The Benefits of Learning Science Through Inquiry While Integrating Aspects of Technology and the Arts

A graduate project submitted in partial fulfillment of the requirements
For the degree of Master of Arts in Education,
Elementary Education

By
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Dedication

The work you see before you is dedicated to my parents who always demonstrated a strong work ethic and emphasized the power behind an education. A special thank you to my father for always believing in me and pushing me to reach for the stars. To my amazing fiancé Brigham Harwell whose unconditional love and support have given me strength on this journey; your wisdom and passion for life have inspired me.
# TABLE OF CONTENTS

Signature Page ......................................................................................................................... ii
Acknowledgement ...................................................................................................................... iii
Dedication ................................................................................................................................. iv
Abstract ...................................................................................................................................... v
Chapter One Introduction ......................................................................................................... 1
Chapter Two Literature Review .............................................................................................. 5
Chapter Three Methodology .................................................................................................... 19

3.1 The New Vision for Teaching Science: Inquiry with the Integration of Technology and the Arts .......................................................................................................................... 19

Figure 3.1 A ............................................................................................................................... 24

3.2 Curriculum Design: Inquiry Based Learning with Integration of Technology and the Arts ................................................................................................................................................. 23

Chapter Four: Curriculum Outline .............................................................................................. 26

4.1 Lesson 1 ............................................................................................................................... 26

Figure 4.1 A ............................................................................................................................... 28

Figure 4.1 B ............................................................................................................................... 31

4.2 Lesson 2 ............................................................................................................................... 33

Figure 4.2 A ............................................................................................................................... 34

4.3 Lesson 3 ................................................................................................................................ 36

4.4 Lesson 4 ................................................................................................................................ 39

4.5 Lesson 5 ................................................................................................................................ 41
ABSTRACT

THE BENEFITS OF LEARNING SCIENCE THROUGH INQUIRY WHILE INTEGRATING
ASPECTS OF TECHNOLOGY AND THE ARTS

By

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For years there has been a struggle over best practices concerning efficient ways
to better increase student achievement in science content matter. In the mean time
standard based test scores reveal non mastery of fundamental science literacy and skill
sets. Research based evidence however, supports inquiry based learning as a successful
teaching method which helps promote student learning specifically with science related
content matter. Although inquiry based learning has proven to optimize student learning
outcomes, in comparison to the traditional lectured approach; there are still some gaps in
learning fundamental science literacy and science related skills. Findings indicate that
inquiry based learning while also, integrating the use of technology and aspects of visual
performing arts, promotes a higher conceptual understanding of science related content
matter and science process skills (Simsek & Kabapinar, 2010). The unit lesson series is
designed with consideration to the inquiry based learning approach while also
integrating opportunities for students to utilize multiple intelligences as Gullatt (2008) describes. This particular project is a study supporting inquiry based learning while also integrating aspects of technology and the arts as a best practice for teaching and learning science content matter and fundamental skills sets. The project is intended to provide an example unit supported by research and resources. My objective was to create a unit teaching and utilizing aspects of science inquiry, while also integrating technology and the arts as a way to maximize student achievement and applying the use of multiple intelligences. The unit can be successful regardless of the student academic achievement level. The science unit referred to in this project was designed for a group of 30, 1st grade students who live in the inner city. These particular set of 1st grade students demonstrated a deficiency with the fundamentals of science and related skills sets. Therefore, the unit was designed with much repetition, integrated use of realia, student collaboration, discussions, visuals, auditory, and kinesthetic practices. The California State Science and Visual and Performing Arts Content Standards were taken in to account as a fundamental focus for the development of the unit. Science inquiry was the teaching pedagogy and the integrated use of technology aided the successful facilitation of a successful unit.
Chapter 1: Introduction

Teaching for in depth, conceptual understanding has been the overarching goal in education for many years, across all subject areas. Throughout the years there has been a pendulum shift over the most effective ways to teach science related content matter. Science education particularly, has experienced a shift from the conservative lecture approach to the more liberal, inquiry driven approach which involves observation and experimentation pedagogy. Both methods have much to offer however. Inquiry based learning with the integration of technology and visual arts, in particular increases conceptual understanding of science related content matter and skills which will serve students multiple purposes (Gullatt, 2008). Integrating aspects of technology and the arts in to science inquiry provides students the ability to transfer conceptual skills and understanding to accurately interpret and evaluate science curriculum and problem solving situations across multiple subjects (Simsek & Kabapinar, 2010). Building science literacy through these means and approaches can demonstrate improvement in student science skills, engagement, and confidence (Simsek & Kabapinar, 2010). The integration of these particular subjects in an inquiry driven approach to science allows students to utilize multiple intelligences which demonstrate a deeper and intellectual understanding of content matter and skills (Gullatt, 2008).

The traditional teaching by telling approach implies that the lecture only method does not take optimal advantage of student abilities (e.g., Eberlein, Kampmeier, Minderhout, Moog, Platt, Nelson, & White, 2008). A logical consequence of the lecture approach has left students with missing pieces of information and thus lacking a clear understanding and mastery skill sets in science related topics (Brickman, Gormally, Armstrong, & Hallar, 2003). The recent approach to teaching science has thus far been spoon feeding information and allowing students to explore
content matter *freely* by attaching a lab to a science lesson. The labs usually contain a series of given steps which deny students the opportunity to think independently and critically about particular issues. The structured teaching method has thus far focused on delivering the content matter aspect rather than teaching students science related skills and approaches required for our community of lifelong learners. Inquiry based learning with the integration of technology and the arts fosters a learning community of students who will acquire an in-depth understanding of science skill sets and thus will allow them to apply what they learned to the rapidly changing world of critical and independent thinkers (Gullatt, 2008).

There has been a raft of published research on this topic in an effort to provide educators with specific pedagogy for student mastery level of understanding for science related content matter. Thus far, traditional academic approaches have narrow learning objectives that emphasize memorization or the application of simple algorithms which greatly decrease the opportunity for critical thinking aspects in a lesson. Traditional approaches have thus far lacked the development of students who are critical thinkers or students who can write and speak effectively. To develop a higher order skill set, students need to take part in complex, meaningful lessons that require sustained engagement, collaboration, research, management of resources, and the development of an ambitious performance or product (Brickman, Gormally, Armstrong, & Hallar, 2003).

A growing body of research also suggests that students gain a deeper understanding and perform better on complex tasks if they have the opportunity to engage in more *authentic* learning by participating in projects and activities that require them to use subject knowledge to solve real world problems (Chiappetta, 1997). The integration of technology within an inquiry driven science lesson, allows students to engage with knowledge and develop a conceptual
understanding of content matter by making links and personal connections to the video, pictures or interactive programs. Technology provides a visual and auditory connection to content matter. It brings students to a new world of learning not otherwise present through your traditional teaching approach (Conley, & Mullin, 2003). Integration of technology within a science lesson can have a wide range of benefits such as developing the ability to collaborate with peers; increase language development, critical thinking and problem solving skills; becoming independent learners, self-starters; and increase writing skills (Kosakowski, 1998). Technology use in a classroom displays benefits to be substantial particularly in Blooms hierarchy of higher order thinking. Technology integrated learning reaches higher order thinking based on Blooms Taxonomy verse non technology integrated learning. Students with technology integrated lessons display signs of critical thinking and conceptual understanding. A particular school in Idaho reported a 15% increase in student test scores when instruction was provided with the integrated use of technology (McNabb, Hawkes, & Rouk, 1999).

Similarly, visual arts also enhance student engagement and allow students to utilize multiple intelligences. Arts integration in science curriculum has been shown to benefit students’ learning. Visual art infused lessons provides students with the opportunity to acquire a means of communicating of their ideas, images, and feelings in to a creative art form. It allows students to build and create personal connections to what they are learning. Art integrated education provides a welcoming learning environment which fosters an ambiguous desire to explore and accept multiple perspectives (Gullatt, 2008).

The design for my curriculum project is centered around inquiry based learning while integrating aspects of technology and the arts because it allows students to engage in lessons that require them to construct and organize knowledge; and consider alternatives; engage in detailed
research, inquiry, writing, analysis of their learning, reflection, and hands on activities with opportunities for discussions. This particular teaching method fosters a community of learners who collaborate to construct their own meaning. The design method involves socio-cultural constructivist perspective in which the role of the teacher is to be a catalyst and facilitate a safe and welcoming learning environment. The teacher is a supportive factor primarily to serve as a guide. The design allows me, the teacher, to use language to guide the development of academic language, select and emphasize the ideas offered by the students as a way to create shared meaning for the community of learners. Inquiry based learning coupled with the integration of technology and the arts open the door to a different set of learning outcomes. This method encourages student discussion; improve reasoning; social learning skills; builds and develops cognitive development as well as enhances creativity; imagination, and student engagement. The application of the arts in particular influences learner outcomes by engaging student sensory motor skills which contains added value benefits linked to critical thinking and higher order levels of attainment.

Research highlights the benefits of inquiry based learning to result in stronger performance regardless of race, gender, or prior achievement (Brickman, Gormally, Armstrong, & Hallar, 2003). The integration of technology and the arts also attains significant value in accomplishing academic student achievement. The methods and curriculum approach is a thought-provoking opportunity which has prompted teachers at all grade levels to experiment with inquiry-based learning, technology, and the integration of the arts into academic curriculum as a way to enhance learner outcomes.
Chapter 2: Literature Review

Why Inquiry?

There are several science driven teaching methods which have been traditionally used in the classroom for centuries. Although these traditional methods where applied with the best intent and purpose, they have left students with missing pieces of a fundamental understanding of science. The science inquiry based approach to learning encourages students to think independently while mastering content matter and various cross curricular skill sets. Barron and Hammond (2008) describe inquiry-based and cooperative learning as the most meaningful way of learning. The model is presented as the most natural way of teaching and learning because it captures students’ attention from the start by posing a question or a problem. Inquiry based learning is much more student driven than your typical teaching model. It provides a realistic approach where students are expected to be engaged and participate in a hands on interaction with subject content matter. The research provided in this article highlights the benefits of implementing inquiry-based and cooperative learning opposed to teaching students content matter in a teacher driven classroom. The academic gain is much more significant when students are given the opportunity to explore subject matter hands on. The article summarizes three very important gains when implementing inquiry-based and cooperative learning: Students learn at a deeper level when they can apply classroom-gathered knowledge to real-world problems, and when they get to take part in projects that require sustained engagement and collaboration, active learning practices have more of a significant impact on student performance than any other variable, including student background and prior achievement, and students are most successful when they are taught how to learn as well as what to learn. The article helps support my curriculum design because it provides research based evidence for an inquiry based unit of the changing states of matter. The article provides three significant reasons why an inquiry based
approach is most effective. The article by Barnett (2005) explores in great depth the relationship between research and the role of the teacher in a classroom. The article defines disciplinary spaces and the role of inquiry based learning. In chapter 1, Barnett describes a classroom teacher to be the mediator linking valuable information to the student based on what they, the teacher, deem of academic value. Barnett emphasizes the importance of creating a “community of practice,” which in part means creating a community of learners who are intrinsically motivated to learn and seek answers by exploring. The inquiry based approach, as Barnett describes, facilitates a community of learners seeking to explore and take control of their learning. The article does however mention some challenges in this approach to teaching and learning because not all students may display an intrinsically motivated characteristic in learning. Barnett’s answer to this problem falls back to the teacher and his/her role in creating this community of learners. Creating a disciplinary space with much support and enthusiasm is an approach many students will gravitate towards according to Barnett.

Haury’s (1993) study examines several distinguishing features specific to science inquiry based learning. Inquiry oriented science instruction has promoted several benefits for student learning outcomes. He describes inquiry as a natural phenomenon using students’ natural skills to construct new meaning and in depth understanding of a particular concept or subject matter. Science inquiry allows students to gather and interpret data while using various resources. The inquiry based approach as Haury describes found to benefit students from all learning styles. Language-monitory students particularly acquired scientific ways of thinking, using academic language, and writing styles. Bilingual students particularly benefited from inquiry based learning by developing classification skills and oral communication. It is important to note that the inquiry approach to learning and teaching employees the use of various resources such as
technology, artifacts, and hands on activities to gather and interpret data.

Brickman, Gormally, Armstrong, and Hallar (2003) demonstrated greater improvements in students’ science literacy and research skills when using inquiry lab instruction rather than the more traditional lesson approach. Inquiry based learning is more student driven than the traditional teacher driven instruction. The study also found that when inquiry based methods were applied, students gained self-confidence in scientific abilities. Traditional students’ gain was greater when using inquiry based learning. The study suggests that the traditional curriculum promoted over-confidence in students’ skills and abilities. However, the traditional curriculum approach suggested students only seemed to understand topics for face value rather than being given the opportunity to construct a deeper understanding of the content matter. The inquiry lab approach suggests that students valued more authentic science exposure but acknowledged that experiencing the complexity and frustrations faced by practicing scientists were challenging. The article helps support my curriculum method because it supports the success of inquiry based learning, specifically when incorporating a lab portion to a specific science lesson. The study explains how inquiry based learning allows students to construct a much deeper meaning of science related topics by allowing them to question and explore the content without the overbearing factor of a teacher. The teacher driven approach can often hinder a student’s individual thought process and thus what might be considered a barrier to construct a deeper meaning.

The study by Simsek and Kabapinar (2010) discussed in this particular journal article analyzed the effect of inquiry based learning on elementary students’ conceptual understanding of science and specific processing skills and attitudes. The article *The effects of inquiry-based learning on elementary students’ conceptual understanding of matter, scientific process skills*
and science attitudes is an article of much use because it discusses specific ways inquiry based learning had a direct and positive outcome for the set of 5th grade science students. The 8 week program proved to have provided a deep conceptual understanding of the scientific process.

The article “Inquiry Based Science: Strategies and Techniques for Encouraging Inquiry in the Classroom,” is an encouraging article examining best practices for science inquiry approach to teaching. The article examines two approaches to inquiry. One is the general inquiry approach and the scientific inquiry approach. The general inquiry approach refers to seeking and answering questions. It is a method which allows students to explore without specific limits or regulations. The general approach is very open ended and liberal. The scientific approach emphasizes the importance of student learning and the importance of gaining an in-depth understanding of a particular scientific topic. Chiappetta (1997) also discusses the background of the inquiry based approach. In the early 50’s and 60’s inquiry became prominent in the science education. Specifically in the biological sciences departments, inquiry was an emphasized part of science education. Inquiry driven learning environments involved students in the learning process by asking questions, sparking curiosity, resolving discrepancies, figuring out patterns, representing ideas, and discussing information. At the time, the approach was “different” as Chiappetta describes. It was not a traditional approach to learning. Inquiry based learning during this time was very specific to the biological science departments. However, in the late 1990’s Science for All Americans (AAAS, 1990) emphasized that the teaching and learning of science should be consistent with the nature of science and the inquiry based approach. After many years of controversy, The National Science Education Standards (NCR, 1996) acknowledged the importance of science inquiry by integrating more aspects of the central approach to its
standards. Since then, the inquiry based approach in science has evolved and continues to change as researcher gain more knowledge and data driven gains.

**What Past Study’s Have Shown**

As an important part of any learning experience, it is important to look back and reflect on others research for pivotal points and gains. The study conducted by Chow, Tse, and Collier (2008) emphasizes the benefits of learning via the inquiry based approach. The authors state the typical teaching norm of a teacher drive classroom are ineffective teaching practice which result in rote learning and regurgitated facts. In recent years there study mentions, the Hong Kong government’s Education Bureau has put inquiry-based learning as the first emphasis for curriculum in primary schools with the objective of “creating more learning space by removing obsolete content, allowing more time for inquiry-based learning.” Now, many schools are attempting to incorporate this mode of learning into their curriculum because of its success. The study reports on two phases of inquiry based learning projects conducted by 141, 4th grade Chinese students in China. Each phase of the inquiry learning process was an estimated two to three months long process. The projects were led by general studies teachers and highly supported by Chinese-language teachers, the information technology teacher, and the school librarian. The studies analysis looked at various aspects of the teaching and learning portion. Analysis of lesson plans, in-class exercises, homework assignments, written reports, presentations by students, and data collected through surveys and interviews. The study focused on the role of the teachers by which they guide students through the inquiry process. The article also analyzed students’ development of knowledge and research skills, as well as students’ and parents’ perceptions of the projects and work completed by students as part of the inquiry analysis.
The focus of the study by Remziye (2011) was to determine elementary school students’ level of success on science process skills and science attitudes. Researchers wanted to know if there were statistically significant differences in their success degree and science attitudes depending on their grade level and teaching method. Therefore, they looked at a Turkish elementary school and examined a total of 241 students (122 boys and 119 girls). The study included a pretest-post test control group and experimental group design was used. The data was collected by using Basic Science Process Skill Test and Integrated Science Process Skill Test and Science Attitude Scale. Results were gathered based on 2 school semesters which showed that use of inquiry based teaching methods significantly enhances students’ science process and skills.

Lieberman and Hoody (1998) conducted a study designed to identify the most successful and innovative ways to close learning achievement gaps. The study was designed to encompass the best educational practices by examining aspect of inquiry based learning through environmental education programs which emphasized a hands on learning approach. The framework for this particular study was defined by integrating interdisciplinary curriculum, collaboration, hands-on learning, and creating an engaging learning environment. Lessons where designed around this framework in anticipation for a distinct learning outcome supporting the positive effect of inquiry based learning and closing the learning achievement gaps. Findings of this study indicated that the integration of various subject matter allowed students to use several skills across multiple subjects. This allowed them to consistently practice a particular skill set. Employing pedagogy that is designed around social-cultural and environmental context makes the subject matter relatable and much more manageable to manipulate as a student. Further findings indicated that employing a hands-on inquiry approach carried benefits of higher
achievement in reading, writing, math, science, and social studies. This particular approach also increased student engagement and enthusiasm for learning. It created a greater pride and ownership of academic accomplishments and reduced disciplinary problems in the classroom. Inquiry based learning enhanced learning outcomes with a science unit regarding climate. The article disuses how the social dynamic of environmental problems was presented by using the inquiry based learning approach. The approach created a natural learning environment to which students received a deeper understanding of the content matter and thus, leading students to their own, self generated solution to the climate problem. The approach used for this particular science lesson produced a deeper understanding for students when compared to a more teacher driven approach to teaching. This article helps support my curriculum approach because it proves positive outcomes when applied properly in the classroom.

This quasi–experimental study in the article investigated the effect of two teaching methods on student content knowledge achievement. Inquiry–based instruction was compared to the subject matter approach in 15 secondary classrooms found across the United States. The study utilized student pretest score as a covariate, there was a statistically significant difference between groups on the posttest. Those students taught through inquiry–based instruction were reported as having higher content knowledge achievement than students taught through the subject matter approach. The study strengthens my approach in my curriculum project because it proves significant difference among 2 groups. Inquiry based learning produced a much deeper understanding of content knowledge.

The article by Lieberman focuses on the classroom characteristics of an inquiry based lesson. It is important to note that inquiry based learning may have several long lasting benefits however, it is imperative for the teacher (who is the facilitator) to know how and when to guide
students in their learning process. Inquiry based learning is a student centered approach to learning adequate science skills and content matter. If the teacher does not know how to appropriately implement the teaching method, results may not have the same long lasting effect. It mentions the role of the instructor is that of a peer facilitator who keeps students on track with their thought process. The teacher poses a question/problem and with teacher guidance, students seek various methods to answer the question/problem. In the mist of the learning process, students learn to question, test, and challenge existing rational to assimilate their own understanding. The classroom structure must be engaging by encouraging meaningful discussions and collaboration of thoughts and ideas. Student engagement and participation is key in inquiry based learning.

The research design in this particular article *Life-cycle analysis and inquiry-based learning in chemistry* included 20 in-service trained chemistry teachers from elementary to high school level and two researchers. Their goal was to figure out a way to effectively teach the life cycle and chemistry in a combined unit. After 2 years of research, their finding resulted in inquiry based learning to be the best and most effective approach when combining this particular subject matter. Their study design allowed students to actively engage in real life concepts and provided the opportunity for students to build and apply what they know. Inquiry based learning fostered a learning community of students that where effectively learning without constraints. The design of inquiry based learning eliminated the teacher driven classroom and constrains it brings when managing student thoughts. The article mentioned that often times students thoughts are driven by the teacher giving the lesson. Perhaps the way a student assimilates knowledge about a particular topic is much different than the way the instructor went about their individual assimilation. When inquiry based teaching is applied, the teacher has less input on
students’ thoughts which can often lead to a deeper understanding of content matter. Inquiry based learning allows students to individualize understanding of content by exploring topics without much constrains.

The Integration of Technology and the Arts

Although inquiry has proven to drive students academic outcomes and abilities; technology and the arts also aid a substantial difference in academic achievement. The article titled, “Benefits of Technology in the Classroom” addresses the wide range of student benefits when technology is involved in academic lessons. Conley and Mullin state that multimedia presentations are engaging and interactive. It provides students with a focal point and a natural engaging factor which may not always be accomplished with the use of a book. Technology allows students to engage with knowledge and develop a conceptual understanding of content matter by making links and personal connections to the video, pictures or interactive programs.

The authors also mention the improvement of technology skills and sophistication developed when students use technology in the classroom. Integrating technology in a lesson allows students to explore a world of the unknown. Technology can also bring multicultural awareness across all subject areas. The article highlights the benefits of integrating technology in a classroom. According to Kosakowski (1998), the integration of technology has the ability to reach all students all types of learning styles. Integrating the use of technology is not only an engaging factor in a lesson, but it also facilitates the learner needs with visuals, auditory connections, solitary working space, logical connections to content matter, and verbal cues.

Technology allows students to take control over their learning and it provides a forum for analytical and critical thinking to occur. Kosakowski (1998) highlights the integration of technology to have a rage of benefits such as developing the ability to collaborate with peers,
increase language development, critical thinking and problem solving skills, becoming independent learners, self-starters, and increase writing skills. Technology in a classroom can play a positive role in student learning outcomes. The article mentions the benefits of technology to be substantial particularly in Blooms hierarchy of higher order thinking. Technology integrated learning reaches a higher order thinking based on Blooms Taxonomy verse non technology integrated learning. Students with technology integrated lessons display signs of critical thinking and conceptual understanding. A particular school in Idaho reported a 15% increase in student test scores when instruction was provided with the integrated use of technology. The comparison was made after the school district invested millions of dollars in computers and academic software. Post technology guided lessons, students where more engaged and performance levels increased.

The article by R. S. Earle brings to light many valid points about the integration of technology in a classroom. He mentions that the term “integration of technology” is used continuously without much meaning. Integration of technology as he defines it is not a mere add-on of a computer to a lesson. That particular type of technology integration holds no value in learning. Integration of technology is a pedagogical tool beyond providing information but rather a resource to encourage critical thinking and instructional learning not possible without the use of technology. The integration of technology is intended to promote deep level thinking and process of ideas in order to produce mastery of content and skill sets. Earle states, “the educational technology that can make the biggest difference to schools and students is not the hardware, but the process of designing effective instruction.” The article places large emphasis on the teacher as the facilitator to be more like “Christopher Columbus” and venture out to seek a new world and new style of teaching.
The report produced by ACT and its authors reveals the effectiveness of technology in our schools. With adequate teacher training and resources, teachers have the ability to integrate a vital resource to enhance student learning. ACT research indicates that the integration of technology with traditional instruction increases student achievement in a variety of subject areas. Students learn content maker at a quicker rate when compared to the traditional lesson approach. Technology integrated lessons produce a higher skill and content retention rate. Technology in a classroom can work to provide structure of material to students, simulate and interact with scientific procedures and models. Technology can also help enhance and extend learning materials for handicap populations and/or EL students. The Benton Foundation Communications Program (2002) suggests a few of the following defining factors which impact the success of student achievement, when integrating technology in the classroom. Real gains in student academic performance will heavily relied on leadership. Leadership around technology use in the classroom will be anchored around realist and solid objectives. Teacher facilitators must have a clear perspective and set of expectations given their learners needs and abilities.

Adequate technological resources at the school and classroom play a major role in students’ academic gains. The article provides a comparison among technology use in the classroom which is used to enhance content matter verses no technology and instead integrate the use of your standard conventional use of text books to assist a lesson. The comparison highlights the benefits of student engagement and participation when technology is involved in a particular unit or lesson. Students also displayed higher academic attainment and conceptual understanding at the time of the assessment. However, the article discloses the negative effects of technology use in the classroom to be that of unclear learning objectives and a misconception of the primary role of the teacher. When integrating technology in to a lesson, students where unclear of the
lesson objective and much more engaged with the fact that they were using technology. Students used technology as their primary source to gather information rather than placing the teacher as their primary source to use and gather information.

The purpose of the article by Sydney (2007) was to examine literature and research surrounding the benefits of the arts integration with other core academic subjects. Gullatt explores (2008) the work of 3 prominent theorist and practitioners in art integrated education. The works of Kosakowski (1998) suggest that art is a fundamental factor in developing the “whole child.” Art integration is associated with many positive gains. Many argue that art integration in academic subjects helps increase standardized test scores. The gain is associated with the increased ability for students to be creative and think outside the box. Visual art infused lessons provides students with the opportunity to acquire a means of transformation of their ideas, images, and feelings in to a creative art form. It allows students to build and create personal connections to what they are learning. Art integrated education provides a welcoming learning environment which fosters an ambiguous desire to explore and accept multiple perspectives. Gullatt provides a series of examples for working professionals looking to integrate the arts in to various academic subjects. He describes a wonderful example of just how easy and engaging a language arts lesson can be integrated with drama. The lessons object was to get students to think about a narrative in terms of sequence of events. The teacher integrated drama as a way to get students to act out and engage in the narrative. The dramatization allowed students to stop, evaluate, and reflect on their work, much like the writing process in a narrative story piece. Gullatt emphasizes the use of multiple intelligences to complete the lesson objective. Drama was a way to build and develop metacognitive strategies. It allowed students to take control of their learning and work collaboratively towards a common goal. Snyder (2007)
emphasizes the importance of the arts connection, correlation, and integration in to academic subjects. She explores Gardner’s Theory of Multiple Intelligences (2008) as a way to support her claim surrounding the importance of the arts in education. Gardner’s theory suggests that all students need to employ multiple intelligences in order to complete full human development. The best way to assure that students utilize multiple intelligences is through the arts. Arts integration allows students to make connections with content matter and particular skills not possible through your traditional teaching methods. Successful integration of the arts allows students to explore a central idea through more than one language or discipline.

Integration of the arts appeals to all types of learners by providing opportunities for students to manipulate content through sound (music), image (visual art), specific gestures (movement/dance), words (auditory), and using symbols and logic (math). The journal further discusses how to create unit themes around central ideas. Providing opportunities for conceptual understanding, while also focusing on the creative process is a great way to maximize student learning. Making correlations across subjects allows students to build and strengthen their skills which are also applicable in the world outside the classroom. The article by Snyder (2007) focuses on the teacher as the shifting agent for change in our schools, particularly concerning the integration of art across academic subject matter. Research in the article supports the integration of subjects with art infused lessons. Art integrated lessons provide students with various avenues of learning. It opens up doors to a cognitive approach enhancing thinking and independent learning. The downfall however, was that lack of prepared teachers and their willingness to deviate from past teaching styles. According to Werner and Freeman’s (2001) study, teachers revealed a resistance to change existing teaching practices. It is difficult to get teachers who have been in the profession
for many years to think differently about their classroom and 21st century set of learners. Most teachers in their study displayed a lack of interest or desire to change their existing teaching practices. However, those who integrated aspects of the arts into their lessons reported an increase in student engagement, participation, and academic performance.
Chapter 3: Curriculum

Traditional Science Teaching Approach

The world of teaching and learning has difficulty keeping up with our rapidly changing world filled with technologically advances and hands on experiences. Our world vastly continues to change with various technological advances and applications. However, education has remained the same with regards to the application of teaching and learning methodologies which originated centuries ago. Educational applications particularly in science has been traditionally taught in a structured manner which many in the educational research field make reference to as “the cookie cutter lesson.” In a traditional science lesson, the teacher is the director and full facilitator who is visually and orally presenting students with new subject matter information. The rigorous structure requires the teacher to lecture students as a way to adequately inform students of important science related content matter. The week long lecture is traditionally followed by a lab, which requires students to apply what they have learned throughout the week long lecture. Although this traditional approach may appear to have structure, it leaves our students with missing pieces of information and often times misconceptions of science related content matter (Barron & Hammond, 2008). Lab recipes lack the facilitation of intrinsic student motivation and engagement. It constrains student thoughts and enables them to think critically and independently when information is spoon fed to students through lecture. This particular leaning process constrains students thinking rather than allowing multiple perspectives and ways to critically analyze information.

The New Vision for Teaching Science: Inquiry with the Integration of Technology and the Art

A new vision for science teaching is the inquiry based approach with the integrated use of
technology and aspects of the arts. As a means to conceptualize an in depth understanding of a particular subject or skill set, technology and the arts are integrated into science inquiry.

Integration of technology is used as a tool to aid student learning and foster cross curriculum skills. It is a way to integrate modern use of technology as a resource to enhance student learning outcomes. Integration of the arts is a way to enhance student learning outcomes by providing students with the opportunity to manipulate content matter and application of skill sets. Visual art allows students to utilize what they learned and apply it through a different means and intelligence. Inquiry based learning is an approach which is much more student centered in comparison to the traditional science teaching method. It is a constructivist approach of instruction aimed to help students acquire skills rather than solely gain scientific content knowledge (Simsek & Kabapinar, 2010). Inquiry based learning provides students with the opportunity to carry out investigations, test their ideas, and construct their own knowledge by making inquiries as young scientists (Barron & Hammond, 2008). The approach allows students to acquire scientific process skills which can be applied in various subject settings. The skill set learned during the inquiry based approach constructs meaningful critical thinking and problem solving skills which may be applied in everyday circumstances; rather than learning about one particular science objective and never applying those skill sets again, as often seen through the implication of the more traditional science teaching method (Remziye, Yeter, Sevgül, Zehra, & Meral, 2011). When engaging in inquiry, students are encourage to ask questions, construct explanations, test explanations against current scientific knowledge, and share their ideas and explorations with others. Students are equipped with the skills to interpret multiple perspectives as a means to question or validate existing ideas. They identify their assumptions, use critical and logical thinking, and consider alternative explanations. Students also actively develop their own
understanding of science by combining scientific knowledge with reasoning and critical thinking skills. The inquiry based approach encourages students to think independently and share their understanding with peers as a way to assimilate knowledge collectively.

Inquiry based learning fosters a natural learning environment where students are required to apply and develop various skill sets such as applying the use of academic language, critical thinking, and actively building ambitious learners with problem solving skills. By nature, scientific experiments are inquiry-based activities (Barron & Hammond, 2008). Therefore inquiry based learning offers a more natural approach for students to learn to propose hypotheses, design experiments, and select appropriate materials (Simsek, Kabapinar, 2010). The integration of technology in to science lessons, allows students to engage with knowledge and develop a conceptual understanding of content matter by making links and personal connections to the video, pictures or interactive programs (Conley & Mullin, 2003). Integration of technology is a pedagogical tool beyond providing information but rather a resource to encourage critical thinking and instructional learning not possible without the use of technology (Earle, 2002). The integration of technology is intended to promote deep level thinking and process of ideas in order to produce mastery of content and skill sets. Earle states, “the educational technology that can make the biggest difference to schools and students is not the hardware, but the process of designing effective instruction.” Technology is not only an engaging factor for students in a lesson, but it also facilitates the learner needs with visuals, auditory connections, solitary working space, logical connections to content matter, and verbal cues (Kosakowski, 1998). Technology allows students to take control over their learning and it provides a forum for analytical and critical thinking to occur. In the article Kosakowski highlights the integration of technology to have a range of benefits such as developing the ability to collaborate with peers,
increase language development, critical thinking and problem solving skills, becoming independent learners, self-starters, and increase writing skills. Technology in a classroom can play a positive role in student learning outcomes.

In addition to technology, infusion of the arts into science related content matter presents substantial gains with student mastery of content and skill sets. The works of Catterall, Eisner, and Gardner suggest that art is a fundamental factor in developing the “whole child.” Art integration is associated with many positive gains. Many argue that art integration in academic subjects helps increase standardized test scores (Gullatt, 2008). The gain is associated with the increased ability for students to be creative and think outside the box. Visual art infused lessons provides students with the opportunity to acquire a means of transformation of their ideas, images, and feelings into a creative art form. It allows students to build and create personal connections to what they are learning. Art integrated education provides a welcoming learning environment which fosters an ambiguous desire to explore and accept multiple perspectives.

A combination of these activities certainly contributes to students’ scientific inquiry skills in addition to their understanding of science concepts. Current research emphasizes the central role played by the science laboratory as a contributing factor to increase students’ perception of science and attitudes by stimulating interest, enjoyment, and motivating students to learn science. The inquiry based approach opens the door to an endless world of learning. It paves the way for a more natural approach to learning science content matter and future application of critical thinking and problem solving skills. The journey begins with a question or problem which captivates student’s attention and sparks ambition. Students work cooperatively to assimilate content knowledge, critical thinking and problem solving skills sets. The pedagogical approach to knowledge building requires students to apply research and experimental skills. When
students are engaged and intrigued by the question/problem, they are intrinsically motivated to construct their own explanation based on what they independently and at some point, collectively know. Students then design a way to test their explanation against existing scientific knowledge. Once students gather sufficient data and information to state their claim, then they present their findings with peers as part of a class discussion. This particular portion of the inquiry based approach serves as much value because it provides students with the opportunity to display the use of academic language, critical and logical thinking process, difficulties or constraints, alternative views, and overall outcomes. The discussion portion allows students to see various point of views and methods of going about a particular problem. It allows students to learn from one another based on experience which is a very meaningful way of learning. Inquiry based learning presents much greater learning outcomes then other traditional approaches because students are thinking independently to construct meaningful learning experiences (Chow, Tse, & Collier, 2008).

**Curriculum Design: Inquiry Based Learning with Integration of Technology and the Arts**

My curriculum unit was designed using the 1st grade California Content Standards: Physical Science 1a., 1b., and Investigation and Experimentation Standards 4a.-4e. The physical science standards make reference to students acquiring content knowledge concerning solids, liquids, and gases. The investigation and experimentation standards allows students to physically manipulate content matter while using inquiry based pedagogy. My curriculum design applied a gradual release of content matter centered on student responses. I integrated continuous repetition of skills and content as a way to solidify understanding. My goal was to create a learning community of independent critical thinkers who can transfer the skills and content they acquired through this unit and apply it to their day to day. I applied inquiry based learning
process as referred to on figure 3.1. The inquiry process is the most effective method for learning about solids, liquids, and gases because it was a great way to intrinsically motivate and engage my students in a natural setting for learning scientific content and skills.

**Figure 3.1 A**

Each lesson was also designed with gradual release of content matter and more focused on student centered activities which required interaction and discussion about solids, liquids, and
gases. Every lesson was designed to build one upon another. Each lesson contained repetition on skills as a way for students to become familiar with the process and build confidence. Students were required to use various science related skill sets in order to reach the lessons objective. Students developed a conceptual understanding by developing their own questions to perform an investigation for reasoning. Throughout the unit, I the teacher will have served as a guide by asking the essential questions. My primary focus as the teacher is to encourage critical thinking by inquiry and foster a natural learning environment similar to scientist in a laboratory. The lessons reflect sustained student engagement as it requires various forms of collaboration, research, analysis, alternatives, writing, articulation of thoughts using academic language, application of listening and speaking skills, management of resources, and discussions. Cooperative learning was vital to the success of the unit. It is extremely important to create a classroom environment in which all students feel valued and willing to take risk. Fostering this particular classroom culture is imperative with all subject lessons because it allows students to become much more open and willing to explore without barriers.

My unit objective is to build an understanding of materials and the different forms (states), including solids, liquids, and gasses. As a basis for understanding this concept: Students will know solids, liquids, and gasses have different properties; students know the properties of substance can change when the substances are mixed, cooled, or heated. Students will arrive to this conclusion by form of inquiry because it allows students to learn how to think critically and apply problem solving skills both independently and cooperatively in their learning environment. By the end of the unit students will have developed a higher order skill set.
Chapter 4: Curriculum Outline

Subject: Physical Science (Investigation and Experimentation)

Topic: Explore solids, liquids, and gases as properties of matter.

Grade: 1st

Methodology: Inquiry based learning with the integrating of technology and the arts.

Unit Standards: Science

- 1. Materials come in different forms (states), including solids, liquids, and gasses. As a basis for understanding this concept:
  - a. Students will know solids, liquids, and gasses have different properties.
  - b. Students know the properties of substance can change when the substances are mixed, cooled, or heated.

- 4. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:
  - a. Draw pictures that portray some features of the thing being described.
  - b. Record observations and data with pictures, numbers, or written statements.
  - d. Describe the relative position of objects by using two references (e.g., above and next to, below and left of).
  - e. Make new observations when discrepancies exist between two descriptions of the same object or phenomenon.
Dance:

- Development of Motor Skills and Technical Expertise Demonstrate the ability to vary control and direct force/energy use in basic locomotor and axial movements (e.g., skip lightly, turn strongly, fall heavily).

- Creative/Invention of Dance Movements

2.2 Respond to movement to a wide range of stimuli (e.g., music, books, pictures, rhymes, fabrics, props).

Art:

- Skill, Process, Materials, and Tools

2.1 Use texture in two-dimensional and three-dimensional works of art.

2.1 Mix secondary colors with primary colors and describe the process.

Lesson 1

Objective: By the end of the lesson, students will be able to classify materials based on their states (solids, liquids, gasses). Students will record their findings by cutting and pasting items and placing them in their corresponding section of the graphic organizer (solids, liquids, or gases).

- **Primary goals for this lesson:** The primary goal for this lesson is to create a clear understanding of the varying properties of matter. Students will understand the clear distinction between characteristic of solids, liquids, and gasses. By the end of the lesson, students will be able to show an understanding of properties by categorizing
• items into solids, liquids, or gases. As part of the inquiry based learning approach, students will take part in a whole class discussion before and after items are classified as a way to give students the opportunity to explain their reasoning behind each classification. This portion of the lesson will also allow students to gain a deeper understanding by addressing any possible misconceptions or uncertainty. The discussion will allow students to interpret multiple perspectives and gather information to question or validate existing knowledge. In addition, students will learn about the different states of matter by singing a catchy song which describes the different states. The song has integrated dance moves which will allow students to learn about the topic through a different means. Kinesthetic learning allows students to carry out a physical activity which will help students build a conceptualized understanding of the content matter.

Procedures:

• Engage: Spark curiosity and student inquiry with teacher read aloud: “What is the World Made of: All about Solids, Liquids, and Gases.” Refer to figure 4.1. A

Figure 4.1 A
• **Build on what we know:** What are our 5 senses? What can we use them for? Define as a natural “power” we have to see, hear, feel, taste, and smell. Chart student response and examples to senses.

• Each table group will be given 3 different items (solid, liquid, and a gas).

• Students will be asked to think like a scientist and observe the items placed on their table.

• **Essential questions:** As a scientist, how would you describe/classify the different items on your table? Based on your observations, what makes these items similar or different? Encourage students to support their thinking by making references to the items utilizing their sense. What questions do you have about the items placed in front of you?

• **Cooperation and Collaboration:** As a group they will be asked to describe the items based on their observations and discuss what they already know about the item.

• Student descriptions and observations will be charted on a large poster paper as a way to keep tract of student generated data.

• Once all groups have shared, they will be asked to compare and contrast their observations.

• **Essential Question:** Are any of these items similar? How? Why?

• Encourage student driven discussion of categories.

• **Essential Question:** How many categories will we need? Why?

• Students will begin sorting items based on student responses. All liquids on one table, solids on another, and gases.
- **Essential Questions:** What are important properties of a liquid/solid/gas? What does it look like, feel like, smell like, taste like? Chart student responses.

- Provide a clear explanation: All of the items/objects around us are a property of matter. Matter comes in different forms it can be a solid, a liquid, or a gas.

- A solid has its own shape and size. Its shape does not change when it is moved. It is easily controlled. An example of a solid would be a rock because it has its own shape which does not change when it is moved; it has its own individual size, and it can be easily controlled if you were to hold it in your hands. Other examples of solids include: a block, coin, ball, etc. Non examples: water in a lake, steam from a tea pot, or juice. Encourage student discussion and justification on both examples and non-examples.

- A liquid is something that takes the shape of the container it is placed in. Liquid can be poured into a container to take its shape. Water in a cup is a liquid. Other examples of liquids are water, juice, and oil. Non-examples of liquids are things such as door, hot air balloon, and a baseball. Encourage student discussion and justification on both examples and non-examples.

- Gases fill any space that is available. Most gases are invisible but some have a smell to them. Air in a balloon is a gas. Other examples include: oxygen, helium, steam etc. Non-examples include water in a balloon, a rock, or a toy block. Encourage student discussion and justification on both examples and non-examples.
• Introduce song “Three States of Matter” by Roy Kindelberger and incorporate dance movement. Have students stand in a circle and move to the tune of the beat. Refer to figure 4.1 B

Figure 4.1 B

Three States of Matter
by Roy Kindelberger

(Sing to the tune of “The Wheels on the Bus”)

The three states of matter are solid, liquid, gas.
Solid, liquid, gas; Solid, liquid, gas.
The three states of matter are solid, liquid, gas.
All day long.

The floor is a solid; you can jump up and down,
Jump up and down; Jump up and down.
The floor is a solid; you can jump up and down.
All day long.

Water is a liquid you can drink right down,
Drink right down, Drink right down.
Water is a liquid you can drink right down
All day long.

Air is a gas you can breathe right in,
Breathe right in: Breathe right in.
Air is a gas you can breathe right in.
All day long.

Super Teacher Worksheets - www.superteacherworksheets.com
• **Essential questions:** What are the properties of matter? What is a solid? What is a liquid? What is a gas? Can any of these properties of matter start as one substance yet end in another form? Provide examples.

• **Assess/Evaluate:** Using a graphic organizer, students will correctly classify solids, liquids, and gases. A minimum of one example per category is required to show mastery.

• **Rubric**

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<td>Student was correctly able to classify 1 or more examples of a solid, liquid or gas.</td>
<td>Student was unable to correctly classify an example of a solid, liquid, or gas.</td>
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Lesson 2:

- **Objective:** By the end of the lesson, students will be able to explain a solid and its potential change of substance when a solid is heated and mixed. Students will illustrate an example of a solid and an example of how the solid may change when heat is applied. A two sentence minimum explanation is required as a part of the illustration.

- **Primary goals for this lesson:** By the end of the lesson students will be able to construct a meaningful explanation of a solid by exploring the world around them. Each student will contain their own individual observation logs to illustrate and label solid items on campus and community. Students will share individually gathered data with peers during a whole group discussion. During the sharing portion, students will be asked to describe the material the solid was made up of (ex: plastic, metal, paper) of the items mentioned, students will be asked to think-pair-share items that could be melted or changed into a liquid or a gas. Students will also be asked to think of matter change inversely (liquid changing to a solid). They will discuss possibilities and the primary factor which will facilitate this change. Each student will then receive a small piece of ice. Students will be asked to find ways to change its current state of a solid to a liquid. Part of the lesson will also include a dramatic demonstration of a solid crayon melting from the heat of a blow dryer and becoming a liquid. The demonstration will be teacher driven however, the objective is simply to provide a rapid change of matter as a way to build on the lessons objective.

- **Essential questions:** Share commonalities among properties mentioned. What is a solid? What solids are made of? Provide examples/non-examples. What can be
mixed, cooled, heated to change? Which objects may change state? How/why? Would some take longer to melt/change then others? Why/why not? Is the type of material they are made of important? Can a liquid change back in to a solid? How and why?

- **Student Inquiry:**

  Each student will be given a small piece of ice and asked to change its state of a solid to a liquid. Students will not be told how to complete the process therefore, processes may vary. Common expectations may include adding heat friction with the back and forth moment of student hands or adding heat from mouth.

  Discuss best process and results with students during an open discussion.

- **Demonstration:** Teacher will provide a colorful assortment of solid crayons to the class. Essential questions: What do you think will happen to the crayons if we apply heat from a blow dryer? Student will generate hypothesis and support their thinking with applied reasoning. Teacher will then begin demonstrating the melting process.

  Follow up with discussion questions of what just took place. Explain the process of a solid crayon changing its original shape once heat is applied. Once it is cooled, it then takes a different shape and becomes a solid. Refer to figure 4.2 A.

  **Figure 4.2 A**

- **Art Extension:** What colors where mixed and changed? Any new color combinations?
- **Assess/Evaluate:** Evaluate observation log. Students will illustrate an example of a solid and an example of how the solid may change when heat is applied. A two sentence minimum explanation is required as a part of the illustration.

- **Rubric**

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Lesson 3:

- **Objective:** By the end of the lesson, students will be able to explain a liquid and its potential change of substance when a liquid is cooled or heated. Students will illustrate an example of a liquid and an example of how the liquid may change when increased or decreased temperature is applied. A two sentence minimum explanation is required as a part of the illustration.

- **Primary goals for this lesson:** By the end of the lesson students will be able to construct a meaningful explanation of a liquid by exploring the world around them while using the inquiry based approach and the use of technology. Students will each have observation logs to illustrate and label liquid items on campus and community. Students will also have access to 1 on 1 iPads as a way to create a picture assortment of liquids. Students will share their data collection with a class during a whole group discussion. During the sharing portion, students will be asked to describe the types of liquids observed during their investigation of liquids around them. Students will be asked to be descriptive in their explanation (ex: liquids in containers, bodies of water). Of the items mentioned, students will be asked to think-pair-share items that could be cooled/frozen and heated/evaporate to change its original property. The lesson will contain integrated use of technology when demonstrating YouTube videos of science related experiments changing liquids in to solids, and liquids in to gas. Technology will be used to enhance student learning process particularly for visual learners because it allows students to make visual connections to the content matter they are learning

**Procedures:**
- **Essential questions:** What is a liquid? How and why may a liquid change? Provide examples/non-examples. Will larger bodies of water take longer to freeze? Will more heat be required to change a large body of water? Why?

- Go outdoors and allow each student to pour a drop of water on the floor. Allow each student to outline their water drop with chalk. The objective is to demonstrate the process of how a liquid changes (evaporates) in to a gas. Return to the same spot in about 1-2 hours depending on the temperature outdoors. Once you return, the drop of water will have evaporated in to the air and has now become a gas. Allow students to discuss the results during a peer discussion.

- Students will also use iPads to collect a different picture assortment of liquids.

- With the use of the projector, computer and internet, display videos from YouTube demonstrating the rapid change of states (liquid to solid, and liquid to gas).

- Allow and encourage student discussion about their observations and logic behind the change of state.

- **Assess/Evaluate:** Evaluate observation log. Students will illustrate an example of a liquid and an example of how the liquid may change when cold temperature is applied. A two sentence minimum explanation is required as a part of the illustration.
### Rubric

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Lesson 4:

Objective: By the end of the lesson, students will be able to explain a gas and explain the process of evaporation by labeling an illustrated example.

- **Primary goals for this lesson:** Review lesson 1 gases. Gases fill any space that is available. Most gases are invisible but some have a smell to them. Air in a balloon is a gas. Examples of gases: oxygen, helium, steam etc. . . Non EX: water balloon, rock, toy block.

- **Lab:** Each table will be given a piece of ice (a small piece simply because of time). Students will be asked to work as a team of research scientist to construct a meaningful explanation of how the piece of ice can go through all the properties of matter starting as a solid, then as a liquid, and end as a gas. They will be asked to collectively use their observation logs and assessment as tool to construct a meaningful hypothesis. A meaningful hypothesis is an educated guess about how things work. Students hypothesis will be structured to look as such, “If _____ (I do this) then ________ (this) will happen.” Example of teacher generated hypothesis: “If I place my block of ice in direct sunlight it will melt then it will evaporate.” Students will have access to direct sunlight outdoors as a possible way to test their hypothesis. They will record their hypothesis on a graphic organizer. Students will then share their hypothesis and findings will be posted on chart paper. I will then conduct my own lab to display how I will test my hypothesis. We will all go outdoors and place the ice on the hot floor as a way to show the melting process. We will the return 5-10 min later to observe if the ice water was in fact evaporated. As a class, we will discuss the accuracy of the hypothesis statement. We will go over my lab results and ask students to make comparisons. Students will be asked to share how and
why their hypothesis was true/untrue/modified. As an extension, students will be required to demonstrate and add understanding to the concept through interpretative dance. Students will work in groups to choreograph various locomotor and axial movements which will help deliver a clear understanding of liquid change. The purpose of this lesson extension is to enhance the use of multiple intelligences required to master skills and content matter.

**Essential questions:** How can a solid change to a liquid, then a gas? Provide examples of gases.

- Interpretive Dance: Students will be placed in groups to perform short dance movements to describe their interpretation of a liquid change. Students will use locomotor and axial movements to dramatize their interpretation of change. Using appropriate vocabulary, students will explain their understanding of the changing state.

- Allow and encourage student discussion and interpretation of movement to describe the changing state of a liquid.

**Assess/Evaluate:** Students will be asked to illustrate and label the ice evaporation process.

- **Rubric**

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Lesson 5:

Objective: By the end of the unit, students will know the different states of matter, including solids, liquids, and gasses by classifying objects based on their state. They will demonstrate an understanding of substance change by providing illustrated examples and written explanations.

- **Primary goals for this lesson:** Display a deep understanding of solid, liquid and a gas. As a class we will review the different properties of matter by classifying student generated examples. A Teacher Tube video will be displayed as a way to visually bring the unit to a close. Students will be asked to illustrate an example and a written explanation as a way to display what they have learned. Students will have a chance to further enhance their understanding by manipulating content matter through artistic means. This is yet another way to allow students to utilize multiple intelligences by using artistic perception to describe their understanding.

- Students will be asked to make new observations when discrepancies exist between two descriptions of the same object or phenomenon.

- Recall various methods analyzing content: logs, discussions, and activities. Discuss the videos seen in class. How did we get to our conclusion about solids, liquids, and gasses and changing states? Did we consider alternatives?

- Each student will be given a graphic organizer and cheerios to artistically demonstrate the difference in atoms presented in each solid, liquid, and gas. The solid box of the graphic organizer will contain the most amount of cheerios demonstrating a tight and compact area of a solid. The next box will contain a less and scattered amount of cheerios demonstrating the less compact form of a liquid. The last box will contain the least and scattered amount of cheerios demonstrating the gas form of matter. Refer to figure 4.5 A

Figure 4.5 A

- **Assess/Evaluate:** Assess individual student work (graphic organizer) and evaluate student explanation. One sentence per category is required to show mastery of content.

- **Rubric**

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understanding of solids, liquids, and gases by artistically placing cheerios on the graphic organizer to represent the amount of space found in each material. Each category displayed a one sentence explanation of what the cheerios represented. Each category did not display a one sentence explanation of what the cheerios represented.
Chapter 5: Findings

The inquiry based approach is a new, student driven way of teaching science. My unit contains the integration of technology and aspects of the arts as a way to utilize multiple intelligences and optimize student results. The unit is designed to optimize student learning outcomes in comparison to the more traditional lectured approach (Thoron & Myers, 2011). The approach requires students to learn about a scientific skill set while they simultaneously assimilate content knowledge. The integration of various teaching methods allows content to be accessible to all students by integrating the use of visuals, auditory, kinesthetic, tactical, and social interactions. The teaching method however, may only be as successful as the design the teacher facilitates. The teacher must be knowledgeable with the inquiry based approach in order to reach expected learner outcomes. Therefore, as the facilitator I centered my unit structure around specific key points which would guarantee optimal learner outcomes. My particular set of classroom students perform better with repeated exposure of content matter and skill sets. They academically excel at a greater rate when they are able to manipulate content matter repeatedly in various occasions and forms. Therefore, I made sure to implement gradual release of information and repeated exposure necessary to acquire inquiry skill set for my young critical thinkers. The structure of my unit was repetitive and simple as a way to assure student success regarding the critical thinking aspect and problem solving skill set I looked to accomplish. I made it a point to make content relatable by using various examples and non-examples of items my students where familiar with. Students also worked in mixed groups throughout the unit much like scientist would in a natural setting. Student participation was a key element in the unit design, thus the small table groups. The small table groups truly forced every student to contribute their own individual thoughts. This was also a very important aspect of the inquiry
based teaching approach, as a created a natural learning environment where students were more engaged because they played a larger role in a lesson. Small group sizes was an important aspect of inquiry because it assured various exposures to content matter as students acquired science related skill sets. The essential questions worked to foster a critical thinking environment of learners and problem solvers. I also incorporated a whole class discussion aspect to each lesson because this would be the time where students would be able to apply academic language, address any misconceptions, problems/difficulties, and showcase what they have learned. This portion of the lessons serves of much value in inquiry based learning because it is a student driven discussion where students can learn from one another. Once students individually and collectively manipulated content matter, I assessed what they individually learned at the end of every lesson as a way to check for understanding.

The recommendations for implementation of the inquiry based approach aimed at creating independent critical thinkers and problem solvers who may collaborate to reach a common goal. I certainly designed my unit lessons to reflect that of a successful inquiry based approach. I made sure my unit structure was realistic concerning my student capabilities and individual student needs. By the end of the unit my anticipated learner outcomes will have been met because of the logical and natural rational behind my inquiry driven structure.
References


ET Magazine Website: http://BooksToRead.com/etp


