

THE EFFECTS OF
INCORPORATING TECHNOLOGY
INTO THE 7TH GRADE SCIENCE CLASSROOM

by

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April 2012

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ABSTRACT

In this investigation technology tools were implemented with the purpose of improving student independence and learning of science content in both school and home settings. Multiple opportunities for technology use throughout all lessons saturated a traditional approach to teaching science with 21st century technological tools. The data was used to analyze whether or not the use of technology enhanced the learning process, improved confidence, and increased independent inquiry while improve science content understanding.

INTRODUCTION AND BACKGROUND

For the past eight years I have been teaching seventh grade science at Brookwood Middle School in Genoa City, Wisconsin. Brookwood Middle School is a grade 5-8 middle school in a small town with a population of about 1,983 people (GIS Planning Inc., 2011). The students come from families that are primarily working class: 49% are considered white-collar workers, and 50% are considered blue-collar workers. Families in this district have a \$56,312 median income and 90.95% of adults hold a high school degree or higher. About 20% of adults have a bachelor's degree or higher (GIS Planning Inc., 2011). According to the National Center for Education Statistics, 30.7% of Brookwood Middle School students were eligible for subsidized lunch in 2009-2010. The K-12 district population was 88.2% white, 10.8% Hispanic, 0.7 % Black, and 0.3 % Asian ($N=624$). The number of students with disabilities was about 14.8 % in 2009-2010 (Wisconsin DPI, 2011). The results of the 2010 Wisconsin Knowledge and Concept Examination showed that by the end of 8th grade, students at Brookwood Middle School scored 84%, 85%, 78%, 62%, and 77% proficient in Reading, Social Studies, Science, Language Arts, and Math respectively (Greatschools Inc., 2011).

As a student at Montana State University, for the purpose of earning a Masters of Science in Science Education, I conducted a research study of my students during the 2011-2012 school year. My interests lie in converging traditional and inquiry based teaching methods with the use of technological tools. Our district school board has a strong affinity for encouraging the use of technology in the classroom; they always provide as much modern technology as the district can afford with the intent that these resources would increase student learning. In recent years all classrooms have been

equipped with Smartboard screens. In addition, teachers have been using and learning the benefits of having personal MacBooks for years. Following their introduction, student sets were also made available and only recently have been portable and functional enough to actually make using them in the classroom practical. Recently, some teachers were given iPads to use depending on whether or not they thought they could incorporate them into their curriculum. I am currently exploring the possibilities for their use in science since classroom sets are likely to follow. Since I have been teaching at Brookwood students have had the use of desktop computers with varied availability. Two 28 computer technology labs are available. Brookwood School also has breakout pods, which are small groups of computers accessible to several grade levels. Each of our three hallway wings has 12 computers available. The computers the district owns vary in age and capability with some computers being capable of doing far greater tasks than others. The district also allows teacher access to portable laptops with limited availability.

Technology is an integral part of everyday life. The number of technological tools that are being introduced into our personal and professional lives is astounding. The question as to whether or not technological tools enhance learning is the primary focus of my research. As a middle school teacher, in addition to teaching scientific understanding of content and processes, I am also responsible for guiding my students toward a certain level of independence. I need to teach them how to seek out information and assistance from sources beyond the classroom. Therefore, my secondary focus is whether or not technological access and understanding could be a portal for students becoming better learners. I would like to know if they use their new gadgets to tap into

resources, both personal and educational, until they are able to better understand the science content being taught.

Using technology, including but not limited to: student laptops, desktops, iPad applications, Smartboard lessons, iPods or smart phones with internet access, photography, video, interactive web applications, and accompanying software, to improve independent thinking and learning, develop a greater mastery of science objectives, and increase appreciation for scientific study is the purpose of the study.

CONCEPTUAL FRAMEWORK

Traditional teaching of science has focused more on fact-based memorization and review of text with teacher driven lectures, laboratory experiments, and sectional reviews (Pursell, 2009; Yager & Akcay, 2008). Some research suggests this approach may inhibit students' ability to think creatively and engage in science at levels where cognitive thinking and problem solving strategies are employed (Harmer & Cates, 2007). Others argue that the direct approach to teaching is more beneficial and that guided instruction is more conducive to positive learning outcomes. Some have found that schools with individualized learning opportunities and whose students are taught higher-level thinking skills tend to perform better than schools that do not (Stansbury, 2011; Cobern, 2010; Sweller, 2009; Kirschner, Sweller & Clark, 2006; Klahr, 2002).

An effective method that teachers can follow to provide opportunities for student engagement, inquiry, and higher level thinking is the 5E Model of Learning. This method of learning was developed, with the philosophies of Jean Piaget as its base, through the careful construction and philosophical contributions of Robert Karplus,

theoretical physicist and educator. Karplus and his co-workers initially constructed several strategies of learning with exploration, invention, and discovery as the main teacher focus to get the greatest positive student response. Karplus published his ideas in the *Journal of Research in Science Teaching* in 1977, where he stressed the importance of employing three instructional phases of learning: exploration, concept introduction, and concept application (Fuller, 2003). In 1988, this learning cycle was modified and enhanced through the work of Roger Bybee and is today known as the 5E Learning Cycle. It includes the original philosophies of both Piaget and Karplus through use of the learning phases of engagement, exploration, explanation, elaboration, and evaluation of students (Su, Chiut & Wang, 2010).

The first stage of the 5E modeled recommended for each lesson is *engage*. An engage activity should make connections between past and present experience and mentally engage students in the content, process or skill to be learned. This is usually done through an anticipation activity that focuses students' thinking on the learning outcomes of the current activity. The second stage recommended for each lesson is *explore*. This phase of the 5E's provides students with a common base of experiences. Here they can identify and develop concepts, processes, and skills. During this phase, students actively explore their environment or manipulate materials. *Explain* is the phase of the 5E's that helps students explain the concepts they have been exploring. They have opportunities to verbalize their conceptual understanding or to demonstrate new skills or behaviors. This phase also provides opportunities for teachers to introduce formal terms, definitions, and explanations for concepts, processes, skills, or behaviors. After instruction the next stage is *elaborate*. This phase of the 5E's extends students'

conceptual understanding and allows them to practice skills and behaviors. Through new experiences, the learners develop deeper and broader understanding of major concepts, obtain more information about areas of interest, and refine their skills. The final stage of the 5E's is *evaluate*. This phase of the 5E's encourages learners to assess their understanding and abilities and lets teachers evaluate students' understanding of key concepts and skill development (Fountain, 2009).

One way for a teacher to recognize and utilize the philosophies of the 5E Learning Cycle is through the use of technology. In February 2011, a study conducted by the George Marshall Applied Cognition Laboratory was published in *Educational Leadership Magazine*. In this study, data indicated that students born after 1990 are continuously spending their time multitasking by using media and technology. This generation, sometimes labeled the iGeneration or the YouTube generation, is continuously immersed in using individualized mobile technologies including the iPhone, iPod, Wii, iTunes, and other popular electronic devices (Rosen, 2011; Pursell, 2009). Because these technologically savvy students are the students in American classrooms today, finding an effective means to adapt to their unique learning styles is recommended.

Incorporating technology use into the middle school science classroom shows benefits such as increased personal relevance, learner engagement, student focus on problem solving rather than memorization, and inquiry (Harmer & Cates, 2007). The use of technology improves students' ability to read content while obtaining direct access to definitions to vocabulary words that typically could prevent students from comprehending what they were reading (Marino, 2009). Understanding the language of

science is essential to students' understanding of the science content (Young, 2005). Instructional sites are also contributing to students' ability to formulate their writing by presenting multiple pictorial applications including graphic organizers, outlines, and images relevant to the main ideas. The use of multimedia applications may have a strong impact on holding student interest. The use of animations, pictures, and simulations are becoming more and more interactive and have the potential to improve student comprehension (Biancarosa, 2007). They are also a great resource to tap into students' creativity and enhance their understanding of the world around them (Tuttle, 2011).

The benefits of using technology in the classroom have driven a wave of school districts towards utilizing technology in the classroom (U.S. Department of Education, 2011). However, if used inappropriately, technology can inhibit rather than increase student understanding. Unfortunately, many e-learning materials have not been developed with the purpose of teaching in mind (Computer in Schools, 1998). Teachers could be accessing materials where effective learning strategies are not the focus of the site. In order to alleviate this problem, districts need to make sure that their instructors have access to teaching technology with a concrete computer based framework and professional training adequate enough to train teachers to translate best practice into real practice.

The needs of the teachers as well as the students in the context to which they are being used are essential to the success of implementing technology in the classroom. These authors also warn that this is a complex, costly, and time-consuming process (Su et al., 2010; Liu et al., 2009). Another factor that can inhibit students' learning while using technology tools is the frustration that can arise from students not knowing how or when

to use the tool. In that case, having the technological tool available will not make a difference. In addition, students who only utilize web tools for certain tasks, such as looking up vocabulary, expend less cognitive energy than traditional learning methods. Studies show that teachers need to balance the use of interactive tool use with traditional teaching methods, and monitor student tool use. Otherwise, content area knowledge may be lost (Marino, 2009).

The iPad, the portable laptop and the cell phone are three technological tools that have had recent attention and some research has been done that indicates that these technological tools could be vital to a new era of understanding science in the context of a technological world. Most of the studies prior to 2003 used the desktop computer in their studies, and current research tends to use this as a foundation. With the advent of the Internet as a resource, now accessible to most districts, and the future potential for broadband to be accessible everywhere in a new model of learning (Figure 1), there is exciting potential for learning through technology (U.S. Dept of Education, 2010). This is especially true due to the mobility of computers with wireless communications through the use and applications of laptops, tablet computers, and cell phones (Bielec, 2010).

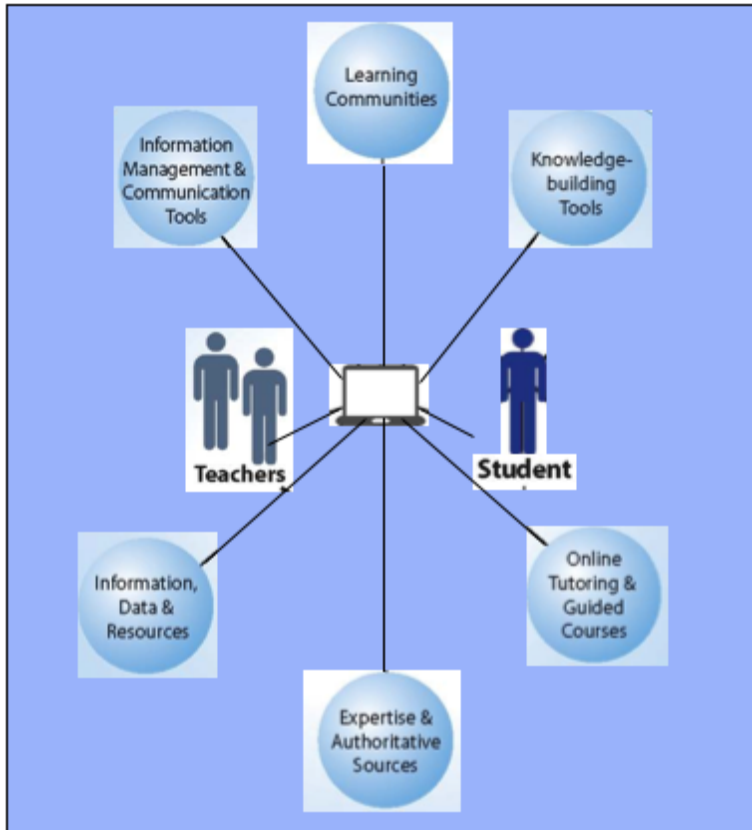


Figure 1. A Model of Learning Powered by Technology (Adapted from U.S. Dept of Education, 2010).

Today, students are spending a majority of their waking hours online with others and in this era of sudden immersion in a climate of wireless interaction, students must have an educational system that keeps up with the change in a way that gives them continuous access to technology that will give them answers to any questions, any time they ask (Bielec, 2010; Rivero, 2010). Desktop computers are no longer used as just word processors, but as an access window to the Internet world. School districts are encouraged to put the new technology to use and to allow the students opportunities for inquiry and further drive their learning. New software and web sites allow students to use their creativity to engage in and to elaborate their understanding of science through visual presentations of content they are learning (Bryne, 2010). They can also share their

work with their peers and their teacher. If teachers incorporate the philosophies of learning into a curriculum rich with technology, students will become better learners and teachers will be better teachers (Lightle, 2011).

With the advent of interactive content and the ability for teachers to incorporate the 5E's of learning into the typical terminology based reading, there is far more promise of student understanding, especially if teachers can effectively integrate interactive enhancements. Incorporating the learning cycle structure with the traditionally written text is an effective way to teach science (Mushino & Lawson, 1999). Science teachers using technology in their classrooms are able to support their standard teaching with methods that include creativity, inquiry, and innovation in learning. By integrating digital photos, word processing, digital movies, probes, freeze frames, simulations, YouTube, wikis, and net-based research into their science curriculum, teachers are certain to not only engage students but also inspire in them a lifelong love of science and ultimately raise their achievement levels (Tuttle, 2007).

In addition to the possibilities for use of applications in mobile computers and desktops, there are a number of new tablets and electronic readers (e-reader) currently available to school districts. The e-reader (i.e. the Kindle) is basically just a digital space to store and read books. Use in the classroom is especially advantageous for readers who struggle because the size of the text can be manipulated (Ferriter, 2010). However, the use of tablet style computers (i.e. the iPad) is even more promising because not only can text size of passages be increased and pages digitally turned, but also an entire array of computer functions and applications are available. These include the ability to combine written knowledge with images, access to interactive activities and videos, multiple

sources through web queries, and student discretion to either work independently or interact socially (Barack, 2010; The iPad, 2010). Use of the tablet computers will not replace classroom lectures, reading, researching, studying socially in groups, discussions, and writing. However, the devices should enhance the learning environment that students currently have (Sandars, 2010; Stephens, 2010).

The technological trends are changing quickly. It would be a mistake to only focus classroom teaching strategies using only laptops, desktops, or other equipment that locks students down to a particular location (Librero, Ramos, Ranga, Trinona, & Lambert, 2007; Pursell, 2009; Bielec, 2010; Rosen, 2011; Scherer, 2011; Kolb, 2011). Cell phones can be used for a number of effective teaching strategies, including addressing the importance of building students knowledge of science vocabulary (Young, 2005). This can be accomplished through the creation of flashcards that can be accessed using the students' cell phones no matter where they are, be it the mall, the movie theater, on the bus, or in their own homes (Pursell, 2009). Other useful approaches in student learning and understanding include using drill and practice games and programs that can be used directly from the cell phone and accessed nearly anytime and anywhere. Teachers can ask students to respond to brainstorming questions or polls by using the text messaging features or directly accessing specific communication sites on-line through blogs, wikis, and other avenues. Because Smartphones have the capability of, and in many cases even higher capability than, the desktop and laptop computers found in the average U.S. classroom, virtually any multimedia creation, picture, movie, podcast, and data that could be saved or sent using a computer can be accessed and stored using a Smartphone (Using Cell Phones, 2010; Kolb, 2011).

Undoubtedly, the use of technology can improve student engagement, motivation, and participation in learning science. Technology can provide enjoyment, and with that enjoyment, an increased potential is derived for students to be motivated and engaged in exploration and experimentation (Harmer & Cates, 2007). Cultures of learning through the use of technology are enhanced by interactions with others, exploration through inquiry, collaboration with teachers, performing new tasks, creatively solving problems, tackling complex questions, and adapting to change by acquiring new skills (Wyer, 1994). When used properly, great benefits can be realized both for the students and the teachers. If a balance between using regular methods of practice, such as the 5E Learning cycle, and incorporating technological tools is met a greater potential for learning can then be achieved (Liu et al., 2000). In the end, this should cement student understanding and successful mastery of the concepts being taught.

METHODOLOGY

Before introducing students to a variety of technology, I gathered baseline data to assist me in my planning. All students were given the Student Attitude and Experiences Questionnaire (Appendix A). This questionnaire served as background information to understand student context. It included questions about student and family perceptions toward science and its importance in their lives. The first set of questions held three themes relevant to my study: science as enjoyable, science as important in daily life, and student confidence levels. The questionnaire also served as a way to gauge student experience and exposure to technology in their home environment and the accessibility that students have to technology outside of school.

All students were also given the Technology Use: Pre-Treatment Questionnaire at the start of treatment (Appendix B). It included questions about student use and perceptions of technology and its importance in their lives, both inside and outside of school. It revealed four themes relevant to my study: experience with technology, preference for use in classroom, difficulties with technology, and student confidence levels.

Finally, all students were asked to consider how their time is spent outside of school either working independently on science or collaborating with their friends or their family members. To assess this, I distributed the Student Independent Learning Pre-Treatment Survey (Appendix D). This survey offered students a semantic scale to which they could answer that they *agreed* or *disagreed* with my statements within the given range, this survey was repeated at the end of the treatment as well.

In order to conduct this study, I needed to be able to communicate with students in and outside of the classroom, so I created a teacher web page. Near the end of the Chemistry Unit, I posted review materials to the Ms. Kretschmer web site at <http://brookwood.badger.k12.wi.us/~KKretschmer/Site/Welcome.html>, and recommended that the students review the science pages often throughout the year. I told them that much of the material that was available to them for review would be directly on the unit tests and quizzes. After their first test, following the launch of the new web page, I gave them the Quick Post Test Self Reflection Questionnaire which asked the students questions about how they prepared for the test (Appendix D). I counted the number of positive responses to the question, “Did you study?” I also counted the number of positive responses to the question, “Did you look at any materials on my web page?”

Finally, I reviewed student comments in response to the question, “Is there anything you would like to tell me?” This served as my first baseline data to compare the future treatment results to and was administered again following each unit test to assess change.

My capstone project spanned several units of study following the Introduction to Chemistry Unit early in the first trimester and continuing through several fields of science that included biology and earth sciences with its conclusion at the end of April, 2012. Using the 5E learning process as a template, I inserted several main technological tools of learning and incorporated similar ideas into my instructional approach (Table 1).

Table 1
Applications for Technology Use

	UNIT 1	UNIT 2	UNIT 3	UNIT 4	UNIT 5	UNIT 6
	Introduction to Chemistry	Cells and Microscopy	Introduction to Life	Microbiology & Immunology	Geology: Earth's Surface	Geology: Oceanography
E n g a g e	Smartboard to Stream Video Clips and Animations	Smartboard and Flex Camera to Project Microscopic Images	Smartboard and Flex Camera to Project Microscopic Images	Cell Phone and iPads: Wiffiti Message Board	Smartboard to Stream Video Clips and Animations	Smartboard to Stream Video Clips and Animations
E x p l o r e	iPads and Laptops: Teacher Web Page with Interactive Web links	iPads and Laptops: Teacher Web Page and Interactive Web links	iPads and Laptops: Teacher Web Page and Interactive Web links	iPads and Laptops: Teacher Web Page and Interactive Web links	iPads and Laptops: Teacher Web Page and Interactive Web links	Cell Phone and iPads: Wiffiti Message Board
E x p l a i n	Smartboard: Guided Notetaking	iPads and Laptops: Teacher Created Webquest Activity Smartboard Guided Notetaking	iPads and Laptops: Teacher Created Webquest Activity Smartboard Guided Notetaking	iPads and Laptops: Students Use Quizlet, Delicious.com, Open Office, and Smartboard for Guided Notetaking	iPads or Laptops: Inspiration for Vocabulary Mapping Smartboard Guided Notetaking	iPads and Laptops: Teacher Web Page and Interactive Weblinks Smartboard to Stream Video Clips and Animations
E l a b o r a t o r y	Teacher Web Page materials, laboratory videos, and photographs of activities in class for student independent study purposes and review	Teacher Web Page materials, laboratory videos, and photographs of activities in class for student independent study purposes and review	Teacher Web Page materials, laboratory videos, and photographs of activities in class for student independent study purposes and review	Smartboard: to display flex scope images from lab Laptops: Virtual Poster Creation using Presentation Software	Teacher Web Page materials, laboratory videos, and photos of activities in class for student independent study purposes and review	Teacher Web Page materials, laboratory videos, and photographs of activities in class for student independent study purposes and review
E v a l u a t e	Traditional teacher created test	Smartboard for Class Interactive Quiz	Smartboard for Class Interactive Quiz	Smartboard Virtual Poster Presentation	iPads and Laptops: Current Event Presentation	Smartboard and laptop for powerpoint speech

Throughout various units I introduced students to technological applications and provided instruction to those students who needed assistance with learning how to use the applications. In addition, embedded into my lessons were various opportunities for students to access enhanced study materials through materials posted on my teacher web page. I developed multiple opportunities for technology use throughout all of my lessons and saturated my traditional approach to teaching science with 21st century technological tools.

The study group consisted of students in all of the three 7th grade science classes ($N=62$). Historically, our class make-up consists of one higher math group ($n=23$), and two middle level groups ($n=19$, $n=20$). For the most part, my data reflects the 7th grade as a whole. Routinely, I also assessed student data in correlation with results of the Wisconsin Knowledge Concept Examination reading Lexile level. I did this so that I could see if there were any distinguishing changes within each Lexile category. The breakdown was as follows: 31% were *below proficient*, 58% were *proficient*, and 11% were *above proficient*. Before the treatment process I received administrator approval and sign off on the methods of collection and permission to research these techniques within my regular classroom environment (Appendix E). The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained.

The first unit of study was Introduction to Chemistry. I prepared my lessons and instructed the students about matter and energy using the first chapter of the American Chemical Society (ACS) Middle School Chemistry On-line lesson plan (Appendix F). In this unit I implemented two technological tools. I used the Smartboard to stream video

clip animations, and posted notes for students to review as needed. The lessons were written with the 5E's as a guide and utilized both traditional and 21st century tools. I carefully reviewed the posted information so students knew how to access the pages during class time well before the matter unit's summative assessment. I encouraged them to refer to the tools on the website as needed to aid in their studying (Figure 2).

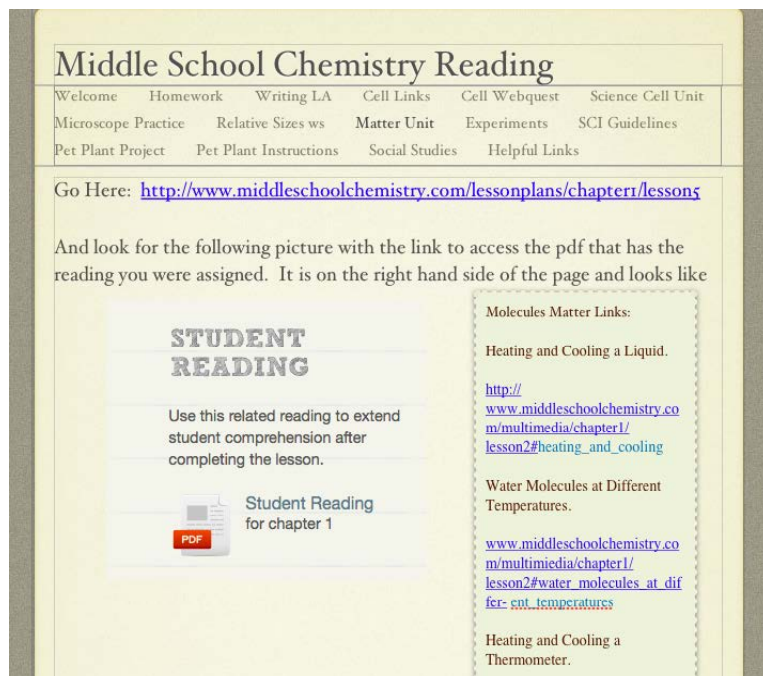


Figure 2. Middle School Chemistry Web Page.

After the test, I administered the Post-Test Self Reflection Questionnaire (Appendix G). I compared the number of yes responses to the questions, “Did you review any of the materials posted on my web page?” from the Quick Post-Test Self Reflection Questionnaire to the number of yes responses on this questionnaire. I also compared the number of positive responses to the question, “Did you study?” I noted the responses to the other questions to use in future data collection analyses.

The second unit was the Introduction to Cells unit. I was pleased with the format of the ACS lesson plan so I decided to rewrite my own future lesson plans for the biology

and geology units in a similar manner (Appendix H). I taught students about microscopes and cells using traditional laboratory methods, with the focus being on the introduction of microscopes, how to prepare slides, practice viewing specimens, and text book readings and vocabulary. After students completed their reading strategies, a post reading assessment to assess student understanding of science concepts, called Understanding Cells Quiz, was administered (Appendix I). I scored the assessment, per question, on a scale of 0 for *no understanding*, 1 for *basic understanding*, and 2 for *complete understanding*. Each student had the potential to score a maximum of eight. I grouped the data according to student Lexile levels ($n=19$, $n=36$, $n=7$), I then tallied the scores, and calculated the percentage.

I then implemented two more strategies into the lesson: the creation of a web page with interactive supplementary materials to stimulate student interest (Figure 3), and the use of iPads to research and complete an Internet research webquest (Appendix J). Students were given iPads during class time to explore the teacher page, to become familiar with the links that were provided, and to begin their webquest research.



Figure 3. Cell Biology Web Page.

After students completed the webquest, I administered the Understanding Cells Quiz again (Appendix I). I scored it the same as before. After the webquest I also did an informal assessment of student feelings about the webquest.

I implemented the last strategy for this unit by projecting two online interactive quizzes for review practice on the Smartboard to reinforce memorization and understanding (Figure 4 & Figure 5). I encouraged students to use their afterschool and weekend time to refer to all of the resources on my webpage including all of the webquest sites and interactive quizzes to prepare for their unit test.

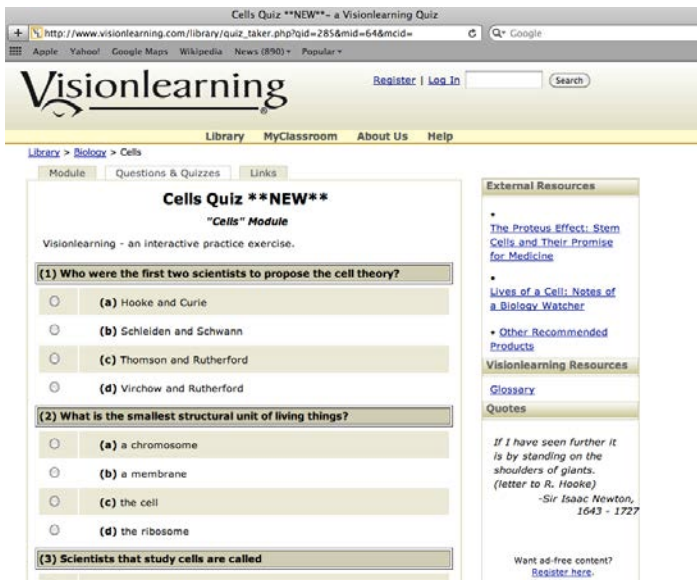


Figure 4. Vision Learning On-Line Quiz.

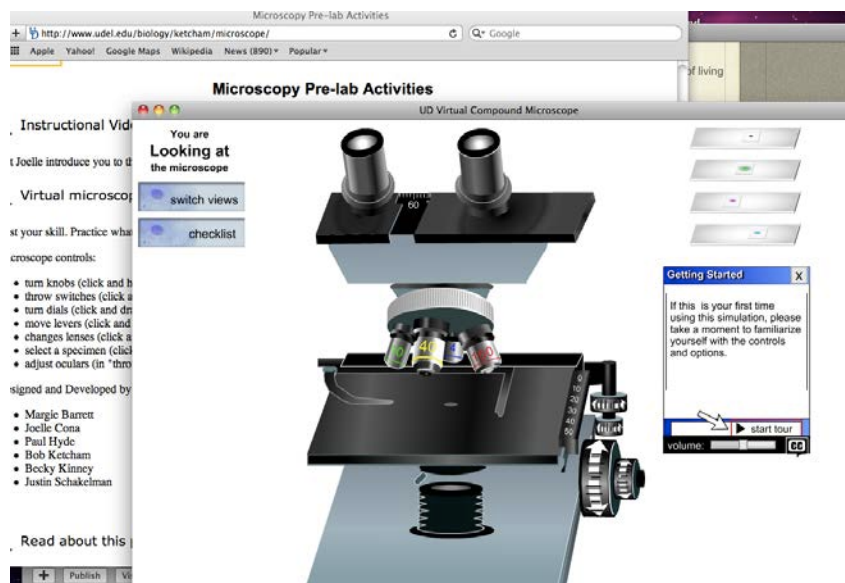


Figure 5. Microscope Practice.

Following the completion of the cell biology unit, students were given a summative assessment which consisted of a teacher created test constructed with multiple choice, matching, and fill in the blank questions with two short answer constructed response questions and an illustration (Appendix K). I scored their unit test using percentages and then compared the growth from the percentages earned for the first two formative assessments (pre-treatment, and post webquest) to see if there were any gains in understanding, again grouping the data according to Lexile level. After the test I distributed two questionnaires, the Post Test Self Reflection Questionnaire (Appendix G), and the Technology Use Reflection Questionnaire (Appendix L), to determine the extent that the students studied outside of school, specifically how much they utilized their technology choices and whether or not they felt they were beneficial.

In the third unit, called the Introduction to Life unit, I introduced three more technological applications. First, I introduced the use of cell phones when a student

asked, “Why are cell organelle names so weird?” Since this treatment included the use of devices that students are supposed to leave in their lockers, per district policy, I developed a student contract with the classes input (Appendix Q). I chose to only implement this treatment in one class period (n=22) because this homeroom responded to having the greatest number of personal devices with access to the internet. In the event that students did not have a personal device, they were to select a school provided iPad.

Students were asked to use their personal devices to find the answer to the meanings behind scientific names and record their answers in their notebooks, and pair up and share what they discovered. They were then asked to go to my website and either text their findings to the message board that was linked to my webpage, or use the Wiffiti website code I assigned to post a message to an online message board. I displayed group responses on the Smartboard, using the Wiffiti.com message board (Figure 6).



Figure 6. Wiffiti Message Board.

After students completed their Wiffiti post I assigned chapter reading and gave a post reading constructed response assessment: Understanding Life Quiz, to assess student

understanding of science concepts, in the same manner as I did in the cell unit. I scored the four question assessment, per question, on a scale of 0 for *no understanding*, 1 for *basic understanding*, and 2 for *complete understanding*. Each student had the potential to score a maximum of eight. I grouped the data according to student Lexile levels ($n=19$, $n=36$, $n=7$), I then tallied the scores, and calculated the percentage.

I then introduced three other technology tools; I used the Smartboard and flex scope to enhance their understanding of content by showing students animations and displaying microscopic images both in real time and later posting these videos and photos on the web page (Figure 7).

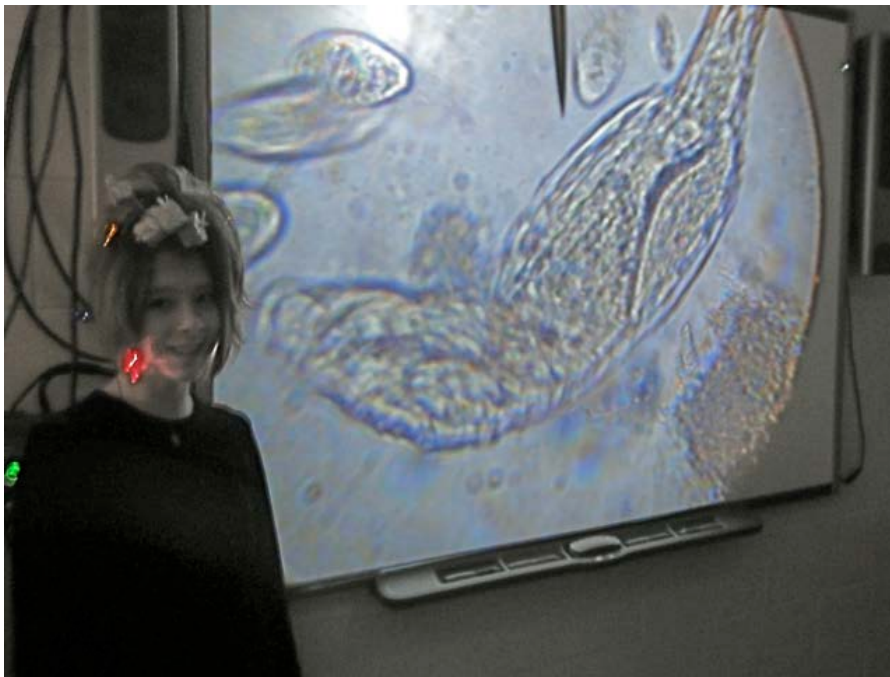


Figure 7. Flex Scope Image Projected to Smartboard.

I also video recorded our Glucose Lab and I displayed the methods, analysis, and conclusions from the lab onto the web page as well (Figure 8).

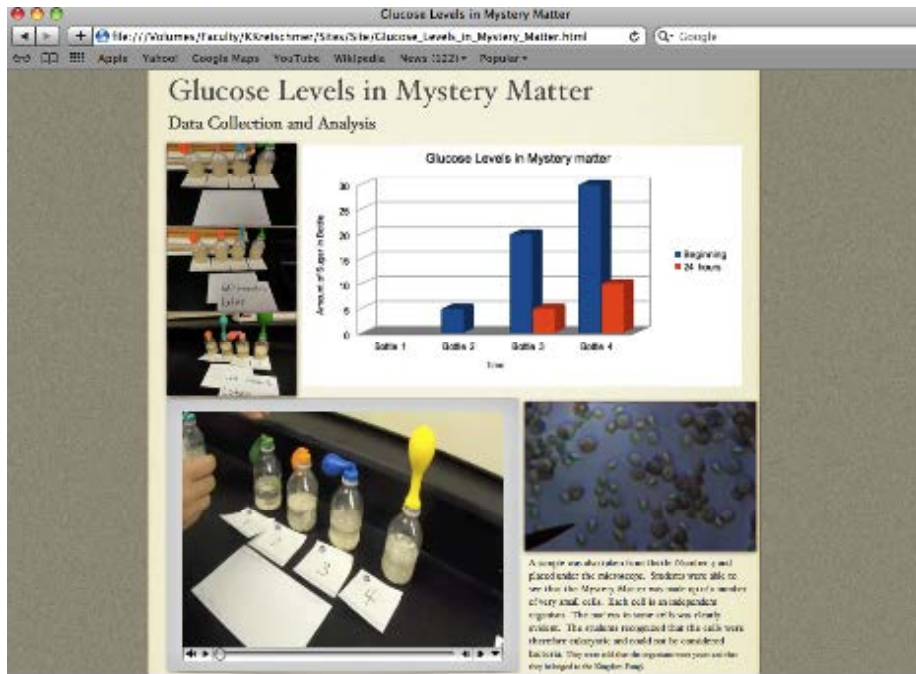


Figure 8. Glucose Lab Posted to Web Page.

After students completed the glucose lab I administered the formative assessment: Understanding Life Quiz. I scored it the same as before. Following the completion of the Introduction to Life unit, I posted materials that included animations and links for students to access for review. They were given one period in class to study with the options of selecting either laptops, iPads, or desktop computers. The following day, students were then given a summative assessment which consisted of a teacher created test constructed with multiple choice, matching, and fill in the blank questions with two short answer constructed response questions and an illustration. I scored their unit test using percentages and then compared the growth from the percentages earned for the first two formative assessments (pre-treatment, and post technology) to see if there were any gains in understanding, again grouping the data according to Lexile level. After the test I distributed two questionnaires, the Post Test Self Reflection Questionnaire (Appendix G), and the Technology Use Reflection Questionnaire (Appendix L), to determine the extent

that the students studied, specifically asking how much they utilized their technology choices and whether or not they felt they were beneficial.

Unit 4, the Microbiology and Immunology Unit, again followed traditional and 21st century learning methods. Students in all three classes used Wiffiti messaging via class assigned iPads to share their predictions for a bacteria culture lab. They then used those predictions to develop hypotheses for their experiment. Throughout the unit I basically followed the same teaching methodology as in the prior units. However, in the Microbiology and Immunology unit, in addition to the reading and post technology formative assessments, I used artifact creation for summative assessment purposes. Students were given iPads to use and were instructed on how to use Delicious.com to gather research material for a virtual poster assignment (Figure 9).

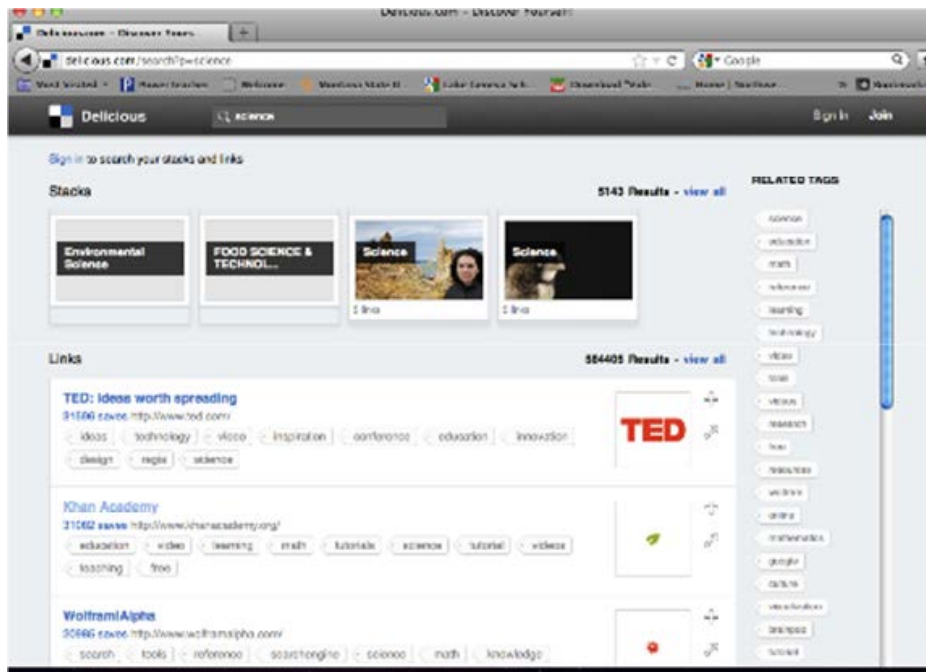


Figure 9. Bookmarking Site for Research: Delicious.com.

Students created and presented virtual posters and I used their presentations to assess their content understanding (Figure 10). After the presentation I also did an informal assessment of student feelings about the virtual poster assignment.

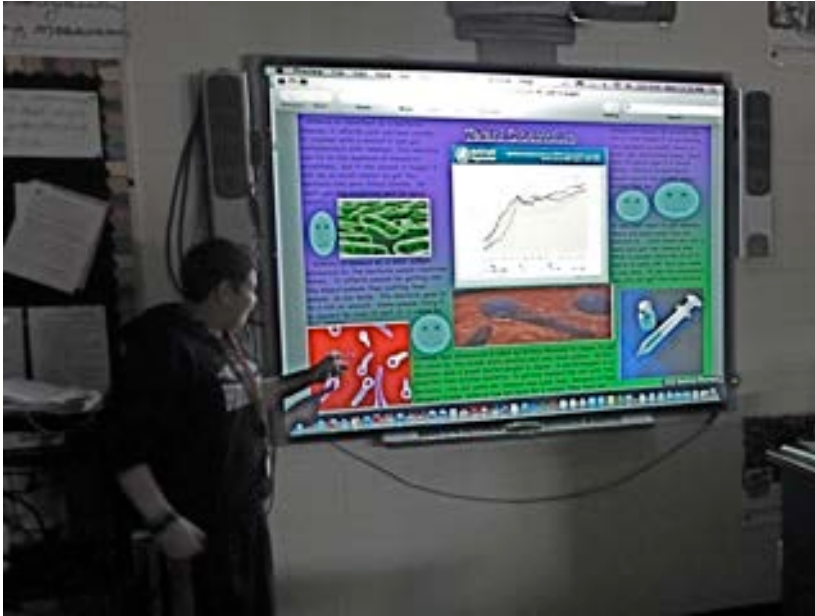


Figure 10. Virtual Poster Presentation Immunology Unit.

Then, I distributed iPads and students accessed the on line tool: quizlet.com (Figure 11).



Figure 11. Review and Study Tool Quizlet.com.

Students used the tool to create flashcards to learn key vocabulary. They used the program to review material in class and at home. Later, I administered the constructed response formative assessment: Understanding Microbiology and Immunology Quiz, in the same manner as I had in past units. I scored it the same as before. Classroom notes and links were posted to the teacher website, and students were given their summative assessment. It was scored the same as in prior units. After the test I distributed the technology use reflection questionnaire and also did an informal assessment of student feelings about using technology.

The 5th unit and 6th unit were geology units. During the Geology: Earth's Surface unit, I introduced vocabulary mapping using Inspiration software, and posted a Wiffiti message board for students to communicate their muddiest point questions from home. These questions were addressed in class the following day to reinforce student understanding. Both the Earth's Surface and the Oceanography units followed the same methodology as all prior units using the technological tools that were previously introduced. However, I extended previously used teaching methods by assigning classroom group challenges where students were given the opportunity to create their own technology applications. First, while in groups of four, students were given data and were required to use the data to create a bar graph. To do this, they had to collectively teach themselves how to learn and apply graphing software, either Numbers, Open Office, or Appleworks. Secondly, students were asked to create their own webquest questions. Several days later they were asked to do those webquests themselves. Following both challenges I assessed student confidence, enjoyment, and acceptance of the challenges through informal whole class discussion. Additionally, before each unit

test, students were introduced to and presented with films from the Khan Academy. Classroom notes and links to those films were posted on the teacher website (Figure 12). Students were again encouraged to review the information provided to prepare for their assessments.

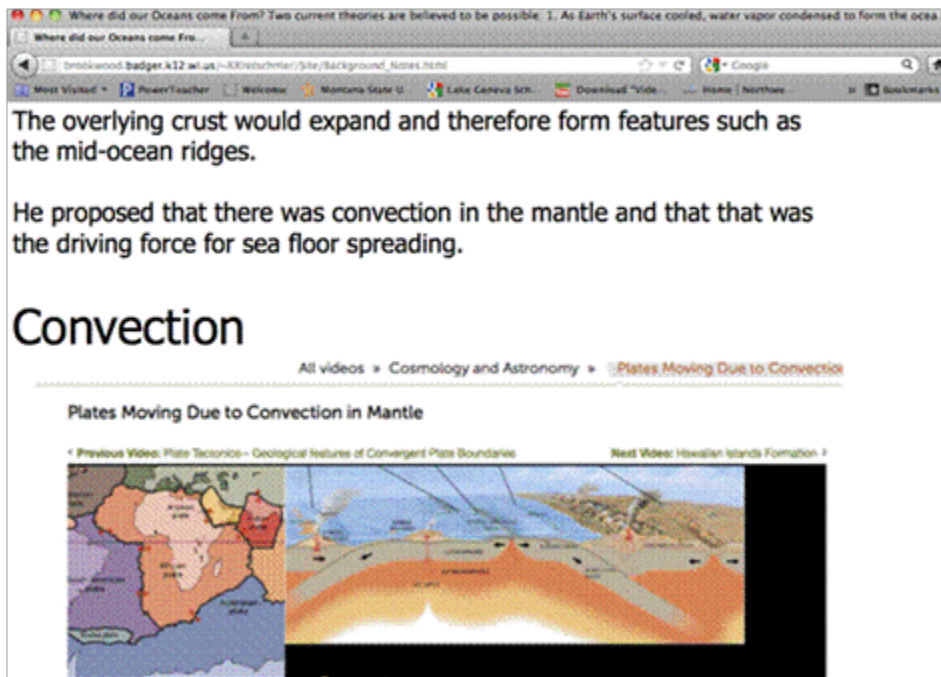


Figure 12. Classroom Review Pages with Khan Academy Video Links.

In summary, I continued to introduce new technology until my lesson plans became saturated with opportunities for students to learn using 21st century technical tools- I continued to encourage students to seek and to use the opportunities available to them both inside and outside the classroom. I used formative assessment strategies throughout the learning process to validate whether or not they successfully gained a better understanding of the concepts being taught. In all cases I gave the formative assessment quizzes (Appendix I), and journal reflection prompts (Appendix M), to gauge how much students understood before the lessons and technology infusion and how much

they gained following the immersion. Nearing the end of each unit I also asked students to create artifacts to express their learning in the form of laboratory reports, computer aided and generated concept maps, graphics, presentations, models, and/or analysis writing. These were also used as formative assessments to determine the level of understanding of the science concepts being taught. I also continued to academically gauge success of learning through a Teacher Created Unit Test for every unit (Appendix K). After each unit test I administered both the Post Test Self Reflection Questionnaire and the Technology Use Reflection Questionnaire to determine if the technology resources were helpful, and how students elected to prepare for their test (Appendix G and L). I tracked and compared all data responses for all units.

Within each unit of study, the data assessment included specific instruments that I used to compare student progress and understanding of the science objectives. I also tracked their satisfaction with the technology choices to determine if they were using them independently outside of class time. At the end of the six units of treatment I compared the pre treatment assessment responses with similar post treatment assessment responses to determine student participation and satisfaction with their technology options and to see if their culture of learning changed for the better. Many data sources were used to evaluate students using both qualitative or quantitative and formative or summative assessment strategies. The method of data collection and techniques are summarized in the data triangulation matrix below (Table 2).

Table 2
Data Triangulation Matrix

	Qualitative Data			Quantitative Data
Research Focus Questions	Experiencing	Enquiring	Examining	Evaluating
Will students have increased understanding of concepts, content knowledge, and objectives?	Observational Journal	Informal Interview/ Thumbs up, down	Constructed Response, Artifacts, Laboratory Analysis, Self Assessment	Teacher made tests, quizzes
Are students willing to spend more time engaging in science inquiry in and outside of class if tech use is encouraged?	Informal Interview/ Thumbs up, Thumbs down, Class discussion	Questionnaire/ Survey, Student Journal Responses	Artifacts, (Assignments, Projects, Models)	Questionnaire/ Survey Semantic Differential or Likert Scale
Are students more likely to ask for assistance if tech tools are made available to them?	Questionnaire/ Survey, Class discussion	Questionnaire/ Survey, Class discussion		Questionnaire/ Survey Differential or Likert Scale
Will students spend more time studying if info reinforcing learning is available?	Questionnaire/ Survey	Questionnaire/ Survey		Semantic, Likert Scale, Questionnaire

DATA AND ANALYSIS

Pre-Treatment

When asked if students had used technology to learn, 58% of students responded that they had ($N=62$) (Figure 13).

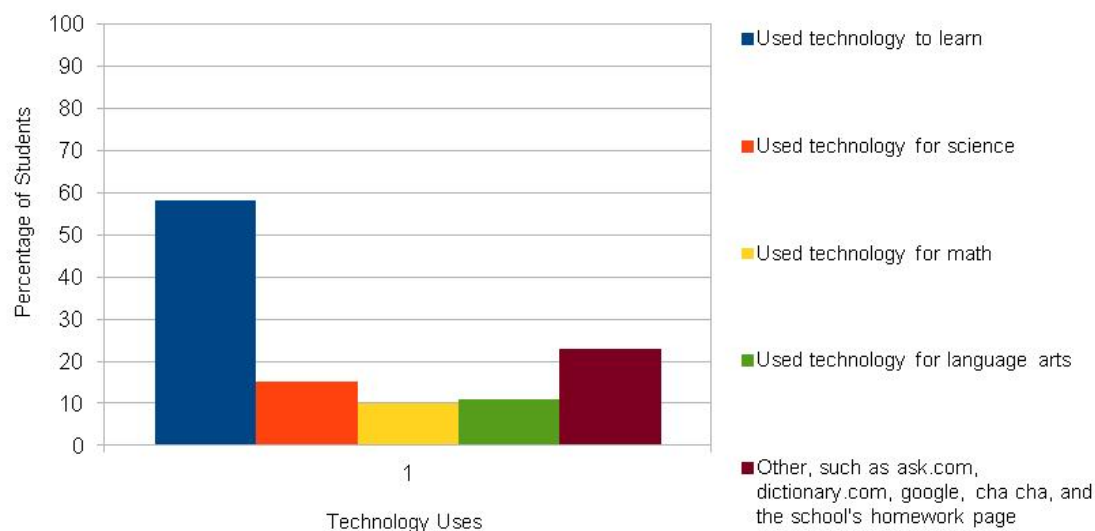


Figure 13. Technology Use, (N=62).

A few students commented that they have been successful with technology at home. One student said, “Some ways that I have used technology to learn is by using my phone to look up something, also using my computer... it has worked for me because if there is something in the book that I don’t understand, I can look it up to see if there is an easier way for it to make sense.” Others commented that if they were given training and access to technology tools that they would find it beneficial, “I would use games and practice answering questions to study for tests to see if I am right or wrong, if I am wrong I need help but if I did do it right then I don’t need any help.”

Most students reported that they enjoyed using technology, and nearly 90% said that given the choice they would prefer being taught with technology integrated within the traditional classroom. Some students were afraid that if technology tools were introduced there would be fewer laboratory experiences. Eight percent of the students who said they would rather learn science using traditional methods said something about how they learn better doing experiments, or “hands-on.” One student summed her

thoughts up by explaining, “I would (prefer to) learn science the old fashioned way because then I could really do experiments, on an iPad you can’t touch the experiments. I think teachers are a little better when they offer tech, but really I think that we should just read from the books and learn it in person, not on a screen.”

Another commented, “I think it is more fun to do experiments like with the goo and other stuff, than when someone does it for you on like YouTube or something.” More than half of students surveyed enjoy science, the most frequent response to questions relating to whether science was fun was that they *agree* that it is (59%).

Most students consider themselves good at using technology, but are not as confident in themselves with regards to science. According to the student responses relating to confidence in science on the Student Attitude and Experiences Questionnaire, more than half of students are confident with their ability in science (61%). More students are very confident with their ability to master technology. According to the Pre-Treatment Technology Use Questionnaire, many think that students are better at technology than teachers (Figure 14). Remarkably, 90% of students felt that they were as good or better at using technology than teachers, mostly because they, “are the technology generation,” “...because we have been using tech (for) our whole life,” and “because we were born with technology.”

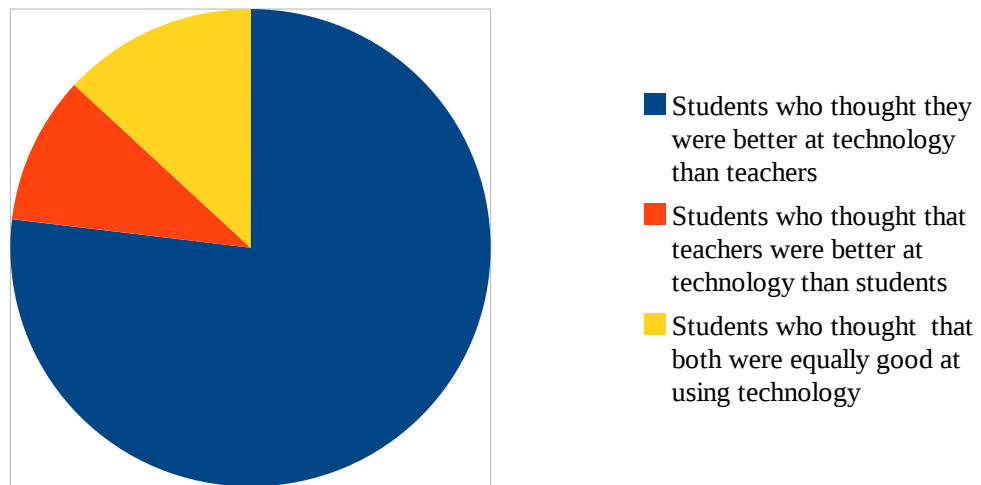


Figure 14. Technology Skill, (N=62).

When asked if students had problems or concerns about using technology, 27% of students have had some problem and mentioned something discouraging about using technology. Of those students who had problems with technology, 35% said that using technology made learning or doing their homework harder, some students were frustrated with having too many choices, “It made it hard to find the right answer because Google had like thousands of websites and I went to six websites and none of them had anything about what I need.” Others had trouble with websites that were not “in kid terms,” and others said that when the teacher was using the Smartboard, they felt like they were just watching, “someone else do something,” when they’d rather do it themselves.

Nearly 18% said that using technology was boring, stating, “Technology in school is okay, but I don’t like constantly going on the computer every day,” and, “I think we should learn in person and read from the book, not on a screen. If I sit there and stare into a screen all day my eyes will start to hurt. It’s not like we sit and stare into a screen all day... yet, in the future we might.”

Additionally, 47% mentioned infrastructure problems relating to printers not working, server crashes, slow Internet, software stalling, and work being lost (Figure 15).

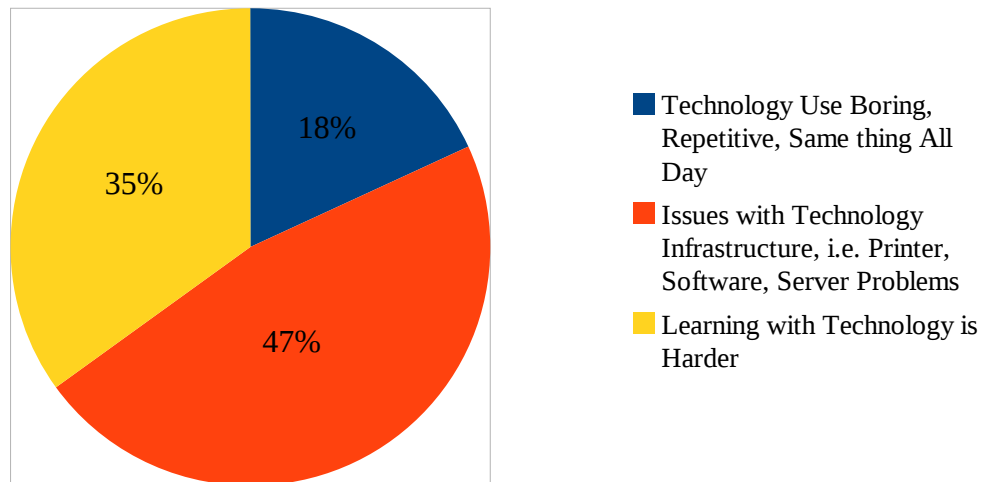


Figure 15. Technology Difficulty, (N=62).

One student summed up his concerns when he said, “Well, the only thing I don’t like about using technology is if something shuts off while you’re using it, because then you have to start all over (if it doesn’t save)!” Another stated, “The only time technology is a pain in the butt is when a server crashes, or something gets deleted on accident or maybe the printer breaks.” A third student wrote, “Sometimes technology is harder because there are a lot of viruses your computer can get easily or your computer/iPad/cellphone can run slow.”

The results of the Student Independent Learning Pre-Treatment Survey indicated that none of them spent time looking up information related to science lessons more than *sometimes*. Even then, only 47% said *sometimes*, while the other half answered *hardly ever* or *never*. The numbers were slightly higher when asked if they spent time outside of school studying for tests and quizzes. About 23% spend time outside of class studying

for quizzes and tests *often*. A similar amount, 24% admitted to studying for quizzes either *hardly ever*, or *never* at all. With regards to collaborating with parents or even discussing science lessons with parents, only 26% of students approached their parents *often*, and 13% of parents approached their children. Students *hardly ever* or *never* asked their parents questions about science 47% of the time. Parents approached their children to assist them with science *sometimes* 44% of the time. Students are more likely to collaborate with their friends. They contact their friends for help with their science homework 56% of the time, at least *sometimes*.

Post-Treatment

Cell Unit

The results of the Understanding Cells Quiz (Appendix I) before and after the Webquest: Cell Research Using iPads (Appendix J), indicated that students in the Advanced Lexile grouping ($n=7$), had the greatest increase in their level of understanding with an increase of 41%. Students in the Proficient ($n=36$) group increased their score by 36%, and students in the Below Proficient ($n=19$) Lexile group, had an increase in their score by 31%. An informal assessment of student feelings about the webquest indicated that students did not like some of the questions because there was, “too much to answer.” One student explained, “Just when I thought I was nearly finished I clicked on question (d)... I was like, oh no, no way I have to do this much more!”

The Technology Use Reflection also indicated that, in general, 85% of students felt that they benefited from increased technology, both inside and outside of the

classroom. One student wrote, “I learned more about the Golgi, (I didn't get it), and, more about the plant cell parts, (they weren't in the book). I also learned how different parts of the cell worked by watching the animations.” This is evidenced by two definite themes that emerged in student responses: technology helped students gain a better understanding of the material and technology was useful for reviewing for the test and reviewing the vocabulary (Figure 16).

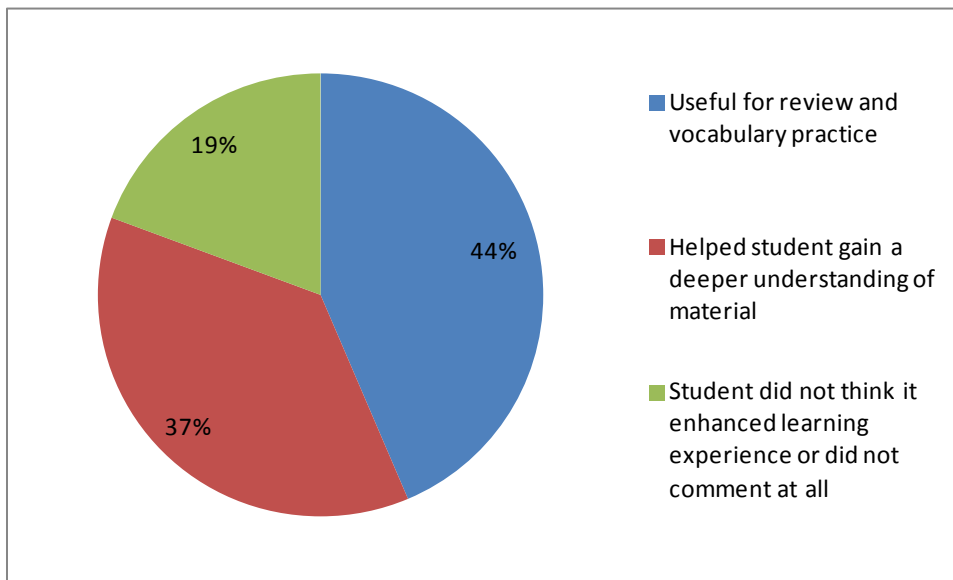


Figure 16. Technology Use Reflection: Cell Unit, (N=62).

Students also voiced their appreciation for the review materials that were made available on the teacher web page, “A couple of things I learned by using technology was probably some of the stuff like the links on prokaryotic and eukaryotic. Because if I looked up something we reviewed, it would show more of an explanation and a picture, too.” They also used the on-line quizzes. One student said, “It helped me with memorizing the parts of the cell, when we did the internet quiz on Monday that really helped me.” Another wrote, “It was easier to remember who first made the microscope. The many quizzes we could go to helped with a lot.”

In addition to student perception of understanding, the assessment data for all three Lexile groups indicated a progressive increase in content understanding as technology was introduced and implemented in the unit (Figure 17).

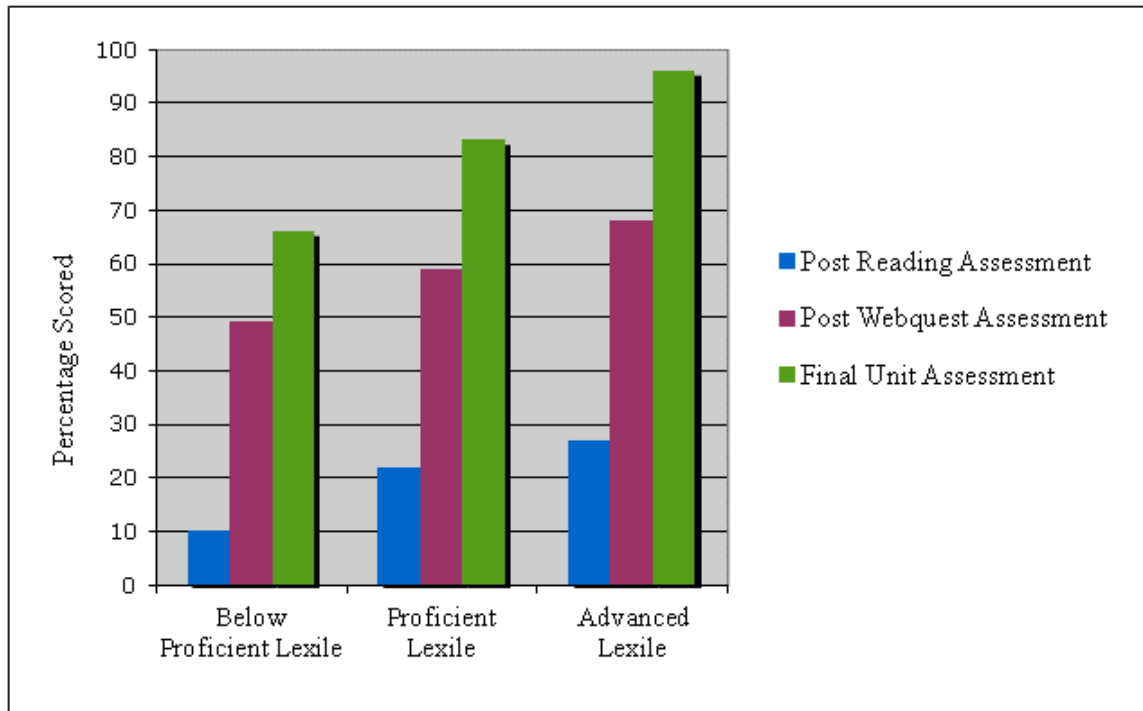


Figure 17. November Charted Growth: Cell Unit, (N=62).

Life Unit

The Lexile level grouped results of the Assessment: Understanding Living Things Quiz indicated that the students in the Advanced Lexile grouping, and the students in the Below Proficient Lexile group had the greatest increase in their level of understanding. Both increased their score by 40%. Students in the Proficient group increased their score by 36%, also showing a marked increase in understanding. The increase in understanding was also obvious by the range of depth in the answers given before and after using technology. One example was when students were asked to explain the

difference between simple and complex carbohydrates. At first attempt, one student answered, “Simple carbohydrate has sugar and complex has some sugar.” But, after technology was used, this same student answered, “The simple carbohydrates have less sugar than complex carbohydrates. The complex carbohydrates have more sugars connected into long strung out ones.” Another question asked students to explain how proteins are used by an organism. A student first answered, “Proteins are used by an organism by dissolving it and then it turns it into energy or ATP.” After technology was implemented, this student answered, “Proteins are used by an organism by coming into the body as food. We dissolve the food and it’s then turned into little proteins. The proteins help make the organism have more tissue or muscle or energy or whatever the cells need.” These responses reflect the level of responses that most students gained after technology was implemented in the unit.

Summative assessment data showed an increase in understanding throughout for all three Lexile groups. The scores indicated a progressive increase in content understanding as technology was introduced and implemented in the unit (Figure 18).

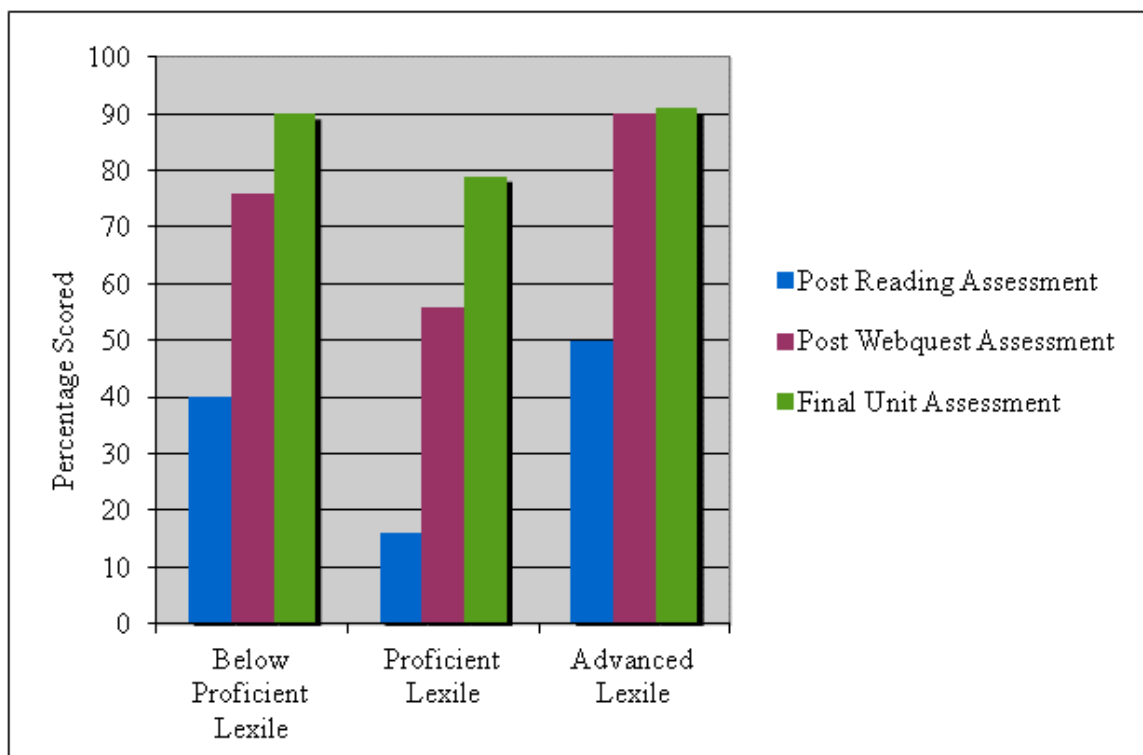


Figure 18. December Charted Growth: Life Unit, (N=62).

Journal reflections expressed that most students, 79%, liked the images or animations and that they provided a deeper understanding and agreed that being able to look at those was helpful. After reading the text and taking notes, many students were unclear about how cells processed nutrients until the instruction was enhanced by video. This was evidenced by responses like, “I really didn’t get how the proteins are made from amino acids until we watched the movie.” Students also used the posted laboratory images while they were completing their lab analysis; nearly 39% reported a benefit in having these images available. Had they not been able to access these images on-line, they would have had to rely entirely on their notes. One example of a student who expressed this wrote, “I looked at the lab pictures and it helped me answer my questions, I could see what happened and remember better.” Students also positively responded to the projected slide images, 28% mentioned this in their reflections, and reported that, “it

was cool to see the protozoa, they look like monsters,” and, “when we saw the cilia on the screen it made it easier to understand how they work.” Although students thought the Wiffiti message board was, “cool,” and, “fun,” not a single student indicated that the message board improved their ability to understand the material. Cell phone use was mentioned as a benefit to their learning less than 1% of the time and in those cases, where the phones were mentioned, the students were looking up vocabulary words while in the car or texting their friends for answers to questions they could not find on their own.

The Technology Use Reflection also indicated that, 87%, agreed that learning in this way was helpful. One student said, “A couple of things that I learned by using technology was probably some of the stuff we were reviewing because if I looked up something we reviewed it would show an animation or more of an explanation,” another explained, “Something it helped me learn was, mostly everything. I learned a lot after school, it all would have been much more difficult without it.” Students who replied that they did not find technology helpful either did not try to access the web resources outside of school, or could not access the internet at home, or didn’t feel they needed it. For example, one student wrote, “I really have not learned much with technology that I didn’t already understand because I already know all the information that I need.” Overall, it was clear by students’ answers that most felt they benefited from the opportunity to use technology inside and outside of the classroom.

Immunology Unit

Students in all lexile groupings had similar gains in understanding. The Advanced Lexile grouping average scores increased by 41%, students in the Proficient

group increased their scores by 42%, and students in the Below Proficient Lexile group, had an increase in their score by 42%.

Overall content understanding showed gains after vocabulary practice Quizlet.com, virtual poster presentations, webquest and independent web based research using desktops, laptops, and iPads (Figure 19).

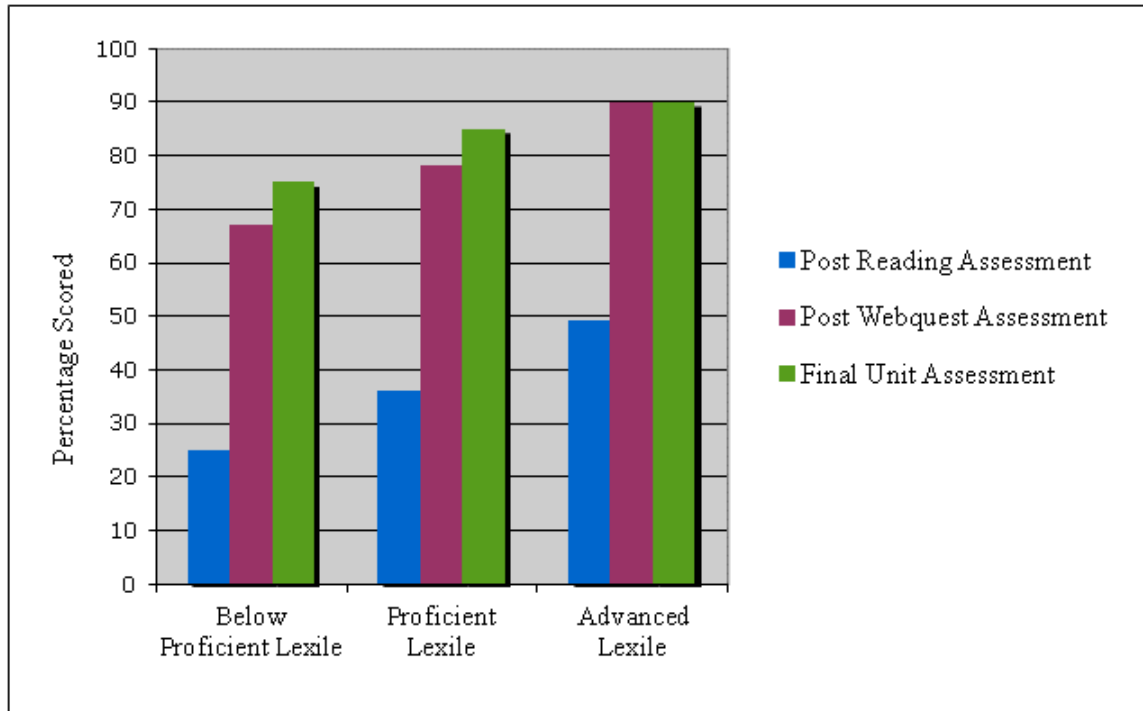


Figure 19. January Charted Growth: Immunology Unit, (N=62).

Reflections after the test indicated that students appreciated the teacher web page, with 59% of students specifically mentioning having gone to the web page to access supplementary materials while learning the material. Students wrote comments like, “All of the animations and diagrams were really helpful in my learning experience. It made learning more fun, you actually got to see how something worked,” and, “The virus webquest links helped a lot because they were fast and reliable. The game of the immune system helped me understand a lot better and the websites with pictures of types of

bacteria helped me understand the different types better...it was easier for me to learn how the immune system works, I didn't really get it in class."

The Technology Use Reflection indicated that 80% of students benefited having to learn the Open Office program, research using iPads, constructing a virtual poster, and presenting their newfound knowledge to the class. One student wrote that he, "learned while using technology lots about salmonella with (his) presentation and lots of things about microbes and pathogens while watching everyone else's presentations," and another reported that, "I learned about my bacteria (tuberculosis) that I would never have learned without technology and making a poster with a graph helped me a lot, plain teaching is confusing to me sometimes, reading on iPads and going on line really helps me!" Overall, even though not all students mentioned all of the tools that they used during the unit, those who did mention the smart phone use, delicious.com, Quizlet, and Wiffiti had positive remarks about them. The only negative responses that I received were with regards to how slow pages were when loading, and how transferring outside of school was frustrating because computer software and versions varied in compatibility.

When students were asked to express if they were getting better at technology, 72% of them responded with a "thumbs up," meaning better than before. There weren't any students who responded with a "thumbs down," meaning worse than before. However, 28% of students felt that they were just as good at technology as they were before the school year started. When asked to respond in the same manner, thumbs up or thumbs down, with how confident they were now about learning science, compared to before treatment started, 45% reported that they were more confident now than they were

before, 47% felt the same about science, and 8% felt they weren't as good at science as they used to be (Figure 20).

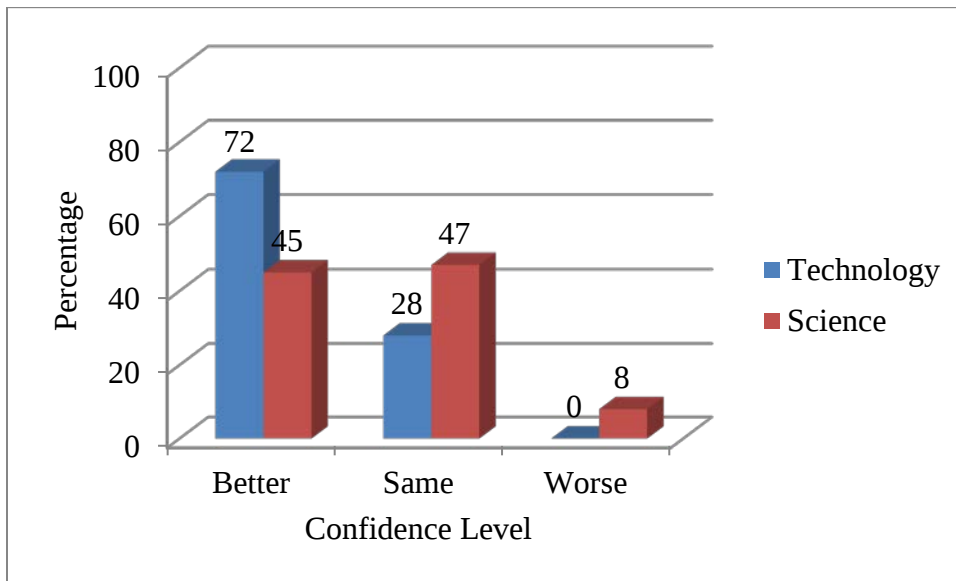


Figure 20. Change in Confidence Level, (N=62).

When asked to write a journal response explaining their thoughts about their levels of confidence, most students wrote positive reflections about using technology. Typical answers included responses much like the following examples: “When I use technology, it makes me think more, it helps me more because that is what I’m used to,” and, “Well, at the beginning of the year I really didn’t know there was so many science websites that are helpful. Now, I can search something on a science site instead of google to get a more clearer answer. I think using technology is sort of fun!” Very few students felt that they were worse at science than they were at the start of the school year. They did not attribute that to the use of technology, though. They just believed science was more difficult. The students who thought that they were “worse” at science than they were before wrote answers like, “science over all is getting more difficult to learn than before,” and, “Science is harder than last year.”

Earth Unit

After implementation of the two student driven challenges, creating their own webquests, and learning how to electronically construct a bar graph, the Lexile level grouped results of the Assessment: Earth Is Always Changing Quiz indicated that the students in the Advanced Lexile grouping had the greatest increase in their level of understanding. Their score increased by 41%. Students in the Proficient group increased their score by 39%, and students in the Below Proficient Lexile group, had an increase in their score by 30%.

Student answers improved after they were exposed to videos, animations, and digitally enhanced explanations of information. Post reading, one student answered, “I think I remember that soil comes from rocks being melted in volcanoes.” Post technology, the same student answered, “Soil comes from a parent rock. As this rock is chemically weathered, like from acid rain or oxidation, or physically weathers, like from ice wedging or another form of physical weathering, it doesn’t matter, the rock will start to break down. It will continue to break down over time and bit by bit the rock will get smaller and smaller until finally it is fine bits of soil. Erosion and deposition can have a part in physical weathering, too, and this will also help make soil.” Another example on the first attempt, before technology implementation, a student responded, “The landscape of Wisconsin has not always been how it is today because of storms and tornados and mini earthquakes that have caused the ground to have moved, or other damages by nature.” Later, she responded, “The landscape of Wisconsin has not always been like this because of the Wisconsin Ice Age. When the glaciers melted, torrents of melt water and ice tore gorges into the landscape. Leftover debris also moved soil into new areas.

Tectonic plates also made little earthquakes happen by rubbing against each other. Most of the lakes and rivers in Wisconsin came from the melting glaciers.”

The Post Treatment Technology Use Reflection (Appendix N) indicated that students were most impressed with the Khan Academy videos, 84% thought that they were useful in learning about the Earth’s changing surface. One student wrote, “I thought the videos were very helpful because I don’t always understand the book, so the videos really just sum up the book. The fact that he draws, too, helps... it’s also helpful to be able to return to the videos to review.”

Students were also quite happy with the “creating your own webquest” assignment, 79% mentioned that they benefitted from the assignment. One student explained, “I liked creating our own webquests. I liked it because we could see what you go through trying to create one for us. Plus, we were doing research and studying without really even knowing it. When I did my webquest, some of the information I read really clarified some of the things I didn’t understand before.” Another student wrote, “I think it was helpful because you actually had to read some of the websites to know what question to ask, so you can’t just skim and be done in 5 minutes.”

Nearly as many students, 77%, expressed that they used and appreciated the Ms. Kretschmer Science web pages. Of those students, most used the pages throughout the unit and not just for study purposes. One student wrote, “Yes, I thought these pages were helpful. I liked that the links to the videos and other websites were there after the lesson. Also, if we needed to review the notes, they were easy to access.” Another student appreciated, “not having to carry extra stuff home,” and still be able to, “review everything we mostly learned in the past.” Finally, another student summed up her

appreciation when she wrote, “This was very, very helpful. I love that you have everything on (your) page. It really helps me understand everything and I like it when I have stuff (to access). I really like it because when I have a question, it’s there.”

The bar graph team challenge was not as popular, and only 44% of students thought it was worthwhile. Most students who answered that they thought it was beneficial quite simply mentioned that it was, “fun,” and that they, “liked working with partners,” and that they, “liked the competition.” Very few of the students described the activity as being a learning tool. Most of the students complained about it being, “too stressful,” or, “too hard to learn by themselves.”

The concluding summative assessment for this unit followed the same trend as earlier units as students exhibited a gain in overall content understanding. This was once again evidenced by their final assessment scores (Figure 20).

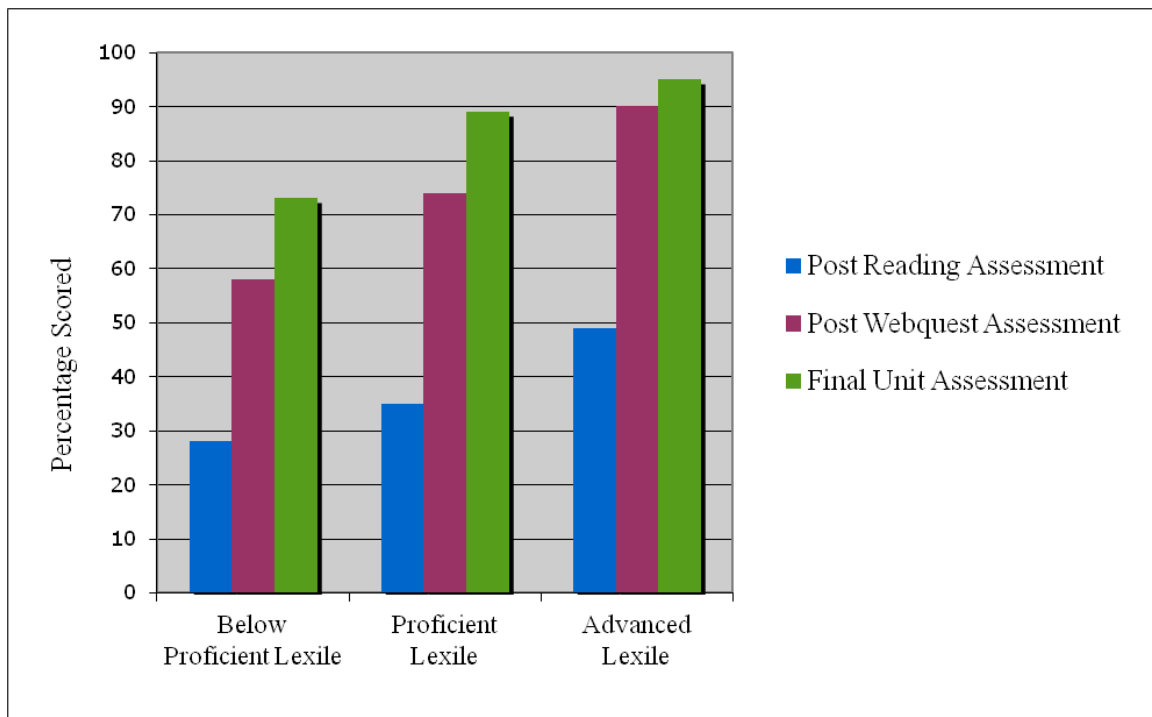


Figure 21. February Charted Growth: Earth Unit, (N=62).

Oceanography

The results of the Oceanography Quiz indicated that students in the Advanced Lexile level had a greater gain in understanding with the average scores increasing by 48%, students in the Proficient Lexile group increased their scores by 37%, and students in the Below Proficient Lexile group had an increase in their score by 37%. Student responses were better after viewing various films describing the pollution in the ocean in the Pacific gyre, this was evident in the improved details in student responses. For example, when asked to differentiate between deep currents and surface currents, one student initially wrote, “A current is where the water is wavy the most. They are similar by they both having to do with the oceans and the way they move.” After exposure to animations, films, and links related to currents in the ocean student understanding increased substantially. The same student later wrote, “A current is a cycle in the ocean. When there is something in the ocean if it gets stuck in a current it will stay in it until it eventually washes up on shore somewhere. Deep currents and ocean currents are similar because they both go in a cycle. They are different because deep currents are deep and surface currents are higher and gather things like trash.”

Student summative assessment scores for this unit were an anomaly, since, for the first time, they did not gain any points on average (Figure 21). This might be due to the fact that Spring Break fell in the middle of the unit, or that students did not read the second part of the reflection question. Most students lost the most points because they neglected to answer that part of the question.

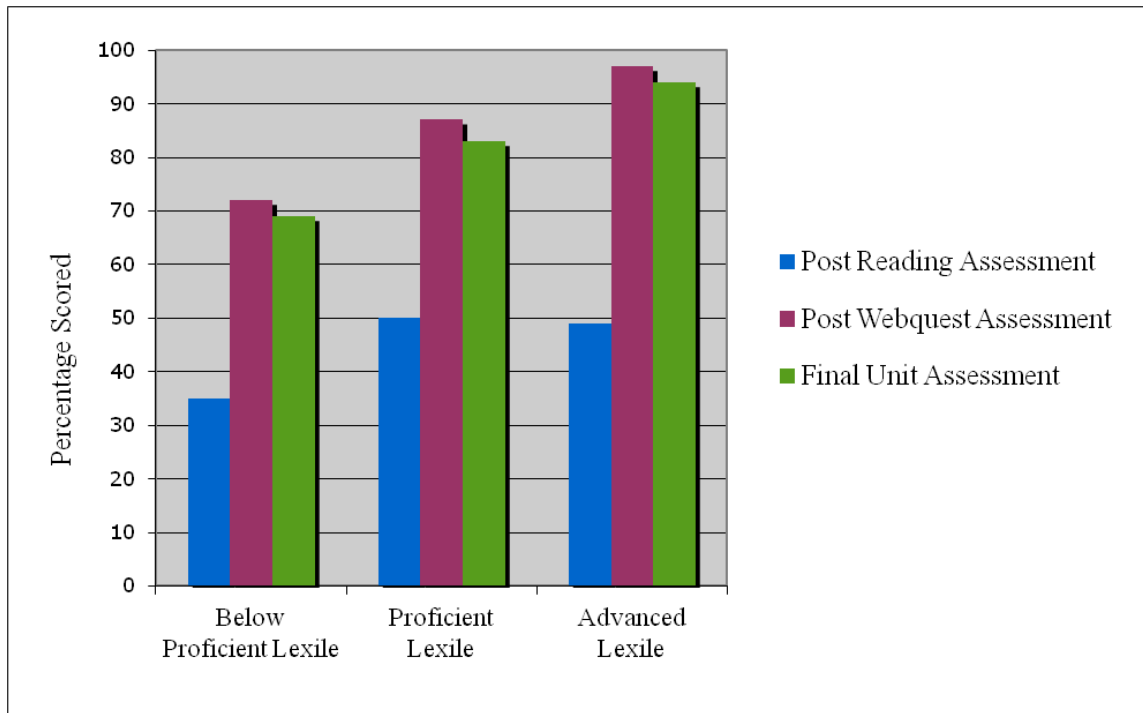


Figure 22. March Charted Growth: Ocean Unit, (N=62).

When I asked students to reflect on the benefits of using technology during the oceanography unit, most students were enthusiastic, especially with the wave animations, 95% of students specifically mentioned that these animations were essential to their understanding of the concept of a wave. Student responses were similar. An example of one such response was, “The wave animations helped me the most. The “Longitudinal Wave” animations helped me, because now I fully understand how longitudinal waves move, because I was confused before. Now, I see that longitudinal waves look just like slinkies, if you move one end of the slinky, the energy transfers through the rest of it.” The Great Garbage Patch YouTube videos were also mentioned by a number of students, 75% of students felt that those videos had a greater impact on their understanding than the reading alone.

INTERPRETATION AND CONCLUSION

Data from the Post-Treatment Technology Use Questionnaire (Appendix O), indicated that, in general, students benefitted from the treatment. This is evidenced by two definite themes that emerged in student responses: technology helped students gain a better understanding of the material and technology was useful for reviewing for the test and reviewing the vocabulary (Figure 11). Post treatment responses revealed positive student perceptions and an increase in appreciation and usefulness from having been exposed to increased technological tools for learning. At the start of treatment, 81% of students felt that they benefited from increased technology, both inside and outside of the classroom; following treatment, 95% of students felt they benefitted. This included the 24% that appreciated having the option to review and access information on-line to better prepare them for tests and quizzes and the 71% that were provided resources to research information and query answers to questions to better understand the content that they were being taught. The most notable difference was that students changed their behavior from simply using the tools for memorization and recall to using the tools for inquiry and investigation (Figure 22).

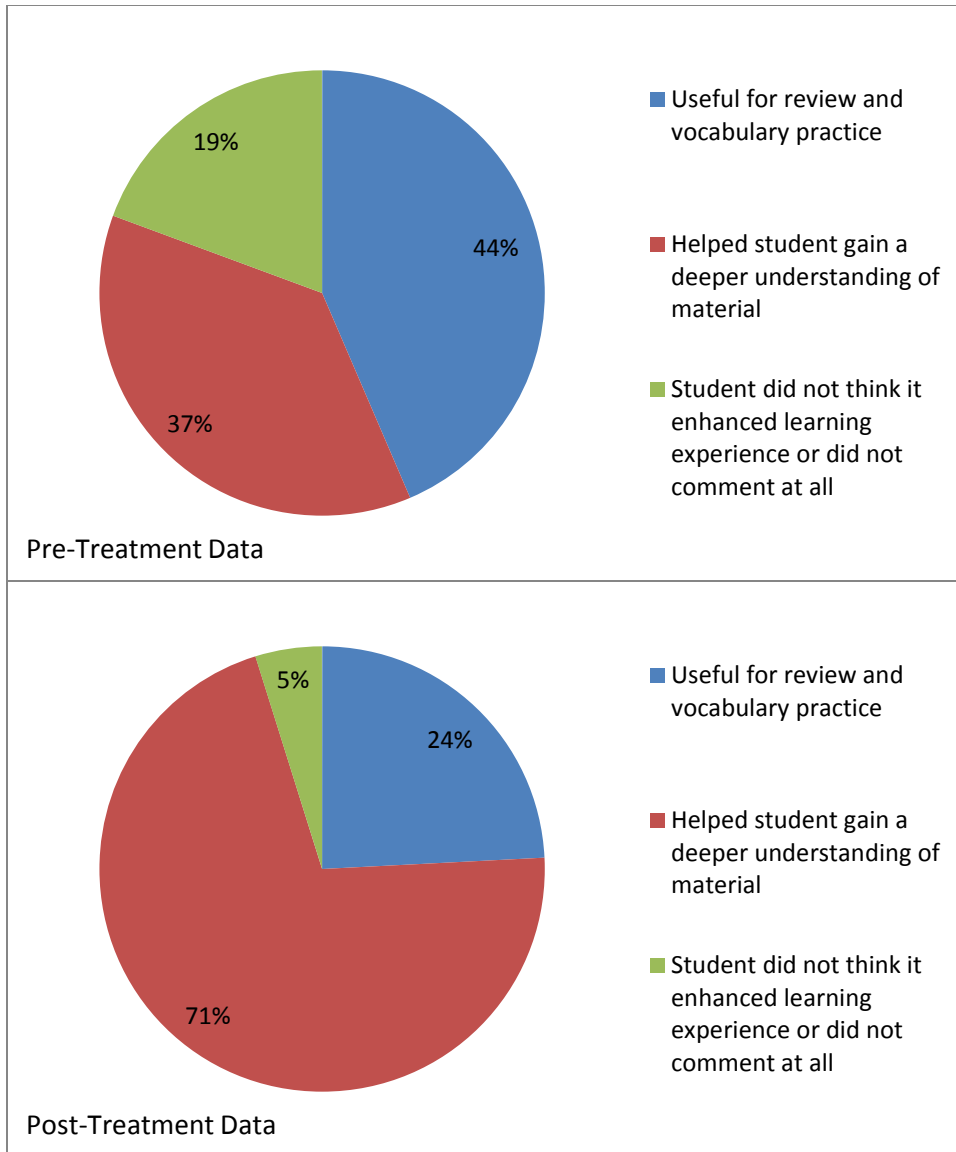


Figure 23. Technology Use Reflection: Pre and Post Treatment, (N=62).

To assess if there was a change in how students spent their time outside of school either working independently on science or collaborating with their friends or their family members, I distributed the Student Independent Learning Post-Treatment Survey (Appendix P). Before the treatment, when students were asked if they spent time outside of school looking up information related to science lessons, none of them answered that they did more than *sometimes*. After treatment, 11% said they spent time outside of

school looking up information often and 57% said *sometimes*. This is far better, with 68% of students spending time outside of school using scientific inquiry as compared to 47% who said that they did before.

The numbers fell remarkably when students were asked if they spent time outside of school studying for tests and quizzes. Before the treatment, about 23% spend time outside of class studying for quizzes and tests *sometimes, or often*. A similar amount, 24% admitted to studying for quizzes either *hardly ever*, or *never* at all. Surprisingly, after the treatment, 52% admitted to studying for quizzes either *hardly ever*, or *never* at all! When I compared the above results from the Student Independent Learning Post Treatment Survey to the data collected from each Post Test Self Reflection Questionnaire, the data appears inconsistent. Immediately following each student summative assessment, students reported studying at least 78% of the time (Table 3)

Table 3
Student Unit Specific Report of Study Habits

Unit	Did you study?	Did you use the Ms. Kretschmer web page to study?
cell	81%	81%
life	87%	25%
immunology	88%	75%
geology	78%	60%
oceanography	80%	47%

According to the same surveys, the amount of time students reported using the Ms. Kretschmer Web page varied from test to test. However, post treatment, when asked how often students used the Brookwood Middle School, “Ms. Kretschmer” web pages to review material that we had covered in class, or to watch animations or simulations related to class, students responded that 24% of them used it *sometimes*, 40% of them used it *often*, and 23% of them used it *all the time*. This indicates that 87% of students

had in fact used the web pages most of the time. Likely, students only think that studying for a test includes the night before, and not the weeks prior to the test or during the course of the unit.

With regards to collaborating with parents or even discussing science lessons with parents, before the treatment, only 26% of students approached their parents *often*. This went down to 15% after the treatment. Before the treatment, 13% of parents approached their children *often*, but that dropped to less than 4% after the treatment. After the treatment, students reported that they *hardly ever* or *never* asked their parents questions about science, 52% of the time. Parents approached their children to assist them with science *sometimes* 44% of the time before and after treatment. These numbers did not change.

Before the treatment, students were more likely to collaborate with their friends. They used to contact their friends for help with their science homework 56% of the time, at least *sometimes*, but after the treatment, students only asked their friends for assistance 19% of the time. It is important to note that informal discussions with students revealed that contact with their friends meant getting their friends to just give them the answers to the questions, and not to actually help them to find the answers for themselves.

Overall, student independence while using technology changed rather dramatically, with 87% of students being confident enough in their own inquiry skills to access the web links provided and internet resources available both in and outside of the classroom. This was evidenced by the greatest increase in the number of students who spent time outside of school looking up information or reading about information related to their science lessons on their own (Figure 23).

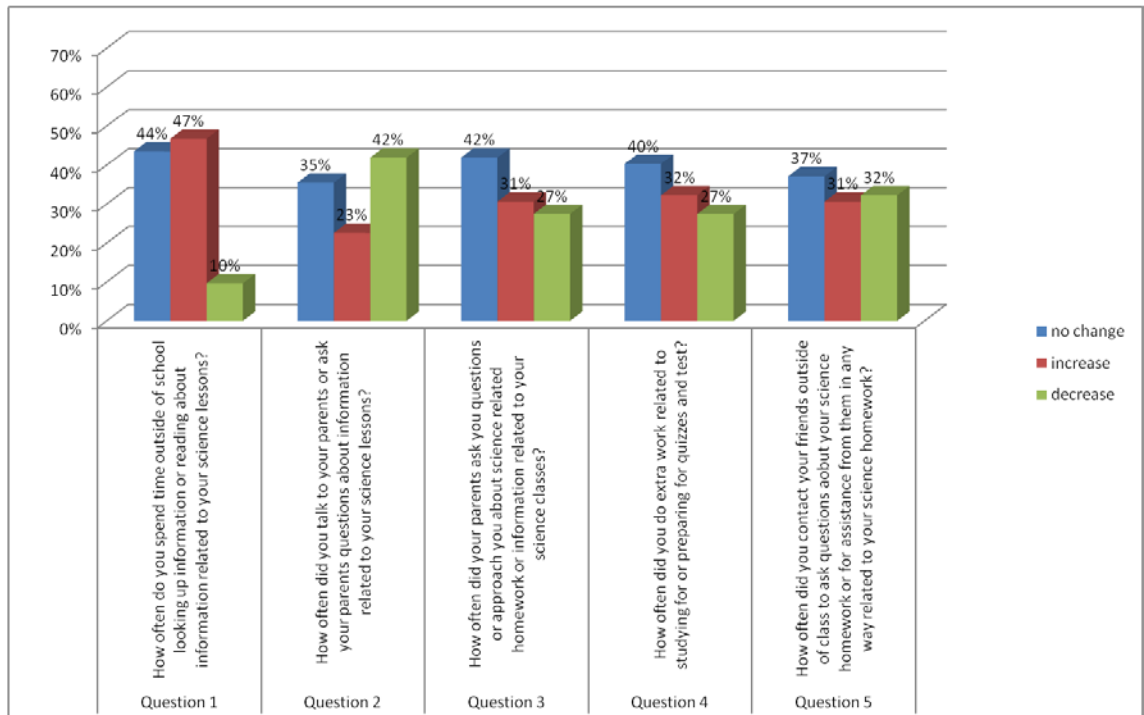


Figure 24. Changes in Student Independent Learning Habits, (N=62).

VALUE

Offering an array of 21st Century technological tools had varied results, with some showing far fewer benefits and ease of use than others. For example, students appreciated the on-line quizzes, but those were not always an available resource that I could provide for every unit. However, even when they were provided, students forgot to use them as a regular part of their study habit. When time was offered in class for students to create on-line study tools like Quizlet, they appreciated it, but usually this took longer than the class time that was available, and students didn't get back to them on their own.

Inspiration was a better tool for students to learn their vocabulary, but again, without setting aside multiple periods for students to use the software to complete an assignment, students did not choose to go into the program on their own. Interactive quiz programs like the microscope parts quiz were really only available if another organization provided

them for students to access. The same can be said for the interactive on-line content specific games; as software creators are not employed by most districts. Wiffiti message board was less of a direct resource for students, it did not enhance student learning because it is more of a resource for the teacher. It gave students the opportunity to ask questions or respond in a manner that made them anonymous, and I felt that I had more candid responses and questions than if students were to raise their hands, but as a learning tool for students it was not particularly useful. Table 4 summarizes the benefits and disadvantages of the various technology tools that were used in this treatment.

Table 4
Advantages and Disadvantages of Technology Tools

	Easy for Students to Use?	Readily Available for Teachers to Post?	Teacher Must Create to Post?	Conducive to both in school and out of school access?	Teacher Tool with Instructional Benefit?	Student Tool that Benefits Student Learning?
Webquest Activities	Yes	Varies by Unit	Yes	Yes	Yes	Yes
YouTube	Yes	Varies by Unit	No	Yes	Yes	Yes
Khan Videos	Yes	Varies by Unit	No	Yes	Yes	Yes
Teacher Web Page	Yes	No	Yes	Yes	Yes	Yes
Wiffiti Message Board	Yes	No	Yes	Yes	Yes	No
On-line Instructional Games	Yes	Varies by Unit	No	Yes	Yes	Yes
Quizlet	Yes	Yes	No	Yes	Yes	Yes
Inspiration	Yes	N/A	N/A	No	Yes	Yes
Interactive Quizzes	Yes	No	Varies by Unit	Yes	Yes	Yes
Podcasts and Video Recordings	Yes	No	Yes	Varies by Unit	Yes	Yes

By far, the tool that offered the greatest positive impact on student learning was the teacher web page. Time and again, students responded that they appreciated the Ms. Kretschmer web page and the links and notes provided. Students accessed the varied animations, video, simulations, and interactive quizzes and viewed the posted data and images that were available from their classroom experiences more than any other resource. Those students that felt technology was the most helpful combined their written resources, notes and book, with the on-line sources to enhance their understanding of the material. They came to expect that the information would be posted in real time, and this became a challenge for me as a teacher to keep as much information as possible available for them to access when they needed it.

A close second to providing the teacher web page for students was having a webquest activity for each unit. The most surprising data that I received was when students resoundingly approved of the “Create your own webquest” assignment. Truthfully, this was not planned. Classroom planning had gotten the best of me and having been sick the weekend before I did not have time to create the webquest that was needed for that unit. It should be noted that when I realized the worth of the webquests in earlier units, I felt it was essential to continue to provide them for the students. However, each webquest would take anywhere from three to six hours to create! For this particular unit I did not have one done, so I asked them to do it themselves. They loved it! However, had they not had three units of prior experience with webquests, I am not sure that they would have been able to create them on their own.

Saturating my classroom with technology definitely helped me to become a better teacher, I learned so much from doing this study. I realized that the success from using

technological tools is like the success of any other educational resource, it does not rely on any one factor. Also, the teacher must not only understand its purpose, but also keep in the forefront the specific objective or goals that they have in mind when using them. In an environment where 21st century technological tools are being introduced exponentially, teachers must be careful to choose wisely.

Teacher preparation is key, but knowing which tools to use for each specific goal is also essential. It is not enough for students to have fun, they also must learn! The greatest challenge for me was providing enough technological application and learning experiences without losing essential hands on laboratory activities. I kept student pretreatment concerns in the forefront of my mind. A number of students at the start of the treatment expressed that they were concerned that with an increase in technology there would be a decrease in labs. Unfortunately, they were right. It was unavoidable. I found myself replacing full classroom experiences with front of the classroom demonstrations. My greatest hope is that someday students will each have personal technological devices, i.e. their own iPads, or laptops, to take to and from school. But, having personal devices comes with it another set of problems, including streaming difficulties, exposure to inappropriate media, cyber bullying, income discrimination, etc. These were the main reasons why personal devices were not used extensively in my treatment. However, if there were ways to prevent negative uses, and if personal devices for all students of all income levels was a realistic possibility in the future, much time could be saved in an out of the classroom and student understanding of science could soar! Classroom difficulties with the infrastructure and hardware inadequacies such as

converting files, and streaming media would be few and far between, and more time would be available again for hands on activities.

During my treatment, I also realized there was an opportunity to improve science literacy while incorporating 21st century technology tools. This is an area that is a common core goal and that teachers are expected to address, so future studies in this area would be beneficial. Currently, laboratory experiences, scientific literacy, mathematical applications, communications of data using graphs and diagrams, technological skill, content understanding, and of course, laboratory performance skills are all areas that science teachers are expected to address. Undoubtedly, technological applications are necessary in today's world. As districts become more and more aware of the importance of connecting these applications to science and math it is becoming increasingly important that teachers are given the time and resources necessary to provide their students with enhanced instruction. I believe that in order to make this happen, districts need to develop and maintain functioning infrastructure, provide adequate classroom time so that hands on laboratory activities are not lost, and ensure that teachers are given the time that they need to prepare their curriculum to infuse the lessons with relevant information so that they maintain student engagement and use of the resources provided. If teacher's needs are met, then the applications would be endless. The knowledge, confidence, and excitement my students showed me during my treatment could very well be just as prolific elsewhere. Perhaps, with fewer infrastructure issues and a balanced classroom approach, classrooms would maintain essential hands on laboratory science experiences with students successfully incorporating independent technological tool use.

This would further feed their inquiry, confidence, and understanding, and teachers would have classrooms that radiate scientific excellence.

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APPENDICES

APPENDIX A

STUDENT ATTITUDES AND EXPERIENCES WITH LEARNING SCIENCE

Appendix A
Student Attitudes And Experiences with Learning Science

Directions: The statements in this survey have to do with your opinions and beliefs about science instruction in school and the importance of science in your life. Please read each statement carefully, and circle the number that best expresses your own feeling.

Remember that this is not a test, and there are no “right” or “wrong” answers. Please respond to every item.

1. To what extent do you agree or disagree with each of the following statements about science? (*Circle one number on each line*).

	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
a. I enjoy science.....	1	2	3	4	5
b. Science is useful in everyday life.....	1	2	3	4	5
c. Scientists often don't have very good social skills.....	1	2	3	4	5
d. Doing science often makes me feel nervous or upset	1	2	3	4	5
e. Science challenges me to use my mind.....	1	2	3	4	5
f. The science instruction that I have received will be helpful for me in the future.....	1	2	3	4	5
g. Scientists usually work with colleagues as part of a team.....	1	2	3	4	5
h. I am good at science.....	1	2	3	4	5
i. Advancements in science and mathematics are largely responsible for the standard of living in the United States.....	1	2	3	4	5
j. I usually understand what we are doing in science class.....	1	2	3	4	5
k. Knowing science really doesn't help get a job.....	1	2	3	4	5
l. Science is difficult for me.....	1	2	3	4	5
m. Working as a scientist sounds pretty lonely to me.....	1	2	3	4	5
n. Studying hard in science is not cool to do.....	1	2	3	4	5
o. Even without a strong background in science, I will probably end up with the kind of job I want.....	1	2	3	4	5

APPENDIX B

TECHNOLOGY USE: PRE-TREATMENT QUESTIONNAIRE

Appendix B
Technology Use: Pre-Treatment Questionnaire

1. What are some ways that you have used technology to learn? Did it work for you, why or why not?
2. If you were given the option of using technology to help you learn science concepts better, what tools would you choose, and how would you use them?
3. Given the choice between learning something using traditional methods: reading, writing, laboratory experiments, discussion, class notes, worksheets and review questions

OR

learning something using traditional methods PLUS using technology tools like laptops, iPads, cell phones, video equipment, and other interactive web based sources to learn. What would you choose, and why?

4. Have you ever found that technology use makes it more difficult for you to learn? If so, please give me at least one example. Explain why it made it harder for you.
5. Do you think teachers are better teachers when they offer technology? Why or why not? Give examples.
6. How good are you at using technology to learn?
7. Do you own a cell phone or or other portable device that connects to the internet? What is it? Do you bring it to school?
8. How often would you say you text during the school day? How about outside of school?
9. Did you ever use texting or the Internet to look up the answer to a question?
10. Who do you think knows more about using technology, teachers or students? Why do you say that?
11. Is there anything else that you would like to share with me about using technology in school?

APPENDIX C

STUDENT INDEPENDENT LEARNING PRE-TREATMENT QUESTIONNAIRE

Appendix C
Student Independent Learning Pre-Treatment Survey

1. How often do you spend time outside of school looking up information or reading about information related to your science lessons?

Never 1 Hardly Ever 2 Sometimes 3 Often 4 All the Time 5

2. How often do you talk to your parents or ask your parents questions about information related to your science lessons?

Never 1 Hardly Ever 2 Sometimes 3 Often 4 All the Time 5

3. How often do your parents ask you questions or approach you about science related homework or information related to your science classes?

Never 1 Hardly Ever 2 Sometimes 3 Often 4 All the Time 5

4. How often do you do extra work related to studying for or preparing for quizzes and tests?

Never 1 Hardly Ever 2 Sometimes 3 Often 4 All the Time 5

5. How often do you contact your friends outside of class to ask questions about your science homework or for assistance from them in any way related to your science homework?

Never 1 Hardly Ever 2 Sometimes 3 Often 4 All the Time 5

6. How often do you use the Brookwood Middle School "Ms. Kretschmer" Web Pages to review material we have covered in class, or to watch animations or simulations related to class?

Never 1 Hardly Ever 2 Sometimes 3 Often 4 All the Time 5

APPENDIX D

QUICK POST TEST SELF REFLECTION QUESTIONNAIRE

Appendix D
Quick Post Test Reflection Questionnaire

1. Did you study?
2. Did you look at any of the materials on my web page?
3. Is there anything you would like to tell me?

APPENDIX E

ADMINISTRATOR EXEMPTION AND PERMISSION

Appendix E
Administrator Exemption and Permission

Exemption Regarding Informed Consent

I, Kellie Bohn, Principal of Brookwood Middle School, verify that the classroom research conducted by Karyn Kretschmer is in accordance with established or commonly accepted educational settings involving normal educational practices. To maintain the established culture of our school and not cause disruption to our school climate, I have granted an exemption to Karyn Kretschmer regarding informed consent.

Kellie Bohn

(Signed Name)

Kellie Bohn

(Printed Name)

Oct. 20, 2011

(Date)

Administrator Approval Sign-off

I, Kellie Bohn, Principal of Brookwood Middle School, verify that

I approve of the classroom research conducted by Karyn Kretschmer.

Kellie Bohn, Principal
(Signed Name, Title of Position)

Kellie Bohn
(Printed Name)

Nov. 3, 2011
(Date)

APPENDIX F

EXCERPT FROM ACS MIDDLE SCHOOL CHEMISTRY LESSON*

* From <http://www.middleschoolchemistry.com/lessonplans/chapter1/lesson1>

Appendix F

Excerpt from ACS Lesson Plan

Note: Some solids, liquids, and gases are made of atoms, and some are made of molecules. Since the concepts covered in Chapter 1 apply to both atoms and molecules, the term “particle” is used as a generic term to include both. At this point, it is enough to give students simple working definitions of “atom” and “molecule.” You can tell students that an atom is the smallest building block of matter and that a molecule is two or more atoms connected together. Let students know that even though atoms and molecules are different, in Chapters 1 and 2, they will both be represented by circles or spheres. Chapters 3 and 4 will go into more depth about the structure of atoms and molecules and will use more detailed models to represent them.

ENGAGE

1. Have a discussion about chemistry and matter.

You could begin the first class by leading a short discussion. Ask students what they think the study of chemistry might be about. You can get a sense of student prior knowledge, identify some misconceptions, and just try to get students on the “same page.”

Tell students that chemistry is the study of matter and what matter does. You could go so far as to say that chemistry is the study of stuff and what stuff does on a very small scale. Ask students for the three common types of matter on Earth (solid, liquid, and gas).

Ask students questions such as the following to guide their thinking:

- **What are some examples of matter?**
Tell students that matter is often defined as anything that has mass and takes up space. Continue the discussion by using water as an example.
- **Does water have mass, and does it take up space?**
A bucket of water is pretty heavy to lift. It definitely has mass. It also takes up space in the bucket. Since it has mass and takes up space, water is matter. But that’s just the very beginning. In chemistry, we want to look deeper and find out more about what matter is made of and how it acts.

Give each student an activity sheet.

Students will record their observations and answer questions about the activity on the activity sheet. The *Explain It with Atoms & Molecules* and *Take It Further* sections of the activity sheet will either be completed as a class, in groups, or individually, depending on your instructions. Look at the teacher version of the activity sheet to find the questions and answers.



EXPLORE

2. Do an activity to explore the attractions water molecules have for each other.

In this activity, students look closely at a drop of water and move drops of water on wax paper. They see that the water holds together well and is not so easy to separate. The goal is for students to begin thinking about water, or any substance, on the molecular level and to conclude that water molecules must be attracted to one another. The reason for these attractions will be dealt with in later chapters.

Question to investigate

Does water hold together well or come apart easily?



Materials for each group

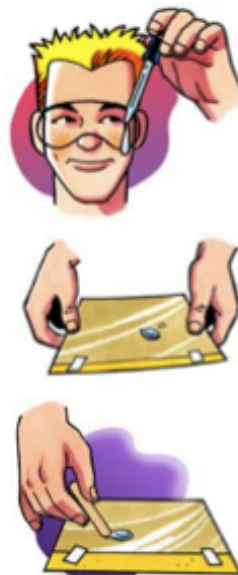
- Water in small cup
- Dropper
- 2 popsicle sticks
- Wax paper
- 2 large index cards (5 × 8")
- Tape

Teacher preparation

Cover a large index card with a piece of wax paper so that the wax paper completely covers the card. Tape the wax paper in place. Prepare two cards for each group.

Procedure

1. Use the dropper to gently squeeze out a drop of water but try not to let the drop fall completely out of the dropper. See how far you can make the drop hang off the end of the dropper without the drop falling.
2. Place 4 or 5 drops of water together on a piece of wax paper to make one medium-size drop.
3. Gently tilt the wax paper in different directions so that the drop moves.
4. Use a popsicle stick to slowly drag the drop around the wax paper a bit. Try using your popsicle stick to separate your drop into two.
5. Use your popsicle stick to move the drops near each other. Then move one drop so that the two drops touch.



3. Record and discuss student observations.

Give students time after the activity to record their observations by answering the following questions on their activity sheet. Once they have answered the questions, discuss their observations as a whole group.

- When you squeezed the drop of water out of the dropper, did the water break apart or did it hold together?
- When you tilted the wax paper, did the drop split apart or stay together?
- When you were pulling the drop around the wax paper, did the water seem to hold together or come apart easily?
- When you tried to split your drop, did the drop separate easily?
- What happened when the two small drops touched?

Expected results

The water beads up on the wax paper and stays together when the wax paper is tilted and when the drop is moved around with a straw. It is difficult to separate the drop into two drops. When the drops touch, they combine quickly and easily.

4. Do a demonstration to show that water molecules are in motion.

Materials

- Tall clear plastic cup
- Water (room temperature)
- White sheet of paper
- Food coloring (red, blue, or green)

Procedure

1. Add water to the cup until it is about $\frac{3}{4}$ filled.
2. Ask students to watch closely as you add one or two drops of food coloring to the water. Do not stir. Instead, allow the color to slowly mix into the water on its own.
3. Hold the cup up with a sheet of white paper behind it so it is easier for students to see the color moving and mixing in the water.

Expected results

The drops of food coloring will slowly move and mix into the water. Eventually all the water in the cup will be evenly colored.

Ask students:

How do your observations support the idea that water molecules are moving?

Help students understand that the drop of coloring mixes into the water because the water

molecules move and push the color in all directions. The molecules of the food coloring themselves are also in motion.

Note: In chapter 5, students will learn that water molecules and coloring molecules are attracted to each other. These attractions also help explain the mixing of the color in the water.

EXPLAIN

5. Show an animation of the molecules in liquid water.



Show the molecular model animation *Particles of a Liquid*.

www.middleschoolchemistry.com/multimedia/chapter1/lesson1#particles_of_a_liquid

Explain that the little balls represent the particles of a liquid, in this case water molecules. Let students know that for now, they will use circles or spheres to represent atoms and molecules, but eventually they will use a more detailed model. For now, students should focus on the motion of the molecules, how they interact, and their distance from one another.

Point out that the molecules of a liquid are in motion but they are attracted to each other. That's why they move past each other but don't get very far apart from one another.

6. Have students draw their own model of water on the molecular level and complete the activity sheet.

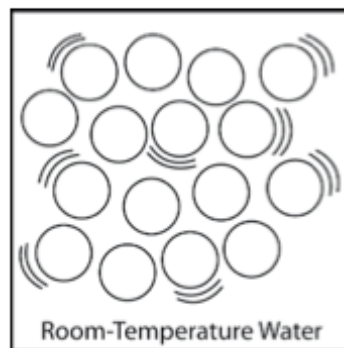


Draw or project the illustration *Water Molecules*.

www.middleschoolchemistry.com/multimedia/chapter1/lesson1#water_molecules

Explain to students that this is a model of water molecules. Point out that the molecules are not in any exact order but are near each other. They have little curved "motion lines" to show that the molecules are moving.

Have students draw a model of water on the molecular level on their activity sheet. They should use the model you have shown them to guide their own drawing.



Students' drawings should show that the molecules are:

- Randomly arranged
- Close together
- Moving

Be sure students realize that this model shows water molecules enormously bigger than they actually are. Not only are water molecules much smaller, they are also much more numerous. A single drop of water is made up of more than a billion trillion extremely tiny water molecules.



To give students an idea of how small and numerous water molecules are, you could tell students the following: In about 1 tablespoon of water, there are about 600 billion trillion water molecules. If you could count 1 million water molecules every second, it would take about 200 million centuries to count all the molecules in that tablespoon of water. Atoms and molecules are huge in number and incredibly small in size.

EXTEND

7. Show a video so that students can see an example that water molecules are attracted to one another.

Show a video of a water balloon popping in slow motion.

www.middleschoolchemistry.com/multimedia/chapter1/lesson1#water_balloon

Ask students:

- **Why do you think the water keeps its shape the moment the balloon is popped?**
Students should realize that water holds together pretty well because the water molecules are attracted to each other.
- **Imagine a drop of water hanging from your finger. How is this similar to the water staying together after the balloon is popped?**
This can also be explained by the fact that water molecules are very attracted to each other.

APPENDIX G

SAMPLE POST TEST SELF REFLECTION QUESTIONNAIRE

Appendix G
Sample Post Test Self Reflection Questionnaire

1. Did you study? Why or why not? Please explain.
2. Did you review any of the materials on my web page? Why or why not? Please explain.
3. Is there anything you could have done better to be more prepared for the test?
4. Is there anything I could have done differently to help you learn better?

APPENDIX H

SAMPLE LESSON PLAN

Appendix H Sample Lesson Plan

The Movement of Ocean Water

Summary

Lesson Plan 1: Students will explore the causes and characteristics of surface and deep currents in the ocean. They will learn about the different factors related to ocean currents and explore the ways currents and climate are related.

Students will also explore the impact that humans have on the natural environment and discuss ways that they can contribute to solutions to existing problems.

Lesson Plan 2: Students will describe the characteristics of waves and will explore wave formation and movement. They will understand the different forces that effect ocean waves and be able to identify different types of waves and their features.

Lesson Plan 3: Students will recognize that there are gravitational forces that create tides on earth that are impacted by where the earth is in relation to the moon and the sun.

Key Concepts

Currents are stream-like movements of water at or below the ocean surface.

Coriolis Effect is the curving of moving objects from a straight path due to the Earth's rotation.

Salinity is the measure of the amount of dissolved solids in a liquid.

Upwelling is a process in which cold, nutrient rich water from the deep ocean rises to the surface and replaces warm surface water.

A wave is a disturbance or variation which travels through a medium.

Wave structure includes its crest, trough, height, length, and period.

A swell is a surface gravity wave that is not generated by local wind.

Tides are daily movements of ocean water that change the level of the ocean's surface.

Spring Tides are tides that have the greatest range between high and low water; they occur at the new and full moons, when earth, the sun, and the moon are in line.

Neap Tides have the least tidal range; they occur at the Moon's first and last quarters, when the Moon is at right angles to the line of centers of Earth and the Sun.

Tidal Bulge is used to describe the area of water on earth that is affected by the pull of the sun's and the moon's gravity.

A Tidal Bore is a body of water that rushes up through a narrow bay, estuary, or river channel during the rise of high tide, causing a very sudden tidal rise.

Evaluation

Journal responses and activity sheets will serve as the assessment or the "Evaluate" component of each 5-E lesson plan. The activity sheets are formative assessments of student progress and understanding. Summative assessments are given at the end of each unit in the form of a unit test.

Safety

Be sure that students are wearing properly fitting goggles when necessary for laboratory experiences.

PRE-LESSON REVIEWS

Students should be assigned reading of Chapter 3, Sections 1, 2, and 3 as homework before the start of each of Lessons 1: Currents, 2: Waves, and 3: Tides. All students should create a Predict and Clarify Chart in their science notebooks as strategies to improve their reading comprehension. The morning after the reading section is assigned, students should begin class with a review of their reading. Have each student journal in their notebooks. First, they should write what they remember from the previous nights homework. Then, they may open their books and look at the key objectives and add to what they've already written to complete their review. They may draw or sketch out their

thoughts however they wish. These journal entries should take only ten minutes with about five minutes for questions and discussion if needed.

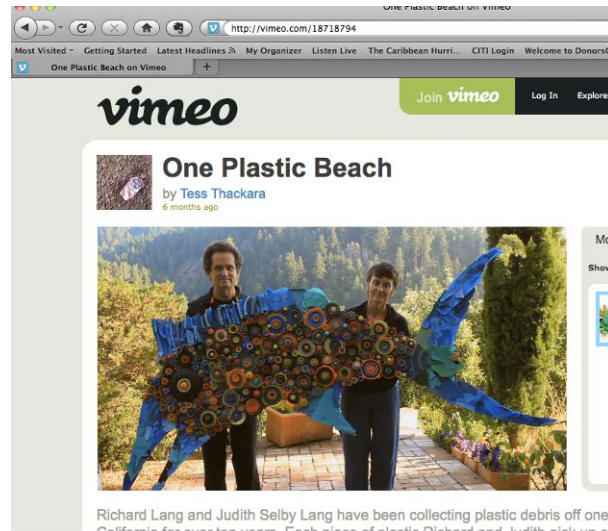
LESSON PLAN 1: Ocean Currents

ENGAGE

1. Gather around the Smart Board. Show the first 3 minutes of this video clip from you tube.

<http://vimeo.com/18718794>

After the film, ask the students this question: where do you think all of the plastic material has come from?



Begin Discussion:

Say: *If you have ever dropped something in a large lake or even in the ocean, you have probably seen how the water tends to carry it away from you and you've probably watched it bob up and down in the waves. The movement you've seen is caused by the influence of the ocean's surface currents and waves on the dropped object.*

Wind and surface currents affect all objects on the surface of the ocean. The direction of surface current movement is the result of the interaction of many forces, including salinity and density currents, land and sea breezes, tides, gravity and global rotation. For that reason, locating an object floating in the ocean can become a complex problem. It requires gathering and processing several pieces of data.

This unit will explore the various aspects that affect the physical make-up of the ocean. We will learn about currents (both surface and deep ocean current) first. Then we will learn about waves and tides and the basic physical properties of them.

2. Tell students that over the last 30 years there have been incidences of many items that have been discovered floating and or washing up on the coasts of the ocean. Grab student interest and attention by showing them this story: <http://www.mnn.com/earth-matters/wilderness-resources/stories/what-can-28000-rubber-duckies-lost-at-sea-teach-us-about->

What can 28,000 rubber duckies lost at sea teach us about our oceans? | MNN – Mother Nature Network

http://www.mnn.com/earth-matters/wilderness-resources/stories/what-can-28000-rubber-duckies-lost-at-sea-teach-us-about-

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What can 28,000 rubber duckies I... +

What can 28,000 rubber duckies lost at sea teach us about our oceans?

A shipping container filled with rubber duckies was lost at sea in 1992, and the bath toys are still washing ashore today.

By Bryan Nelson
Tue, Mar 01 2011 at 6:24 PM EST

104 Like 5K +1 0

Photo: poole/Flickr

In 1992, a shipping crate containing 28,000 plastic bath toys was lost at sea when it fell overboard on its way from Hong Kong to the United States. No one at the time could have guessed that those same bath toys would still be floating the world's oceans nearly 20 years later.

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DETAILS AND RULES

TODAY'S MOST POPULAR mnn

- Should hot dogs come with a warning

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Don't miss the week in photos

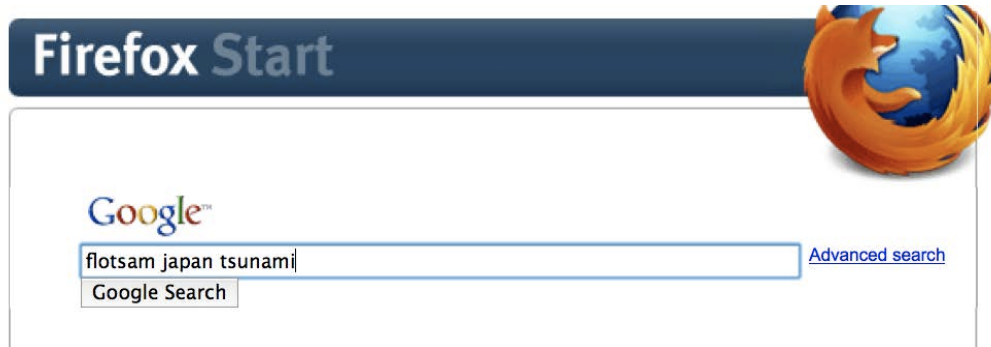
Scientists discover how to reverse memory loss. (Seriously.)

How to spend less money on laundry

EXPLORE

3. Distribute iPads. First ask the students to record in their science notebook a prediction as to what they think may have happened to all of the debris that was cast into the ocean from the Japanese tsunami of 2011.

Then, ask students to type in the following search keywords: flotsam japan tsunami



After doing about twenty minutes of research have them gather in small groups to share what they have learned. Ask them to write a one paragraph summary in their own notebook explaining: who, what, when, where, why of the Japanese flotsam, and how scientists today predict where it will end up.

Here is a good example story for your own review, however, it is best to allow the students to drive their own research to teach them how to query a question such as this.

<http://blog.earth-touch.com/nature-news/tsunami-flotsam-wheres-it-all-going/>

EXPLAIN

5. Use Powerpoint Presentation as a guide to teach students about ocean currents.

Chapter 3 Section 1

Classroom Notes

Classification of Currents

1. Surface Currents – stream-like movements of water that occur at or near the surface of the water. example: Gulf Stream (one of the longest surface currents)
2. Deep Currents – stream-like movements of water FAR BELOW the surface of the water.

Throughout the notes periodically access the slides from the following link. This narrated tutorial is an excellent discussion of the main points.



http://www.coolclassroom.org/cool_windows/SlideShowVoice.htm

How does the Ocean Move? with audio – the script may also be downloaded if needed.

Integrate activities, labs and demonstrations throughout the instruction and note taking in order to exercise student interest and keep their attention - particular attention should be spent to stress the factors that control surface currents.

Use the film clips that are embedded in the powerpoint as a way to describe and reinforce the concepts.

Demonstrate the continental deflections by acting out the movements of the currents in the classroom by pretending to be a current and bumping into and going around the desks and countertops. You can involve students as well.

Include “Earth’s Uneven Heating” Activity as an introduction to solar radiation and its affect on Earth’s temperature.

Use the Earth’s Rotation and the Coriolis Effect Activity to reinforce student understanding of the rotation of the Earth through the building of models.

Integrate Activity 7.4, "Changing Density of a Liquid-Adding Salt" and Activity 7.5, “Changing the density of a liquid – Heating and cooling” into the lesson to ensure a deeper understanding of the molecular behavior of deep ocean currents.

Use the “Deep Water Masses and Global Circulation Activity” as a reference for a demonstration of the movement of currents and as a tool for students to practice recording data and creating charts and graphs to present information they collect.

EVALUATE

6. Distribute MEDITERANEAN DEEP CURRENT Lab Activity. As a performance based assessment, have the students follow the lab procedure and use the questions to assess student understanding.

7. Distribute iPads or laptops and have students use the Inspiration concept mapping program to develop a concept map to show their understanding of the vocabulary for this unit.

EXTEND

Show the video clip from Scripps Institution of Oceanography.



<http://www.youtube.com/watch?v=tFSv2eW7g6E>

Miriam Goldstein on the Great Pacific Garbage Patch

earthskyscience 14 videos Subscribe

Miriam Goldstein SEAPLEX chief scientist
Scripps Institution of Oceanography

EarthSky

3,938

Uploaded by earthskyscience on Mar 30, 2010

Miriam Goldstein, an oceanographer at the Scripps Institution of

12 likes, 1 dislikes

Suggestions:

- Contract Manufacturing by 66551914 14,618 views Promoted Video
- The Great Pacific Garbage Patch Clean-Up: The G... by MicheWalsh 929 views
- Great Pacific Garbage Patch by TheEasleyme 50 views
- John Hildebrand on whale songs by earthskyscience 3,585 views
- inFact: The Pacific Garbage Patch by volleybrian 7,831 views

Distribute iPads. Ask students to compile a list of some things that they can do to help reduce the size of the great garbage patch. They could use a bookmarking site such as <http://delicious.com> to gather a collection of sites important to their research.

Using Animoto, students should develop a presentation of their ideas to convince the community of the importance of protecting our oceans from litter.



APPENDIX I

SAMPLE ASSESSMENT: UNDERSTANDING CELLS QUIZ

Appendix I
Sample Assessment: Understanding Cells Quiz

1. What are cells?
2. What do all cells have in common?
3. Are all cells the same? Explain.
4. Why do you think that cells need DNA?

APPENDIX J

SAMPLE WEBQUEST: CELL RESEARCH USING iPADS

Appendix J

Sample Webquest: Cell Research Using iPads

WRITE YOUR ANSWERS IN YOUR GREEN SPIRAL NOTEBOOK.C.O.P.S.Counts!

Please go to the <http://brookwood.badger.k12.wi.us> homepage. Click on Grade Level Links. Click on 7th grade. Click on Ms. Kretschmer. Click on Chapter 1 Webquest. Then, answer the questions using the links provided! Have fun! This is like a scavenger hunt. You may use websites more than once or not at all.

1. Go to this link and study the parts of the animal cell.
<http://publications.nigms.nih.gov/insidethecell/chapter1.html>

Read the definitions and try to understand what they structures do. Choose one part (organelle) to draw. Draw it in your notebook. Label your drawing and write a definition telling me what it is.

2. Go to Biology 4 Kids: http://www.biology4kids.com/files/cell_main.html

Answer these questions about cells:

- a) What is the main purpose of a cell?
- b) How many cells do you have in your body?
- c) What is one thing that ALL cells have in common?

Scroll down and click on

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

- d) Why are there holes in a cell membrane?

Scroll down and click on

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

- e) What is the function of the nucleus?

- f) What is cytoplasm?
- g) Do all cells have a nucleus?
- h) How do scientists classify cells?

3. Using any or all of the cell links, answer the following questions:

- a) What are the scientific names for the two types of cells? (Hint: one kind has a nucleus, the other does not)
- b) Draw and Identify as many parts of both types of cells as you can (this can be done on a plain white piece of paper or a page of your notebook).

Remember, cell drawings do not always look identical! Try to figure out which parts match the structures on the yellow study sheet. Leave the ones that are not on one site blank until you come across another site that helps you figure them out 😊 Have fun!

4. Make a chart. For **each item listed below** write down

a) Which is bigger (hint, look at the site that says: Introduction to Cell and Virus Structure – relative sizes).

b) Then, write its size and the detection device used to see it.

Specimen	SIZE	DETECTION DEVICE
Human or Ant		
Wasp or Atom		
DNA or Cell		
Bacteria or virus		

5. Tell me what a ribosome looks like. Where do you find the most ribosomes?

6. Tell me two major differences between plant cells and animal cells.

7. Go to website: Inside the Cell-- history and Cell Theory

<http://publications.nigms.nih.gov/insidethecell> Click on Chapter 1 “An Owner’s Guide to the Cell”. Click on the typical animal cell.

- a) What shape are the lysosomes?
- b) What structure surrounds the nucleus and looks like a maze?
- c) Which structure looks like kidney beans sliced in half?
- d) Go to the “Got It?” link. Answer all of the questions on a separate sheet of paper.

8. According to the website called Cell Biology:

http://www.biology.arizona.edu/cell_bio/tutorials/cells/cells.html

What are the 3 basic parts of the cell theory?

9. Go to website: <http://www.ology.amnh.org/genetics/youYou/youyou.html>

Play the cartoon What makes you, you?. Zoom IN! and keep Zooming IN!

- a) What “tells the cell just what to do?”
- b) How many chromosomes does a human have?
- c) What are DNA shaped like?
- d) What are genes?

10. Go to this website: http://www.botany.uwc.ac.za/sci_ed/grade10/cells/index.htm

Click on “Structural Differences between Plant and Animal Cells.”

- a) What is the difference between the vacuole in a plant cell and a vacuole in an animal cell?
- b) Does the Animal Cell have a cell wall?

APPENDIX K

SAMPLE TEACHER CREATED TEST: CELL UNIT

Appendix K
Sample Teacher Created Test: Cell Unit

Name: _____ Class: _____ Date: _____

Cell Multiple Choice

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

____ 1. Humans like you are
a. machines.
b. systems.
c. organisms.

____ 2. A group of cells with the same function make up
a. an organism.
b. an organ system.
c. a tissue.

____ 3. An organ consists of
a. two or more tissues.
b. a group of cells.
c. two or more systems.

____ 4. What is smallest unit that can perform all the processes necessary for life?
a. cell
b. nucleus
c. organelle

____ 5. Which of the following statements is not part of the cell theory?
a. Animals and plants share the same kinds of cells.
b. All organisms are made up of one or more cells.
c. The cell is the basic unit of all living things.
d. All cells come from existing cells.

____ 6. What part of the cell forms a barrier between the cell and its environment?
a. cell membrane
b. ribosome
c. mitochondria

____ 7. What part of the plant cell keeps the cell from collapsing?
a. cell wall
b. cytoplasm
c. cytoskeleton

____ 8. A cell's nucleus contains DNA, which carries genetic material with

- a. instructions for how to make protein.
- b. the cytoskeleton.
- c. the endoplasmic reticulum.

____ 9. Ribosomes, the organelles that make proteins, are found on the membranes of the

- a. cell wall.
- b. endoplasmic reticulum.
- c. mitochondria.

____ 10. What part of the cell acts as the cell's delivery system?

- a. nucleolus
- b. mitochondrion
- c. endoplasmic reticulum

____ 11. Energy released by a cell's mitochondrion is stored in

- a. ATP.
- b. DNA.
- c. the ER.

____ 12. Most of a cell's ATP is made and stored in the inner membrane of the

- a. mitochondrion.
- b. Golgi complex.
- c. endoplasmic reticulum.

____ 13. Which phrase describes a cell?

- a. is always microscopic
- b. does everything needed for life
- c. always looks like an egg

____ 14. What are all organisms made of?

- a. plants
- b. protists
- c. cells

____ 15. Where do all cells come from?

- a. animals
- b. ponds
- c. cells

____ 16. What is cytoplasm?

- a. the nucleus of a cell
- b. the fluid inside a cell

c. the genetic material in a cell

____ 17. Where does photosynthesis take place in a cell?

- a. in the nucleus
- b. in the mitochondria
- c. in the chloroplasts

____ 18. What does the Golgi complex do in a cell?

- a. It packages and distributes proteins.
- b. It is the power source of the cell.
- c. It makes sugar and oxygen.

Completion

Complete each sentence or statement.

Use the terms from the following list to complete the sentences below.

cell organ
structure tissue
multicellular system

19. The lowest level of organization is the _____.

20. Cells that are like each other and do the same job form a(n) _____.

21. A structure made of two or more tissues working together is called a(n) _____.

22. A group of organs that work together form an organ _____.

23. Larger size, longer life, and more-specialized cells are characteristics of _____ organisms.

24. How a part of an organism works is related to how it is built, or its _____.

Matching

Match each item with the correct statement.

- a. cell membrane e. endoplasmic reticulum
- b. cell wall f. Golgi complex
- c. mitochondrion g. nucleus
- d. ribosomes

____ 25. a rigid structure that gives support to a cell, found in plant and bacteria cells

____ 26. a barrier that encloses and protects the cell allowing only certain materials to come in and out

____ 27. a large organelle that produces and stores the cell's DNA

____ 28. organelles that make proteins

____ 29. a system of folded membranes that functions as the internal delivery system of a cell

____ 30. an organelle that functions as the main power source of a cell, breaking down sugar to produce energy

____ 31. the organelle that packages and distributes materials

Match each item with the correct statement.

- | | |
|--------------|---------------|
| a. DNA | c. nucleus |
| b. eukaryote | d. prokaryote |

____ 32. a cell with a nucleus

____ 33. a cell without a nucleus

____ 34. genetic material in cells

____ 35. where DNA is stored

Match each item with the correct statement. You may use more than once.

- a. found in plant cells b. found in animal cells c. found in both plant and animal cells

____ 36. cellulose, a complex sugar used to build cell walls

____ 37. nucleus

____ 38. organelles called chloroplasts that aid photosynthesis

____ 39. vacuoles, vesicles that store water and other materials

Short Answer (C.O.P.S. Counts!). Choose TWO of these to answer. (5 pts each).

40. List the main difference between prokaryotic and eukaryotic cells.

.

41. Why weren't cells discovered until 1665? What invention made their discovery possible?

.

42. Are all cells the same? Explain.

APPENDIX L

TECHNOLOGY USE REFLECTION QUESTIONNAIRE

Appendix L Technology Use Reflection

Please write a few things that made it beneficial to learn using tools of technology at home or in school. Also, please note any difficulties you encountered.

Which technological tools or software did you use to help you learn the material?	home ✓	school ✓	Please describe both the pros and/or cons of using this technology to learn.

a. Please write two or more examples of something you learned while using technology (that may have been difficult understanding without it).

b. Is there anything that you think that I could do, or could have done differently to improve your learning experience?

c. Is there anything that you think that YOU could do, or could have done differently to improve your learning experience?

APPENDIX M

SAMPLE JOURNAL REFLECTION PROMPTS

Appendix M
Sample Journal Reflection Prompts

	Journal Prompt
Nature of Science	Describe what science means to you. Start by telling me who scientists are, and what you think that they do for a living. Then explain what you think a scientific investigation is.
Microbiology	All living things are made up of at least one or more cells. Why do you think complex organisms have so many cells? What could their purpose be?
Geology (Earth)	Do you think the Earth has always looked the way it does today? Think about the landscape, including the rivers, mountains, valleys, streams, and oceans. Has anything changed over time? Explain your thoughts.
Geology (Oceans)	Where do you think the water in the ocean came from? Explain your reasoning.
Streams, Rivers, Lakes, and Aquifers	Do you think that our Earth might run out of all of its fresh drinking water someday? What would happen if we didn't have fresh water? Explain your thoughts on this.

APPENDIX N

SAMPLE POST TREATMENT TECHNOLOGY USE REFLECTION

Appendix N
Sample Post Treatment Technology Use Reflection

During this unit you were given several different uses of technology to learn the material. For each one, please tell me: 1) If you thought it was helpful for you in your learning about Earth's Changing Surface, and 2) Please, also tell me what you liked or disliked about it.

Khan Academy videos

Bar Graph Team Challenge

Creating your own Webquest

Ms. Kretschmer Science Web Pages

Is there anything else you would like to share with me about the technology uses during this unit?

APPENDIX O

POST TREATMENT TECHNOLOGY USE QUESTIONNAIRE

Appendix O
Post Treatment Technology Use Questionnaire

1. What are some ways that you have used technology to learn? Did it work for you, why or why not?
2. If you were given the option of using technology to help you learn science concepts better, what tools would you choose, and how would you use them?
3. Do you think teachers are better teachers when they offer technology? Why or why not? Give examples.
4. How good are you at using technology to learn?
5. Who do you think knows more about using technology, teachers or students? Why do you say that?
6. Is there anything else that you would like to share with me about using technology in school?
7.
 - a. Please write two or more examples of something you learned while using technology (that may have been difficult understanding without it).
 - b. Is there anything that you think that I could do, or could have done differently to improve your learning experience?
 - c. Is there anything that you think that YOU could do, or could have done differently to improve your learning experience?

APPENDIX P

STUDENT INDEPENDENT LEARNING POST TREATMENT SURVEY

Appendix P
Student Independent Learning Post Treatment Survey

1. How often did you spend time outside of school looking up information or reading about information related to your science lessons?

Never 1 Hardly Ever 2 Sometimes 3 Often 4 All the Time 5

2. How often did you talk to your parents or ask your parents questions about information related to your science lessons?

Never 1 Hardly Ever 2 Sometimes 3 Often 4 All the Time 5

3. How often did your parents ask you questions or approach you about science related homework or information related to your science classes?

Never 1 Hardly Ever 2 Sometimes 3 Often 4 All the Time 5

4. How often did you do extra work related to studying for or preparing for quizzes and tests (include extra credit work).

Never 1 Hardly Ever 2 Sometimes 3 Often 4 All the Time 5

5. How often did you contact your friends outside of class to ask questions about your science homework or for assistance from them in any way related to your science homework?

Never 1 Hardly Ever 2 Sometimes 3 Often 4 All the Time 5

6. How often did you use the Brookwood Middle School “Ms. Kretschmer” Web Pages to review material we have covered in class, or to watch animations or simulations related to class?

Never 1 Hardly Ever 2 Sometimes 3 Often 4 All the Time 5

7. When did you usually use Ms. Kretschmer’s Web Pages? Why? Was it helpful?

APPENDIX Q

PERSONAL TECHNOLOGY TOOL USE CONTRACT

Appendix Q
Personal Technology Tool Use Contract

I, _____ agree that it is a privilege to use
technology tools in the classroom.

If I am given the opportunity to bring my personal technology tool, i.e. cell phone, smart phone, iPod touch, or other device with access to the Internet into the classroom,

I agree that, unless classroom teacher gives me specific permission, that there will be:

- No texting
- No going on other Apps
- No going on games like “Angry Birds,”... etc.
- No taking pictures
- No taking movies or recording people
- No listening to music

I also agree that:

- The student is responsible for their own device (not the school)
- Only the student who owns it can use it
- The volume will be turned off
- The student must only use it during class time and return it to lockers when instructed

If any of these agreements are broken, the student agrees that the teacher can take it away and call parents before returning the device to student.

Student Signature

Date