

Living Environment Field Trips in Wyoming and
Genesee Counties, New York

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Chapter One: Introduction

The purpose of field trips is to engage students in hands on or real world learning opportunities. Science fairs and field trips are two examples of how students can experience out of classroom activities. Through these activities, students may understand or practice an aspect of a topic as experienced in the real world, outside of the school setting (Tal, et. al., 2014); exploring skills and physical beings, having discussions with historians or scientists, and synthesizing or analyzing information (Rohlf, 2015). Especially in science, new technology and knowledge is ever changing. Field trips allow students to practice or use technology that many schools or organizations are unable to purchase for student use.

Many students' families cannot provide or support students' learning by taking them to outside learning events or activities (DeSouza, 2016). Through expeditionary learning, or field trips, that are available to students in school or through after school programs, all students are able to experience how individuals of all races and backgrounds can work together to form a successful scientific environment.

By having students attend field trips, they not only are learning about science, but are practicing other life skills such as communication (Bozdogan, 2012). Students not only need to communicate with each other during tasks or about observations, but often need to communicate teachers or research guides. Communication skills are essential for all students whether they enter the science field after the completion of high school or not. Furthermore, field trips allow students to pursue areas of interest and may influence their entrance into the STEM field post-high school (Schmidt & Kelter, 2017).

Field trips allow students to experience aspects of learning that are not able to be practiced in the classroom setting (Rohlf, 2015). Although all of the aforementioned are beneficial for students and their learning, field trips are often still questioned for their integrity. Learning, balanced with fun, is the basis of the concern; do students actually learn on field trips or does the fun atmosphere overtake student learning?

Chapter Two: Literature Review

More than School Learning

When students participate in field trips, they learn much more than just educational content. If field trips have well rounded designs, all students can grow and learn from them as individuals. Field trips allow students to experience real world scenarios where educational content is intertwined with people and places. Through interactions with these individuals, students are able to learn more about the world, communication, and social norms (Tal et al., 2014).

In a study performed by Adedokun et al. (2015), students participated in a virtual field trip where they interacted with local scientists. Although students learned content from the scientists, they also learned about the scientists as individuals. Prior to the virtual field trip, students were surveyed about their initial thoughts on scientists. The results of the surveys identified that students believed stereotypes that scientists were “nerdy” or “uncool”. After the virtual field trip, students in all age groups studied had significantly less stereotypes of scientists. Scientists is a very broad term that covers a great amount of occupations. Generally, stereotypes are negative, including: scientist’s jobs are boring, scientists are nerdy, etc. Reducing stereotypes

for these careers is very important when suggesting and encouraging children to go into the STEM field after high school. The more relatable scientists are as individuals to students, the more likely students are to be interested in the field as a future.

In a study performed by Bell et al. (2011), students from urban schools participated in a four day expedition field trip to a secluded rural area. Each day was filled with different activities and learning projects; to increase student understanding of the global world. For example, an activity called Bafa Bafa where students need two “different cultures” to communicate and interact through specific speculations tested students’ communication skills. The final assessment on the expedition was a scavenger hunt, where students explored the surrounding rural community; one very unlike their own. The major findings in the research were that students not only learned content from the expedition, but many returned as leaders or started their own leadership roles in their local schools or communities. The expedition program also taught students to live in a global community, where many applied and were accepted to post-secondary schools; a feat fairly uncommon from the urban areas these students came from.

In addition to these studies, field trips offer experiences to low-socioeconomic students who may otherwise never have a chance to experience (Bell et al., 2011). Students from low-socioeconomic backgrounds come from families who do not have the resources to send their children to visit learning centers or participate in these activities. Even if a family did save their resources and finally have the financial ability to send their child to an educational location, often they do not have the means to get them there. If it weren’t for classrooms or after school programs providing field trip opportunities, many low-socioeconomic students would never have the chance to attend.

Parents having positive attitudes and supporting their children on participating in educational field trips has a direct relationship with student motivation (Knapp et al., 2016). It has been proven the more supportive a parent is about successfully completing school work, the higher student motivation is. Parents providing support through assisting on field trips and offering themselves as chaperones is one way that parents can show their support and high expectations of students. If a student understands and strives to reach their parent's goals in school and life, they are more likely to be successful. High school graduation rates and postsecondary attendance are two factors that parental aspirations correlate to (Ross, 2016). As indicated for all educators, expectations should be high so that all students are able to reach their maximum potential. If parents do not have high expectations and aspirations for their children, these children will not have anything to work towards (Ross, 2016). Having high aspirations and supporting students, in education or by attending field trips with them, allow students to have higher aspirations for themselves, which may lead to more successful careers and lives.

The previous studies suggest that students from all backgrounds and all learning levels can experience success outside the classroom; field trips providing a platform to do so. All students are able to explore and practice basic skills such as communication which are necessary in their future lives while attending field trips. Basic skills may not necessarily help students directly with content teachers wish for them to learn, but will help them in all classes for the rest of their learning and professional careers. (Bell et. al., 2011).

Educational Value

In the educational environment today, schools are constantly promoting increases in reading and mathematics; as those are the most recent demands of society and the Common Core

standards. By matching these demands, schools have had to allocate resources in different areas and cut some all together (Greene et al., 2014). Field trips are commonly included in the areas schools cut from their budgets. The amount of students partaking in field trips has significantly decreased in recent years, almost eliminating non-classroom education. Many areas of learning can be concluded to be limited in the classroom, as students may not be exposed to content outside the state or national mandated curriculum. It has been suggested that field trips not only increase learning in students, but may increase critical thinking, as well as expose students to activities and phenomena that they may not otherwise ever be able to experience.

The major findings of research performed by Benton (2013), is that a majority of students who participate on field trips describe words associated with play and exploration as their favorite parts of the experience. As described in previous studies, there is a link between play and intrinsic motivation. The study by Benton (2013) suggests that since students supplied these terms as their favorite aspects of field trips, students had increased intrinsic motivation while on them. An increased intrinsic motivation in students correlates with increased learning. Field trips are often described as one of the lessons that students will remember most throughout their lives (Kenna & Russell, 2015). In the consideration of this statement, it can be concluded that field trips increase retention rates of presented information compared to traditional classroom learning. Field trips are also known to increase knowledge in inquiry skills. The high pressures and demands of testing, and having test scores tied back to teacher evaluations, creates fear that test prep is the only practice classrooms have time for. Alternatively, students increase knowledge and retention of information more by participating in real world scenarios that field trips provide.

In a study performed by Greene et. al. (2014), eighth grade students took a trip to a local art museum and completed surveys, as well as essays, to measure student learning, critical thinking, and engagement. The results of the surveys indicated that students learned and retained a significant amount of information from the field trip. From the essays collected, students were proven to have significantly higher critical thinking skills when partaking on the field trip compared to in the classroom. The field trip environment, as well as guides or chaperones, may suggest or show students how to think in new and creative ways about the topic they are exploring. Critical thinking is a high level skill that will benefit students both in their current schooling situation as well as in their future endeavors. Field trips engage students through exposing them to new and exciting aspects of content they may not otherwise be exposed to. Workers on field trips are very often excited about their jobs and the topics they speak about. Students pick up on that excitement and become excited themselves. Engagement alone has been attributed to increasing student learning. All the aforementioned topics promote the involvement of students and classes to attend field trips outside the traditional classroom environment.

The implementation of field trips not only supports student learning and retention, but ultimately will assist them in understanding and participating in Common Core Standards. Field trips provide a platform for student learning and inquiry activities; both of which support Common Core standards they are to be learning and ultimately will be tested on (Kenna & Russell, 2015). Students who attend field trips and understand the processes which occur throughout them are also more prepared for future learning. Often, field trips introduce new information or techniques to students. For example, a field trip to a laboratory may introduce students to gel electrophoresis. Gel electrophoresis is a skill often discussed about in the high

school classroom, but not completed until college. By having students prepared and able to perform this activity in high school, students will be more prepared and proficient in the skill by the time they attend college. The more prepared students are for college, the more successful students will be.

Inquiry Experiences on Field Trips

In order for students to become proficient in the STEM field, educators need to begin exposing them to inquiry and design young (Abbas, 2017). Common Core and Next Generation Science Standards have implemented many new inquiry standards; content that is also tied to high stakes testing (Kenna & Russell, 2015). Many STEM schools have been created throughout the past decade to increase the number of students interested and proficient in the STEM field and to better follow these new inquiry standards (Abbas, 2017). By preparing students in inquiry during their younger years, students are more ready for upper level education and therefore will be more proficient by the time they enter professional industry. Inquiry and design are two of the most substantial areas students need to become proficient in, as these are most like real world scenarios. Field trips can promote and incorporate inquiry, if designed to do so.

In a study performed by Abbas (2017), students from a STEM school were assigned an inquiry design project about nanotechnology. Many of the newest areas of interest in STEM are included in nanotechnology. As the world's technology becomes more sophisticated, areas that individuals are able to study are becoming smaller and smaller. Although nanotechnology areas are microscopic, they have large effects on society. The students in the study were required to design a visual test to measure an object nanometers in size, as well as create a portfolio of their results. Both the design and physical production of their results are real world practices that will

carry through with these students to careers in the STEM field. At the conclusion of the study, Abbas (2017) was able to determine that having students design their own study, as well as produce a product that allows students to present their findings, was effective in implementing learning independence in this group of students. After the activity, Abbas (2017) was able to measure student growth towards independence. Abbas (2017) concluded that the group of students in the study were more prepared for higher level education compared to their peers learning in the traditional teacher centered model.

It has been suggested that gifted students also greatly benefit from an inquiry design model (Horak & Galuzzo, 2017). Problem based learning (PBL) is one inquiry model that has been proven to increase gifted student attention rates, while promote learning. In a study performed by Horak & Galuzzo (2017), two groups of gifted students were taught lessons on identical content standards. One group of gifted students was taught using a PBL approach while the other group was taught using a teacher centered approach. The group of students who were interacted with through PBL performed at a higher level in the categories of attention rates and final grades. One key area that promotes gifted student learning in the PBL model is the fact that students are able to work at their own pace and perform more individually. Many classes learn at rates slower than what gifted students are able to. The lag in time is potentially what decreases gifted students' attention rates and interest from the lesson. By using the PBL approach, gifted students are more interested in the lesson and ultimately stay focused longer.

In a study performed by Skoda et al. (2016), three out of four learning styles from the Honey and Mumford's Learning Styles Scale benefitted from inquiry based science education (IBSE). The benefits of determining student's learning styles at the beginning of a year include

determining the type of instruction which will best suit them. By determining students' learning styles, educators can better change and alter their teaching methods and activities to better suit the students in their classroom. The more designed an education is around students, the more likely those students are to reach their maximum potential and score significantly higher on achievement and retention assessments (Kanadli, 2016). The success of students is important because mastery and understanding of content is the main goal of any educator.

Many times on field trips, students are required to perform independent research or activities (Abbas, 2017). By preparing students before they reach the field trip location, students will be more likely to participate effectively and learn substantially more throughout the experience. Inquiry, as well as physical production and presentation of results, are two methods that could potentially be used to prepare students for independent learning. Students need the skills of data collection and communication not only to be successful on the field trip or lesson, but to be successful in potential future STEM education and careers. Field trips are one way to incorporate and facilitate methods based from inquiry into student learning.

Pre-Field Trip

Field trips are additional learning opportunities where students can experience real world scenarios and activities (Miele & Adams, 2016). In order to experience success on a field trip, students and educators need to be prepared for what the field trip will encompass; not only the curriculum that will be gone over, but the transportation, engagement activities, lunches, and directions to ensure students get to their field trip destination safely and are prepared to learn the maximum amount they possibly can (Roscoe & Orr, 2010). Field trips should fit seamlessly with content being taught in the classroom, as well as background information students already know

(Miele & Adams, 2016). Students need to know necessary background information and content prior to the field trip, often encompassing many class days worth of teaching in order to understand and comprehend the information that is going to be presented to them. Selecting engaging field trips, where students will be involved in exciting activities, is also important in the preparation of an out of classroom experience so students are engaged and able to learn throughout the entire exploration period.

First, the educator planning the field trip must determine objectives, often associated with state or national standards, that associate with both curriculum and the desired field trip (Smith-Walters, et. Al., 2014). By connecting the field trip to mandated objectives, the educator has rationale for taking his or her students on the expedition. Secondly, the educator must consider the population of the class and the location they desire to visit. A topic that many educators need to consider is if there are any special education students in the group of students to attend the field trip; whether mentally, emotionally, or physically handicapped, these students may need accommodations to make the field trip successful. Educators need to contact the facility of the desired field trip location and discuss any adaptations that are already in place for this group of students. Many times, physical disability adaptations are provided by the location. Students with mental or emotional disabilities may need adaptations that are designed by the teacher or school and brought to the field trip. Adaptations are necessary to provide a learning environment that is safe and effective for all students. The educator also needs to determine the need for chaperones. An honors, or higher grade class, may require less chaperones compared to a lower grade class due to the level of understanding and respect shown by students. An increase in the number of special education students, or location of the field trip, may also alter the number of necessary

chaperones. Finally, the educator must determine if the weather will have an impact on learning while students are on the field trip. Many field trips in science are located at least partially outdoors. If there is a chance for rain or snow on the day of the field trip, the educator must determine how to best protect his or her students and ultimately determine if the field trip needs to be rescheduled so students are able to perform the activities requested to the best of their potential and as safely as possible. If any of the aforementioned ideas are forgotten or not considered in the preparation of a field trip, there may be difficulties or dilemmas once the class reaches the field trip location. By being prepared and planning well in advance, the educator and students should be able to conduct the field trip to the best of their abilities, which will increase student learning to the students' maximum capacity.

The new and unfamiliar environment of field trips often have students looking and wondering in excitement (Leydon & Turner, 2013). By preparing students for what they are going to experience, both background information and the inquiry question they will be studying, students are able to better prepare and focus when they arrive at their destination (Kenna & Russell, 2015). Field trips are used not only for fun and entertainment, but for instructing students on curriculum based standards. If students do not know the standards or the importance of learning while on the field trip, the entire purpose of the field trip is compromised. Additionally, students who know increased amounts of content before the field trip have been found to have higher motivation and ultimately learn more while on the field trip (Morentin & Guisasola, 2015). Furthermore, students who know what they are going to be participating in will be able to have better understanding of background knowledge and of the processes that will occur before attending. Knowing procedures and processes allow more students to complete

activities in a shorter amount of time. Being time efficient is a necessary step in bringing large group of students to a field trip location (Leydon & Turner, 2013). All of the preparation for a field trip is able to be done in the pre-field trip lesson or lessons. The information taught prior to the field trip is essential to prepare students for what they are going to experience throughout the expedition, as many students have never seen or experienced such events before.

The pre field trip lesson or lessons are also where educators need to seamlessly tie together the content of the field trip with the curriculum standards students are learning in the classroom setting. One model that fits extremely well for combining field trips with classroom content is the 5E model (Miele & Adams, 2016). The 5E model of learning comprises engage, explore, explain, elaborate, and evaluate modules for each lesson. Though the 5E model, students are able to be engaged in the topic, explore and have the topic explained to them in the classroom, and then elaborate on the topic while at the field trip site. The elaborate section of the model allows students inquiry and guided practice; exploring and developing skills in the field area. The final evaluation allows teachers to determine how much students learned and retained from the field trip. The evaluation piece of the lesson could include an assessment, discussions, or overview of the student's participation worksheets from the field trip. Often, it is effective for educators to provide students with graphic organizers to write and collect information while on the field trip. Graphic organizers can be borrowed or made by teachers to include specific areas of learning that will occur on each field trip. Student completion of graphic organizers allows them to go back to their data and analyze or conclude further, once the field trip is completed.

Unlike other classrooms, science classrooms and field trips have an increased possibility for danger with all the glassware and chemicals within them (Roscoe & Orr, 2010). As well as

teachers following safety guidelines, students need to understand the importance of following all safety and behavior guidelines in science classes and at field trip locations. Rather than getting in trouble, students could become severely injured from poor decisions. Safety guidelines and rules for field trips should be discussed prior to attending, as well as once students have reached their destination. Safety guidelines for field trips may be included in the pre-field trip lesson during the explain phase of the 5E lesson planning model. Additionally, it is important for teachers to always be paying attention to students and detect any possible issues that may arise, while trying to stop them before they occur.

Science has many standards as well as vocabulary, procedures, and alternative concepts that students need to understand (Buehl, 2017). If students have gaps in their understanding of concepts, complex texts or other sources of literature will be difficult if not impossible for students to comprehend. Through front-loading activities, such as pre-lessons of field trips, students are reminded or instructed of different concepts that are essential to know for comprehension. It is important when deciding on a front-loading activity that all students are engaged and that deeper level thinking is necessary to complete the task. Only through deeper level thinking will students be able to connect new material to old information and “build bridges” over their gaps of knowledge.

On the Field Trip

Students need to have some type of facilitation when they travel on field trips in order to stay focused and complete required tasks accurately. The two most common types of facilitation on field trips are worksheets and guides or chaperones. Each type of facilitation has different positives and negatives associated with it. Teachers need to identify what is offered by the field

trip location first and then supplement additional materials for students to complete the indicated learning objectives.

Chaperones or field trip guides may be provided by the field trip location to facilitate learning for students (Basten et. al., 2014). Often, there are already outlines for specific field trips at facilities such as museums or laboratories. Guides or scientists may assist students as they learn and grow through the planned activities and experiences. On less structured field trips, students may need chaperones or teachers to help guide them in the activities required to learn objectives and content standards. By having students interact with facility personnel, students are becoming more knowledgeable about content as well as practicing their communication skills; life skills important to any career or individual (Nyamupangedengu & Oyoo, 2010).

Often, instead of educators having students listen and perform activities they indicate on field trips, worksheets can be used to free students and give them learning independence (Nyamupangedengu & Oyoo, 2010). By creating well designed worksheets, students are able to maximize their learning of not only core curriculum related to the classroom, but information that interests them as well as social interaction. Aspects of worksheets that need to be considered include: task density, orientation cues, information source, level of choice, cognitive level, response format, question format, classroom connection, social interaction, and site specificity. The task density of worksheets should be low, allowing students time to observe and inquire on their own; concurrent with high level of choice. Students will learn more as they are able to pay closer attention to what they are interested in, rather than just the objectives provided by the teacher or worksheet. Orientation cues should be specific and short to help students navigate the field trip and quickly locate different exhibits or activities. The less time students are searching

for items, the more time they have to inquire with them. The information source for worksheets should be object dependent. By having students observe and engage in objects, they are learning more from the experience compared to reading; a task possible to do in the classroom. Teachers should limit facilitation worksheets to few open ended questions as they take more time to answer which gives students less time to experience and explore the field trip location. Field trip tasks need to connect with prior learning performed in the classroom. By connecting to prior information, students are able to understand the implications of what they are performing or observing and are able to learn more through bridging connections between new and old information. Finally, worksheets should encourage social interaction, as it is an additional, non curriculum based, objective. Through the combination of facilitators and worksheets, students should be able to learn the material required as well as explore and learn additional interesting information (Basten et al., 2014). By providing time for exploration, students are able to increase their learning in the field and may possibly become interested in furthering their schooling or careers to include such interests (Nyamupangedengu & Oyoo, 2010).

The above mentioned worksheets work congruently with inquiry models of learning (Rohlf, 2015). Inquiry models of learning allow students to use information or data collected on field trips for further analysis; a higher level thinking skill. Students may need to synthesize or connect information collected on the field trip, through the use of facilitation worksheets, with prior knowledge to determine a conclusion. The analysis and thinking required for inquiry models of field trips are what drives student learning. Especially in the sciences, many field trips follow the scientific model, which promotes students practicing real world skills. It has been proven through research that by including the inquiry model on field trips, students retain

information at greater rates; up to 96% of children and adults surveyed remember one thing they learned on a field trip even years later.

For the natural sciences, including gaming as a supplemental activity for real world scenarios can also benefit students in their learning (Chen & Hwang, 2017). Games can implement real world scenarios, instructing students what to do but adding a challenging aspect to the task. By adding a challenge, students may be more motivated and engaged to successfully complete the task and to do so well in order to “win”. Motivation and engagement are both essential for a positive learning environment. An additional benefit from students playing games on field trips is that they are simultaneously practicing their literacy (Caroll, 2016). In games, students are reading narratives, comprehending directions, and changing their thinking tactics in order to succeed. All of these tasks are literacy based. The more students are able to practice these skills, the more they potentially could adapt them to the real world or outside game environments.

Data Collection

Smartphone and tablet prevalence has increased tremendously throughout recent years (Medzini, et al., 2015); 4.8 billion mobile cellular subscriptions since 2005. The decrease in cost and increase in internet connectivity allows students to access data collection tools and services that were never before able to be used. Larger screens with better optics allow students to record information and review it with great detail. The use of smartphone and table devices in the classroom, as well as on field trips, give students a fun and interactive opportunity to increase their learning while interacting with devices that are convenient and easy to use.

Much like more sophisticated real world tools, smartphones allow students to collect, measure, and share information regarding inquiry or research activities while on field trips (Medzini, et al., 2015). Cameras and audio recordings on smartphones can be used as data collection tools. Cameras and screens of smartphones have clear precise images that can be used for further analysis of the activity at hand. Apps or other internet sites can also be used as data collection tools. For geography students, odometer, altimeter, or compasses can be used to collect data necessary for analysis outside of the classroom setting. Many of the measurements apps are able to make would not be possible financially for schools to provide to students through the use of additional devices, often that only measure one variable. Additionally, students are able to share their collected information with one other. Through email and texting, students can share data quickly and reliably. Reports can be generated through online services such as Google Docs, and an entire laboratory report can be produced; all through the use of a single smartphone.

Smartphones allow students access to significantly more measurement devices than schools are otherwise able to provide (Medzini, et al., 2015). Not only can students measure more variables, often with more accuracy, students can also record and share that data with their peers or educators all while on a field trip. The use of smartphones in inquiry activities allow students to complete their entire research activity with the use of that one device. In addition to the productivity of smartphones, students are often very interested in using them. Students use smartphones outside of the classroom as entertainment or socially, and enjoy doing so. By integrating smartphones into the classroom, students will be more engaged and interested in the lesson they are performing, which ultimately will increase learning and retention.

Post-Field Trips

Finally, post-field trip activities should have students continuing their inquiry discovery by proposing solutions or conclusions. Students should be able to evaluate information and data they collected on the field trip and be able to use such data to support conclusions to their inquiry question (Kenna & Russell, 2015). There are many methods or ideas that teachers can use to have students analyzing and interpreting data they collect on field trips.

Field trips are a common way that teachers are able to show their students real world phenomena that connect conceptually to what students are currently learning in the classroom (Lei, 2010). To determine if students are learning or taking in what they are being exposed to, assessments are an essential part of the field trip process. In order for the field trip to be successful, it should be determined what students know and understand conceptually. Students need to have a solid understanding of the background information that will be presented on the field trip in order to increase understanding and make connections to the real world experiences they are about to go through. Some examples of assessment pieces that students are able to complete on or after a field trip include “portfolios, field practicals, research reports, research projects, oral and poster presentations, learning or reflective journals, along with peer or teacher observations”.

Debates are a tool used for students to compare and contrast two very different ideas. Through the use of a scientific method, debates can be beneficial for students because they are able to use each others ideas and build off each other. By introducing new materials and resources slowly throughout, students can continue to build and clarify their ideas scientifically, without bias from outside influences (Prusak, et. al., 2012).

Any of the above listed activities allow students to prove to both the teacher and the class what they learned on the field trip, and how they can connect it conceptually to theories learned in the classroom. Many of the assessments listed include higher level thinking, which is an essential and desired objective expected of students on field trips. Assessments which occur on or after the field trip can prove the success of the field trip and if the activities that students experienced on were successful. From these assessments, educators can alter the field trip for the next year and better be prepared to encourage students' success. By following the aforementioned guidelines, teachers are able to seamlessly include field trips in their areas of study and evaluate students on information learned (Miele & Adams, 2012). The ultimate goal of a field trip is for students to learn new information and retain that information for later use. The use of graphic organizers not only helps teachers assess student learning, but allows students to go back to the data or information they collected for later use.

Summary

Over the past ten years, the amount of field trips students have been able to attend has decreased drastically (Greene et al., 2014). The decrease in field trips has limited student learning as well as experiences and activities they may not otherwise be able to participate in. Field trips, or expeditionary learning, are out of classroom experiences that allow students to experience procedures, personnel, and activities that they otherwise wouldn't be able to (Tal et al., 2014). Field trips allow students to attend and visit locations related to content learning. It has been proven that if field trips are executed appropriately, student learning increases as well as retention rates (Kenna & Russell, 2015). Many adults still identify field trips and the aspects learned within them as their most memorable school activity. As students are able to remember

and retain more information from field trips, which should be related to school content, teachers should be aiming to take their students on more field trips so they are more prepared for the high stakes testing at the end of the year. In addition to content learning, students learn much more about the world around them. Field trips introduce students to locations and individuals they may not otherwise be able to experience. Students are able to practice their communication skills as well as view the world around them in a different manner. Field trips may eliminate stereotypes of individuals or careers and interest students in pursuing a future career in that direction (Adedokun et al., 2015). In order for all the aforementioned to occur, field trips need to be planned appropriately. Field trips need to be planned much in advance to the date that students actually attend (Miele & Adams, 2016). Aspects such as transportation, accommodations, price, and time need to be accounted for and often approved by schools first. Next, teachers need to align the content of the classroom with the content of the field trip. Connections between the field trip and state or national standards give teachers rationale for taking their students to these locations. One or many lessons prior to the field trip should be planned to prepare students for the trip itself. Students should learn content as well as be prepared for what will occur on the field trip. By being prepared, students are more successful at focusing on their task at hand, prepared by the teacher or institution the field trip occurs at. Additionally, student facilitation on the field trip can be conducted by many different variables (Basten et al., 2014). Students may be guided by teachers, chaperones, or field guides from the location. The different guides provide different insight and aspects of the field trips to students. Discussions with the facilitation guide will also enable students to practice communication skills, necessary for all future individuals. Worksheets are another aspect of facilitation that may be present on a field trip

(Nyamupangedengu & Oyoo, 2010). Worksheets should be low in density of work as well as include questions with lower thinking skills. By allowing students more time away from completing assigned worksheets, they are able to explore more information they are interested in and ultimately will gain more information in such manner. Cell phones and other electronic devices may be used as data collection tools on the field trip (Medzini et al., 2015). Students are often very interested and attached to their mobile devices. By allowing students to use these devices as a learning tool, engagement and therefore learning will be higher. After students return from a field trip, the next class or classes should include the higher level thinking skills that were absent on the field trip worksheets: analyzing, synthesizing, etc. Students can connect information they learned prior to the field trip with examples or activities they performed while they were away from school. Presentations or other forms of showing data are ways that students can use their data to formulate discussions (Lei, 2010). Field trips are beneficial to students in a significant amount of ways more than just having fun. Students learn and retain significantly more information while practicing life skills such as communication.

Chapter Three: Final Project with 10 Field Trip Lessons

Narrative: Significance of Project

Many times in classes students ask how things pertain to the real world or how they will ever use this topic outside of the classroom. By participating in field trips, students will not only understand the significance of topics outside the classroom, but will increase learning and retention of materials. Often, field trips are some of the lessons that individuals remember most; even into their adult years. For a field trip to be a successful learning excursion, much planning and preparation has to be done in advance so students learn to their maximum potential.

The following information contains ten field trip modules to potential Living Environment locations throughout Wyoming and Genesee Counties, New York. Each location contains detailed information educators must consider prior to attending the field trip as well as pre, during, and post lesson plans to engage students in learning. Each field trip has attached assessment pieces that students may complete in order to determine the amount of content specific learning each student was able to complete. In addition to content learning, educators must remember that students are often practicing and learning more about communication as well as the world around them. The goal of this project is to increase interests in educators taking their students on field trips as well as be able to signify that importance and increase of learning that can occur on each.

Living Environment Field Trips in Wyoming and Genesee Counties, New York

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8. Silver Lake State Park	140-151
9. Tonawanda Creek	152-171
10. Baker Brook Dairy, LLC.	172-186

Field Trip 1: Beaver Meadow Conservatory

Location:

1610 Welch Rd.
Java, New York 14028

Cost/Requirements:

- \$5.00 per person or \$50 per groups (10 people or less)
- Maximum number of people per group are 120, which require a \$50 deposit

Field Trip Description:

- The field trip will begin with an ecology walk throughout the many acres on premises. Wheelchair accessible trails are available.
- Next, students will stop by the Visitor Center to learn more about the natural world. Details of discussions are flexible depending on curriculum needs.

Objectives:

- Students will be able to describe both positive and negative potential impacts of local animals on their ecosystems.

New York State Living Environment Content Standard Alignment:

- 6.3a The interrelationships and interdependencies of organisms affect the development of stable ecosystems.
- 6.3c A stable ecosystem can be altered, either rapidly or slowly, through the activities of organisms (including humans), or through climatic changes or natural disasters. The altered ecosystem can usually recover through gradual changes back to a point of long- term stability.

Pre-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Animal Effects in the Environment

<p>Central Focus for the learning segment: Students will learn how organisms can alter an environment, which could potentially lead to a complete change in the ecosystem.</p>
<p>Content Standard(s): NYS CCLS or Content Standards</p> <ul style="list-style-type: none"> • 6.3c A stable ecosystem can be altered, either rapidly or slowly, through the activities of organisms (including humans), or through climatic changes or natural disasters. The altered ecosystem can usually recover through gradual changes back to a point of long- term stability.
<p>Learning Objectives:</p> <ul style="list-style-type: none"> • Students will be able to discuss how not only humans, but organisms can alter their environments both positively and negatively.
<p>Instructional Resources and Materials to engage students in learning: Twigs, sticks, clay, paint tray, reading and summary worksheets</p>
<p>Instructional Strategies and Learning Tasks that support diverse student needs:</p> <ul style="list-style-type: none"> • Students will have a three minute quick write to list all the “good” and “bad” animals they can think of. After listing the animals, partners will discuss their lists and why they believe each animal is good or bad (Engage). • Students will begin by dividing into groups and attempting to make dams out of twigs for handmade streams in paint trays (Explore). Students will be asked to discuss how this change in the water flow could effect an ecosystem. • Student will be divided into groups. Each group will read and fill out their summary sheet on a section of the reading provided. The groups will read aloud their summary when they are finished, to check for understanding. Once all groups have read aloud, students will travel to each group’s summary sheet and copy the information (Explain) (Contant, 2014).
<p>Differentiation and planned universal supports: Students will be put into groups for each reading summary. Strong readers will be placed with weaker readers and the summary will be asked to be read aloud in each group. The combination of strengths in the group will ensure that the summary is read in fashion that all students are able to understand.</p>
<p>Language demands and language supports: Ecosystem, environment, dam, beaver</p>

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** Observations of students participating in the Quick Write and dam building projects will be used as informal assessments. Teachers will be able to determine any misconceptions and prior knowledge from these activities.
- **Formal Assessment:** The reading summaries that student group's present will allow educators to determine understandings that animals, such as the beaver, can be both positive and negative to an environment.

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

0:00-5:00 Quick Write

5:00-20:00 Building a dam activity

20:00-45:00 Students will participate in the reading explanation phase of the lesson

Quick Write

Good Animals and Why	Bad Animals and Why

Beavers and the Environment

What happens to the neighborhood when beavers move in? Surely their visible impact on vegetation and waterways disrupt riparian habitat? The best answer is the more complex: beavers can have both a restorative and damaging effect on different aspects of their habitat under different conditions. Although instinct and common sense might suggest our beavers are depleting their creek there is a large body of scientific research that says the benefits of beavers significantly outweigh the costs in most areas. While study after study has shown that beavers do impact their habitat: the impact is largely for the better. In this section of the report the impact of beavers on specific aspects of their habitat will be examined.

What is a Keystone Species?

KEYSTONE SPECIES



What is a Keystone Species?

The Beaver is often called a —Keystone Species. This concept was introduced in 1966 by R.T. Paine who studied the impact of removing one predator from an ecosystem. (In that case a starfish) He found that the original 15 species community was quickly reduced to only 8 species when the starfish was removed, prompting his analogy to the collapse of an archway if a —keystone is taken out. (The keystone is the center piece which holds up both sides of the arch) Beavers have a similar role because their dams create habitat which are used by other wildlife. Bruce Baker, Ph.D. & Edward P. Hill wrote the seminal chapter on beavers in Feldman's *Wildlife of North America* (2003). They described the beavers role as both a keystone species and an ecosystem engineer.

Beavers change soil deposition and augment nutrients in pools. There is even a growing body of evidence that dams may act as a kind of filter that improves water quality.

Beaver impact on Vegetation

Beaver foraging affects vegetation growth patterns. They remove trees and branches for food and dam-building. By current estimate some 60 trees of various sizes have been taken by our beavers, almost all native Arroyo Willow. However, the roots remain in tact and will retain bank soil and eventually create new growth. Beavers use natural coppice cutting of trees, a forestry term for spurring future brushy growth by removing the main trunk and allowing shoots to spring around the base.

Beavers coppice willow and cottonwood trees, creating the low, dense habitat preferred by vireos. Indeed, beaver foraging promotes the growth of willow.

A not-uncommon sight over the summer was to see a large partially felled tree sticking out of the stream. This is a kind of —beaver refrigerator---the beaver does this to allow foliage to continue to grow and stay —freshll but to make feeding more accessible for the kits. Beavers have been shown in some studies to decrease tree density and their selective foraging can reduce some species and increase others. They shape tree dispersal by removing target food trees and leaving others to grow and reproduce.

One key factor as to whether or not vegetation is depleted or enhanced is the browsing of livestock, which can produce enormous impact especially during dormant months when grass is less desirable. Obviously this is not an issue for this beaver habitat. Nonetheless, considerable interest has been expressed in augmenting willow habitat for our beavers with replantation, and this is discussed under the volunteer section of this report.

Beaver impact on Insects & other Invertebrates

Dams slow current and increase deposition of sediment and organic material in the water. These ponds play a key role in the development of complex insect life, which in turn feed fish, birds and mammals. Beaver activity greatly affects both aquatic and non-aquatic insect life in response to increased sediment deposition and still water behind the dam. Insects that prefer running water are replaced by insects that prefer still water, and the variety and density of species has been shown to increase.

This of course leads to natural questions about mosquito larvae, which are known to accumulate in still pools. However, beaver ponds have been shown to actually reduce mosquito population. There are nearly 3000 known species of mosquito but beaver ponds tend to shift composition of larvae – making conditions less desirable for some and ideal for others. All mosquitoes are not created equal, some are much more damaging to human populations. For example, one of the species most associated with West Nile Virus and yellow-fever (*Aedes*) cannot survive in the permanent water of a beaver pond. Continued involvement by Mosquito Abatement can monitor conditions and help control negative species.

Beaver impact on Fish

Beaver Ponds impact Fish in many ways. It has been shown that the standing crop of plankton in beaver ponds is 5 times larger than in the unaltered flowing stream. This means that fish life is denser and more varied. In fact, this winter's Oregon TWS Conference on Beavers featured a lecture on the promotion of beaver to increase salmon Kelly Moore, NW Region Program Manager for ODFW research lab wrote,

“The primary effect is on over winter survival of juvenile salmonids – streams with abundant beaver created habitat had 2-3 times better over winter survival rates than streams with simpler riffle-pool structure.”

There has been concern that ponds impact reproduction by raising the temperature of the water and obstructing flow and dispersal of fish. The Oregon Department of Fish & Wildlife has noted that beaver dams can interfere with salmon passage. However Ms. Moore continues, —The consensus of Oregon fish biologists is that the benefits clearly outweigh the negative effects and that salmon and trout are better at moving over, around, and through beaver dams than we thought.” She referred to a much referenced native legend called —Beaver taught salmon how to jump which basically credits beaver for Salmon prominence. Recent research shows that salmon and steelhead can navigate dams in periods of high flow and that the dam itself becomes a kind of reproductive —source in fish community and dispersal. Even small ponds have been shown to impact the diversity and density of fish species.

Beaver Impact On Amphibians and/reptiles:

Beaver ponds create an ideal habitat for amphibians. Some species of newt may actually depend on beaver ponds for their survival. Frogs, salamanders and toads are the hallmark of a healthy beaver pond. Towards the end of summer last year limited frog song could be heard at our beaver pond, which had not been documented before. Now a strong chorus of many pacific tree frogs can be heard at dawn. “Amphibians, as a group, are sensitive to changes in water quality and so are considered indicators of environmental cleanliness. The return of these frogs reflects the habitat restoration done by the beavers, and its subsequent benefits. There is some evidence that certain species are increased by the presence of beaver ponds (such as frogs) while others are decreased (such as salamanders). Turtles and other reptiles seem to gravitate towards and rest above the lodge, which is often warmer than the surrounding terrain. There has been research documenting that older beaver ponds produce more kinds of snakes, lizards and turtles than younger beaver ponds, but that even a young pond had more reptile species than an undammed stream.

Beaver impact on Birds

A morning stop by the beaver pond reveals a larger cast of avian characters this winter than last. An early response to the deeper water was a breeding pair of secretive green heron that used the brushy shores to hunt for an increased fish population. By mid-summer kingfishers and great and snowy egrets were observed on both sides of the dam. A cormorant paid close attention to the dam lowering efforts by city staff in December and was photographed feeding opportunely on the fish suddenly displaced. The experience was so appreciated he continues to frequent the area, joined by a collection of winter ducks, coot and grebe. Observed songbirds include the marsh wren, song sparrow and common yellow throat. This spring many barn swallow families produced a second clutch of young, and at least 2 black phoebes were fledged. Winter visitors have included a ruby-crowned kinglet and a regular flock of nearly 30 lesser scaup that arrived unexpectedly in early February --possibly to feed on the sudden chorus of tree frogs but definitely enjoying the bubbling mussels in the mud seen as far up as Starbucks. Certainly not every visitor is seen everyday, but at least one makes an

appearance on any given day. This is not unexpected given the research on beaver impact on bird life.

A survey of birds at eight beaver ponds in eight counties in New York State demonstrated that active beaver sites support more species of birds than do vacant or potential sites.

Beavers create better foliage and feeding for birdlife, allowing a greater variety and density of bird species to accumulate. Although beaver is occasionally sited as destroying habitat for songbird nesting their gnawing actually spurs the very type of growth most breeding birds prefer.

Often when waiting for the arrival of the somewhat unpredictable beaver, visitors can pass the time by watching the more visible and varied birdlife.

Beaver impact on other Mammals

Mammals are most likely to be seen where they can find are food, water and cover. Obviously the deeper pool, denser foliage created by coppice cutting and augmented fish and insect life draw other mammals to the beaver pond.

Our small stretch of beaver pond has already revealed at least two families of muskrats, an adult otter and baby otter this summer, a succession of raccoons and other small rodents. Obviously the most exciting of these is the otter, which feed on the fish that the beaver dam encourages. Interestingly, beavers and otters tend to overlap in their habitat a great deal (it was not uncommon to see the baby otter going over and even inside the lodge at times!) However, they are not exactly friends and the few aggressive tail slaps seen by these beavers haven often been in response to otter. Otters are carnivores and there is some research to indicate that they can take small kits at times. Indeed, many sources consider them a natural predator of the beaver.

Source: <http://www.martinezbeavers.org/wordpress/wp-content/docs/Beavers%20and%20the%20Environment.pdf>

Beaver Reading Summary Sheet

Name: _____

Section Read	
Positive or Negative Impact	
Supporting Detail 1	
Supporting Detail 2	
Supporting Detail 3	

Field Trip Activities

Animal Inferences

Name: _____

Throughout the conservation walk or demonstration, list four animals seen or discussed. Write if you think these animals have positive, negative, or neutral effects on the environment and why you think so.

Animal	Positive, Negative, or Neutral Effect	Reasoning

Post-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Digging Deeper

<p>Central Focus for the learning segment: Students will use the animals they recorded from the field trip to produce a concept web of their positive and negative impacts on the environment</p>
<p>Content Standard(s): NYS CCLS or Content Standards</p> <ul style="list-style-type: none"> • 6.3c A stable ecosystem can be altered, either rapidly or slowly, through the activities of organisms (including humans), or through climatic changes or natural disasters. The altered ecosystem can usually recover through gradual changes back to a point of long- term stability.
<p>Learning Objectives:</p> <ul style="list-style-type: none"> • Students will be able to synthesis positive and negative impacts of organisms to their impacts in the surrounding environment.
<p>Instructional Resources and Materials to engage students in learning: Computer, internet, construction paper, writing utensil</p>
<p>Instructional Strategies and Learning Tasks that support diverse student needs:</p> <ul style="list-style-type: none"> • Students will use the animals they described on their field trip log to create concept maps. Students will create one positive and one negative concept map. Additional data and details will be used from credible references (Elaborate). • Students will present an overview of their concept maps to the class (Evaluate) (Contant, 2014).
<p>Differentiation and planned universal supports:</p> <ul style="list-style-type: none"> • Students may use computer resource to create their concept map if difficulty writing. References may be at any academic level, as long as they are scholarly.
<p>Language demands and language supports:</p> <p>Impact, environment, ecosystem</p>
<p>Type of Student Assessments and what is being assessed:</p> <ul style="list-style-type: none"> • Informal Assessment: Teacher observations of students working on completing their concept maps will be used to correct any misconceptions. • Formal Assessment: The presentation and concept map itself will be used as a formal assessment to determine how much students understand and can relate the positive and negative impact of organisms to a real life scenario.

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

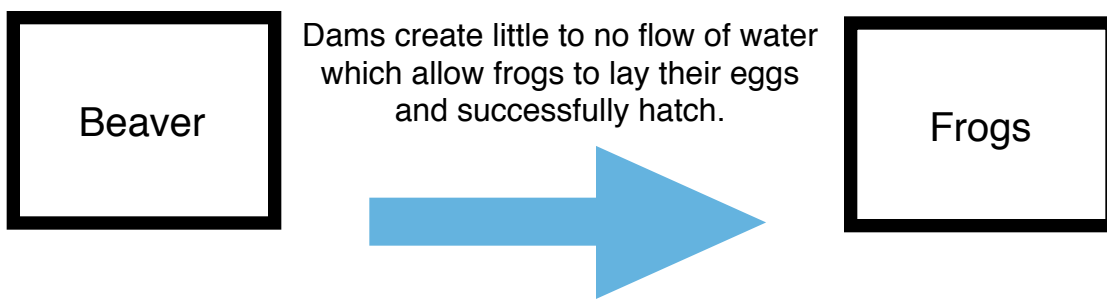
0:00-30:00 Production of concept maps

30:00-45:00 Presentation of concept maps

Concept Map

Name: _____

For this activity, you will select two of the organisms you listed from the field trip. For one organisms, you will create a positive concept map and for the other a negative concept map. Both concept maps need ten connections. In the boxes/circles are objects/organisms etc. and on the arrows or lines go the effects they have on each other. An example is provided below:



Field Trip 2: Burley's Berries

Location:

5840 Route 20A
E. Warsaw, NY 14569

Cost/Requirements:

- \$5.00 per student/teacher/chaperone
- Includes:
 - Quart of Strawberries
 - Educational Materials
 - \$1 off strawberry coupon on a future visit
- A location for lunch is available, but students must pack their own

Field Trip Description:

- Students will meet their tour guide at the berry patch. Students will go through the weeding and cultivating equipment to understand all the necessary resources needed to successfully grow strawberries. Students will perform the Journal Activity in the Strawberry patch. Upon successful completion of the Journal Activity, students can pick their free quart of strawberries (30 minutes).
- Students will continue their tour of the planting and maintenance of the Berry patch with a tour of the farm (1 hour).

Objectives:

- Students will be able to describe the steps of the genetic engineering process
- Students will be able to differentiate between advertisements with bias
- Students will be able to test for GMOs

New York State Living Environment Content Standard Alignment:

- 2.2b In recent years new varieties of farm plants and animals have been engineered by manipulating their genetic instructions to produce new characteristics.

Pre-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: GMOs

Central Focus for the learning segment: Students will learn the background of genetic engineering and the truths of it in food.

Content Standard(s): NYS CCLS or Content Standards

- 2.2b In recent years new varieties of farm plants and animals have been engineered by manipulating their genetic instructions to produce new characteristics.

Learning Objectives:

- Students will be able to identify the steps in genetic engineering of GMOs

Instructional Resources and Materials to engage students in learning:

Computers, internet, GMO labels, KWL Chart, Genetic engineering worksheet, guided notes

Instructional Strategies and Learning Tasks that support diverse student needs:

- GMO food labels will be posted on the board. Students can work with a partner to fill out the K and W (Know, and would like to know) sections of the KWL chart about GMOs (Engage). Discussions about what students already know and what they would like to find out will complete the activity.
- Students will then participate in a genetic engineering simulation online. Students may produce cinnamon flavored apples or pest resistant corn (<http://agbiosafety.unl.edu/education/whowants.htm>) (Engage).
- Students will then take notes and look at images in support of or against GMOs. Students will understand bias and try to identify neutral positioned advertisements (Explain).
- Students will finish by filling out the L (learned) column in their chart to be handed in (Evaluate) (Contant, 2014).

Differentiation and planned universal supports:

The steps of the online simulation can be read aloud for students who struggle with reading. Since the words of the steps are present, students who struggle with writing will also be given an advantage.

Language demands and language supports:

GMO, restriction enzyme, DNA, protein, ligase

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** Discussions with the class at the beginning and end of the lesson will be used as informal assessments.
- **Formal Assessment:** The L column of the KWL chart will be used as a formal assessment to determine student growth throughout the lesson.

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

0:00-5:00 Introduction Activity

5:00-25:00 Genetic Engineering Online Simulation

25:00-40:00 Guided Notes

40:00-45:00 Complete the KWL Chart

KWL Chart

Name: _____

K (Already Know)	W (Want to know)	L (Learned)

Genetic Engineering Simulation

Name: _____

In this simulation, you will explore the steps necessary to create genetically modified foods. Go to the website, <http://agbiosafety.unl.edu/education/whowants.htm>. You may choose to do the cinnamon apple or corn application. Fill out the table as you complete the activity.

Step	Step Name	Step Description
1		
2		
3		
4		
5		

Genetic Engineering

- All DNA is the same in all organisms in terms of basic structure
- Because of this, DNA can be transferred between _____
- When DNA from one species is inserted into another, this is called _____ DNA
- _____ are obtained from bacteria and they cut DNA at specific sites
- Some of these enzymes cut DNA in a staggered fashion
- For example, the restriction enzyme EcoR1 cuts as follows:

GAATTC

CTTAAG

- This leaves “sticky ends”

G AATTC

CTTAA G

- The sticky ends can form bonds to place the strand together again if they come in contact
- Once back together DNA ligase can form covalent bonds to seal them back together
- Bacteria have small rings of DNA known as _____
- Human (and other) genes can be spliced into plasmids using restriction enzymes and DNA ligase

Steps in Cloning a Gene

- Cut plasmid and DNA to be cloned with a restriction enzyme
- Both now have complementary sticky ends
- Mix DNA and plasmids
- The DNA couples to the plasmids
- Place plasmid into bacteria
- As bacteria divide the gene will be copied and passed along—all identical copies (clones)

Source: http://www.edu.pe.ca/rural/class_webs/biology/files/genetic%20engineering%20notes.pdf

What do you know about GMOS?

A genetically modified organism (GMO) is an organism whose DNA has been altered using genetic engineering techniques.

Genetically Engineered... to do what?

Commercially

80% of corn, 90% of soybeans and 90% of cotton are genetically modified.

In Research

- Enhanced Nutritional Content:** Bio-engineering produces "Golden Rice" to help with widespread vitamin A deficiency in developing nations.
- Resistance and Disease Resistance:** Scientists are developing transgenic plants that are resistant to insect pests and plant diseases.
- Stress and Adaptation:** GMOs are being developed for drought resistance, increased salt tolerance and other abiotic stresses.

Who owns it?

Research patent ownership

Who grows it?

16 major GM crop foods by country

the good

- Reduces or eliminates use of insecticides:** An estimate of insecticide use for GM crops in 2004 was 1.5 million metric tons, compared to 2.5 million metric tons for non-GM crops.
- Car produce higher yields:** The average farmer, GM or non-GM, produces more than 10% more food per acre. Higher yields, longer shelf life and improved pest control reduce the need for insecticides.
- Benefits for farmers:** Many GM crops have experienced increased productivity, decreased risk due to pests and diseases and improved crop storage.
- Car provide effective options for aggressive diseases:** In the US, about 1 percent of the world's population is allergic to peanuts. A GM variety of peanut with allergens disabled was approved by the FDA in 2000.
- Helps to fix world problems:** Agriculture biotechnology provides opportunities to address the significant challenges of meeting food security needs for the world's growing population. The National Academies of Sciences, Engineering and Medicine (NASEM) report of May 18, 2016.

the bad

- Concern about health:** Use of an allergenic protein in a GM crop could result in allergic reactions. The World Health Organization (WHO) has stated that GM crops are safe for human consumption.
- Concern with IP ownership:** GM crop patents are often held by a few large corporations. This could limit access to GM crops for small farmers and researchers.
- Superbugs and superweeds:** Herbicide-resistant weeds and insecticide-resistant insects have become a major problem for farmers. This is due to the overuse of herbicides and insecticides on GM crops.
- Lack of transparency:** In the US, there is no mandatory labeling of GM foods. This makes it difficult for consumers to make informed choices.
- Gene transfer:** Some GM crops could transfer their genes to wild relatives. This could create superweeds or superpests that are resistant to herbicides and insecticides.

and the ugly

- The introduction of confusing & sensational labeling & sensational claims:** The introduction of GM crops has led to a proliferation of misleading and sensational claims. Some claim that GM crops are " Frankenfoods" or "GMO-free" products. These claims are often based on fear and misinformation.
- Many GM products are hard to find:** Many GM products are not available in all countries. This is due to regulatory differences and consumer preferences.

ACTIONS SPEAK LOUDER
Than Words
THE TRUTH
ABOUT GMO FOODS

THE TALK	THE TRUTH
<p>GMO FOOD IS DANGEROUS AND UNHEALTHY</p>	<p>GMO FOODS ARE NUTRITIONALLY AND CHEMICALLY IDENTICAL <small>TO FOODS GROWN FROM NON-GENETIC CROPS</small></p> <p>Real GMO foods are still extensively regulated for safety by groups like the FDA and the USDA.</p>
<p>BIOTECHNOLOGY IS BAD FOR THE ENVIRONMENT</p>	<p>IN 2009, BIOTECHNOLOGY HELPED FARMERS REDUCE CO2 EMISSIONS BY 39 BILLION POUNDS</p> <p>That's the same as removing 8 MILLION CARS FROM THE ROAD FOR THE ENTIRE YEAR</p>
<p>BIOTECHNOLOGY IS A NEW AND UNPROVEN SCIENCE</p>	<p>FOR ROUGHLY 10,000 YEARS, OUR ANCESTORS HAVE BEEN GENETICALLY ALTERING PLANTS AND SEEDS TO DEVELOP THINGS LIKE:</p> <p>CHEESE BREAD WINE BEER</p> <p>Modern biotechnology simply offers a quicker, more efficient path to accomplishing the same goals.</p>

BOTTOM LINE

In the 12 years since the modern biotech crops have been commercially grown, their use has had a single detrimental case of an allergic reaction thought to be caused by a person eating it.

COMMON SENSE
 INFORMATION FROM THE NATIONAL CENTER FOR FOOD SAFETY AND INSPECTION SERVICE
 www.commonground.org

commonground
Common Sense Information

FindOutCommonGround.com

Images are for illustrative purposes and are not intended to be used in any way.



Source for Images: <https://www.uaf.edu/case/lessons-1/GMOs.pdf>

Field Trip Activities



Burley Berries



Warsaw, NY

This Journal Belongs to: _____

My Strawberry Plant Journal

1. Today's date: _____



2. The weather is _____. (Draw a picture in the box to the left that represents today's weather.)

3. The temperature is _____. (Show the temperature on the thermometer to the right.)



4. My strawberry plant is _____ inches high and _____ inches wide. My strawberry plant has _____ leaves, _____ flowers, and _____ strawberries on it today.

5. This is what my strawberry plant looks like: (Draw a picture in the box below.)



Post-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: GMO Testing

<p>Central Focus for the learning segment: Students will be testing for GMOs in different foods bought from the grocery store and their berries collected from the field trip.</p>
<p>Content Standard(s): NYS CCLS or Content Standards</p> <ul style="list-style-type: none"> • 2.2b In recent years new varieties of farm plants and animals have been engineered by manipulating their genetic instructions to produce new characteristics.
<p>Learning Objectives:</p> <ul style="list-style-type: none"> • Students will be able to hypothesize which produce has GMOs, provide rational, and test for the presence of GMOs
<p>Instructional Resources and Materials to engage students in learning: Store bought strawberries, strawberries from the field trip, GMO test strips, paper and a writing utensil</p>
<p>Instructional Strategies and Learning Tasks that support diverse student needs:</p> <ul style="list-style-type: none"> • Students will first hypothesize which produce has GMOs (the produce will be labeled A and B so students will not know which is which). Students will have to provide rational for their reasoning to which produce has a GMO. Students will then homogenize their fruit and test for the presence of GMOs with GMO test strips (Elaborate). • Students will write down their findings and a conclusion whether their hypothesis was correct or incorrect and any surprises they may have experienced (Evaluate) (Contant, 2014).
<p>Differentiation and planned universal supports: The writing of the hypotheses and conclusion may be done on an electronic device for those students who struggle with writing. The homogenization of the fruit may be performed by a partner for students who struggle with physical movement.</p>
<p>Language demands and language supports:</p> <p>GMO</p>
<p>Type of Student Assessments and what is being assessed:</p> <ul style="list-style-type: none"> • Informal Assessment: Discussions and observations of the class throughout the laboratory process will help teachers determine the level of knowledge about GMOs. • Formal Assessment: The hypothesis and conclusion paper will be collected and assessed to see student's rational and understanding of GMOs.

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

0:00-15:00 Hypothesis and rational writing

15:00-35:00 Testing of produce

35:00-45:00 Conclusion Writing

GMO Testing

Name: _____

In front of you is strawberry A and strawberry B. One has been brought from the grocery store and one is from the Burley's Berries field trip. Indicate if you believe either A, B, or both have GMO and your rationale behind your hypothesis.

Berry	GMO?	Rationale
A		
B		

Next, you will homogenize the berries in separate beakers. To homogenize, smash the berries apart in approximately 10mL of water. You may need more or less water depending on the size of your berry. Once the substance is almost completely liquid form, you may use the GMO test strips to determine the presence of a GMO.

Berry	GMO +/-
A	
B	

Write a conclusion about how your hypotheses matched up with your GMO testing. Were you surprised by any of the results? Why or why not?

Field Trip 3: Genesee County Park

Location:

11095 Bethany Center Rd.
East Bethany, NY 14054

Cost/Requirements:

- Pavilions must be requested prior to the field trip
- No cost to students or staff for visiting the park or acquiring a pavilion

Field Trip Description:

- Students will use the park and wooded areas to identify organisms from each area of the food chain (Carnivore, omnivore, herbivore).

Objectives:

- Students will be able to use organisms identified at the park in order to create a food web that is naturally occurring in their own ecosystem.

New York State Living Environment Content Standard Alignment:

- 1.1a Populations can be categorized by the function they serve. Food webs identify the relationships among producers, consumers, and decomposers carrying out either autotrophic or heterotrophic nutrition.
- 1.1f Every population is linked, directly or indirectly, with many others in an ecosystem. Disruptions in the numbers and types of species and environmental changes can upset ecosystem stability.

Pre-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Food Webs

Central Focus for the learning segment: Students will learn how all organisms function as part of the food web (producer, consumer, decomposer) and how the removal of even one organism can disrupt the entire web.

Content Standard(s): NYS CCLS or Content Standards

- 1.1a Populations can be categorized by the function they serve. Food webs identify the relationships among producers, consumers, and decomposers carrying out either autotrophic or heterotrophic nutrition.
- 1.1f Every population is linked, directly or indirectly, with many others in an ecosystem. Disruptions in the numbers and types of species and environmental changes can upset ecosystem stability.

Learning Objectives:

- Students will be able to identify and describe producers, consumers, and decomposers
- Students will be able to identify the flow of energy through an ecosystem
- Students will be able to determine possible ramifications of removing one organism from a food web

Instructional Resources and Materials to engage students in learning:
Animal pictures, paper, pencil, owl pellet, guided notes

Instructional Strategies and Learning Tasks that support diverse student needs:

- Different types of organisms from the local environment (mushrooms, grass, trees, birds, insects, rabbits, hawks, fox, etc.) will be posted on the board. Students must come up with a scenario or story of how all these animals fit together. Once students have completed their story, a few stories will be shared to the class (Engage).
- Next, students will divide into groups and be given an owl pellet. Students will dissect the owl pellet, while wearing gloves, to determine what the owl has eaten. Students will create a concept map from this data (Explore).
- Students will be able to determine that all organisms cycle and there is no end to the food web. Students will take notes which identify specific points of a food web (Explain) (Contant, 2014).

Differentiation and planned universal supports:

Students will be working in groups to support students who have different strengths and weaknesses. Tasks may be divided by the group members so each student participates to their best ability. Notes are not hand written to support students who struggle with writing.

Language demands and language supports:

Producer, consumer, decomposer, food web

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** Students discussions and stories at the beginning of class will determine prior background knowledge.
- **Formal Assessment:** The final completion of the concept map will be graded to determine student learning.

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

0:00-7:00 Storyline

7:00-32:00 Dissect an owl pellet

32:00-45:00 Guided Notes

Owl Pellet Dissection

Name: _____

Each group will be given an owl pellet. Dissect the owl pellet and identify components trapped within. Each component is an organism that the owl previously ate.

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.

Use the identified objects to make a concept map of who ate what. The head of each arrow should point at the organism consuming the other.

Energy Transfer Notes

- Producer (Autotroph) – an organism that makes its own food and stores energy
 - Example: plants
- Consumer (Heterotroph) – an organism that obtains food and energy by eating other organisms
 - Types of Consumers:
 1. Herbivores – organisms that eat only plants
 - Example: cattle
 2. Carnivores – organisms that eat only animals
 - Example: coyotes
 3. Omnivores – organisms that eat both plants and animals
 - Example: bears
 - Decomposer (also a heterotroph) – organisms that obtain energy by breaking down wastes and the remains of dead organisms
 - Examples: mushrooms and earthworms
- Food Chain – model that shows how energy passes from one organism to another
 - In a food chain, an arrow points from the organism being eaten to the organism doing the eating
 - Primary source of energy in a food chain is the sun
 - Example: Plant → Rabbit → Weasel
- Levels of Consumers:
 - First level: Consumers that eat producers
 - Second level: Consumers that eat first-level consumers
- Only about 10% of the energy consumed by a first-level consumer is available for the second-level consumer. The other 90% is used to support the life processes (keeping warm, pooping, etc) of the primary consumer

- This means that the higher the level of consumer, the fewer there are of them because they have to eat A LOT to get enough energy
- Food Web – a series of overlapping or connected food chains that exist in an ecosystem. More accurate than a food chain because they show ALL the feeding relationships within an ecosystem

Source: <http://www-bioc.rice.edu/pblclass/6th%20grade/Biology/ecosystems/Energy%20Transfer%20Notes.pdf>

Field Trip Activities

Genesee County Park

Name: _____

While on your trip to the park, try to identify at least three organisms in each of the following categories. Remember to look up, down, and side to side to identify each organism!

	Organisms
Producers	- - -
Herbivores	- - -
Carnivores	- - -
Decomposers	- - -

Post-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Food Web Analysis

Central Focus for the learning segment: Students will analyze organisms identified on their field trip and create food webs from this analysis.

Content Standard(s): NYS CCLS or Content Standards

- 1.1a Populations can be categorized by the function they serve. Food webs identify the relationships among producers, consumers, and decomposers carrying out either autotrophic or heterotrophic nutrition.
- 1.1f Every population is linked, directly or indirectly, with many others in an ecosystem. Disruptions in the numbers and types of species and environmental changes can upset ecosystem stability.

Learning Objectives:

- Students will be able to identify and describe producers, consumers, and decomposers
- Students will be able to identify the flow of energy through an ecosystem
- Students will be able to determine possible ramifications of removing one organism from a food web

Instructional Resources and Materials to engage students in learning:
Field trip table, activity worksheet

Instructional Strategies and Learning Tasks that support diverse student needs:

- Students will use their table of organisms identified on the field trip to create a food web and complete the activity below (Elaborate).
- Students will then compare the food webs they created to other groups. Students should be able to realize that food webs are complex and overlap; there is no one correct arrow configuration between organisms (Evaluate) (Contant, 2014).

Differentiation and planned universal supports:

Students will be using worksheets to help guide them in their thinking. Students may draw or write animals, depending on their preferences. The comparison of food webs will occur verbally for students who struggle with writing.

Language demands and language supports:

Producer, consumer, decomposer, food web

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** Student discussions while creating their food webs will be used to correct any misconceptions.
- **Formal Assessment:** The completion of the food web activity, using the organisms identified on the field trip, will be used as a formal assessment. This assessment will determine if students can use previously learned information in real world scenarios.

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

0:00-30:00 Creation of food webs

30:00-45:00 Discussion and comparison of each other's food webs

Build a Food Web Activity

Name _____ Period _____ Date _____

Once you have completed the food web, complete the tasks below.

1. Using your identified organisms, classify the different types of consumers in your table as one of the following:

Carnivores:

Herbivores:

Omnivores:

Decomposers:

2. Draw in three different food chains based on the feeding relationships on your food web.

	Food Chain #1	Food Chain #2	Food Chain #3
Producer			
	↓	↓	↓
Primary Consumer			
	↓	↓	↓
Secondary Consumer			
	↓	↓	↓
Tertiary Consumer			

3. What would happen to your food web if aquatic plants died out because of pollution?

4. What would happen to your food web if the population of a tertiary consumer was to double?

5. Asian carp consume zooplankton, which many fishes typically feed on in their juvenile stages, and have no known predators (in Asia). How would the introduction of Asian carp affect your food web?

Source: <http://internet.savannah.chatham.k12.ga.us/schools/nhs/staff/Lowery/Shared%20Documents/Unit%202%20Assignments/Build%20a%20Food%20Web%20Activity.pdf>

Field Trip 4: MCA Gymnastics

Location:

MCA Gymnastics
7820 Caswell Rd, Byron NY 14422
(585)409-1882

Cost/Requirements:

- \$150/day
- 9:00 am-2:30 pm, although flexible
- Students need to bring a lunch and water bottle
- Students should dress in comfortable athletic clothing with no hanging jewelry
- A signed waiver must accompany any student or staff who plan on partaking in activities on the field trip for that day

Field Trip Description:

- When students arrive, they will be greeted by an instructor and will be able to claim a cubby for the day. In the cubby, students are able to keep any extra clothing as well as their shoes, lunch, and water bottle. Any final payments and waivers need to be collected by the facility upon arrival (15 minutes).
- Next, students will be given a tour of the facility as well as shown a quick video about safety in the gym. The instructor will facilitate a discussion about safety as well as show students examples of acceptable behavior in the facility. Students will need to pass a safety quiz in order to participate throughout the day (30 minutes).
- Before any physical activity, students will need to stretch and warm up their muscles. Different games as well as stretching will be directed by the instructional staff (30 minutes).
- Students will then participate in basic activities and skills, as determined by the instructor, on each of the four women's apparatus (vault, bars, beam, floor) plus the tumble track. Students are able to partake in whatever activities they feel comfortable with, as all students may have different abilities (1.5 hours).
- After the morning is complete, students will be able to take their lunch break. A sitting area with tables is provided for students as well as teachers. It is suggested that students finish their lunch as well as rest for 30 minutes prior to reengaging in physical activity. During this break, students may work on their facilitation worksheets (1 hour).
- After lunch, students are able to complete their facilitation worksheets as well as explore the gymnastics facility. Safety is a priority, but students will be able to partake in activities or games of their choosing (1.5 hours).
- Students will then have time to complete a survey as well as empty their cubbies of any materials they stored in them throughout the day. Students will be given fliers if they are interested in signing up for the facility (15 minutes).

Objectives:

- Students should come into the field trip having a background in cellular respiration

- Students will be able to determine the amount of cellular respiration taking place during different gymnastics activities. This aspect of the field trip will represent the Elaborate phase of the 5E model.

New York State Living Environment Content Standard Alignment:

- 1.2a Important levels of organization for structure and function include organelles, cells, tissues, organs, organ systems, and whole organisms.
- 1.2f Cells have particular structures that perform specific jobs. These structures perform the actual work of the cell. Just as systems are coordinated and work together, cell parts must also be coordinated and work together.
- 1.2h Many organic and inorganic substances dissolved in cells allow necessary chemical reactions to take place in order to maintain life. Large organic food molecules such as proteins and starches must initially be broken down (digested to amino acids and simple sugars respectively), in order to enter cells. Once nutrients enter a cell, the cell will use them as building blocks in the synthesis of compounds necessary for life.
- 1.2i Inside the cell a variety of specialized structures, formed from many different molecules, carry out the transport of materials (cytoplasm), extraction of energy from nutrients (mitochondria), protein building (ribosomes), waste disposal (cell membrane), storage (vacuole), and information storage (nucleus).
- 5.1d In all organisms, the energy stored in organic molecules may be released during cellular respiration. This energy is temporarily stored in ATP molecules. In many organisms, the process of cellular respiration is concluded in mitochondria, in which ATP is produced more efficiently, oxygen is used, and carbon dioxide and water are released as wastes.
- 3.1a Interpretation of data leads to development of additional hypotheses, the formulation of generalizations, or explanations of natural phenomena.
- 3.4b Claims should be questioned if the data are based on samples that are very small, biased, or inadequately controlled or if the conclusions are based on the faulty, incomplete, or misleading use of numbers.

Pre-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Organelle Introduction

Central Focus for the learning segment: Cells are made of substructures called organelles. Each organelle has a specific role in order to maintain homeostasis in the cell.

Content Standard(s): NYS CCLS or Content Standards

1.2a Important levels of organization for structure and function include organelles, cells, tissues, organs, organ systems, and whole organisms.

1.2f Cells have particular structures that perform specific jobs. These structures perform the actual work of the cell. Just as systems are coordinated and work together, cell parts must also be coordinated and work together.

1.2i Inside the cell a variety of specialized structures, formed from many different molecules, carry out the transport of materials (cytoplasm), extraction of energy from nutrients (mitochondria), protein building (ribosomes), waste disposal (cell membrane), storage (vacuole), and information storage (nucleus).

Learning Objectives:

- Students should be able to name and describe the main functions of organelles found in human cells: cytoplasm, mitochondria, ribosomes, cell membrane, vacuole, nucleus, nucleolus

Instructional Resources and Materials to engage students in learning:

Picture engagement cards, white boards, dry erase markers, computers/iPads, Youtube Video (<https://www.youtube.com/watch?v=hRvh26xu-SE>), Webquest, Note sheet, Analogy assessment

Instructional Strategies and Learning Tasks that support diverse student needs:

- Students will be read descriptions of organelles from the cell. Students will work in groups to determine what the description could be describing. For example, “I create power and energy”. Students could identify this description for a mitochondria as a windmill, water power source, etc. Students will share their answers using white boards before the actual organelle is introduced (5E, Engage)
- Students will then complete the webquest on their computer or iPad. Students will go through the different organelles presented by the website in order to answer the questions on the facilitation worksheet (5E, Explore).
- Students will take notes and watch a YouTube video for exact explanations of what certain organelles do and their physical descriptions (5E, Explain).
- Students will finally be formatively assessed using the analogy worksheet. Students will need to relate each organelle to a common object and describe why the two are related (Contant, 2014).

Differentiation and planned universal supports:

Students who have reading or writing difficulties may have the text presented in the virtual cell tour read aloud electronically for better understanding.

Language demands and language supports:

Cell, organelle, cytoplasm, mitochondria, ribosome, cell membrane, vacuole, nucleus, nucleolus, endoplasmic reticulum, golgi apparatus, lysosome

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** The webquest will be gone over to determine student understanding through the reading and videos it provides.
- **Formal Assessment:** Students will be formatively assessed on the analogy worksheet to determine learning and any misconceptions that need to be corrected

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

00:00-5:00 Description Engagement Activity

5:00-25:00 Webquest

25:00-40:00 Notes/Videos

40:00-45:00 Analogy Assessment

Description Engagement Activity

1. Controls what enters and exits/protection - Cell membrane
2. Creates power and energy - mitochondria
3. Storage - vacuole
4. Keeps materials in place - cytoplasm
5. Control center - nucleus
6. Creates packages and transports materials - golgi apparatus
7. Destroys invaders/garbage - lysosomes

The Virtual Cell Tour

Name: _____

Go to www.ibiblio.org/virtualcell/ Click on the "The Virtual Cell Tour" and answer the following questions:

1. Describe the process in which proteins are packaged by the golgi body.
 2. What are the functions of lysosomes.
 3. Describe the outer and inner structure of mitochondria.
 4. Why is the inner membrane of mitochondria ruffled?
 5. Where might have mitochondria originated from? Why?
 5. Describe the outer membrane of the nucleus.
 7. Describe the inner contents of the nucleus.
 8. Describe the appearance of the nucleolus.
 9. Describe the appearance of the endoplasmic reticulum.
 10. What makes rough ER "rough"?
- Source: <http://www.ibiblio.org/virtualcell/>

Organelles

Organelle	Structure(s)	Function(s)	*Found in
Nucleus	Double membrane envelope with nuclear pores		
Nucleolus			
Ribosome			
Rough Endoplasmic Reticulum (ER)			
Smooth Endoplasmic Reticulum (ER)			
Golgi Apparatus			
Lysosome			
Vacuole			
Mitochondrion			

Source: <http://safarmedapps.com/cell-organelles-worksheet/>

Analogies

Name: _____

Please complete the following table by identifying a common object that has the same purpose as each cell organelle and describe the similarity.

Organelle	Common Object	Similarity
Nucleus		
Cytoplasm		
Endoplasmic Reticulum		
Lysosome		
Vacuole		
Cell Membrane		
Mitochondria		

Pre-Field Trip Lesson 2

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Cellular Respiration Introduction

Central Focus for the learning segment: Energy for the body comes from the molecule Adenosine Triphosphate or ATP. ATP is produced in organisms through the process of cellular respiration. Cellular respiration begins with the process of glycolysis in the cytoplasm and continues through the processes of the Krebs Cycle and electron transport chain in the mitochondria. Glucose and oxygen are essential reactants for the process of cellular respiration and ATP, water, and carbon dioxide are the products.

Content Standard(s): NYS CCLS or Content Standards

1.2h Many organic and inorganic substances dissolved in cells allow necessary chemical reactions to take place in order to maintain life. Large organic food molecules such as proteins and starches must initially be broken down (digested to amino acids and simple sugars respectively), in order to enter cells. Once nutrients enter a cell, the cell will use them as building blocks in the synthesis of compounds necessary for life.

5.1d In all organisms, the energy stored in organic molecules may be released during cellular respiration. This energy is temporarily stored in ATP molecules. In many organisms, the process of cellular respiration is concluded in mitochondria, in which ATP is produced more efficiently, oxygen is used, and carbon dioxide and water are released as wastes.

Learning Objectives:

- Students should be able to identify glucose and oxygen as the reactants and ATP, water, and carbon dioxide as the products of the cellular respiration process
- Students should be able to describe the steps of the cellular respiration process (glycolysis, Krebs cycle, electron transport chain) and where each one occurs in the cell

Instructional Resources and Materials:

Crackers, manipulation and record sheets, 6 atom molecule from atomic building kit, 48 2-sided color chips, notes worksheet

Instructional Strategies and Learning Tasks that support diverse student needs:

- Give students a cracker and together identify that carbohydrates are present in the cracker. Allow students to brainstorm how the glucose in that cracker becomes energy in the human body. Share hypotheses.
- Students will then be given directions and go through the phases of cellular respiration using the manipulative station rotation. Students will record their results in their respiration record.
- The teacher will go over the students' results from the station rotation by allowing students to share their information. The teacher will then pass out notes and students will clarify misconceptions.
- The exit ticket will be students writing the true pathway of glucose to energy that they learned in the day's lesson.

Differentiation and planned universal supports:

Students can work on the manipulation either in partners or by themselves. Students may write the exit ticket on lined paper or through the use of an electronic classroom website. The manipulatives give students a kinesthetic activity while the notes contain an auditory/visual representation of the material.

Language demands and language supports:

Glucose, energy, aerobic respiration, glycolysis, Krebs's Cycle, electron transport chain, anaerobic respiration, ATP

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** Observations of students participating in the manipulative exploration
- **Formal Assessment:** An exit ticket which students must write in detail how glucose can be transformed into energy in the body

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

0:00-5:00 Eating engagement

5:00-25:00 Manipulative Exploration

25:00-40:00 Notes/Video

40:00-45:00 Exit Ticket

The Simulation Story-line

Before you Begin: Look at your Respiration Record and be sure to have a way to represent low-energy molecules and high-energy molecules.

To Begin: Lay out all of your matter and energy molecules in an organized fashion and complete the section of your Respiration Record that is labeled "Before Cellular Respiration."

Step 1 of Respiration Simulation: Glycolysis

Begin with your sugar molecule. Notice that the molecule has 6 Carbon atoms joined together by bonds. Chemical energy is stored in the chemical bonds of your sugar molecule. In order to release the chemical energy in the bonds, you will need to break the bonds by **cutting your 6-Carbon molecule into 2 molecules with 3 Carbons each**. Breaking the bonds requires using 2 high-energy molecules. These 2 high-energy molecules will be transformed into low-energy molecules. Be sure to represent the transformation of 2 high-energy molecules into low-energy molecules using your manipulatives. Although energy is required to break the chemical bonds; more energy is released when the bonds break. **The energy released from breaking the bond in this step transforms 6 low-energy molecules into high-energy molecules.**

Be sure this step is accurately recorded in your Respiration Record.

Step 2 of Respiration Simulation: TCA Cycle (or Krebs's Cycle)

Move your molecules with 3 carbons into the Mitochondrion. (Note: before you entered the mitochondrion, you were in the cytosol.)

During this stage, **the Carbons are broken apart producing 6 Carbon Dioxide molecules**. The energy released from breaking these chemical bonds is used to **transform a total of 12 low-energy molecules into high-energy molecules**.

Be sure this step is accurately recorded in your Respiration Record.

Step 3 of Respiration Simulation: Electron Transport Chain

The Electron Transport Chain utilizes molecular machines embedded in the mitochondrial membrane. As hydrogens move across the membrane, they activate molecular machines that transfer energy to low-energy molecules to produce high-energy molecules. These molecular machines **require O-O (oxygen) molecules and release water (H-O-H) molecules**. The Electron Transport Chain **converts 32 low-energy molecules into high-energy molecules**.

Be sure this step is accurately recorded in your Respiration Record.

Source: <http://www.cpalms.org/Public/PreviewResourceLesson/Preview/63496>

Cellular Respiration Record

Name _____

Date _____

Before you begin the simulation, be sure your matter and energy are organized.

Step	Matter	Energy	Notes and Questions to think about
Before cellular respiration	<u>Draw your molecule:</u> 	2 high-energy molecules 48 low-energy molecules	During cellular respiration, the chemical energy of molecules is transferred from food sources to energy-storing molecules, such as ATP in the cell. High-energy molecules such as ATP can be used by the cell as energy for lots of process, such as growth and reproduction.
Step 1 Glycolysis (splitting the sugar)	<u>Draw what happens to the molecules during this step:</u> 	At the end of glycolysis you have: ____ high-energy molecules ____ low-energy molecules	How did the matter change during this step? How did the energy change during this step?

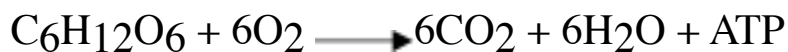
<p>Step 2 TCA Cycle</p>	<p><u>Draw what happens to the molecules during this step:</u> <i>Remember to draw the production of carbon dioxide (CO₂)</i></p>	<p>At the end of this step you have:</p> <p>_____ high-energy molecules</p> <p>_____ low-energy molecules</p>	<p>How did the matter change during this step?</p> <p>How did the energy change during this step?</p>
<p>Step 3 Electron Transport Chain</p>	<p><u>Draw what happens to the molecules during this step:</u> <i>Remember Hydrogens (H) move across the mitochondrial membrane and combine with Oxygen (O) (H₂ molecules).</i></p>	<p>At the end of this step you have:</p> <p>_____ high-energy molecules</p> <p>_____ low-energy molecules</p>	<p>How did the matter change during this step?</p> <p>How did the energy change during this ste</p>

Source: <http://www.cpalms.org/Public/PreviewResourceLesson/Preview/63496>



Name _____ Date _____ Period _____

Notes Cellular Respiration

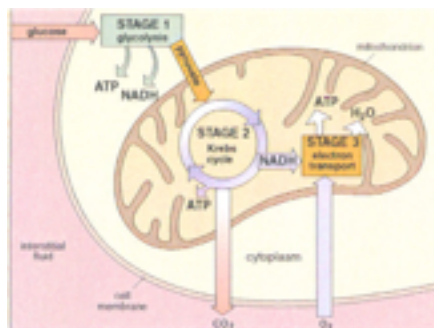


Glucose Oxygen enzymes Carbon Dioxide Water Energy

- occurs in the cells of all living organisms
- it breaks down fuel (glucose) to yield energy required for cells to function
- can occur with or without the oxygen

Aerobic respiration – cellular respiration that uses oxygen

There are three main stages in the process: **glycolysis**, **Kreb's cycle**, and the **electron transport system**.



First stage Glycolysis (does not require oxygen)

- occurs in the cytoplasm
- 6-carbon glucose is split in half to make two molecules of 3-carbon pyruvate
- only 2 ATPs are produced

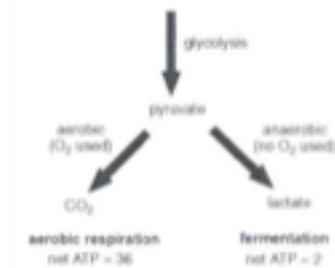
Second stage The Krebs Cycle (occurs when oxygen is present)

- occurs in the mitochondria
- pyruvate is broken down to carbon dioxide which is released as a gas
- more ATP is made

Third stage Electron Transport System

- occurs in the mitochondria's inner membrane
- requires oxygen
- is a series of electron carrier molecules
- electrons and hydrogen ions pass along electron carrier molecules
- net 36 ATPs are produced
- the electrons and hydrogen ions join with oxygen to form water

Anaerobic respiration – cellular respiration that occurs when oxygen is low or absent



Glycolysis

- occurs in the cytoplasm
- 6-carbon glucose is split in half to make two molecules of 3-carbon pyruvate ○ only 2 ATPs are produced

Fermentation

- pyruvate is converted to
 - ethyl alcohol by yeast (how wine is produced)
 - lactic acid in bacteria cells and muscle cells

ATP: The Fuel of Cells

- ATP stores chemical energy in its structure
- the energy first came from the sun and then stored in food
- cellular respiration produces ATP
- every cell requires large amounts of ATP each day to do its work
- ATP provides the energy for biosynthesis, reactions that form larger molecules
 - formation of starch from glucose
 - building of proteins from amino acids
- example: energy stored in food is like stocks and ATP is like cash

Source:swift.tahoma.wednet.edu/tjhs/jhagen/documents/.../7-4_cellular_respiration_notes.pdf

Field Trip Activities

Safety Quiz

Please indicate whether the following pictures are safe and unsafe. For unsafe pictures, please list the reason(s) why the action is unsafe.



Concept Map

After the demonstration and option for you to try a cartwheel, round off, or back-handspring, draw a concept map of how food turns into the energy necessary to complete these skills. The concept map must have at least, but is not limited to, five boxes or concepts. The lines connecting the five concepts must have definitions or explanations. The following terms must be included in the concept map: food, cellular respiration, ATP, and energy.

A large, empty rectangular box with a thin black border, intended for the student to draw a concept map. The box is currently blank.

Exercise & Cellular Respiration

Purpose:

The purpose of this lab activity is to analyze the affect of exercise on cellular respiration.

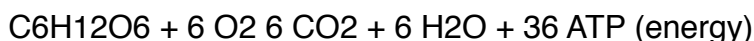
Background:

I. Purpose.

- To observe the effects of exercise on cellular respiration.
- To identify the role of carbon dioxide production, breathing rate, and heart rate in determining the rate of cellular respiration.

II. Background Information.

Cellular respiration (see chemical reaction below) is a chemical reaction that occurs in your cells to create energy; when you are exercising your muscle cells are creating ATP to contract. Cellular respiration requires oxygen (which is breathed in) and creates carbon dioxide (which is breathed out).



This lab will address how exercise (increased muscle activity) affects the rate of cellular respiration. You will measure 3 different indicators of cellular respiration: breathing rate, heart rate, and carbon dioxide production. You will measure these indicators at rest (with no exercise) and after 1 and 2 minutes of exercise. Breathing rate is measured in breaths per minute, heart rate in beats per minute, and carbon dioxide in the time it takes bromthymol blue to change color.

Carbon dioxide production can be measured by breathing through a straw into a solution of bromthymol blue (BTB). BTB is an acid indicator; when it reacts with acid it turns from blue to yellow. When carbon dioxide reacts with water, a weak acid (carbonic acid) is formed (see chemical reaction below). The more carbon dioxide you breathe into the BTB solution, the faster it will change color to yellow.



Materials:

Beaker/Test tube/cup
bromthymol blue solution (BTB)
straw
stop watch

Pre-Lab: Use your background information AND your Cellular Respiration notes to answer the following pre-lab questions.

1. What is the equation for cellular respiration? Label which items are the reactants and the products.
2. In what part of the cell does cellular respiration occur?

3. Write a prediction/hypothesis of how exercise will affect your body's production of carbon dioxide (i.e. do you think your body will produce more or less carbon dioxide as you exercise). Make sure you EXPLAIN WHY you feel that way.

Procedure:

PART A: Resting (no exercise)

Measuring Carbon Dioxide Production:

1. Use a graduated cylinder to measure out 20 mL of tap water and pour it into a small beaker.
2. Use a dropper to add 8 drops of bromthymol blue to make a BTB solution.
3. Using a straw, exhale into the BTB solution. (CAUTION: Do not inhale the solution!)
4. Time how long it takes for the blue solution to turn yellow. Record the time in Table 1.
5. Wash out the beaker repeat steps 1-4 twice more.
6. Average the results of the 3 trials. Record this in Table 1.

Measuring Breathing Rate:

1. Count the number of breaths (1 breath = inhale + exhale) you take in 1 minute. Record this in Table 2.
2. Repeat this 2 more times.
3. Average the 3 trials to get your average breathing rate. Record this in Table 2.

Measuring Heart Rate:

1. While you calculate your breathing rate, have your partner take your pulse. Count the number of beats in 30 seconds and multiply that number by 2. Record this in Table 3.
2. Repeat this 2 more times.
3. Average the 3 trials to get your average heart rate. Record this in Table 3.

PART B: Increased Muscle Activity (Exercise)

1. Exercise for exactly 1 minute by doing a gymnastics exercise of your choice. Photos or videos of each partner performing the exercise of their choice need to be taken.
2. While you are exercising, your partner should get the BTB solution ready as in Part A.
3. After 1 minute of exercise, immediately exhale through the straw into the BTB solution. Time how long it takes for the BTB to turn yellow. Record this in Table 1.
4. Then quickly calculate your breathing and heart rates as you did before. You only need to do this once.
5. Record these values in Tables 2 & 3. Remake your BTB solution.
6. Exercise as you did before, but for 2 continuous minutes.
7. Immediately exhale through the straw into the BTB solution. Time how long it takes for the BTB to turn yellow. Record this in Table 1.
8. Then quickly calculate your breathing and heart rates as you did before. You only need to do this once.
9. Record these values in Tables 2 & 3.

10. Repeat these steps for all four partners in your group.

Results:

Table 1. Carbon Dioxide Production

		Partner 1	Partner 2	Partner 3	Partner 4	Average
Resting	Trial 1					
	Trial 2					
	Trial 3					
	Average					
Exercise	1 Minute					
	2 Minutes					

Table 2. Breathing Rate (breaths/minute)

		Partner 1	Partner 2	Partner 3	Partner 4	Average
Resting	Trial 1					
	Trial 2					
	Trial 3					
	Average					
Exercise	1 Minute					
	2 Minutes					

Table 3. Heart Rate (beats/minute)

		Partner 1	Partner 2	Partner 3	Partner 4	Average
Resting	Trial 1					
	Trial 2					
	Trial 3					
	Average					
Exercise	1 Minute					
	2 Minutes					

Analysis & Conclusions: Answer the questions below using your BACKGROUND information in the lab, as well as your lab data. ANSWER THE QUESTIONS IN COMPLETE SENTENCES

1. How did exercise affect the time needed for the solution to change color? Explain why the color change occurred (How does BTB work?)
2. What can you conclude about the effect of exercise on the amount of carbon dioxide that is present in your exhaled breath? Why is this so?
3. What can you conclude about the effect of exercise on breathing rate? Why is this so?
4. What can you conclude about the effect of exercise on heart rate? Why is this so? What do your muscles need during exercise that the blood brings?
5. State whether your hypothesis was correct or incorrect and why. In doing so, discuss what you think is going on in the muscles of the body as muscle activity is increased. Address the need to get oxygen to the muscles and get rid of carbon dioxide, as well as how the muscles cells get the energy needed to continue contracting.

Source: <http://www.westbranch.k12.oh.us/userfiles/293/classes/1769/exercisecellularrespirationlab.pdf>

Post-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Cellular Respiration Conclusion

Central Focus for the learning segment: Students will be able to take their knowledge of cellular respiration and data collected on the field trip to organize and present their laboratory reports.

Content Standard(s): NYS CCLS or Content Standards

3.1a Interpretation of data leads to development of additional hypotheses, the formulation of generalizations, or explanations of natural phenomena.

3.4b Claims should be questioned if the data are based on samples that are very small, biased, or inadequately controlled or if the conclusions are based on the faulty, incomplete, or misleading use of numbers.

Learning Objectives:

- Students will be able to present their data and pictures/videos collected during the field trip to the class in a coherent series of events
- Students will be able to interpret their results to determine which person or exercise lead to the greatest amount of cellular respiration
- Students will be able to determine sources of error and how their experiment's results could become more valid or accepted

Instructional Resources and Materials to engage students in learning:

Rubric, markers, data collected on the field trip, pictures or videos taken on the field trip, poster board, tape/glue, computer, PowerPoint/Prezi/etc.

Instructional Strategies and Learning Tasks that support diverse student needs:

- Students will listen to the description of what they are going to complete to present to the class. Students will also obtain the rubric they will be assessed using to ensure they include all elements required. Students may create physical or electronic presentations.
- Students will then present their data to the class as the group they participated in the field trip activity in (5E, Evaluate) (Contant, 2014).

Differentiation and planned universal supports:

Students who have extensive anxiety may present their presentation to the teacher independently away from the rest of the class period.

Language demands and language supports:

Mitochondria, cell, ATP, exercise, bromothymol blue, carbon dioxide

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** Observations of students working in groups
- **Formal Assessment:** Presentations by each student group will be performed using a rubric

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

00:00-2:00 Directions on the day's tasks and distribution of the rubric

02:00-20:00 Creation of presentation boards/PowerPoints

20:00-45:00 Presentation of material

POWERPOINT RUBRIC INDIVIDUAL WORK

ELEMENT	3	2	1	Points
Planning	Storyboard clearly and completely outlines the project.	Storyboard outlines the project somewhat.	Storyboard was created, but is not useful or complete.	
Organization	There is logical sequence of information. Title slide and closing slide are included.	There some logical sequence of information.	There is no logical sequence of information.	
Content	Presentation covers topic completely and in depth. Information is clear, appropriate, and accurate.	Presentation includes some essential information. Some information is confusing, incorrect, or flawed.	Presentation includes little essential information. Information is confusing, inaccurate, or flawed.	
Multimedia Design (text, graphics, sound, video, animation)	Presentation is attractive and appealing to the viewer (s).	Most multimedia elements contribute to the presentation. Some slides may have too much text.	Multimedia is absent, or if used, detracts from the presentation.	
Language	Spelling, grammar, capitalization, punctuation usage are accurate.	There are minor problems in spelling, grammar, capitalization, and punctuation usage.	There are persistent errors in spelling, grammar, punctuation usage.	
Appearance	Presentation is attractive and appealing to the viewer (s).	Presentation is somewhat appealing to viewers.	Little to no attempt has been made to make presentation appealing to viewers.	
TOTAL SCORE	Comments:			18

Source: <http://teacherweb.com/WQ/HighSchool/Poe2/gallery1.aspx?print=true>

Field Trip 5: Hidden Valley Animal Adventure

Location:

2887 Royce Rd.
Varysburg, NY 14167

Cost/Requirements:

- Group Trolley: \$13 per student/teacher and \$16 per additional parent/chaperone
 - Every 21st guest receives complimentary visit
- Small Animal Adventure Only:
 - \$6 per student/teacher/chaperone for 45 minutes
- Small Animal Demonstration:
 - \$30 per half hour
- A \$200 deposit and final head count is due a week prior to scheduled visit
- Cash or check only
- A “rain or shine” experience. If inadequate weather, students will need to be dressed prepared to still participate
- Students are able to bring a packed lunch or contact the staff at HVAA for additional “price friendly” dining options

Field Trip Description:

- Students will arrive to Hidden Valley Animal Adventure thirty minutes prior to the experience to ensure all students are able to take adequate bathroom breaks and load the covered trolleys.
- Group Trolley: Lasts approximately an hour. Students will travel in a covered trolley while exploring the over 30 different species HVAA hosts from around the world. A guide will give students background information about the animals and the environments they come from. Each student will be given a cup of grain to interact and feed the animals throughout the experience. Trolleys are covered and wheel chair accessible.
- Small Animal Adventure: Students will be allowed in the small animal enclosure with the smallest animals from the adventure farm. Running at, hitting, or being unkind to the animals will not be tolerated.
- Small Animal Demonstration: A demonstration put on by HVAA staff and small animals from the property. Explanations and descriptions of the various animals will be given.

Objectives:

- Students will be able to describe evolution and physical adaptations
- Students will be able to analyze real life adaptations and their use
- Students will support their analysis of adaptations on real organisms with research and elaborate with their findings

New York State Living Environment Content Standard Alignment:

- 3.1f Species evolve over time. Evolution is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of

offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring.

- 3.1i Behaviors have evolved through natural selection. The broad patterns of behavior exhibited by organisms are those that have resulted in greater reproductive success.

Pre-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Evolution

Central Focus for the learning segment: Students will analyze different aspects of evolution and be introduced to the pieces of evidence supporting this theory.

Content Standard(s): NYS CCLS or Content Standards

- 3.1f Species evolve over time. Evolution is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring.

Learning Objectives:

- Students will be able to identify that species evolve due to changes in environment or genetics
- Students will be able to explain different pieces of evidence used to explain the differentiation or evolution of a species over time.

Instructional Resources and Materials to engage students in learning:

Animal Pictures, web-quest worksheets, guided notes, YouTube Video (<https://www.youtube.com/watch?v=hOfRN0KihOU>)

Instructional Strategies and Learning Tasks that support diverse student needs:

- Groups of pictures of related but very different animals will be placed on the board. Students will have to discuss and determine ways that these animals are potentially related (Engage).
 - Koala and rat, Echidna and platypus, Elephant and Manatee
- Students will explore the activity of relatedness and how organisms change over time through an evolution web-quest (Explore).
- Students will take notes and watch videos to explain the process of evolution (Explain) (Contant, 2014).

Differentiation and planned universal supports:

Students will participate with the web-quest online. Different formatting options will be available for students who need enlarged or spoken text. The notes are guided so students who struggle with reading and writing will have an easier time taking and understanding them.

Language demands and language supports:

Evolution, macromolecules, DNA, mutation, fossil, embryo

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** Educators will observe and listen to students as they participate in the engagement discussion and web-quest. Any misconceptions may be corrected and evaluation of student prior knowledge will be able to be gauged at this time.
- **Formal Assessment:** N/A

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

0:00-5:00 Discussion about the relatedness of animals to each other

5:00-30:00 Web-quest

30:00-45:00 Guided Notes/Video

Name: _____
 Period: _____

EVOLUTION WEBQUEST
 From Shara Carlson at Foster High School

Part A: Go to <http://science.discovery.com/interactives/literacy/darwin/darwin.html>. Click on “Learn about Natural Selection.” Answer the questions below as you are able to.

1. What was Charles Darwin’s theory on the driving force of evolution called?

2. What are the parts of Darwin’s ideas? List them below:

3. What does “survival of the fittest” mean?

Part B: Answer questions 4-7 below as you set up “Darwin’s Evolution Game” in the beginning. DO NOT go through the game without answering the questions below in the beginning!!!!!!!

4. How would you describe your starting environment? What kinds of landforms are present?

5. What kind of vegetation is there?

6. Anything else that is noteworthy?

7. Draw your 3 starting variants of your species and describe why you chose the ones that you did in the table below. What advantages did you think they might have over some of the other options?

Picture of variant	Reason for choice
1.	
2.	
3.	

Trial #1

How long did your species survive on your first attempt? _____

8. Repeat the above **until you make it to 1,000,000 years!!** What was different between the variants you chose the first time, and the ending population after a successful attempt?

9. Once your species has succeeded, take the quiz on the site and write in the letter to the correct responses below:

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

11. What was the name of the guy
 pictured on the right page?

Part C: Click here: www.youtube.com/watch?v=ewtw_nZUIDQ and watch the video clip “How do we know evolution happens?” Write a 5 sentence paragraph summary for the video clip.

Part D: Investigate a variety of types of evidence for evolution. You are responsible for learning about:

***Fossil evidence (based on paleontology, or the study of prehistoric life)

***Anatomical evidence (in regards to structure and anatomy)

***Molecular evidence (based on comparing DNA and protein molecules)

1. Look for websites in regards to your chosen specialty and find two **specific** examples of evidence for evolution for each category. Make sure you use credible Web sites.
2. Complete the chart below as you gather information.

Source: <https://www.google.com/search?client=safari&rls=en&q=evolution+notes&ie=UTF-8&oe=UTF-8#>

Evidence of Evolution

DNA / Macromolecules:

- _____ / _____ (Macromolecules) :
 - Compare organisms on a _____ level using _____ & _____
 - Determining Relatedness
 - _____ the strands of DNA from 2 or more different organisms.
 - The more base pairs that “_____” the more related you are
 - Differences in DNA sequences are caused by _____
 - Mutations that cause beneficial traits are passed on to offspring.

Example:

1. Which organism is more related to a human and why?
2. What evidence do you have to support your answer?

Fossils:

- Comparing present day organisms to extinct organisms looking for similarities.
- _____:
 - Using _____ to determine the _____ of fossils.
 - _____ layers are on the _____, _____ fossils on the _____

Structural Evidence:

- _____:
 - Similar features that originate from a _____
 - look _____ and have different _____

- skeletal structures (_____) very similar and are derived from same embryological structures
 - Ex: Forelimbs of animals
- _____:
 - Features that exist, but are _____
 - Feature that was useful to an ancestor, but is no longer useful to the modern organism
- Ex:
 -
 -
- _____:
 - Embryological _____ repeats throughout evolutionary history
 - Earliest stage of _____ and _____
 - Occurs while still in the egg or womb

Source: <http://www.sunprairie.k12.wi.us/faculty/nmolsen/evolution-notes.cfm>

Pre-Field Trip Lesson 2

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Evolution - Adaptations

Central Focus for the learning segment: Students will explore different animal adaptations and learn how these are essential for survival.

Content Standard(s): NYS CCLS or Content Standards

- 3.1f Species evolve over time. Evolution is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring.

Learning Objectives:

- Students will be able to describe the cause and effect of animal adaptations.
- Students will be able to analyze what possible adaptations may be used for.

Instructional Resources and Materials to engage students in learning:

Color changing cups and pencils, Beak of Finch's activity worksheets, guided notes and YouTube video (https://www.youtube.com/watch?v=U_YD0XU0TNU)

Instructional Strategies and Learning Tasks that support diverse student needs:

- Students will be able to play with color changing (due to heat) cups and pencils. Students will have to determine pros and cons to the changing color and relate how this could be related to animals (Engage).
- Students will participate in the Beak of the Finch activity. Students will use different items to simulate different beaks that Finch's may have. Students will realize that different beaks are proficient to pick up different items, although they all come from the same related genus of bird (Explore).
- Students will take guided notes and watch related brief videos (Explain) (Contant, 2014).

Differentiation and planned universal supports:

Students with physical impairments may participate in the Beak's of Finch's activity with a partner. Notes are guided to assist students who struggle with reading and writing.

Language demands and language supports:

Evolution, adaptation, behavioral, physiological, anatomical

Type of Student Assessments and what is being assessed:

- **Informal Assessment:**

- **Formal Assessment:**

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

0:00-5:00 Students will have time to interact with color changing cups and pencils and determine pros and cons for the change of color

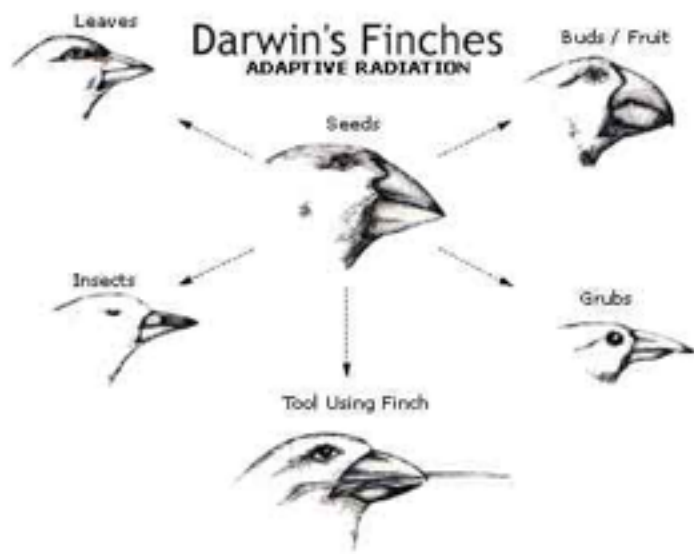
5:00-30:00 Beak's of Finch's activity

30:00-45:00 Guided notes/video

Beak of the Finch Activity

Name _____

On the Galapagos Islands today there are 13 species of closely related finches. The birds are all about the same size (10–20 cm). The most important differences between species are in the size and shape of their beaks, and the beaks are highly adapted to different food sources. The birds are all brownish or black. Their behavior differs, and they have different song melodies. The current belief by scientists is that one species of finch arrived on the islands and evolved to fill the many niches that were not being filled by other birds. One species evolving to fill many different niches is an example of adaptive radiation.



In August 2006 in the *Journal Nature*, a group led by Harvard biologist Clif Tabin showed that the beak shapes of Darwin's finches are due to slightly different timing and spatial expressions of a gene called calmodulin. Calmodulin is used by the developing embryo to help lay down skeletal features (including the beak) and using microarray data and early embryo staining from each of the species, this groups could show how the different beak shapes were obtained. His article does not explain how adaptive radiation may have changed calmodulin

expression, only that this was the way that the beak changes were reached.

Today you are going to participate in an activity designed to demonstrate how different adaptations help different birds in collecting different types of food.

You will be given a tool used to represent a bird beak and will be asked to collect as much “food” as you can in a 30 second period. Then you will compare what how “birds” with different “beak adaptations” are better at collecting different types of seeds.

My tool _____

Data table 1. what I collected:

_____ large Styrofoam beads

_____ Large Seeds

_____ Small seeds

_____ Tooth picks

Class data

Average collected by each tool

Food Type	Spoon	Fork	Clip	Tweezers	Chop Sticks
Styrofoam					
Large Seeds					
Small Seeds					
Toothpicks					

Analysis questions:

1. Which tool collected the most seeds on average?
2. What type of "seed" was it best at collecting?
3. How do these different tools represent different adaptations?
4. Which type of seed was the bird that collected the least amount of seeds best at collecting?
5. If the environment changed such that the seed type from question #4 was more abundant, what do you think would happen to the population of that bird?
6. Does having a different shape beak or different tool help reduce competition between the birds searching for food? Explain why or why not.

Source: <https://www.galapagos.org/wp-content/uploads/2012/04/Beak-of-the-Finch-Activity.pdf>

Adaptations

Adaptations

- Inherited _____ that help an organism survive and reproduce within a particular environment.
- Can be _____, _____, or _____.

Anatomical Adaptations

- An _____ physical feature that helps an organism adapt to its environment.
- Examples:
 - Bill of a bird
 - Fur on a bear

Behavioral Adaptations

- _____ or _____ that organisms do to survive
- Examples:
 - Bird calls
 - Migration
 - Nocturnal

Physiological Adaptations

- Any _____ that helps a plant or animal carry out life functions.
- Examples:
 - Toxins
 - Slime Secretion

Examples: For the following organisms identify each type of adaptation.

● Organism #1: _____

- Anatomical Adaptation:
- Behavioral Adaptation:
- Physiological Adaptation:

● Organism #2: _____

- Anatomical Adaptation:
- Behavioral Adaptation:
- Physiological Adaptation:

● Organism #3: _____

- Anatomical Adaptation:
- Behavioral Adaptation:
- Physiological Adaptation:

Source: http://www.sunprairie.k12.wi.us/faculty/nmolsen/Adaptation%20Notes%20AVID%20style%202015_16%20-%20Google%20Docs.pdf

Field Trip Activity

Habitats and Adaptations Scavenger Hunt

Directions: Check the box for each clue as you find the answer and write it in the blank.

- The Oakland Zoo is divided into the African _____ and the _____ of Southeast Asia, Central and South America, and Africa.

Hint: Look at the map!

- Animals that are dark, small, and LOUD tend to live in _____.

- Animals that live in groups, are lighter colored and LARGE tend to be found in _____.

Find an animal adapted for:

- Walking in sand _____
- Digging in the dirt for roots and fungus _____
- Getting leaves from tall trees _____
- Running from predators _____
- Hunting prey _____
- Digging for and eating insects _____
- Hiding in bamboo _____
- Climbing trees and ripping open logs _____
- Swinging quickly through trees _____
- Sitting on hard rocks and dirt _____

Check the box for each clue as you find the answer and write it in the blank.

Find an animal with:

- Ears like fans _____
- A nose like a hose _____
- A large hairy "helmet" _____
- A striped coat to confuse enemies _____
- Hairy nostrils to keep out the sand _____
- Claws for catching prey _____
- Feet like hands for climbing _____
- Big beaks for eating fruit _____
- A handy sitting cushion _____

Find an animal doing this:

- Looking for food _____
- Making a very loud noise _____
- Swinging in the trees _____
- Hiding _____
- Doing look-out duty _____
- Napping in a tree house _____
- Playing _____

Post-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Adaptation Analysis

<p>Central Focus for the learning segment: Students will research the adaptations they found on animals during the field trip and will present these findings to the class.</p>
<p>Content Standard(s): NYS CCLS or Content Standards</p> <ul style="list-style-type: none"> • 3.1f Species evolve over time. Evolution is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring.
<p>Learning Objectives:</p> <ul style="list-style-type: none"> • Students will analyze specific adaptations and describe the evolutionary track for the organism to obtain such adaptations
<p>Instructional Resources and Materials to engage students in learning: Internet, computers, PowerPoint or Prezi</p>
<p>Instructional Strategies and Learning Tasks that support diverse student needs:</p> <ul style="list-style-type: none"> • Students will research one of the adaptations they identified on the field trip and determine its evolutionary track or related structures in other organisms (Elaborate). • Students will present these findings to the class (Evaluate) (Contant, 2014).
<p>Differentiation and planned universal supports: Students who struggle with anxiety may present their findings to the teacher individually. Presentation format may have little to no writing to support students who struggle with reading or writing.</p>
<p>Language demands and language supports: Evolution, adaptation</p>
<p>Type of Student Assessments and what is being assessed:</p> <ul style="list-style-type: none"> • Informal Assessment: Teacher will observe and listen to students research and put together their presentation • Formal Assessment: The information provided by students during their presentation will be used as a formal assessment.
<p>Relevant theories and/or research best practices: Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.</p>

Lesson Timeline:

Day 1: Research

Day 2: Present

Adaptation Analysis

Name: _____

Identify one of the organisms with an adaptation from the field trip. You will do research to determine when that adaptation came into existence and will explain the evolutionary process to the class. Make sure to only use reliable sources!

Organism: _____ Adaptation: _____

Climate and area the organism is natively found _____

Describe the physical characteristics of this organism's adaptation

What is the adaptation used for?

Related Organisms: _____

Do these organisms have the same or related adaptations? Why or why don't you think so?

When was this species distinguished as it's own? _____

Did the adaptation occur before or after the identification of the species? _____

Presentation Rubric

Category	2	1	0
Organism/ Adaptation	Both organisms and adaptation listed	Organism or adaptation listed	Neither organisms or adaptation listed
Native Climate/ Biome	Native climate listed and described	Native climate listed	No discussion of native climate
Description/Use of Adaptation	Description and use of adaptation described	Description or use of adaptation described	No description or use of adaptation described
Related Organisms	Related organisms listed	N/A	No related organisms listed
Related Adaptations	Related adaptations on related organisms listed and explained	Related adaptations on related organisms listed	No related adaptations discussed or explained
Timeline of speciation and acquirement of adaptation	Timeline of speciation discussed	N/A	No timeline of speciation discussed
Total	/12		

Field Trip 6: Letchworth State Park

Location:

1 Letchworth State Park
Castile, NY 14427

Cost/Requirements:

- \$35 Non-profit bus entrance fee
- \$1 adult and \$0.50 child museum donation fee
- \$50 half day and \$100 whole day shelter rental
- If a shelter rental is not completed, field trip members will have to dress for the weather. Although there are pavilions scattered throughout the park, there are no other four walled areas available

Field Trip Description:

- Students will arrive to the park and place their items in one of the rental shelters if obtained by the school. Students will then begin their morning with hiking the trails of Letchworth State Park to experience the ecosystem and environment they are in. Handicap accessible trails are also available so all students are able to participate (1 hour).
- Students will then participate in leaf and trash removal throughout an area of the park. Students will be provided gloves and trash bags to put their trash. Additionally, students will be given a table to record the types of trash and how much they collect (1 hour).
- Students will discuss with each other the types of trash they collected. Students will determine what effects those types of trash can do to the ecosystem (30 min).
- Students will eat the lunches they brought with them on the field trip (30 min).
- After lunch, students will be able to identify invasive plant species and find them throughout a park area. After identification, students will be able to remove the invasive plant species and place them in an identified container for disposal (1 hour).
- Students will identify through discussion how these invasive plant species could alter the ecosystem of Letchworth State Park (30 min).

Objectives:

- Students will be able to determine how human activities can degrade ecosystems through pollution and how a loss of diversity can result. Real life examples of this concept will be observed.
- Students will be able to identify what an invasive species is and how they effect ecosystems. Specifically, students will be able to identify invasive plants in the Letchworth State Park and determine their effect on the ecosystem.

New York State Living Environment Content Standard Alignment:

7.2a Human activities that degrade ecosystems result in a loss of diversity of the living and nonliving environment. For example, the influence of humans on other organisms occurs through land use and pollution. Land use decreases the space and resources

available to other species, and pollution changes the chemical composition of air, soil, and water.

7.2b When humans alter ecosystems either by adding or removing specific organisms, serious consequences may result. For example, planting large expanses of one crop reduces the biodiversity of the area.

Pre-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Pollution

Central Focus for the learning segment: Human activities sometimes alter the ecosystem in negative ways, mainly through pollution. These changes in the ecosystem change the sustainability of the land for resident organisms.

Content Standard(s): NYS CCLS or Content Standards

7.2a Human activities that degrade ecosystems result in a loss of diversity of the living and nonliving environment. For example, the influence of humans on other organisms occurs through land use and pollution. Land use decreases the space and resources available to other species, and pollution changes the chemical composition of air, soil, and water.

Learning Objectives:

- Students should be able to describe negative human interactions with the ecosystem and determine their impacts on the environment.

Instructional Resources and Materials to engage students in learning:

Computers, paper with polluted or not polluted written on it, <https://www3.epa.gov/carbon-footprint-calculator/>, lined paper

Instructional Strategies and Learning Tasks that support diverse student needs:

- Students will provide ideas to be listed on the board including prior ideas or knowledge of pollution (Engage).
- Students will go to an open area and be divided into three groups (producers, vegetarians, and carnivores). Pieces of paper will be on the ground, turned upside down, indicating whether there is pollution present in that area. First, the producers will stand on a piece of paper. Next, the herbivore and carnivores will link to the initial producer. Finally, the producer will look under his or her piece of paper and determine if all of the linked “family” is polluted or not. If the family stood on a pollution piece of paper, they are “killed” and the second round begins (Explore). (<http://www.discoveryeducation.com/teachers/free-lesson-plans/protecting-our-planet.cfm>)
- Students will come back to the classroom and discuss the event and how a single piece of pollution will effect an entire ecosystem with notes (Explain).
- Students will then go on the EPA website to determine their family’s carbon emissions (air pollution). From their data, the students will determine ways in which they could reduce their carbon emissions. The discussion of the student’s emissions and their ideas to reduce emissions will be used as a formative evaluation (Elaborate) (Contant, 2014).

Differentiation and planned universal supports:

The pollution activity is handicap assessable for all students with physical disabilities. Students with learning disabilities may write and turn in their final assessment piece electronically since they will already be using the computers for the previous activity. Spell check will help any students who need writing support.

Language demands and language supports:

Emissions, pollution, ecosystem, producer, herbivore, carnivore

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** Student discussions during the pollution activity and engage activity will be used as formative assessments.
- **Formal Assessment:** The final writing piece about how large a student's carbon emission footprint is and how they can reduce it will be used.

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

0:00-5:00 Engage

5:00-20:00 Explore pollution activity

20:00-30:00 Explain notes

30:00-45:00 EPA website/conclusion write-up

Human Impact on the Environment Notes

Pollution:

- ❖ Pollution is the _____ of something into the environment which has a _____ or poisonous affect.
- ❖ “Every year in the U.S. factories release over 3 million tons of toxic chemicals into the land, air, and water. This causes us to lose over 15 million acres of land every year.”

Air Pollution:

- Air pollution occurs when we introduce _____ or _____ into the _____ that harm us and all other life on Earth
- Some different types of air pollution include:
 - _____ Rain
 - Greenhouse _____
 - Smog
 - Ozone _____
- Smog is a combination of the words _____ and _____ because smog is literally a smoky fog that hangs in the air.
- Smog is created by the burning of _____, _____, which occurs in industrial plants, _____, and more.
- In areas where there is more _____ and cars we see _____ smog
- Smog can get into people’s _____ and cause damage just like smoking would, it blocks out _____ plants and organisms need to survive, and it causes changes in _____

Land Pollution:

- We pollute the land in many different ways:
 - Our _____ which creates landfills

- Industries dump _____ wastes
 - Agriculture poisons the soil with _____, fertilizers, and other chemicals
 - _____ kills helpless animals
- Consequences of land pollution are dire . . .
- Chemicals that pollute the land can lead to _____ problems, skin irritation, birth defects, and _____ in humans and animals
 - We are running out of space to store our garbage because it takes a very long time for certain materials to _____
 - Land pollution can run off into _____ and _____ which will run into the oceans and start destroying _____ ecosystems
 - We are losing _____ in any ecosystem where pollution is present

Water Pollution:

- Water pollution is any chemical, physical or biological change in the quality of water that has a harmful effect on any living thing that _____ or uses or _____ (in) it
- There are several different types of water pollutants:
- _____ causing agents such as bacteria, protozoa, viruses, and parasites
 - Oxygen-demanding _____
 - Nitrates or phosphates
 - Organic compounds such as _____ and _____
 - Suspended _____ which limits light from getting through the water
 - _____ compounds that can cause cancer

Source: <http://www.bcs1.org/webpages/kcappella/livingenvironment.cfm?subpage=17107>

Pre-Field Trip Lesson 2

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Invasive Species

Central Focus for the learning segment: The introduction of not native plants and animals to an ecosystem can change or alter the habitat for native species.

Content Standard(s): NYS CCLS or Content Standards
7.2b When humans alter ecosystems either by adding or removing specific organisms, serious consequences may result. For example, planting large expanses of one crop reduces the biodiversity of the area.

Learning Objectives:

- Students should be able to describe negative impacts of invasive plant and animal species on different environments.

Instructional Resources and Materials to engage students in learning:
Invasive species sheets, construction paper, sticky notes, guided notes

Instructional Strategies and Learning Tasks that support diverse student needs:

- Pictures of invasive species (plants and animals) will be on the board. Students will have to list similarities and differences to try and determine what all the species have in common (Engage).
- Students will obtain different fact sheets about invasive species. Students will read their fact sheet and write important information on a piece of construction paper. Once students are completed, they will rotate through each group's poster and write sticky notes about surprises or additional facts they may know (Explore). Students should be able to connect that all species are invasive or take over areas that they are not native to.
- Students will take guided notes to support their learning (Explain).
- Students will be assessed in a ticket out the door where they have to write the definition of an invasive species and provide an example of why they are detrimental to an ecosystem.

Differentiation and planned universal supports:

The notes are provided in skeleton form for students who struggle with reading or writing. Readings are provided in different levels for students at different reading levels.

Language demands and language supports:

Invasive species

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** Students working on the Think Group Share with Sticky Note activity. Teachers can monitor and correct any misconceptions they hear throughout.
- **Formal Assessment:** Teachers can assess student learning and any misconceptions or areas that need to be retaught.

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timesline

0:00-5:00 Picture Comparison

5:00-30:00 Think Group Share with Sticky Notes

30:00-40:00 Guided Notes

40:00-45:00 Ticket out the Door



Aquatic Invasive Species

Zebra mussel (*Dreissena polymorpha*)

What are zebra mussels?

Zebra mussels are small freshwater mussels that are not native to Minnesota. Adults range from ¼ to 1 ½ inches long and have yellow and brown striped shells. Unlike native mussels, they can attach themselves to hard surfaces in the water.



Zebra mussel
(*Dreissena polymorpha*)

Where did zebra mussels come from?

Zebra mussels are native to Eastern Europe and Western Russia. They have spread throughout much of Europe and Asia over the past 200 years. They were likely brought to North America in the ballast water of ships and were discovered in Lake Erie in 1988.

What problems can they cause?

Zebra mussels can:

- clog irrigation intakes and other pipes,
- attach to boat motors and boat hulls, reducing performance and efficiency,
- attach to rocks, swim rafts and ladders where swimmers can cut their feet on the mussel shells,
- attach to and smother native mussels, and
- eat tiny food particles that they filter out of the water, which can reduce available food for larval fish and other animals, and cause more aquatic vegetation to grow as a result of increased water clarity.

Zebra mussels in Minnesota

Zebra mussels were discovered in the Duluth harbor in 1989. As of 2014, the DNR had documented zebra mussels in fewer than 100 water bodies in Minnesota. The DNR has listed a total of 213 water bodies as "infested" with zebra mussels, a regulatory classification which includes some water bodies that are connected to water bodies where zebra mussels have been found.

How do they spread?

Zebra mussels can attach to boats or aquatic vegetation and be carried to a different lake or upstream in a river. The microscopic larvae (called "veligers") may be carried in bait buckets, live wells, or other water.



Zebra mussels attached to a native mussel

What should you do to prevent their spread?

Before you leave any water access, clean weeds and debris from your boat, remove drain plugs and keep them out while traveling, and dispose of unused bait in the trash. For additional recommendations see mndnr.gov/AIS.

Regulatory classification

Zebra mussels and quagga mussels (a related species) are both classified as *prohibited invasive species* in Minnesota. It is illegal to import, possess, buy, sell, transport, or introduce them into state waters.

Aquatic Invasive Species Best Management Practices

Zebra mussel (*Dreissena polymorpha*)

What can be done to control zebra mussels?

In the U.S. and Canada, facility managers use pesticides to control zebra mussels in closed systems, such as water-cooling systems of power plants, in order to maintain functioning infrastructure. Many of the pesticides used in closed systems are not allowed for use in open water. In open systems such as natural lakes, attempts to control zebra mussels are uncommon and considered experimental at this time.

To date, we have documentation of less than ten attempts to control zebra mussels by treatment with pesticides in North America outside Minnesota.

Attempts to control zebra mussels in Minnesota

In Minnesota, we have documentation of five lakes where people attempted to eradicate zebra mussels using pesticide treatments. In addition, one Minnesota lake was drawn down in an attempt to reduce zebra mussels.

Pesticides and zebra mussels

The pesticides that have been used for zebra mussel control in Minnesota are: Zequanox®; copper products such as copper sulfate; and potassium chloride (also known as potash; use in open water requires review and approval from the U.S. Environmental Protection Agency).

What might be achieved by controlling zebra mussels?

Because pesticides have rarely been used to control zebra mussels in open water, pilot projects in Minnesota will help answer this question. In situations where zebra mussels are found in an isolated area or in a small water body, it may be possible to kill all the target zebra mussels using pesticides. Even if the mussels are killed, their shells will persist and can remain attached to surfaces even after the animals are dead.

What control of zebra mussels will the DNR permit?

Most lakes that are currently infested with zebra mussels are not good candidates for these pilot projects and permits. Pilot projects would be more likely to be permitted in situations where:

- the water body has been surveyed, and the survey finds zebra mussel populations are limited in size and localized, not scattered throughout the water body (the DNR may require third-party verification of zebra mussel distribution); and
- there are sufficient resources or partners (e.g., watershed districts, local units of government, lake groups) available to fulfill monitoring requirements.

We will assess all proposed projects on a case-by-case basis.

Permits and technical assistance

If you would like more information on management of zebra mussels or other aquatic invasive species, contact your local invasive species specialist:

Park Rapids	218-699-7293
Fergus Falls	218-739-7576 ext. 254
Grand Rapids	218-999-7805
Brainerd	218-203-4354
Saint Cloud	320-223-7847
Saint Paul	651-259-5828
Hutchinson	320-234-2550 ext. 238
Waterville	507-362-8786

Minnesota Department of Natural Resources
500 Lafayette Road, Box 25
St. Paul, Minnesota 55155
1-888-646-6367 or 651-259-5121
www.mndnr.gov/AIS

Prepared by the Invasive Species Program,
Minnesota Department of Natural Resources
May 2015

SAVING YOUR HIGH-VALUE ASH

A simple guide for homeowners and municipalities with true ash (*Fraxinus*) trees

Piera Siegert, NH State Entomologist



Emerald ash borer adult
Photo credit: N.W. Siegert

The problem: Emerald ash borer is an introduced and destructive pest of all North American true ash (*Fraxinus*) such as white, green, and black/brown ash. Trees infested with emerald ash borer will die from the infestation within 3-5 years. Management strategies to slow the spread of ash mortality are effective at reducing *overall* emerald ash borer populations, but they may not save the ash tree in front of **your** house or in **your** park. Potential costs associated with emerald ash borer for municipalities and homeowners include:

- Costs to remove/replace/treat infested trees
- Loss of landscaping and community character
- Increased heating/cooling costs
- Reduction in property value
- Potential property damage/personal injury suits
- Increased power outages



Emerald ash borer killed tree in Concord, NH
Photo credit: P.Y. Siegert



Ash-lined neighborhood in Lebanon, NH.
Photo credit: P.Y. Siegert

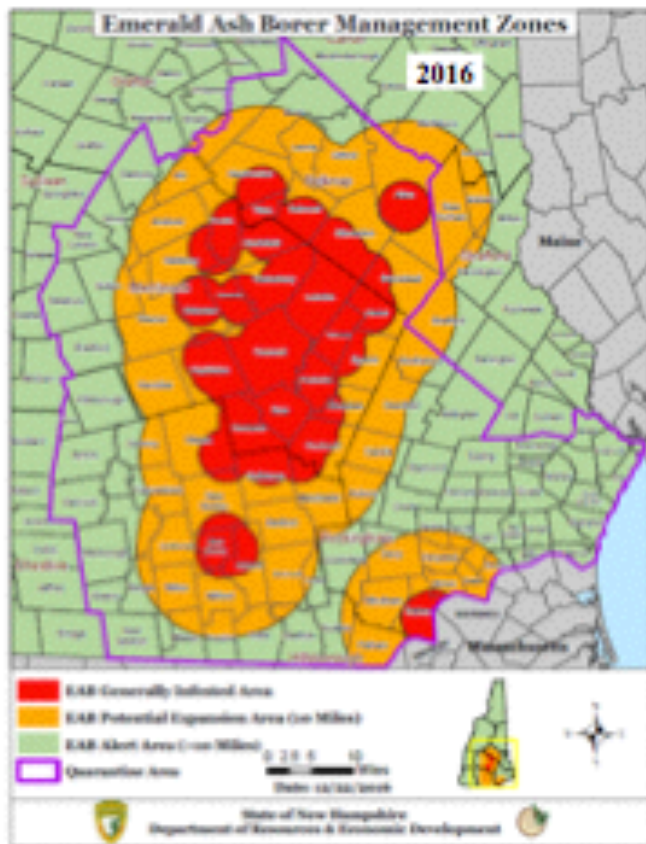
Although you cannot control the arrival of emerald ash borer on your property, you can decide what impact emerald ash borer will have by developing an emerald ash borer plan. This should be done regardless of proximity to known emerald ash borer populations. The first step is to stay informed about known emerald ash borer populations in the state (www.nhbugs.org). Next, determine if you have ash trees, what size they are, where they are located, and if they add value to your property or community. Use local foresters and arborists, on-line calculators (www.extension.entm.purdue.edu/treecomputer/ and other sites) or smart phone apps (ARBORJETP for iPhone and iPad and others) to estimate the costs associated with tree removal, replacement or treatment. Once you have determined your investment in ash and considered your budget, you can develop a plan for which trees will be removed, replaced or treated with insecticides when emerald ash borer arrives. Having a plan empowers you to make informed decisions about your property or community.

Don't let the beetle decide what to do with your trees!

More information about using insecticides for emerald ash borer on the reverse

WARNING: Insecticides are chemicals that can have health or environmental impacts. If you use insecticides always follow all label instructions or hire a licensed pesticide applicator.

Pollinator impact note: Some studies have linked imidacloprid to CCD, a world-wide decline in honeybee populations. The body of evidence is inconclusive, but potential impacts to pollinators should be considered when initiating an insecticide regime. For information on insecticides used for EAB see www.emeraldashborer.info/files/Potential_Side_Effects_of_EAB_Insecticides_FAQ.pdf.



Pesticides can be a useful tool for protecting valued ash trees. There are important considerations to keep in mind, however, when selecting an insecticide regime:

- Proximity to generally infested area—insecticide treatment is only recommended in the red and orange areas (see map left or visit www.nhbugs.org for the most current information)
- Size of tree—measure the diameter (in inches) at 4.5 feet above the ground with a calliper or tape measure to get Diameter at Breast Height (DBH)
- Health of tree—systemic insecticides are less effective in trees that are already in decline
- Proximity to socially or environmentally sensitive habitats (like school properties, wells, or wetland areas)
- Mode of application of insecticide
- Effectiveness of treatment
- Cost of treatment
- Frequency of treatment

Not all emerald ash borer-approved insecticides are equally effective, nor are they all appropriate in every circumstance. Choosing an ineffective treatment for your conditions may result in product failure and is not cost-effective. Less effective treatments may prolong the life of an ash tree early in the invasion process but as neighboring untreated ash trees start showing signs of decline, indicating increasing local emerald ash borer populations, a more effective pesticide treatment may be necessary. There are resources available to help you assess the management options and products that are right for you. The table below summarizes recommended chemicals available for use. Active ingredients are listed, not trade names. Most formulations are only available for use by a licensed pesticide applicator. For more detailed information about available insecticides, visit: www.emeraldashborer.info/files/Multistate_EAB_Insecticide_Fact_Sheet.pdf. More resources are also available through www.nhbugs.org and www.emeraldashborer.info, as well as by contacting an experienced certified arborist.

<i>See map above to determine your management zone.</i>		Ash is less than 18" DBH	Ash is greater than 18" DBH
Generally Infested	Ash appear healthy	Imidacloprid, dinotefuran, or emamectin benzoate	Emamectin benzoate
	Ash are in decline	Emamectin benzoate	
	Ash are dead or with greater than 50% crown dieback	Tree removal. Insecticides unlikely to be effective.	
Expansion management zone		Imidacloprid, dinotefuran, or emamectin benzoate	Emamectin benzoate
Alert management zone		Treatment not yet warranted. Develop a plan.	



Moneywort

Lysimachia nummularia L.



Description:

Herbaceous, creeping perennial, stems reaching 60 cm (1.3 ft). Forms dense low mats ranging from 5-10 cm (2- in) in height. Leaves opposite, rounded. Yellow flowers with five petals (occasionally six) that unite at their bases; arise singly in leaf axils. Often does not flower. Fruit a small capsule.

Habitat:

Grows in open wetlands, floodplain forest, wet meadows, and along lakes, ponds, rivers and streams.

Mode of spread:

Spreads vegetatively by stems, unknown mechanism for dispersing over longer distances; fragments may be dispersed by water.

Survey:

Blooms from June-August if it produces flowers; rounded leaves

Source: <http://mnfi.anr.msu.edu/invasive-species/AquaticsFieldGuide.pdf>

Pest Alert

FDACS-P-01678

Pest Alert created 09-February-2010

Florida Department of Agriculture and Consumer Services, Division of Plant Industry
Charles H. Bronson, Commissioner of Agriculture

Giant African Land Snail and Giant South American Snails: Field Recognition

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INTRODUCTION: Two agricultural pest snails, the giant African land snail (*Achatina fulica*) (Bowditch) (Fig. 1) and the giant South American snails (*Megalobulimus* spp. and relatives) (Fig. 2), are presently not established in Florida or the Continental US. These snails are of regulatory significance and are not allowed to be possessed or sold within Florida, even though both are popular as pets. Both of these large snails are known to feed on many varieties of plants, in some cases causing serious damage.

Any very large snail will draw attention and may be considered exotic and possibly invasive. Yet, there are native snails which are similar in appearance and occasionally reach large size (up to 3 inches in length). Immature snails or smaller specimens of these exotic snails can be easily confused with native species that are protected by state and federal laws.

The following information will assist in the field recognition of these pest snails, support state and federal regulatory efforts to prevent establishment of the snails in Florida, and help protect our native snails by preventing unnecessary collection and destruction.

IDENTIFICATION: There are many snails in Florida which can become very large. These species are mostly aquatic or marine snails and are not the subjects under consideration. For example: Florida has several species of apple snails (*Pomacea* spp.) (Fig. 3) some of which can be up to 4 inches in length, and are considered serious pests of our waterways (Anonymous 2010; FWC 2008; Stange 1986). They are readily distinguished by their more globose shape and the fact they are always found in or near aquatic situations.

The giant African and South American snails are terrestrial or land snails with more elongate, conical shells. Although they may be found near water, they cannot survive prolonged submersion in water.

Native Floridian Tree Snails (*Orthalicus* spp. (Fig. 4), *Liguus fasciatus* (Muller) (Fig. 5), and other genera). Adults up to 3 inches in length, most are less than 2 inches long. Shell elongate-oval, apex conical, shell usually ceramic-like. Columella of shell usually short, smooth, and lacking free curled edge (some *Liguus* specimens have a thickened edge), never truncate at apex. Coloration can be quite variable (Deisler 1983, Frank 2010), entirely pale, but usually with distinct bands and stripes.



Florida Department of Agriculture and Consumer Services
Adam H. Putnam, Commissioner

Source: <https://www.invasivespeciesinfo.gov/resources/identify.shtml#gen>

Invasive Species:

- You might think that releasing a new species into an area that was not its original habitat would increase the biodiversity, but it actually has the opposite affect.
- Invasive species have no natural _____ and will _____ on native organisms
- This disrupts the food _____, kills off the _____ species, and creates more _____
- One of the worst things about invasive species is the techniques we have tried to use to get rid of them
- The most effective way to control species populations is through _____, that uses chemical _____ to attract the organism
- We have also tried breeding and releasing _____, but that is not always successful

Source: <http://www.bcs1.org/webpages/kcappella/livingenvironment.cfm?subpage=17107>

Field Trip Activities




Leaf and Trash Removal

Please provide the types and amount of trash you pick up. After completing the trash pick up, you will compare what types of trash you picked up with a partner and determine the potential consequences of this pollution on the ecosystem.

Type of Trash	Number Picked Up	Potential Detrimental Effects

Invasive Species Record Sheet

Below are three invasive species found in Letchworth State Park. Identify the organisms or find your own by using your phones to identify other invasive species in the park. Describe the area you find the plant and dispose of the plant in the correct disposal area.

Species	Number Picked Up	Area Picked Up	Possible Detrimental Effects of Plants
 <p>Emerald Ash Borer</p>			
 <p>Giant Hogweed</p>			
 <p>Japanese Stiltgrass</p>			

Source: <http://silverlakeassociation-wny.org/wp-content/uploads/2016/07/Stop-the-Invasion.pdf>

Post-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Debate

Central Focus for the learning segment: Students will be debating what is worse for an ecosystem, pollution or invasive species.

Content Standard(s): NYS CCLS or Content Standards

7.2a Human activities that degrade ecosystems result in a loss of diversity of the living and nonliving environment. For example, the influence of humans on other organisms occurs through land use and pollution. Land use decreases the space and resources available to other species, and pollution changes the chemical composition of air, soil, and water.

7.2b When humans alter ecosystems either by adding or removing specific organisms, serious consequences may result. For example, planting large expanses of one crop reduces the biodiversity of the area.

Learning Objectives:

- Students will be able to identify the repercussions of both pollution and invasive species.
- Students will be able to use higher level reasoning to compare and contrast the effects of pollution and invasive species and determine which is more detrimental to an ecosystem

Instructional Resources and Materials to engage students in learning:

Guided notes from the pre-field trip lessons and the data collection sheets that were completed on the field trip.

Instructional Strategies and Learning Tasks that support diverse student needs:

- Students will begin by discussing their results of pollutants and invasive species found while on the field trip to Letchworth State Park
- Students will then split into two groups and be assigned invasive species or pollutants. The two groups will build a case, with reasoning, which variables is worse for an environment (Elaborate).
- The two groups will hold a debate with the teacher as moderator to determine if one variable is worse than another for an ecosystem (Evaluate).

Differentiation and planned universal supports:

Students will be divided into two groups. Each group will contain varying level of abilities so that all students are able to support the group using their various strengths.

Language demands and language supports:

Invasive species, pollutants

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** The teacher will observe students working in groups to determine which variable, pollutants or invasive species is more detrimental to an ecosystem.
- **Formal Assessment:** The debate which is held between students will be used as a formal assessment. A participation grade may be given in addition to knowing exactly what information students know and how they use it in context.

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

0:00-5:00 Field Trip Overview

5:00-25:00 Building an Argument

25:00-45:00 Debate

Field Trip 7: Maple Moon Farms, LLC

Location:

1058 Attica-Gulf Rd
Attica, NY 14011

Cost/Requirements:

- No cost requirements for students or faculty
- Participants will have opportunities to taste or buy maple products from the vender
- Food allergies should be taken into consideration prior to the arrival at this location

Field Trip Description:

- Students are met inside the farm shop and offered free samples while initial questions are answered regarding products or the operation
- Students will then load on a wagon for a 30 minute tour to the sugar house; located approximately 0.5 miles back in woods
- At the sugar house, the history of Maple Moon Farm's operation is explained. As students walk inside, staff will explain the operation of equipment such as the vacuum and Reverse Osmosis (RO) process. Samples are given to students of raw sap and sap that has only been run through RO
- Next, students will advance to the arch and be explained the process of evaporation. The arch will be opened for students to see the fire box and flues. Occasionally, students will have the opportunity to taste fresh maple syrup right off the arch before it is stored in drums
- Final questions are answered and typically the next round of students are waiting for a tour

Objectives:

- Students will be able to identify the processes of osmosis and what occurs during each process
- Students will be able to identify where the processes of diffusion and osmosis are used to create materials for everyday life

New York State Living Environment Content Standard Alignment:

- 1.2g Each cell is covered by a membrane that performs a number of important functions for the cell. These include: separation from its outside environment, controlling which molecules enter and leave the cell, and recognition of chemical signals. The processes of diffusion and active transport are important in the movement of materials in and out of cells.

Pre-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Osmosis

Central Focus for the learning segment: Students will visually and linguistically learn about osmosis and diffusion.

Content Standard(s): NYS CCLS or Content Standards

- 1.2g Each cell is covered by a membrane that performs a number of important functions for the cell. These include: separation from its outside environment, controlling which molecules enter and leave the cell, and recognition of chemical signals. The processes of diffusion and active transport are important in the movement of materials in and out of cells.

Learning Objectives:

- Students will be able to identify osmosis as a type of diffusion
- Students will be able to identify that water in osmosis goes from high to low concentration

Instructional Resources and Materials to engage students in learning: eggs, liquid egg whites, water, vinegar, maple syrup, cups, triple beam balance, string, ruler, guided notes, lab handout, YouTube video (<https://www.youtube.com/watch?v=Ptmlvtei8hw>)

Instructional Strategies and Learning Tasks that support diverse student needs:

- At the end of the previous days lesson, students will place three eggs in vinegar. By the next day, the egg shell will be removed and just the membrane will be present. Students will be able to observe and touch their eggs while responding to the question, what do membranes do for cells? (Engage).
- Next, students will complete the shell-less egg lab. Students will explore what occurs to the egg when it is placed into different solutions (Explore).
- Students will be given notes and watch videos which explain osmosis (Explain).
- Students will then write a conclusion, referencing data collected in the lab, on what occurred to each egg in the lab experiment (Evaluation) (Contant, 2014).

Differentiation and planned universal supports:

Students who have physical disabilities may work in a group to help facilitate the activities in the lab. Notes are guided so students who struggle with writing are assisted. All three learning methods are included: visual, kinesthetic, and auditory.

Language demands and language supports:

Diffusion, active transport, osmosis, cell membrane

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** Listening to student conversations throughout the laboratory will allow the teacher to determine student knowledge and understanding throughout the process.
- **Formal Assessment:** The conclusions about what occurred to each egg in the laboratory experiment will be the formal assessment for this lesson. Students should be able to identify the correct term of diffusion or osmosis as occurring in each of the egg scenarios in the lab.

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

Day 1:

0:00-5:00 Engage in the egg membrane

5:00-45:00 Engage in Day 1 of lab

Day 2:

0:00-25:00 Engage in Day 2 of lab

25:00-40:00 Notes/Videos

40:00-45:00 Conclusion

Cell Diffusion

Name: _____

What will happen to eggs (cells) that are separately placed in syrup, distilled water, and liquid egg whites?

If I place an egg in syrup, then _____, because
_____.

If I place an egg in distilled water, then _____, because
_____.

If I place an egg in liquid egg whites, then _____, because
_____.

Day 1 – Initial Observations and Set Up

1. Take the three cups and label them “syrup”, “distilled water”, and “liquid egg whites”, respectively.
2. Take the three eggs with shells dissolved by vinegar, and place an egg in each cup.
3. Measure circumference (in centimeters) of the “syrup” egg. Record in the data table.
*For circumference, wrap a piece of string around the width of the egg until both ends meet. Then straighten the string and align against a ruler to record the circumference.
4. Measure mass (in grams) of the “syrup” egg. Record in the data table.
5. Measure circumference (in centimeters) of the “distilled water” egg. Record in the data table.
6. Measure mass (in grams) of the “distilled water” egg. Record in the data table.
7. Measure circumference (in centimeters) of the “liquid egg whites” egg. Record in the data table.
8. Measure mass (in grams) of the “liquid egg whites” egg. Record in the data table. 9. Gently place each egg back into their proper cups.
10. Cover the “corn syrup” egg with corn syrup, completely filling it. If the egg floats in the corn syrup, add a small amount of corn syrup into a plastic sandwich bag and place over egg to add weight on top of it.
11. Cover the other two eggs with their respective solution.
12. Let the eggs soak in their cups overnight.

Day 2 – Final Observations and Clean Up

1. Gently remove each egg from their respective beaker. Gently rinse the eggs that were in the corn syrup and liquid egg whites under running water.
2. Gently dry all three eggs by blotting with a paper towel.
3. Measure the circumference in centimeters and mass in grams for each egg just as you did previously. Record in the data table.
4. Calculate in the data table the CHANGE in circumference and mass for each egg. Record in the data table.

$$\text{CHANGE} = \text{Final Circumference} - \text{Initial Circumference AND}$$

$$\text{CHANGE} = \text{Final Mass} - \text{Initial Mass}$$

Note: Be sure to include a (+) sign if it is a positive change or a (-) sign if it is a negative change.

5. Calculate the PERCENT CHANGE in circumference and mass for each egg using the formula below. Record in the data table.

$$\text{Percent Change} = \frac{\text{Final circumference} - \text{Initial circumference}}{\text{Initial circumference}} \times 100$$

AND

$$\text{Percent Change} = \frac{\text{Final Mass} - \text{Initial Mass}}{\text{Initial Mass}} \times 100$$

		Initial Measurement	Final Measurement	Change (cm/g)	Percent Change (%)
Egg 1: Corn Syrup	Circumference (cm)				
	Mass (g)				
Egg 2: Distilled Water	Circumference (cm)				
	Mass (g)				
Egg 3: Liquid Egg Whites	Circumference (cm)				
	Mass (g)				

Source: <https://web.stanford.edu/group/lpchs/science/cgi-bin/wordpress/images/Cell-Diffusion-and-Permeability-T.pdf>

Diffusion and Osmosis Student Guided Notes

Importance of Water

Why is water so important?

1. All the **chemical reactions** in living things take place in water _____.
2. Organisms use water to **transport materials** through their bodies.
 - Plants use water to _____ minerals and sugars between roots and leaves.
3. The large percentage of water in living things **acts like an** _____.
4. The **water in a cell helps keep its temperature** _____, which allows life-sustaining chemical reactions to take place.

Cell Membrane

Cells take in food, and oxygen, from their environment and release waste material.

- A cell has a membrane around it that works like a window screen.

A cell's membrane is _____.

-Allows some things to enter or **leave** the cell while **keeping** other things _____ or _____ the cell.

-Cell membranes will allow _____ molecules like O₂, H₂O and, CO₂, to pass through.

-Cell membranes _____ allow larger molecules like Sucrose, and Starch. to pass through.

Passive Transport

How things move through a cell membrane depends on:

- The size of the particles.
 - The path taken through the membrane.
 - Whether or not energy is used.
- The _____ of substances through the cell membrane **without** the input of energy is called _____ **transport**.

Two Types of Passive Transport

1. _____
2. Osmosis
3. _____

1. Diffusion

Molecules in solids, liquids, and gases move constantly.

• This random movement of molecules from one area, where there are more of them **into** another area, where there are fewer of them is called _____

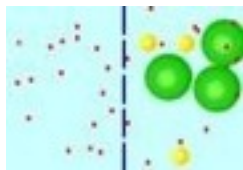
• Example: Food Coloring and Water

Equilibrium

• Molecules of a substance will continue to move from area into another until the number of these molecules is _____ in the two areas.

• When this occurs, **equilibrium** is reached and diffusion stops.

2. Osmosis



Water molecules **move by diffusion** _____ and _____ of cells.

Osmosis is the **passage of water** from a region of high water concentration _____ **a semi-permeable membrane** to a region of low water concentration.

• If the area surrounding the cell has a lower concentration of water molecules than inside the cell, the cell will **lose** water by _____.

•If the area surrounding the cell has a higher concentration of water molecules than inside the cell, the cell will **gain** water by _____.

Example: Carrots

Why do carrots in salt water become limp?

•When there is a **lower** concentration of water molecules surrounding the carrot cells, water is lost from inside the cells. The cell membrane comes away from its

_____.

•The loss of water reduces pressure against the cell wall, and carrot cell becomes

_____.

Why do carrots stay crisp in pure water?

•When there is a **higher** concentration of water surrounding the carrot cells than inside the cell, water moves into the cells.

•The cells would _____ with water.

•Their cell membranes press against their cell walls.

•Pressure _____ and the cells become firm.

Re-Cap

Diffusion is the movement of molecules from one area where there is more of them **into** another area where there is fewer of them.

Osmosis is the **passage of water** from a region of high water concentration **through a semi-permeable membrane** to a region of low water concentration.

Source: www.boone.k12.ky.us/.../Diffusion%20and%20Osmosis%20Student%20Guided%20

Field Trip Activity

Field Trip Data

Name: _____

Please complete the following graphic organizer while attending the field trip to Maple Moon Farms, LLC. The information collected here will be essential for the next class period!

	Raw Sap	Sap Run Through Reverse Osmosis (RO) Only	Sap Run Through RO and Evaporated
Color			
Thickness			
Taste			
Additional Details			

Post-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Osmosis/Diffusion Real World Applications and Discussion

Central Focus for the learning segment: Students will participate in research to determine areas of life where diffusion or osmosis occur, other than in the maple syrup making process.

Content Standard(s): NYS CCLS or Content Standards

- 1.2g Each cell is covered by a membrane that performs a number of important functions for the cell. These include: separation from its outside environment, controlling which molecules enter and leave the cell, and recognition of chemical signals. The processes of diffusion and active transport are important in the movement of materials in and out of cells.

Learning Objectives:

- Students will be able to apply their knowledge of diffusion and osmosis to real world scenarios which contain such processes
- Students will upload to VoiceThread and be able to explain the information they collected to peers
- Students will peer review each other's materials

Instructional Resources and Materials to engage students in learning:
Computer, internet access, VoiceThread application, PowerPoint

Instructional Strategies and Learning Tasks that support diverse student needs:

- Students will identify an area where osmosis, diffusion, or reverse osmosis occur to create a product or are necessary for the process of an item (Elaborate).
- Students will present this information to the class electronically through the VoiceThread application. Students will upload a PowerPoint including relevant information and a voice over for each slide. Students will have to comment on their peers' VoiceThreads on the information they provided (Evaluate) (Contant, 2014).

Differentiation and planned universal supports:

Students will be able to record their information on a computer interface so that spelling and grammar check are available for students who struggle with writing. The voiceover option will also help this group of students. Research articles may be used with any reading level to help students with reading difficulties.

Language demands and language supports:

Diffusion, active transport, osmosis, cell membrane

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** Teacher observation of students throughout the research process.
- **Formal Assessment:** Evaluation of student VoiceThreads and their peer evaluations.

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

Day 1

0:00-45:00 Preparation of Research

Day 2

0:00-30:00 Creation and upload of VoiceThread

30:00-45:00 Commenting on Peer's Uploads

Real World Examples

Name: _____

Other than maple syrup production, diffusion and osmosis occur in the production of many products we use in our daily lives. Research one product whose production uses diffusion or osmosis and answer the following questions.

1. What is the name of the product whose production uses diffusion or osmosis?
2. In what way is diffusion used in the production of this product?
3. What material(s) are diffusing? Describe the concentration differences.
4. What would the implications be if diffusion or osmosis was removed from the production of this product?

Once all four questions have been answered, you will create a powerpoint describing an outline of your responses from questions 1-4 above. The powerpoint must be detailed and creative including the following points:

- The answers to questions 1-4 above
- At least 1 picture on every slide
- A title and reference slide
- Bullet points rather than complete sentences

You will upload this Powerpoint to VoiceThread where you will create a voice-over to read and explain the PowerPoint. Additional directions for uploading and adding voice-overs will be provided.

Once your PowerPoint is uploaded, you must comment on two peers uploaded presentations. Your comments may include surprise facts, additional information, or critiques which are necessary for the validity of the presentation.

Field Trip 8: Silver Lake State Park

Location:

4229 West Lake Rd
Castile, New York 14427

Cost/Requirements:

- A \$6.00 vehicle entry fee will be charged to every vehicle entering the park

Field Trip Description:

- Students will be released from the bus to begin partaking in their research. Students will be given one hour to collect data and gather information pertaining to their research question.
- Students will be bringing their own lunches to eat. Picnic tables are available for use at the state park.
- After lunch, students will continue and complete collecting their data. Analysis and conclusions can be made back in the classroom setting.

Objectives:

- Students will partake in their own research study, using data and information collected from Silver Lake State Park.

New York State Living Environment Content Standard Alignment:

- 1.1a Scientific explanations are built by combining evidence that can be observed with what people already know about the world.
- 1.2a Inquiry involves asking questions and locating, interpreting, and processing information from a variety of sources.
- 2.2a Development of a research plan involves researching background information and understanding the major concepts in the area being investigated. Recommendations for methodologies, use of technologies, proper equipment, and safety precautions should also be included.
- 2.3a Hypotheses are predictions based upon both research and observation.
- 3.1a Interpretation of data leads to development of additional hypotheses, the formulation of generalizations, or explanations of natural phenomena.

Pre-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Research Basics

Central Focus for the learning segment: Students will learn how research studies are set up and initiated.

Content Standard(s): NYS CCLS or Content Standards

- 1.1a Scientific explanations are built by combining evidence that can be observed with what people already know about the world.
- 1.2a Inquiry involves asking questions and locating, interpreting, and processing information from a variety of sources.
- 2.2a Development of a research plan involves researching background information and understanding the major concepts in the area being investigated. Recommendations for methodologies, use of technologies, proper equipment, and safety precautions should also be included.
- 2.3a Hypotheses are predictions based upon both research and observation.
- 3.1a Interpretation of data leads to development of additional hypotheses, the formulation of generalizations, or explanations of natural phenomena.

Learning Objectives:

- Students will be able to list the steps and explain each in the process of research

Instructional Resources and Materials to engage students in learning:
Research image, Spongebob activity worksheet, Guided Notes

Instructional Strategies and Learning Tasks that support diverse student needs:

- Students will be shown the spontaneous generation image from their notes. Students will discuss what is being researched and possible outcomes/results as well as errors (Engage).
- Students will complete the Spongebob practice task. Many students have background or can write experiments without realizing the steps they are producing. This worksheet will show students how much they already know (Explore).
- Students will take notes to understand the different aspects of research (Explain).
- Students will go back and correct, label the different steps of their Spongebob design (Evaluate) (Contant, 2014).

Differentiation and planned universal supports:

Notes are guided to help students who struggle with reading and writing.

Language demands and language supports:

Independent/Dependent/Control variable, hypothesis, conclusion

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** Student discussions and Spongebob activity will be observed for initial understanding and possible misconceptions.
- **Formal Assessment:** The corrected Spongebob design will be used to determine how much students learned throughout the lesson.

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

0:00-5:00 Explore research image

5:00-25:00 Spongebob Experiment

25:00-40:00 Guided Notes

40:00-45:00 Correct/ label initial experiment

Scientific Method Bikini Bottom Experiments

Name _____

The Bikini Bottom gang loves science class and wanted to do a little research. Read the description for each experiment and use your knowledge of the scientific method to answer the questions.

(1) Flower Power

SpongeBob loves to garden and wants to grow lots of pink flowers for his pal Sandy. He bought a special Flower Power fertilizer to see if will help plants produce more flowers. He plants two plants of the same size in separate containers with the same amount of potting soil. He places one plant in a sunny window and waters it every day with fertilized water. He places the other plant on a shelf in a closet and waters it with plain water every other day.

What did SpongeBob do wrong in this experiment? Explain.

What should SpongeBob do to test the effectiveness of Flower Power fertilizer? Write an experiment.

Source: <http://sciencespot.net/Media/scimthdexps.pdf>

The Science of Biology

- Biology – the study of life. It is the science that seeks to understand the living world. The goal of science is to investigate and understand the natural world, to explain events in the natural world, and to use those explanations to make useful predictions. Science is an organized way of using evidence to learn about the natural world. Observation is the process of gathering information about events or processes in a careful, orderly way.
- Data is the information gathered from observations.
- An inference is a logical interpretation based on prior knowledge or experience.
- A hypothesis is a proposed scientific explanation for a set of observations. A hypothesis must be in the form of a statement, not in the form of a question.

Whenever possible, a hypothesis should be tested by an experiment in which only one variable is changed at a time. All other variables should be kept unchanged, or controlled.

- Dependent Variable - Variable dependent on the changing of another
- Independent Variable - What the scientist changes to see effects of
- Control Variable - Variables which remain the same to ensure they have no influence over the results

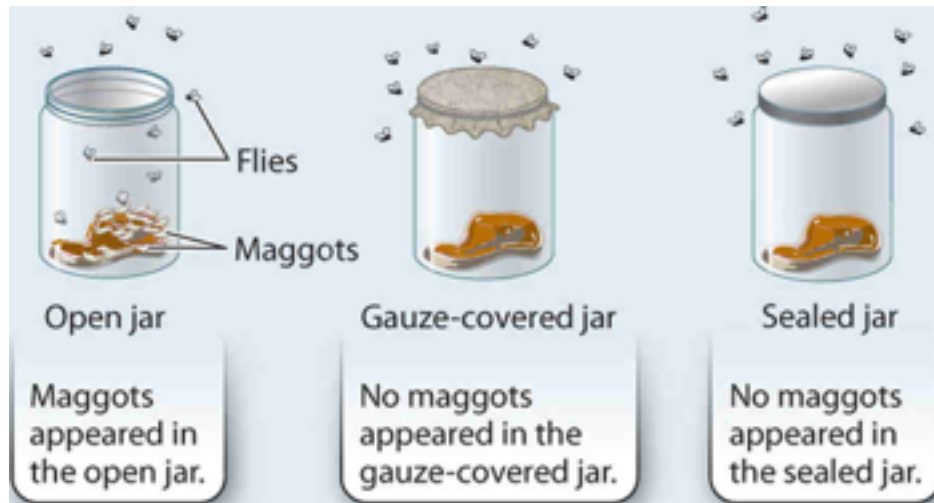
Designing an Experiment

1. Identify the problem to be solved by asking a question
2. Form a hypothesis (educated guess) – must be in the form of a statement
3. Set up a controlled experiment – the independent variable is the one that is manipulated or changed; the dependent variable is what we observe changing in response to the manipulated variable
4. Record and analyze results – collect observations and data
5. Draw a conclusion – use data to evaluate the hypothesis and make a conclusion

Repeating Investigations

It is necessary to repeat experiments/investigations to show the results are the same each time and ensure the results are reliable. Experiments should have a large sample size to increase precision.

Example: Redi's experiment on spontaneous generation (life from nonliving). In 1668, Francesco Redi challenged the idea of spontaneous generation using jars with meat (uncovered, covered, and with a gauze covering). It showed that maggots appeared on the meat when uncovered but not on meat when covered.



In the 1700s, John Needham challenged Redi's work, claiming spontaneous generation could occur under the right conditions. He boiled gravy to kill microorganisms but days later the gravy was filled with microorganisms. Lazzaro Spallanzani read about both experiments and showed microorganisms will not grow in boiled gravy when the flask is sealed but will grow when the flask is open. Many scientists argued his experiment was unfair because no air = no life.

Source: <http://msgrfarrellhs.org/ourpages/auto/2009/6/9/51337912/Living%20Environment%20Notes.pdf>

Pre-Field Trip Lesson 2

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Research Set-Up

Central Focus for the learning segment: Students will design their own research study to be performed on the field trip.

Content Standard(s): NYS CCLS or Content Standards

- 1.1a Scientific explanations are built by combining evidence that can be observed with what people already know about the world.
- 1.2a Inquiry involves asking questions and locating, interpreting, and processing information from a variety of sources.
- 2.2a Development of a research plan involves researching background information and understanding the major concepts in the area being investigated. Recommendations for methodologies, use of technologies, proper equipment, and safety precautions should also be included.
- 2.3a Hypotheses are predictions based upon both research and observation.
- 3.1a Interpretation of data leads to development of additional hypotheses, the formulation of generalizations, or explanations of natural phenomena.

Learning Objectives:

- Students will set up their own research experiment to perform on the field trip to Silver Lake State Park. Students will use the steps learned in the previous lesson to set up their research experiment.

Instructional Resources and Materials to engage students in learning:
Research rubric

Instructional Strategies and Learning Tasks that support diverse student needs:

- Students will use their prior knowledge of research design to create their own research experiment to perform at Silver Lake State Park. A rubric will be provided to students for what they need to include for their pre, during, and post field trip lessons. Students will be reminded of ethical considerations as well as be informed of possible activities to initiate their creativity in designing their research experiment (Elaborate-Planning) (Contant, 2014).

Differentiation and planned universal supports:

Students will be paired and will be able to choose their own research topics; students should be interested in their topics. The rubric is present so students are able to check their own work for possible errors or missing components.

Language demands and language supports:

Independent/Dependent/Control variable, hypothesis, conclusion

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** Student observations and assistance from the teacher will be used as informal assessments. If many students are unable to perform one section, brief reteaching or reminders may be necessary.
- **Formal Assessment:** N/A

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

0:00-45:00 Design Research Experiment

Field Trip Activities

List of Areas at Silver Lake State Park

- Water
 - Fishing
 - Bait, size, behavior, type
 - Kayaking
 - Speed, power, rowing
 - Beach Organisms
 - Trees/Plants

		Points Possible	Points Received
Pre Field Trip	Name/Lab Title	2	
	Statement of Problem/Purpose of Lab	1	
	Hypothesis	1	
	List of Variables (independent, dependent, control)	3	
	Materials List	2	
	Procedures (be specific)	2	
	Data Table Set Up	2	
On Field Trip	Perform Procedures		
	Fill Data Table		
	Record Observations/Take Pictures		
Post Field Trip	Graphs (if applicable)	2	
	Calculation Formula Included	1	
	Calculation Accurate	1	
	Units Labeled Appropriately	1	
	Error Analysis	1	
	Conclusion (stating purpose, results and possible errors)	3	
Considerations	Correct Spelling, Capitalization and Punctuation	2	
	Typed or Written in Pen, Graphs Created with Rulers	2	
Total:		22	

Post-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Research Conclusions

Central Focus for the learning segment: Students will analyze data and make conclusions about the research they performed at Silver Lake State Park.

Content Standard(s): NYS CCLS or Content Standards

- 1.1a Scientific explanations are built by combining evidence that can be observed with what people already know about the world.
- 1.2a Inquiry involves asking questions and locating, interpreting, and processing information from a variety of sources.
- 2.2a Development of a research plan involves researching background information and understanding the major concepts in the area being investigated. Recommendations for methodologies, use of technologies, proper equipment, and safety precautions should also be included.
- 2.3a Hypotheses are predictions based upon both research and observation.
- 3.1a Interpretation of data leads to development of additional hypotheses, the formulation of generalizations, or explanations of natural phenomena.

Learning Objectives:

- Students will use the data they collected on the field trip to analyze and make conclusions regarding their initial research question and hypothesis.
- Students will complete a research report (typed or written in pen) using the rubric they were given during pre-field trip lesson 2.

Instructional Resources and Materials to engage students in learning:
Research rubric, calculators, computers or pens

Instructional Strategies and Learning Tasks that support diverse student needs:

- Students will use the rubric and data collected on the field trip to analyze and make conclusions regarding their initial research question and hypothesis. Students will then use the rubric to complete a lab report. All sections of the rubric should be completed (other than possible graphs). The report must be typed or written in ink (Evaluate) (Contant, 2014)

Differentiation and planned universal supports:

Students may use a word processing program with spelling and grammar check to help students with writing or reading difficulties. Teacher assistance is available to all students throughout for clarification of the rubric or analysis of data.

Language demands and language supports:

Independent/Dependent/Control variable, hypothesis, conclusion

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** Student observations and assistance from the teacher will be used as informal assessments.
- **Formal Assessment:** Research Report

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

0:00-45:00 Create Research Report

Field Trip 9: Tonawanda Creek

Location:

Various entrances throughout Genesee and Wyoming Counties

Cost/Requirements:

- No cost or requirements

Field Trip Description:

- Students will compare underwater plant species photosynthesis with land plant species. Students will need to enter shallow places of the creek to obtain water plant samples, so water proof shoes or sandals need to be worn.

Objectives:

- Students will be able to describe the process of photosynthesis and identify that the process occurs in plants and some single celled organisms.
- Students will be able to identify chloroplasts as being the organelle where the photosynthesis process occurs.
- Students will be able to measure the amount of photosynthesis occurring in water and land based plant species

New York State Living Environment Content Standard Alignment:

- 5.1b Plant cells and some one-celled organisms contain chloroplasts, the site of photosynthesis. The process of photosynthesis uses solar energy to combine the inorganic molecules carbon dioxide and water into energy-rich organic compounds (e.g., glucose) and release oxygen to the environment.

Pre-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Chloroplast Introduction

Central Focus for the learning segment: Students will learn the process of photosynthesis.

Content Standard(s): NYS CCLS or Content Standards

- 5.1b Plant cells and some one-celled organisms contain chloroplasts, the site of photosynthesis. The process of photosynthesis uses solar energy to combine the inorganic molecules carbon dioxide and water into energy-rich organic compounds (e.g., glucose) and release oxygen to the environment.

Learning Objectives:

- Students will be able to describe the process of photosynthesis and identify that the process occurs in plants and some single celled organisms.
- Students will be able to identify chloroplasts as being the organelle where the photosynthesis process occurs.

Instructional Resources and Materials to engage students in learning:
Styrofoam pieces, saran-wrap, computer, internet, web-quest worksheet, guided notes handout, bromothymol blue, exit ticket

Instructional Strategies and Learning Tasks that support diverse student needs:

- Students will begin class by looking at circular styrofoam pieces connected in stacks by saran-wrap. Students will brainstorm what these could represent in a cell (Engage)
- Students will complete a web-quest to determine details about photosynthesis (Explore)
- Students will complete notes about photosynthesis (Explain)
- The teacher will demonstrate to students that blowing into bromothymol blue will change the color from blue to yellow. Students will identify that carbon dioxide is being blown from the mouth to change the color and be able to practice this concept (Explore 2)
- Students will be assessed on the information learned in the two day lesson by completing an exit ticket (Evaluation) (Contant, 2014).

Differentiation and planned universal supports:

Notes are guided to help students who struggle with reading and writing. The webquest is done on a computer so students may translate or have transcript services to assist in the comprehension of the activity.

Language demands and language supports:

Photosynthesis, ATP, NADPH, chloroplast, water, carbon dioxide

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** The webquest will be used to determine student progress throughout the lesson.
- **Formal Assessment:** The exit ticket will be used to formally assess student learning.

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

Day 1

0:00-5:00 Styrofoam Hypotheses

5:00-35:00 Photosynthesis Webquest

35:00-45:00 Notes

Day 2

0:00-20:00 Finish Notes

20:00-35:00 Bromothymol Blue explanation and experimentation

35:00-45:00 Assessment

Photosynthesis Webquest

Name: _____

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

1. What does a plant need to survive and grow?
2. What does an animal need to survive and grow?
3. How do animals and plants depend on each other?

Gizmo Warm-up: The Cell Energy Cycle Gizmo™ illustrates two processes that are essential to life: photosynthesis and cellular respiration.

Although both of these reactions involve a series of complex steps, the basic reactants and products in each process are four relatively simple molecules.

1. What is the chemical formula of oxygen?
2. Glucose is a simple sugar. What is the chemical formula of glucose?
3. What is the chemical formula of carbon dioxide?
4. What is the chemical formula of water?

Introduction: Photosynthesis occurs in the chloroplast, an organelle found in plant and algae cells. Within the chloroplast, a green pigment called chlorophyll converts the radiant energy of sunlight into chemical energy that the plant can use.

Question: What are the reactants and products of photosynthesis?

1. Predict: Of the molecules shown on the CHEMICALS pane, which do you think are reactants (ingredients) in photosynthesis? Which do you think are products?

Reactants: _____ Products: _____

2. Explore: Drag each molecule from the CHEMICALS pane to the chloroplast on the PHOTOSYNTHESIS pane. If a molecule is a reactant, it will stay in the chloroplast. Which molecules are reactants in photosynthesis?

3. Observe: Click Add light and look at the Output. What are the products of photosynthesis?

4. Summarize: A chemical equation shows reactants on the left side of an arrow, and products on the right, like this: reactant + reactant \rightarrow product + product.

Based on your observations, what is the chemical equation for photosynthesis?

Turn on Show chemical equation to check. Were you correct? Check answers

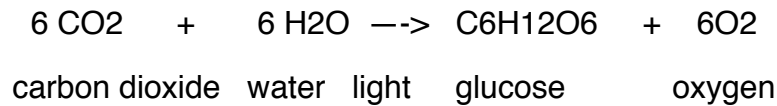
5. Challenge: A chemical equation is balanced when each side of the equation includes the same number of each type of atom.

A. Is the equation balanced as written? Why or why not?

B. If you are familiar with balancing equations, balance the photosynthesis equation. Write the balanced equation below, and then check your work by clicking Balance.

Source: <http://www.cabarrus.k12.nc.us/cms/lib09/NC01910456/Centricity/Domain/3785/Gizmo%20Cell%20Energy%20Cycle%20worksheet%20Answer%20Key.pdf>

Photosynthesis: Process by which light energy is captured and stored as chemical energy in the form of carbohydrates (sugars).



Photosynthesis takes place in two sets of reactions:

1. Energy capturing step
2. Food making step

Where?: Takes place in chloroplasts, pigment containing organelles found in leaves

Thylakoids- membranes arranged as flattened sacs

Grana- stacks of thylakoids

Stroma- solution-filled space between grana stacks

Thylakoid space- space inside thylakoid sacs

Thylakoids contain pigments (compounds that absorb light)

Light is either absorbed, transmitted, or reflected.

The color you see is the wavelength that is reflected.

The color you don't see is the wavelength absorbed.

Pigments important to photosynthesis:

Chlorophyll a- absorbs red wavelength, reflects green

Chlorophyll b- absorbs blue wavelength, reflects green

(funnels blue light energy to chlorophyll a)

Carotenoids- absorbs green wavelength, reflects brown & orange

(funnels this energy to chlorophyll a)

Chlorophyll a is the only pigment directly involved in photosynthesis. The other pigments are accessory pigments, which allow the chloroplast to absorb a broader spectrum of light energy.

Stomata: openings (pores) in the bottom of the leaf through which carbon dioxide enters and water and oxygen exit

Photosynthesis takes place in two sets of reactions:

1. Light dependent reactions: Energy capturing step which takes place in thylakoids.
 - Capture the sun's energy and convert it into chemical forms usable by the cell:
 - ATP- stores energy in its phosphate bonds
 - NADPH- molecule carrying high energy electrons which will be used at another location

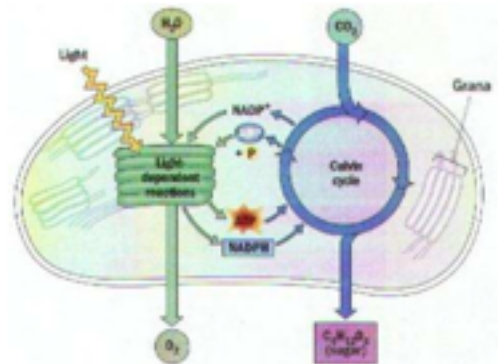
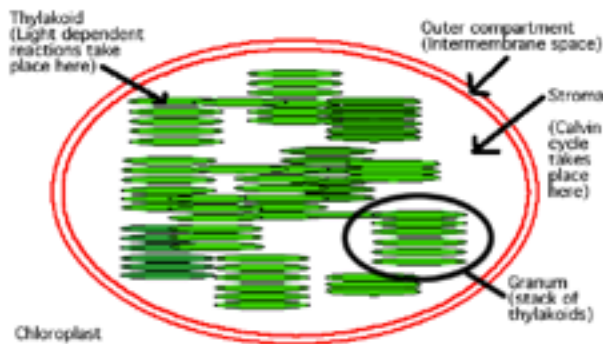


- Uses H₂O and releases O₂ as a by-product

2. Light independent reactions: Food making step which takes place in stroma.

The light independent reactions are known as the Calvin Cycle.

Uses the energy captured by the light dependent reactions to produce carbohydrates (sugar) from CO₂



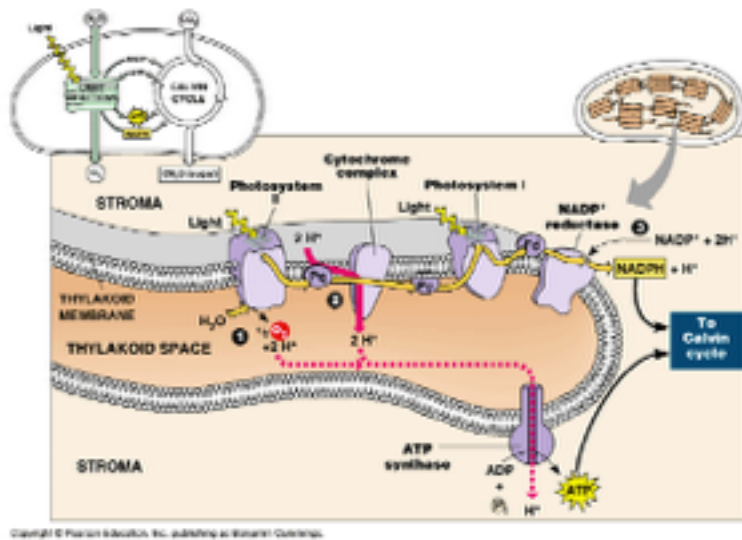
Light Dependent Reactions:

Light energy captured as chemical energy of NADPH and ATP

Where does it occur? Thylakoid membrane

Structures involved:

- Photosystem II:
Group of several hundred pigment molecules (chlorophyll a, chlorophyll b, and carotenoids) that absorb the energy of light
- Photosystem I:
Group of several hundred pigment molecules (chlorophyll a, chlorophyll b, and carotenoids) that absorb the energy of light
- Electron Transport Chain:
Group of protein/enzyme molecules that can pass a high energy electron (e⁻) along a pathway.
There are 2 electron transport chains, one associated with each photosystem.
- ATP Synthase:
Protein molecule that is able to channel protons across the membrane.
It is also an enzyme that can convert ADP to ATP.
- Water-splitting enzyme:
Enzyme that can split water into H⁺ ions (protons) and O₂
- NADP⁺:
Carrier molecule for high-energy electrons.
NADP⁺ can carry two high energy electrons.



Light Independent Reactions: Calvin Cycle

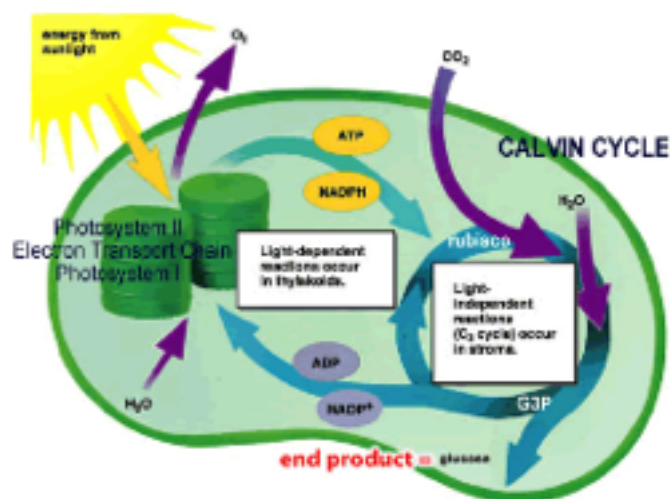
Uses the energy stored in ATP and NADPH (which can only store energy for a few minutes) to produce carbohydrates (which can store energy for a long time)

Where does it occur? In the stroma

Six carbon dioxide molecules are required to produce 1 glucose molecule.

ADP and NADP are also produced during this cycle, and they are fed back into the light dependent cycle of reactions.

Overview of Photosynthesis



Source: <http://williams7thgradescience.pbworks.com/f/PhotosynthesisNotes.pdf>

Field Trip Activities

Biology

Name _____

Photosynthesis Lab - Elodea & Bromothymol Blue Period _____ Date _____

Background:

In this lab, you will investigate the process of photosynthesis. More specifically, you will learn how the type of plant affects photosynthesis. In order to do this, you will use a water plant and a land plant and the chemical **Bromothymol Blue** (which acts as an indicator to show if photosynthesis is occurring). Bromothymol blue works because it is able to detect the presence of **CO₂** (needed for photosynthesis) and **O₂** (released during photosynthesis) in solution.

In a test tube, you will see that:

- bromothymol blue + CO₂ = *green/yellow color*
- bromothymol blue + O₂ = *blue color*

Equation:

Write the equation for photosynthesis. _____

Hypothesis:

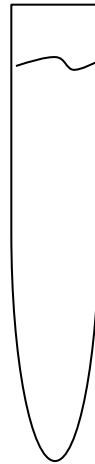
Material Preparation:

If concentrated bromothymol blue (BTB liquid) is available, dilute with water (distilled works best) and test the concentration by adding 10 ml of your BTB solution to 15 ml water and bubbling one lung full of air through a straw into the water. It should turn greenish. (If it stays blue, the BTB is too concentrated; if it turns yellow, the BTB is too diluted.) Adjust your solution as necessary and place in dropper bottles for lab teams to use.

Procedure:

1. Pour 75 mL of water into a 250 mL beaker.
2. Add 2 mL of bromothymol blue to the water. It should be a blue solution.
3. Using a straw, GENTLY blow into the solution causing it to bubble for approximately 1 minute.

4. Label 3 large test tubes: 1, 2, & 3
 - Tube 1 will be the control (no plant)
 - Tube 2 will be the water plant
 - Tube 3 will be the land plant
5. Pour 25 mL of the bromothymol blue + water solution into each of the three test tubes.
6. Cover Tube 1 with tin foil (there is no plant in Tube 1) and place it in the test tube rack
7. Add equal amounts of water plant and land plant to test tubes 2 and 3. Add these test tubes to the rack.
9. Place the entire test tube rack in the sun and allow to sit for 1 hour. Answer the pre-lab questions while waiting.

**Tube 1****No Plant****Tube 2****Water Plant****Tube 3****Land Plant**

Pre-Lab Questions:

1. Predict what will happen to the color of the solution when you blow into the straw (causing the bromothymol blue + water solution to bubble). Explain your prediction.

2. Predict what color Tube 1 will be after the experiment. _____
3. Predict what color Tube 2 will be after the experiment. _____
4. Predict what color Tube 3 will be after the experiment. _____

Results: Record your results in the table below.

Sample	No Plant	Water Plant	Land Plant
Color Before Experiment			
Color After Experiment			

Conclusions: Write 2 to 3 sentences based on your results.

Post-Lab Analysis:

5. What color does the bromothymol blue solution turn after you exhale into it? _____

Explain your answer.

6. What happened to the color in Test Tube 1? Explain why you obtained the results that you did.

7. What happened to the color in Test Tube 2? Explain why you obtained the results that you did.

8. What happened to the color in Test Tube 3? Explain why you obtained the results that you did.

9. What is the purpose of the control?

10. Compare the water plant to the land plant. How do you account for any differences in color?

11. What gas (or gases) can bromothymol blue serve as an indicator for?

12. What gas do you exhale? _____

13. What gas do plants give off? _____

14. List three things that a plant needs to undergo photosynthesis.

a. _____

b. _____

c. _____

15. Write the overall equation for photosynthesis.

Source: teacherweb.com/FL/MaterAcademy/.../lab_-_photosynthesis_with_btb__elodea.doc

Post-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Photosynthesis Comparisons

Central Focus for the learning segment: Students will test and design their own photosynthesis experiment, testing a variable other than plant type.

Content Standard(s): NYS CCLS or Content Standards

- 5.1b Plant cells and some one-celled organisms contain chloroplasts, the site of photosynthesis. The process of photosynthesis uses solar energy to combine the inorganic molecules carbon dioxide and water into energy-rich organic compounds (e.g., glucose) and release oxygen to the environment.

Learning Objectives:

- Students will determine how variables of photosynthesis effect the process.

Instructional Resources and Materials to engage students in learning:
Various depending on what variable students decide to test.

Instructional Strategies and Learning Tasks that support diverse student needs:

- Students will design their own experiment to test a variable, other than plant type, on photosynthesis rate. Other possible variables that could effect photosynthesis are heat, light amount, light type, water, chemical pollutants, etc. (Elaborate)
- Students will present their findings to the class through the multimedia they choose (PPT, prezi, construction paper, etc). Students will be provided rubrics to determine what information needs to be included (Evaluate) (Contant, 2014)

Differentiation and planned universal supports:

Students may work in groups so students with variable skills will work together. The experiment design is laid out for students to collaborate from. Teacher assistance is always available to students.

Language demands and language supports:

Photosynthesis, ATP, NADPH, chloroplast, water, carbon dioxide

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** Teacher observations of student groups and presentation design.
- **Formal Assessment:** Students formal presentation, using the above mentioned rubric

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

Day 1

0:00-45:00 Perform lab

Day 2

0:00-45:00 Finish lab and create presentation

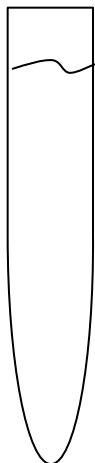
Day 3

0:00-45:00 Present lab information to class

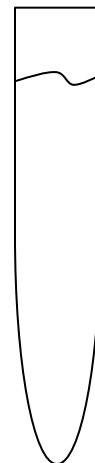
Tube 1



Tube 2



Tube 3



Indicate what will be located in each of the three test tubes

Results: Record your results in the table below.

Sample	Tube 1	Tube 2	Tube 3
Color Before Experiment			
Color After Experiment			

Conclusions:

1. What happened to the color in Test Tube 1? Explain why you obtained the results that you did.

2. What happened to the color in Test Tube 2? Explain why you obtained the results that you did.

3. What happened to the color in Test Tube 3? Explain why you obtained the results that you did.

	3	2	1	0
Research Question	X	X	Included	Not Included
Variables	Independent, Dependent, and Control Variables listed	Two of the three variables listed	One of the three variables listed	No variables included
Hypothesis	X	X	Included	Not Included
Procedure Overview	Could decipher each step of the procedure. Could repeat if necessary	Could decipher most steps in the procedure. Could repeat closely if necessary	Little information about the procedure included	Procedure not included
Results	Results clear and in table format	Results clear, no data format	Results unclear	No results
Conclusion	Conclusion indicates why each result occurred. Related back to the original research question and hypothesis	Conclusion indicates why some results occurred. Relates back to the original research question or hypothesis	Conclusion contains some information relating back to the research question or hypothesis	No conclusion
Total:	/14 Points			

Field Trip 10: Baker Brook Dairy, LLC.

Location:

3512 East Main St.
Attica, NY 14011

Cost/Requirements:

- Free to students and chaperones
- Allergy concerns for students who are allergic to hay or dairy

Field Trip Description:

- Upon arrival students will begin by entering the upstairs parlor "viewing area" to watch cows get milked. Sixteen hundred cows are milked 3x a day in a "Dairy Master" rotary milking system (It looks like a big merry-go-round). Forty cows are milked at a time, and it takes 7 hours to complete one milking cycle. From the time a cow gets on and gets off it is one full revolution and takes 12 minutes. This is followed by one hour of washing down and cleaning the milking area. This goes on 24 hours a day, so the farm tells people it's like a hospital... "the lights are never turned off." The parlor was designed SPECIFICALLY for this farm and manufactured in Ireland. It was shipped by boat, and upon arrival in NYC several trucks were waiting for it to load and deliver right to the farm. When the parlor arrived here, a team of men worked for one month to assemble it.
- Next, students would come down from the viewing area and into the milk house. There they would see two 8,000 gallon stainless steel refrigerated milk tanks. At each milking the milk is immediately pumped and cooled to 38 degrees in these tanks. A milk truck comes 2x a day to pick up milk. The loads the truck drives away with are generally 55,000 to 70,000 pounds. All of the milk is sent to Sorrento in Buffalo and made into cheese.
- Upon leaving the parlor and milk house area, students would proceed to one of the main barns. Each barn is 110' wide by 725' long. The students will be allowed to walk the length of the barn, get "up close and personal" with the cows, and take pictures. Cows tend to be timid, but are very curious. If you put your hand out, they will sniff. If a cow decides she trusts you, she may decide to lick your hand and a student would find out that a cow's tongue feels like sandpaper. The cows are all "bedded" on sand. In the past the farm has used straw, newspaper, and sawdust. Sand has proved to be the most comfortable, and as the saying goes.... "Content cows give sweet milk!"
- On to the Maternity pen. In the maternity area the farm usually has between 20 to 30 moms-to-be that are resting until their due date. The computer system keeps track of all of the breeding and birthing records. This allows the farm to know which number (they wear a number ear tag) cows are getting close to their due date. They are removed from the herd several weeks in advance to get ready to have their calf.
- Finally, the group will be taken out back to look at the heifer barn. Lot of people don't know the difference between a cow and a heifer, and it will be explained that a female cow is called a heifer until she has a calf, at which point she becomes a cow. It will be explained that a cow only gives milk if she's had a baby.... just like people. Therefore,

if the farm has an animal that has trouble getting pregnant after a long period of time, they have to sell her because she will not make them any money. The farm presently has about 130 heifers in their heifer barn.

- Making the walk back to our starting point, students will be walking by an earthen storage that stores the manure. This area is clay lined meeting all the requirements of the EPA. The farm's feed is stored on Maplewood road, so they wouldn't see that on the field trip. Feed is brought up three times a day. A typical cow eats about 100 pounds of feed per day and drinks about 30 gallons of water per day. The farm has a cow nutritionist that creates the balance of corn, hay, soy and cornmeal that provides the healthiest diet for the cows.
- At the end of the tour, students will be given ice cream skippy cups for their enjoyment.

Objectives:

- Students will be able to identify that an offspring obtains half its genetic material from its mother and half from its father
- Students will be able to identify that offspring are not identical to either parent
- Students will be able to describe why offspring resemble their parents

New York State Living Environment Content Standard Alignment:

- 2.1e In sexually reproducing organisms, the new individual receives half of the genetic information from its mother (via the egg) and half from its father (via the sperm). Sexually produced offspring often resemble, but are not identical to, either of their parents.
- 2.1j Offspring resemble their parents because they inherit similar genes that code for the production of proteins that form similar structures and perform similar functions.
- 2.2a For thousands of years new varieties of cultivated plants and domestic animals have resulted from selective breeding for particular traits.

Pre-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Heredity

<p>Central Focus for the learning segment: Students will identify why offspring resemble their parents.</p>
<p>Content Standard(s): NYS CCLS or Content Standards</p> <ul style="list-style-type: none"> • 2.1e In sexually reproducing organisms, the new individual receives half of the genetic information from its mother (via the egg) and half from its father (via the sperm). Sexually produced offspring often resemble, but are not identical to, either of their parents. • 2.1j Offspring resemble their parents because they inherit similar genes that code for the production of proteins that form similar structures and perform similar functions.
<p>Learning Objectives:</p> <ul style="list-style-type: none"> • Students will be able to identify that an offspring obtains half its genetic material from its mother and half from its father • Students will be able to identify that offspring are not identical to either parent • Students will be able to describe why offspring resemble their parents
<p>Instructional Resources and Materials to engage students in learning: Pictures of baby animals and their parents, trait inventory worksheets, guided notes, exit ticket</p>
<p>Instructional Strategies and Learning Tasks that support diverse student needs:</p> <ul style="list-style-type: none"> • Pictures of baby animals with their parent animals will be mixed on the board. Students will identify which offspring goes with which parent. Students will identify how they know which animals match (Engage). • Students will complete a trait inventory about what traits they have and will compare these to the rest of the class (Explore). • Students will then complete guided notes about heredity (Explain). • Students will be assessed on their learning by completing an exit ticket that will be completed and collected before students leave the classroom (Evaluate)
<p>Differentiation and planned universal supports: Notes are guided to support students who struggle with reading or writing. The trait inventory will show students results in numerical and graph format; students who struggle with reading will be supported through the graphical representation of the data.</p>
<p>Language demands and language supports: Heredity, genes, offspring, dominant, recessive, trait</p>

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** Student observations throughout the trait activity
- **Formal Assessment:** Exit ticket

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

0:00-10:00 Matching Offspring

10:00-30:00 Trait Graphing

30:00-40:00 Guided Notes

40:00-45:00 Exit Ticket

An Inventory of My Traits – Survey

What combination of these traits do you have? Complete the survey to find out.

- | | | |
|---|-------------------------------|---------------------------------|
| 1. I have detached earlobes | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| 2. I can roll my tongue | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| 3. I have dimples | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| 4. I am right-handed | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| 5. I have freckles | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| 6. I have naturally curly hair | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| 7. I have a cleft chin | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| 8. I have allergies | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| 9. I cross my left thumb over my right when I clasp my hands together | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| 10. I can see the colors red and green (I am not color blind) | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| 11. The hairline on my forehead is straight. | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| 12. I am a: | <input type="checkbox"/> Male | <input type="checkbox"/> Female |

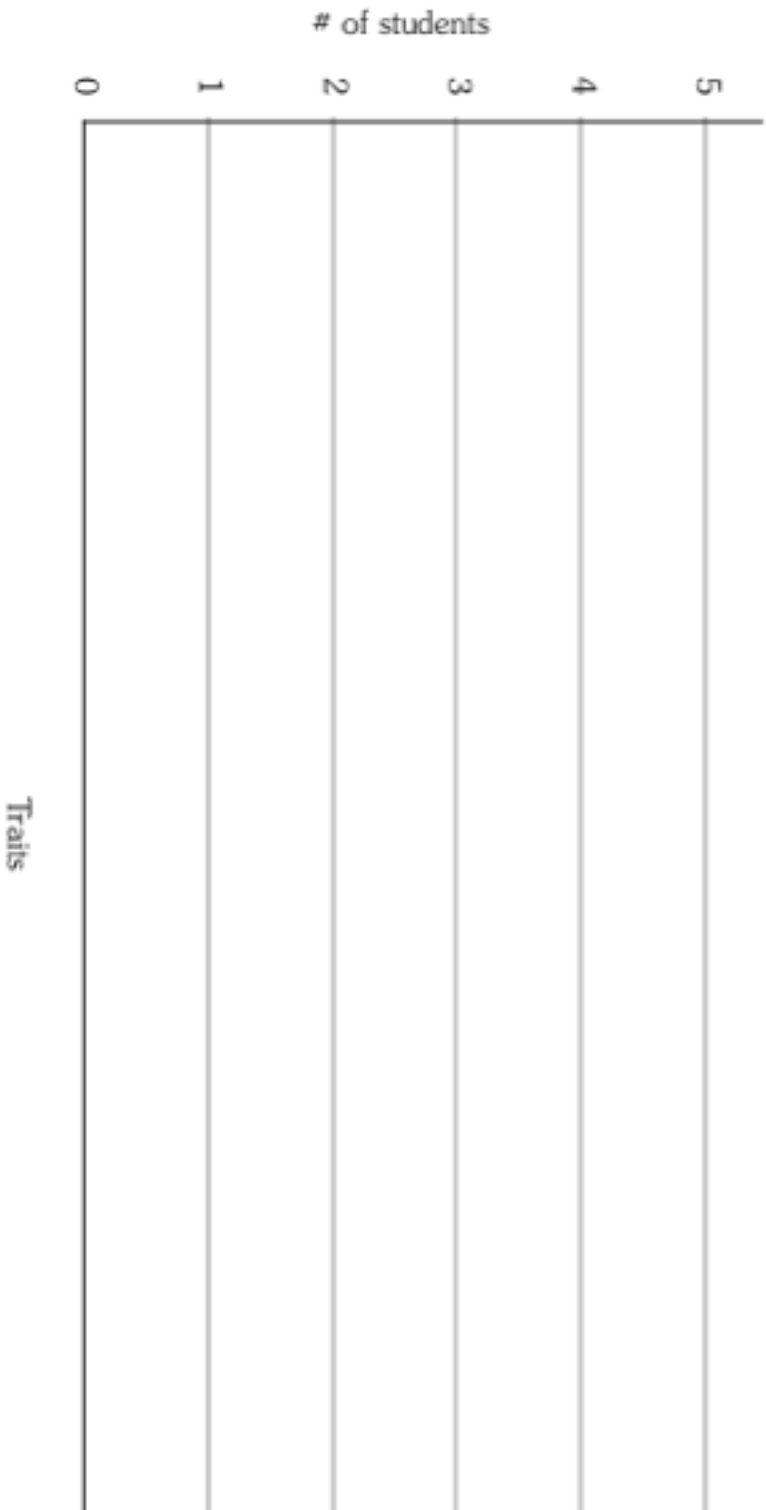
An Inventory of My Traits – Data Table

How many people in your group have each trait?
Fill in the data table below by counting the number of people who marked “yes” and the number of people who marked “no” for each trait.

TRAIT	YES	NO
Detached earlobes		
Tongue rolling		
Dimples		
Right-handed		
Freckles		
Naturally curly hair		
Cleft chin		
Allergies		
Cross left thumb over right		
See the colors red and green		
Have a straight hairline		

An Inventory of My Traits – Graph

Make a bar graph showing how many people in your group answered “yes” for each trait.
Be sure to label each trait under the bar you draw for it.



Images Source: <http://teach.genetics.utah.edu/content/heredity/files/InventoryOfTraits.pdf>

Heredity Notes

Heredity- the passing of **traits** from parent to **offspring**

Genetics- the scientific study of **heredity**

Mendel- is the **father** of heredity, scientist who discovered the principles of heredity

Gene- the set of instructions for **inherited** traits. Basic unit of **heredity**

Trait- genetically determined **characteristics**

Sexual Reproduction

Definition- **male** and female reproductive cells combine to form an offspring with genetic material from

An offspring made from sexual reproduction can **NEVER** be **identical** to their parents, because it has genetic material from both mom and dad

Asexual Reproduction

Definition- produces one or more organisms that are **IDENTICAL** to itself.

Example- amoeba

Dominant vs. Recessive Traits

Dominant Trait- is a gene that determine the phenotype (physical characteristics) of an individual

Recessive Trait- a gene that is NOT expressed when combined with a dominant gene

Codominance Trait- both versions of a gene are expressed equally

-Example- blood type AB

Source: www.hudson.k12.oh.us/site/.../filedownload.ashx?...17464...Heredity%20notes.pdf

Exit Ticket

Name: _____

Write 3-5 sentences explaining why offspring look the way they do and where those looks come from:

Field Trip Activity

KWL

Name: _____

K- What I already know about dairy farming	W- What I want to know about dairy farming	L- What I learned about dairy farming

Post-Field Trip Lesson 1

Grade Level: 9/10

Subject / Content area: Living Environment

Lesson Title: Selective Breeding

Central Focus for the learning segment: Students will research what traits farmers selectively breed for. Students will identify the positives and negatives associated with selective breeding for farming.

Content Standard(s): NYS CCLS or Content Standards

- 2.2a For thousands of years new varieties of cultivated plants and domestic animals have resulted from selective breeding for particular traits.

Learning Objectives:

- Students will be able to define selective breeding
- Students will be able to describe the positives and negatives of selective breeding associated with farming

Instructional Resources and Materials to engage students in learning:

Selective breeding notes, research guideline/handout, computers or devices with internet access

Instructional Strategies and Learning Tasks that support diverse student needs:

- Students will begin by discussion what they thought of the field trip. The teacher will then direct the class to their thoughts about how heifers who are unable to provide calves are sold (Engage)
- The teacher will then provide students with a handout about selective breeding and describe the process (Explain)
- Students will brainstorm different traits that dairy farmers would choose to selectively breed for. Students will research the positive and negative associations of selective breeding, ideally specifically for dairy farming (Elaborate)
- Students will hand in their research, which will be used as an evaluation piece (Evaluation)

Differentiation and planned universal supports:

Notes are guided to support students who struggle with reading or writing. Students may use grammar and spelling check while completing their handouts.

Language demands and language supports:

Heredity, genes, offspring, dominant, recessive, trait

Type of Student Assessments and what is being assessed:

- **Informal Assessment:** Student discussions will be used to determine prior knowledge and any misconceptions
- **Formal Assessment:** The research packet will be used as a formal assessment piece

Relevant theories and/or research best practices:

Contant, T.L., Bass, J.E., Carin, A.A. (2014). Teaching science through investigation and inquiry (12th ed.). Boston, MA: Pearson.

Lesson Timeline:

0:00-5:00 Field trip discussion directed towards calving and selling heifers who are unable to

5:00-15:00 Discussion and informal notes about selective breeding

15:00-45:00 Research about the positives and negatives of selective breeding on dairy farms

Selective Breeding

The process of breeding plants and animals for particular genetic traits.

Parent organisms are bred by people to produce the desired traits in the next generation

Domestic animals are commonly bred for various traits.

Domestic animal: animal that has been tamed and kept by humans for work, food or as a pet

Example:

Selective Breeding - Dogs



Dogs are bred for many reasons such as their intelligence, trainability, and good looks

Dogs are all the same species, just varieties!

Source: http://www.flippedoutsience.com/uploads/2/7/8/2/27824091/selective_breeding_notes_and_activity_student_version.pdf

Selective Breeding in Dairy Farming

Name: _____

For this activity, you will identify different traits that are desired when it comes to dairy farming. Using details and observations from the field trip as rational to defend why these are desired traits.

Desired Trait and Rational for Why it is Desired

1.

2.

3.

Personal Reflection

When I first began researching ideas, I wanted to find a topic that was exciting and interesting to me. As a student, I had difficulty sitting in lecture settings and was often the student doodling in their notebook. As I continued to grow in my education, I realized that learning outside of the classroom was one of my favorite activities. As indicated in the research, field trips are some of the most memorable activities I have of my educational experience.

Limiting the field trips to Wyoming and Genesee Counties was an easy choice for me to make. Growing up in rural Wyoming County, individuals often say there is “nothing to do”. My goal for this project was proving exactly how much there was to do in the county not only for fun, but for educational opportunities. Students are able to learn throughout any environment they are in, whether it be suburban, rural, or urban.

Being familiar with the area, it was easy to select ten locations. After the selection process, discovering more information about each location was different in every case. Some of the locations had websites while others had very little information provided. Coming from a small town area, it was easy to come in contact with the owners or workers of such facilities and obtaining the necessary information for each field trip. Connecting these field trips with standards and exploring and creating the activities that would come before and after was the most fun aspect of this document. I was able to be as creative as possible while still following the 5E and research guidelines. Through the production of this document I have learned a great deal as well as promoted Wyoming and Genesee Counties. I am excited to share this document with my colleagues; especially those who live in the areas discussed.

Discussion and Summary of Process

In the project titled *Field Trips in Wyoming and Genesee Counties, New York*, different field trip locations were researched as well as lessons and state objectives to go with each. After determining the importance and support of field trips through previously published literature, ten field trip locations from Wyoming and Genesee Counties, New York were identified. Each location was researched either through websites, email, or phone calls. A description of the field trips or tours they offer as well as accommodations, price, location, and any other necessary details were determined.

Next, each field trip was connected to New York State Living Environment Standards. The standards were used to create a pre-, during, and post-lesson module. Research supports pre-lessons occurring prior to field trips to provide students with background information and material. Students being familiar with what is going to occur on the field trip will allow them to be more focused on the standards and expectations of the location or educator. Each module follows the 5E method of teaching, as supported by the literature. Objectives and activities were designed specifically for each field trip and content standard. Each pre and post lesson contains central focus, objectives, activities, accommodations, language demands, materials, and assessments. Worksheets are provided throughout the project pertaining to each lesson. Assessments and accommodations were the last piece of the project to put together. Assessments were identified by looking at the lesson and determining if what students performed could be classified as an assessment or if an additional assessment needed to be created. Accommodations were also added at the end of each lesson. Often, classes are heterogenous in terms of the students they contain. Although additional accommodations may be necessary for specific

students in a class, each lesson includes general accommodations and differentiated parts of the lesson that allow all students to be successful.

The above field trips are able to be used by educators to instruct their students through out of classroom experiences. Each field trip has a pre, during, and post lesson template educators can use to help engage their students in the content and provide background to students prior to participating on the field trip. The continuation of material from before, during, and after each field trip will allow them to fit seamlessly in a unit or plan of study. Relating each field trip to content standards also gives educators rationale for taking their students to each location. Students will be learning not only the content standards, but will be practicing communication skills as well as learning about the global community.

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