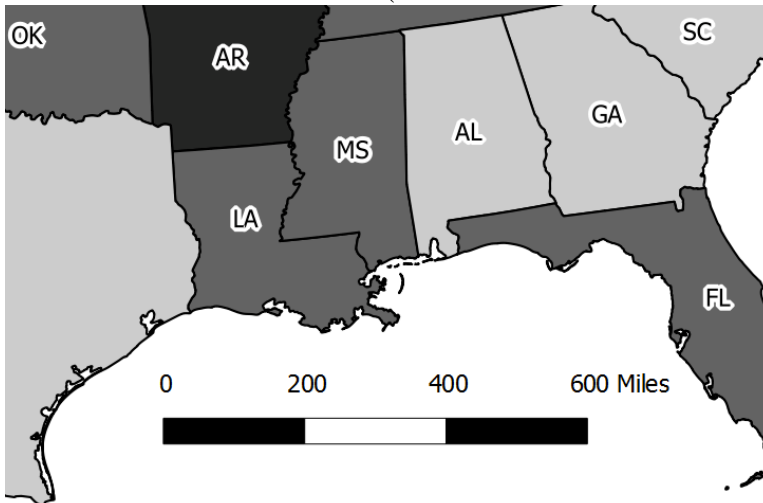
This is a beautiful butterfly. The one in the middle is actual size (2 cm wingspan). The one on the left is an enlargement (4 cm wingspan) and the one on the right is a reduction (1 cm wingspan).



When comparing the middle butterfly to the left butterfly, how do you represent the scale factor?

When comparing the middle butterfly to the right butterfly, how do you represent the scale factor?

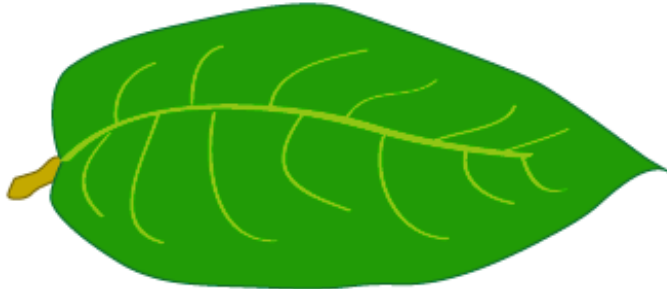
How far is it from FL to SC? (Measure between the abbreviations)



Use your ruler for the next 2 questions

Measure this leaf (stem included) the nearest cm. _____

Measure this leaf (stem included) the nearest mm. _____

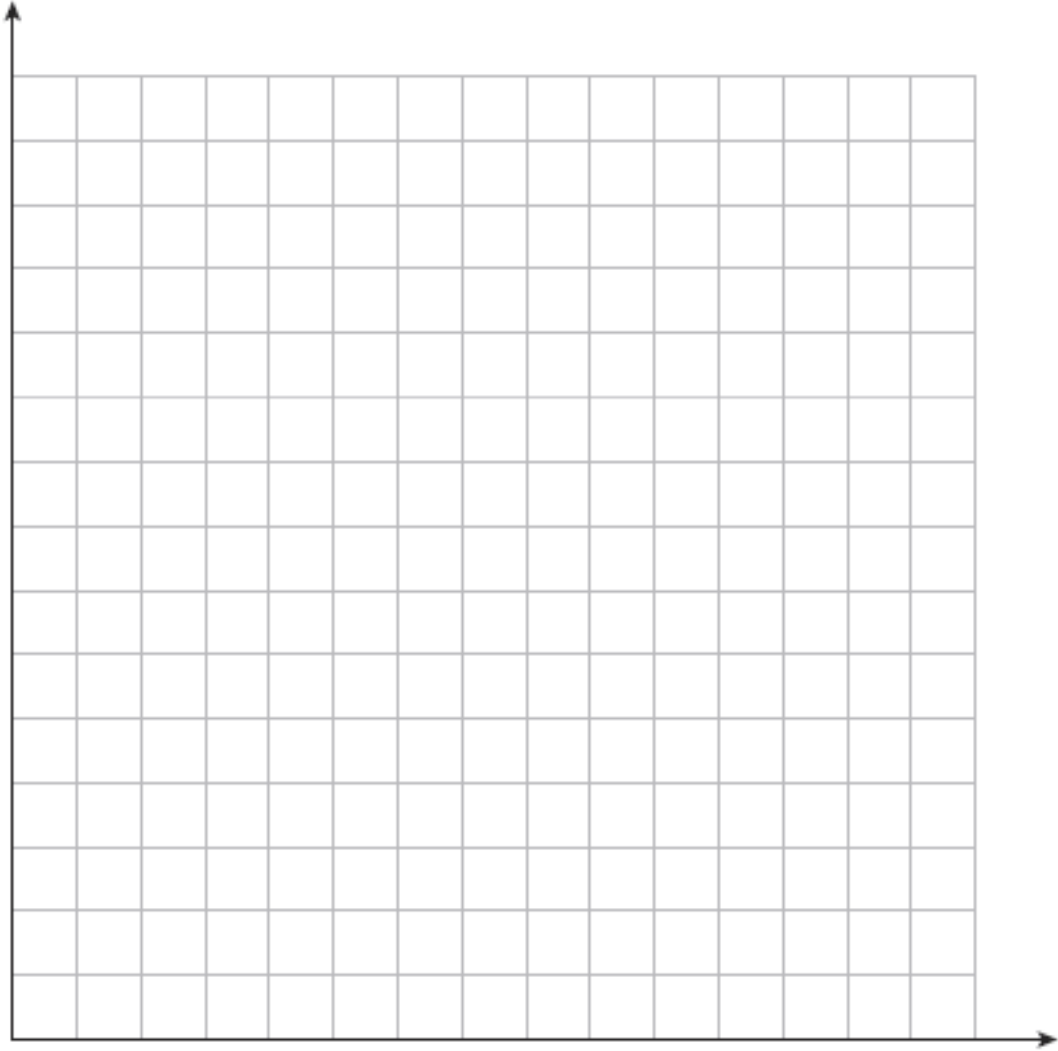


What would be one reason for using cm instead of mm or vice versa?

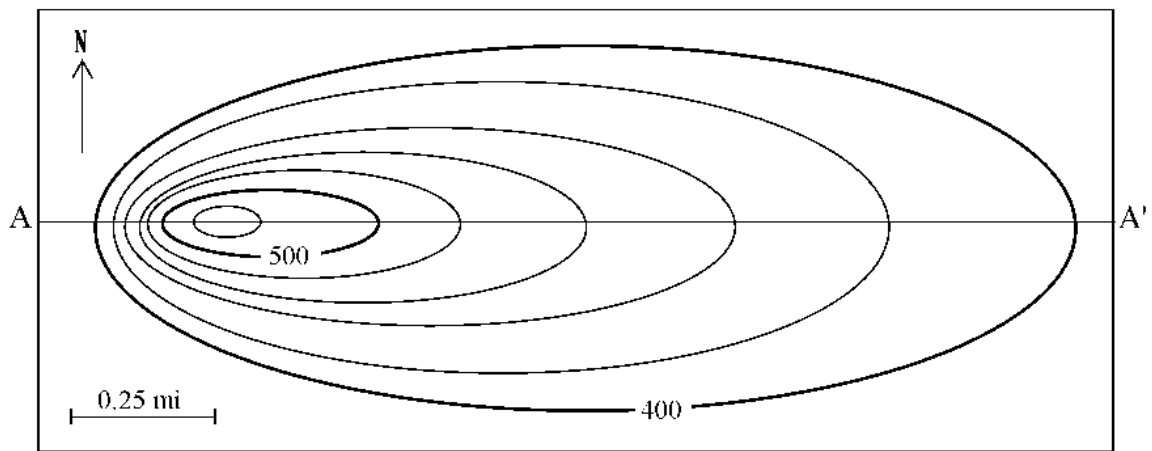
Milli means 0.001. Micro means 0.00001. What is one logical reason you don't go around measuring things in micrometers?

You need to travel 459 meters to get to your set destination. You measured that your right leg touches the ground 82 times per ever 100 meters you walk. How many steps will you need to take to travel the 459 meters?

You start at the origin which is your camp. You hike 5cm at 80° . You then spend the night. The next day you hike 3 cm at 260° . You want to go back to your camp. What is your vector? (How far do you hike and in what direction?)

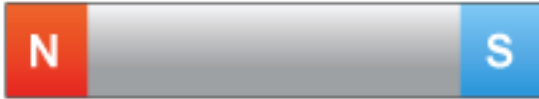


Construct a topographical map profile from this segment of topographical map.

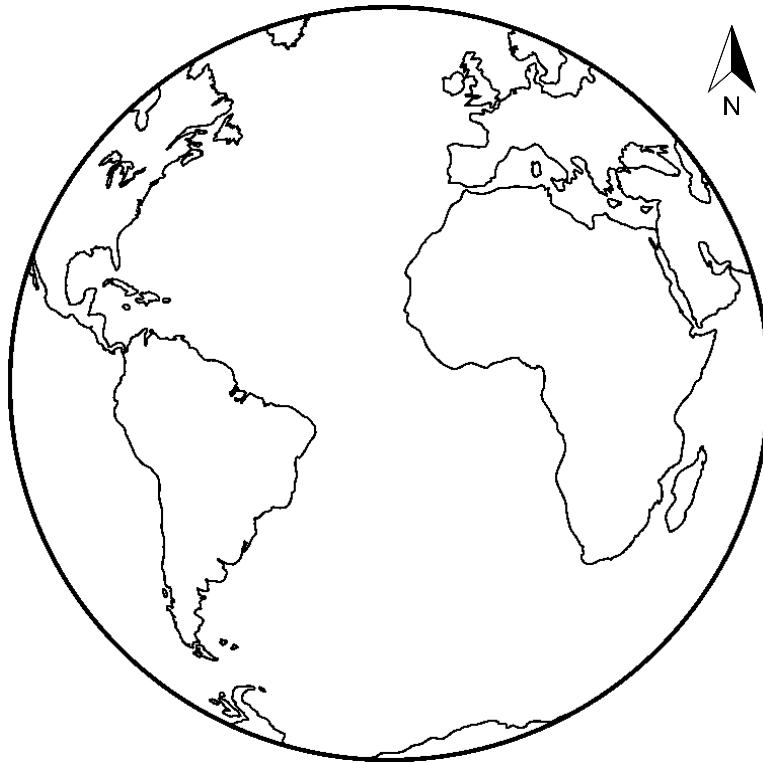


Land Navigation Posttest

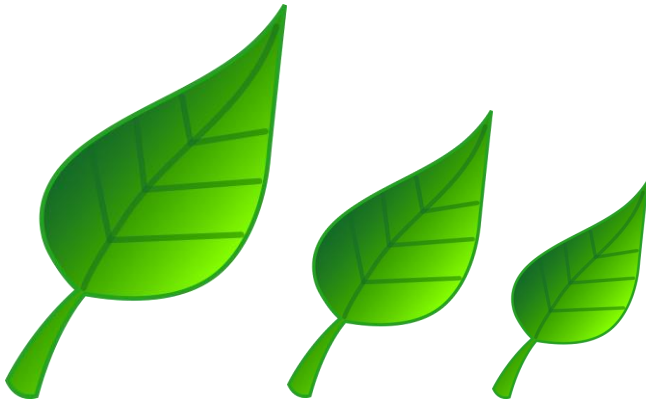
Draw the magnetic field around this bar magnet.



Redraw this bar magnet on top of the globe so it is properly orientated in relation to the north and south pole.



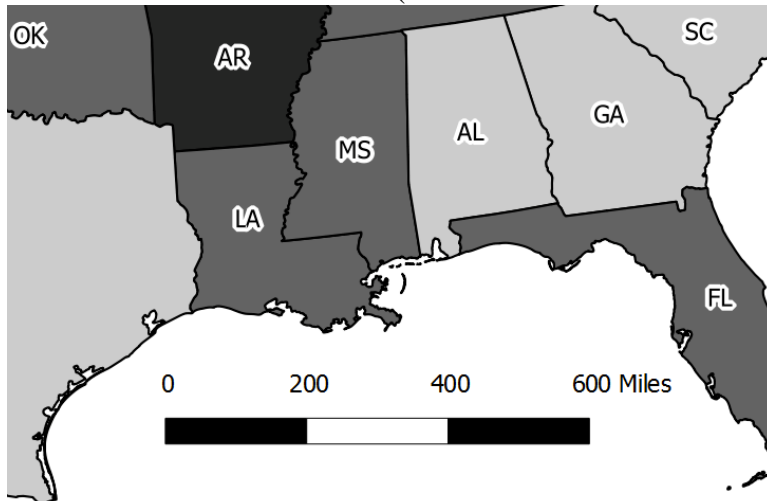
This is a leaf. The one in the middle is actual size (4 cm across). The one on the left is an enlargement (8 cm across) and the one on the right is a reduction (2 cm across).



When comparing the middle leaf to the left leaf, how do you represent the scale factor?

When comparing the middle leaf to the right leaf, how do you represent the scale factor?

How far is it from MS to SC? (Measure between the abbreviations)



Use your ruler for the next 2 questions



Measure this butterfly's wingspan from the #1 to #2 the nearest cm. _____

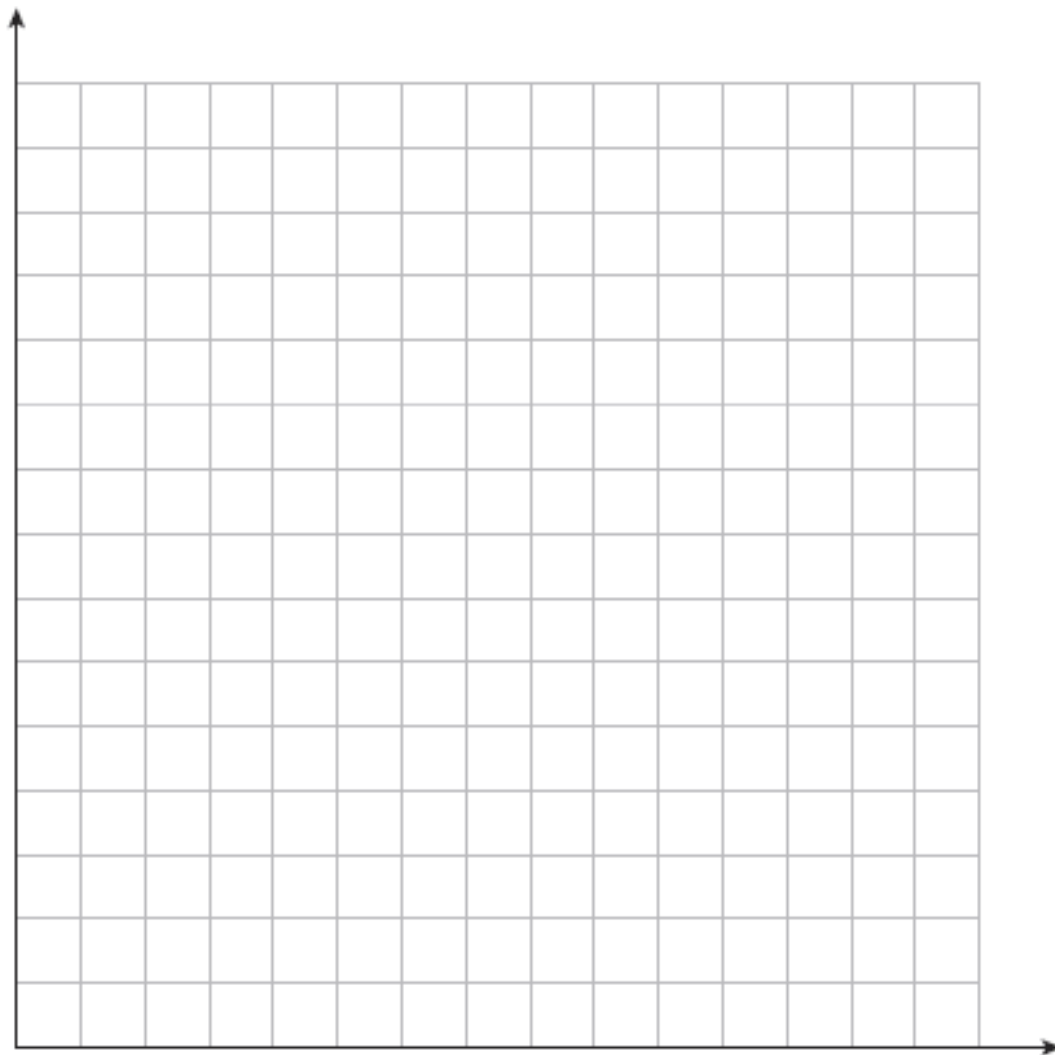
Measure this butterfly's wingspan from the #1 to #2 the nearest mm. _____

What would be one reason for using cm instead of mm or vice versa?

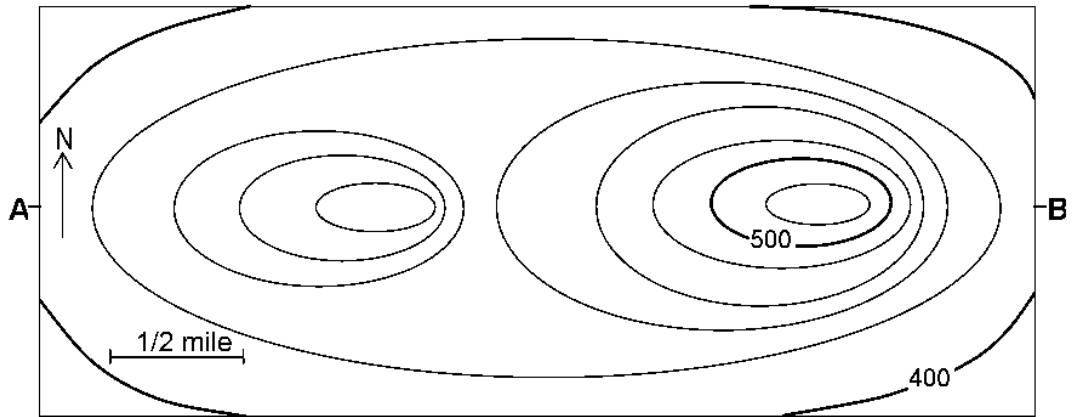
A meter is the standard unit of length in the metric system. Kilo means 1000. People's homes are typically measured in square meters, not kilometers. What is one logical reason why this is?

You need to travel 623 meters to get to your set destination. You measured that your right leg touches the ground _____ times per ever 100 meters you walk. How many steps will you need to take to travel 623 meters?

You start at the origin which is your camp. You hike 8 cm at 60° . You then spend the night. The next day you 6 cm at 300° . You want to go back to your camp. What is your vector? (How far do you hike and in what direction?)



Construct a topographical map profile from this segment of topographical map.



APPENDIX J

ALPINE ECOLOGY PRE AND POSTTEST

Alpine Ecology Pretest

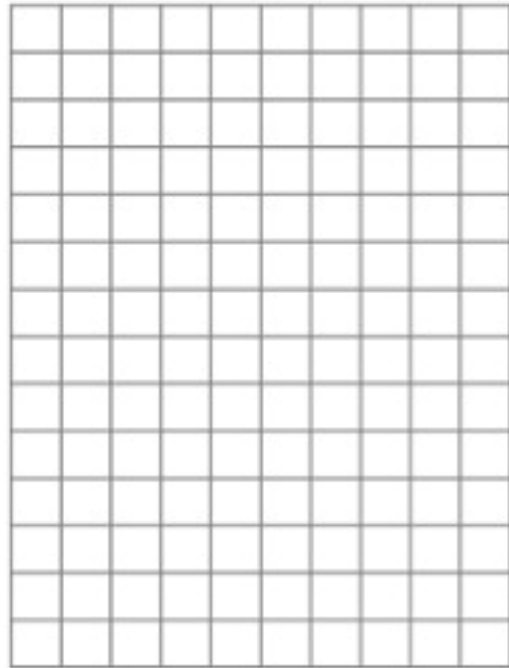
What is Alpine? _____

What are biotic factors? _____

What are abiotic factors? _____

Make a graph with the following data

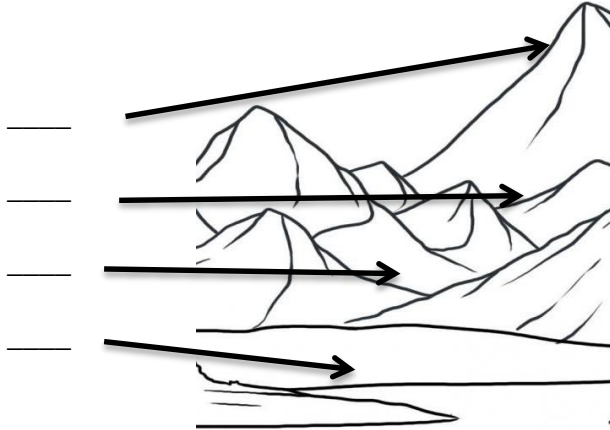
Day	Height of grass
1	10mm
2	12mm
3	13mm
4	16mm
5	16mm



If you can, make one conclusion about the graph. _____

Place the following plants where they would most likely be found along a mountain side.

- A) Bare rock and moss
- B) Evergreen trees such as fir and spruce
- C) Hardwood trees such as maple and oak
- D) Krummholz effected trees and grasses



What is the difference between primary and secondary succession. An avalanche is an example of what one?

Which picture is mechanical and chemical weathering?



What is the main difference between mechanical and chemical weathering?

Alpine Ecology Posttest

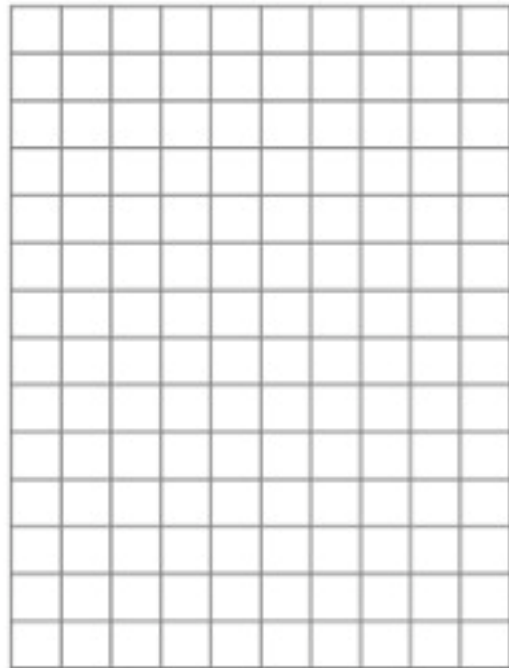
What is Alpine? _____

What are biotic factors? _____

What are abiotic factors? _____

Make a graph with the following data

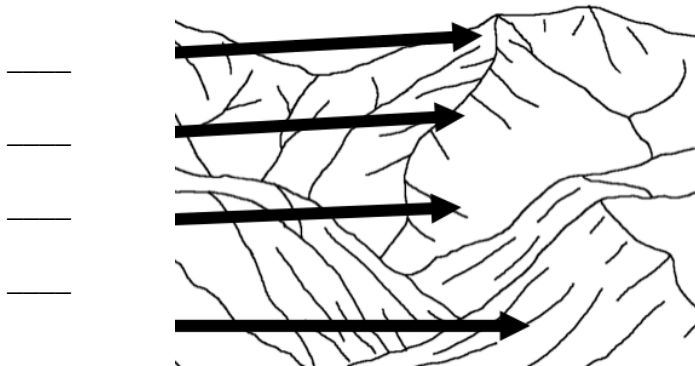
Minute	Height of candle
0	14mm
1	13mm
2	12mm
3	11mm
4	10mm
5	9mm



If you can, make one conclusion about the graph. _____

Place the following plants where they would most likely be found along a mountain side.

- A) Krummholz effected trees and grasses
- B) Bare rock and moss
- C) Hardwood trees such as maple and oak
- D) Evergreen trees such as fur and spruce



What is the difference between primary and secondary succession. A forest fire is an example of what one?

Which picture is mechanical and chemical weathering?



What is the main difference between mechanical and chemical weathering?

APPENDIX K

PRE AND POST OUTDOOR CLASSROOM INTERVIEW

Pre Outdoor Classroom Interview

1. Describe your feelings about learning math.
2. Describe your feelings about learning science.
3. How do you feel about being outdoors in general? Do you spend much time outdoors?
4. How do you feel when your teacher tells you that the class is going outside or on a field trip?
5. What is your favorite thing about learning math?
6. What is your least favorite thing about learning math?
7. What is your favorite thing about learning science?
8. What is your least favorite thing about learning science?
9. Are you afraid of or worried about anything when you spend time in nature?
10. What is the best outdoor science experience you have ever had?
Follow up: Why was that the best?
11. What is the worst outdoor science experience you have ever had?
Follow up: Why was that the worst?
12. Are you comfortable learning in outdoor settings?
Follow up: Why are you comfortable/uncomfortable learning outside?
13. Is there anything else you'd like me to know?

Post Outdoor Classroom Interview

1. Describe your feelings about learning math.
2. Describe your feelings about learning science.
3. How do you feel about being outdoors in general? Do you spend much time outdoors?
4. How do you feel when your teacher tells you that the class is going outside or on a field trip?
5. What is your favorite thing about learning math?
6. What is your least favorite thing about learning math?
7. What is your favorite thing about learning science?
8. What is your least favorite thing about learning science?
9. Are you afraid of or worried about anything when you spend time in nature?
10. What is the best outdoor science experience you have ever had?
Follow up: Why was that the best?
11. What is the worst outdoor science experience you have ever had?
Follow up: Why was that the worst?
12. Are you comfortable learning in outdoor settings?
Follow up: Why are you comfortable/uncomfortable learning outside?
13. Would you like to attend a fulltime outdoor school?
14. Is there anything else you'd like me to know?

APPENDIX L

PRE AND POST OUTDOOR CLASSROOM SURVEY

Pre Outdoor Classroom Survey

Directions: This test contains statements about learning math and science in your traditional setting. For each statement, circle around ONE specific numeric value corresponding to how you feel about the statement. This is your opinion. There are not right or wrong answers for these statements.

5 = Strongly Agree [SA]

4 = Agree [A]

3 = Undecided [U]

2 = Disagree [D]

1 = Strongly Disagree [SD]

Statement	SA	A	U	D	SD
1. I enjoy going to school.	5	4	3	2	1
2. When I learn math, I typically ask/wonder, "When am I going to use this in real life?"	5	4	3	2	1
3. When I learn science, I typically ask/wonder, "When am I going to use this in real life?"	5	4	3	2	1
4. Math and science lessons are fun.	5	4	3	2	1
5. Doing experiments is better than finding information out from teachers.	5	4	3	2	1
6. I see a connection of the things I learned in school to a real life application.	5	4	3	2	1
7. I enjoy math.	5	4	3	2	1
8. I enjoy science.	5	4	3	2	1
9. When learning math, I find it better to learn the information by doing some type of application project rather than solving multiple problems of similar nature.	5	4	3	2	1
10. The outdoors is a good place to learn math.	5	4	3	2	1

Post Outdoor Classroom Survey

Directions: This test contains statements about learning math and science through use of the outdoor classroom. For each statement, circle around ONE specific numeric value corresponding to how you feel about the statement. This is your opinion. There are not right or wrong answers for these statements.

5 = Strongly Agree [SA]

4 = Agree [A]

3 = Undecided [U]

2 = Disagree [D]

1 = Strongly Disagree [SD]

Statement	SA	A	U	D	SD
1. I enjoy going to school in the outdoor classroom more so than my traditional school setting.	5	4	3	2	1
2. When learning math in the outdoor classroom, I typically ask/wonder, "When am I going to use this in real life?"	5	4	3	2	1
3. When I learn science in the outdoor classroom, I typically ask/wonder, "When am I going to use this in real life?"	5	4	3	2	1
4. Math and science lessons are fun in the outdoor classroom.	5	4	3	2	1
5. Learning by the act of doing is better than finding information out from teachers.	5	4	3	2	1
6. I see a connection of the things I learned in the outdoor classroom to a real life application.	5	4	3	2	1
7. I enjoy learning math more in the outdoor classroom than in my traditional school setting.	5	4	3	2	1
8. I enjoy learning science more in the outdoor classroom than in my traditional school setting.	5	4	3	2	1

9. When learning math, I find it better to apply it while I learn it as I did in the outdoor classroom rather than solving multiple problems of similar nature.	5	4	3	2	1
10. The outdoors is a good place to learn math and science.	5	4	3	2	1