S^2
Super Science By Any Means Necessary!

Annette Boles
Sharpstown Middle School

Faster than a "graphing calculator," more powerful than the "pull of gravity!" Able to "teach science and math" in a single unit! Look it's a "theory." It's a "law." No it's "Super Science!"

INTRODUCTION

In the pursuit of knowledge and information, most scientists pride themselves in their ability to detect and decode scientific mysteries about the world around us. Most scientists have been honored with degrees and titles such as "Doctor," or "Director of Centers for Superconductivity and Advance Materials," or "Professor of Physics, Chemistry, Electrical and Computer Engineering." The masterminds, the geniuses, and the brilliant men and women in our society have attained a wealth of information about science from Ivy League Institutions around the world. Many have gone as far as outer space to acquire theories and principles. Our society is depending on these masterminds to advance our lives. My question is, are we raising and preparing more young minds to take their place or are we letting them fall through the cracks of our educational systems? There are too many young minds that, due to their circumstances, will yield little or no contribution unless we address it.

It is my goal to use this single animated unit "Super Science" to encourage the formation of educational partnership between students, teachers, and their parents in a unit that will encourage our "at-risk" learners. This unit will provide teaching strategies using animation to teach basic scientific and mathematical concepts.

The animated S^2 Unit will use the adventures of a Super Hero and her sidekick to teach basic science and math concepts. Educators can use comic books, Saturday Morning Cartoons and the adventures of Super Heroes to teach a nine-week science and math unit. This unit will cover Metric Measurement.

WHAT EDUCATORS ARE FACING

Some educational institutions have established multi-million dollar science programs by purchasing science equipment, laboratory animals, and curriculum guides that have not motivated nor engaged middle school students to excel in science. Therefore, money should not be the driving force behind a great science education nor should the lack of money be an excuse for not having a great science program for every child in our

educational system. There are many ways that you can expand a student's interest in Science without a whole lot of *dinero*.

It is the goal of the animated S^2 Unit and its creator to motivate and encourage at-risk middle school students to pursue excellence in science education. This animated unit can equip the educator with a fun and creative way to teach science and math concepts. If our society wants to remain an advancing society, educators and members of our society must share the goal of excellence in science education.

"At-risk Students?" What are at-risk students? The answer depends upon the person you talk to. There are many definitions of what an at-risk student or disadvantaged child is. In my opinion, risk factors may include, but are not limited to, one or all of the following factors in this small list. Usually more than one factor contributes to whether a child is seen as "at-risk." The factors come in all forms; they may cause a disadvantage that influences the education of the child. These influences include but are not limited to low socioeconomic status, under achievement, low motivation, single parent homes, poor test scores, and retention and learning disabilities.

These influences are overwhelming to students, parents and teachers. Therefore, we need to form an educational partnership that will minimize the effect that these influences have on the at-risk middle school student. These influences will have little or minimal effects on the at-risk student if good instruction is occurring in the classroom. But the partnership is important. It is an element that is crucial for the program's success.

The animated S^2 unit will address all the concepts in the lessons using animated activities with sound teaching strategies such as: drill and practice, peer tutoring, student/teacher relationship, cooperative learning, homework, success learning, action learning, imagination learning, and direct instruction. Every stage of learning is important; therefore, an effective teacher would want to include these practices. The goal of all instruction is to have academically successful students. I have incorporated the different stages of learning into the animated S^2 unit in order to lay a foundation that would provide academic success for at-risk students in science and math.

This unit will include a place for the parent to have inclusion in the process of their child's learning. The homework is structured so that the student will have work that both parent and child can accomplish together.

MY INSPIRATIONS

In creating this unit I was looking for a new way to present rudimentary lessons. I attended a session lead by Paul G. Hewitt at the National Science Teacher's Convention 2003, in Philadelphia. This is a foreword quote from his book "Conceptual Physics." He inspired my plans:

> The teaching and writing of conceptual Physics is my life's work. My aim is to share my passion for physics, to guide the reader to see physics as the rules of the physical world, and to teach how the equations of physics concepts themselves, their similarities, and their differences (Hewitt xvii).

During the fall of 2002, Mayra Muller-Schmidt followed me for days and encouraged me to attend the 2003 Houston Teachers Institute Seminar Program and today she is following me around to turn in my final paper. Ms. Schmidt is the awesome example and illustration of a teacher not giving up on her pupil. Being at-risk not to finish my paper she has encouraged, nagged and carried me through the process of completing this paper. She has inspired me to continue to teach with passion and perseverance. Her passion for the Houston Teachers Institute has taken me to a new level of teaching – the level that reminds me I am still a student and my students will always need me to teach them with passion and perseverance to carry them to a successful academic level.

Alex Ignatiev is the Director of the Texas Center for Superconductivity and Advanced Materials and Professor of Physics, Chemistry, and Electrical and Computer Engineering at the University of Houston and my Houston Teachers Institute Seminar Leader. He inspired me to encourage my middle school students to keep a sense of humor in life. Dr. Ignatiev impressed me with his wealth of knowledge and his ability to remain human and humorous. As he would speak about different science fiction accounts aboard the Starship Enterprise, he always pointed out the science in the science fiction episode and then teach an hour-long lesson on topics such as "Does zero gravity really exist when we leave earth?" He always encouraged me to teach and have a great time doing it.

SCIENCE RULES!

Does science have anything in common with science fiction? Is science real or is science fiction? I will pose this question: can science be both? Is science a form of science fiction? I believe the answer can be found in the definition for science and the definition for science fiction.

The Merriam-Webster's Intermediate states that **science** is the state of knowing, knowledge. Students need to know that the concept of science means "to know" or "to learn about the world around you" by observing and obtaining information about their environment.

This definition of science can be paired with the Merriam-Webster's Dictionary definition of **science fiction**. Science fiction deals with the influence of real or imagined science on society or individuals. Science fiction as a genre has provided science disciplines with a rich environment for teaching difficult science concepts to at-risk students.

If students are taught to dream and to use their **imaginations,** then science fiction brings new meaning to difficult science concepts. It assists in making these concepts real, comprehensible and come to life! The concepts can be based upon real or imagined science. That's it. It's science fiction!

NOW ADD ANIMATION . . .

It my goal to give my students skills and strategies to obtain information about what they must "know" and what they must "learn" about the world around them "by any means necessary." Animation has been used in the past as a form of entertainment for children; however, animation can be used as an educational tool that can provide scientific knowledge or experiences for children in order to learn the difficult concepts of science and math. The educational system must stimulate and encourage at-risk children to pursue scientific knowledge about their world.

Animation provides an innovative way to teach students difficult science and math concepts in such a way that they will actively want to "know" about the environment around them. This can be done without an expensive science curriculum by using Saturday morning cartoons, the Sunday morning comics and outdated comic books.

Middle school students can learn science concepts through illustrations and models. When science concepts and models of science concepts are animated, they bring life and vigor that will give students a different perspective on difficult concepts. These difficult concepts now have the ability to come to life for the students. The once old and boring concepts have new purpose and meaning to the students that bring with it new meaning and understanding. Newfound understanding can introduce academic success and establish positive self-esteem for at-risk students with limited academic success and low self-esteem.

Science equipment is usually a problem for the classroom science or math teacher. They are told, "There is no money to buy new equipment." Many classrooms have out of date equipment or equipment that is broken. Some schools have state of the art technology, but their students don't know how to use the equipment. However, there is free equipment for every child in every school district. Every child comes to school with this important piece of equipment. The educational system is not required to purchase this equipment; however, the education system is responsible to teach the children how to use and maintain this priceless piece of equipment. The equipment is the child's imagination.

Educators must teach children how to use and value their imagination. This priceless tool is the originator of so many scientific inventions and even animation! According to Merriam Webster, the imagination is the act, process, or power of forming a mental picture of something not present and especially of something one has not known or experienced. "Bingo" – My definition for education can be adapted or interwoven with

the stated definition of imagination. I believe education is the power to gain or acquire a working knowledge about something one has never experienced or known.

With this new knowledge students can explain and communicate difficult science concepts with ease and authority. In the animated S^2 unit I have incorporated animation, science and science fiction to promote academic excellence in science and math for the at-risk student. Charles Dickens' father gave him an animated definition of what the imagination is and he encouraged young Charles to use his imagination.

> "Well," said Mr. Dickens, "it means being able to take something real – like that house – and use it to make pictures in your mind of something that isn't real yet." (Johnson 9)

Our imagination is the birthplace of every concept, every dream, every theory, every idea, every opinion, every fact, and every law. The animated S^2 unit is a demonstration of how the imagination can be used to learn difficult math and science concepts. Educators should imitate the example of Mr. Dickens' father when he gave him the definition when he was a young boy. Animation can help middle school students to take real-life concepts and gather newfound knowledge that would help them understand science and math concepts.

A dream gives birth to an idea; an idea gives birth to a thought; a thought becomes a concept which embraces many principles that one day support a theory that evolved from "something real-life, that isn't real yet." This process can occur when animation is paired with concepts, facts, laws and theories of science.

Educators must acknowledge that every Space Shuttle launch, every medical achievement, every scientific theory, and every computerized drawing originated from individuals that valued and used their imagination. Our medical, scientific, technical, mechanical, and political advancements are examples of how the world has benefited from individuals who learned how to utilize and valued their imagination to the fullest extent. Walt Disney's Wonderful World of Disney demonstrates his artistic talents using animation to create "something real-life, that was not real yet." Just think about Disneyland's "Mother Ship Earth" or Epcot Center, which is all about science and technology. Today NASA and other scientists are using concepts adapted from these futuristic notions.

In a society that is complex and ever changing, the animated S^2 Unit will provide educators of at-risk students with an educational strategy to promote academic success by using action learning coupled with classroom learning. This strategy can be used inside and outside of the classroom. Homework is an example of action learning and the animated S^2 unit will use several homework activities to reinforce science and math concepts. "Action learning is a term used to describe non-formal, out of school learning experiences during or after the regular school day" (Maryland State Dept. of Education).

The animated S^2 Unit will encourage educators to use action learning as a strategy to supplement the science and math curriculum

Research shows a high number of at-risk middle school students drop out of school. Action learning is a promising approach for motivating at-risk middle school students to improve academically and graduate from high school. D.H. Eichhorn states, "The learning climate should be active and dynamic. A variety of learning experiences should be provided. Experience is an indispensable element as students pursue their curiosity and grow intellectually" (Maryland Dept. of Education).

The animated S^2 unit will use action learning. It will provide hands-on learning as students experience and master the objectives for measuring. Within this unit the students will explore animated science and math concepts that explain and illustrate difficult math and science objectives.

Many superheroes and villains use super powers and special abilities to accomplish great feats. Some of these astonishing things are the ability to fly, the ability to demonstrate abnormal physical strength, and the ability to conquer death, the enemy of mortal man. Animation has the medium to illustrate and demonstrate the alternate mode of transportations for superheroes and their sidekicks.

The animated S^2 unit will compare and contrast how we use measurements with how animated cartoons support or destroy measurement concepts. Cartoons can give an inaccurate impression of gravity and distance – like Bugs Bunny burrowing from New Mexico to Scotland in mere seconds. The teaching strategy of direct instruction provides students with support and encouragement from the classroom teacher.

According to the research on disadvantaged or at-risk middle school students, teachers who provide direct instruction to at-risk students promote learning. The students learn more when teachers provide active instructional support and provide opportunities for students to receive help in mastering skills. (Maryland Dept. of Education)

The S^2 Unit will provide educators with lessons and strategies that provide direct instruction to the students. These direct and active instructionals will give opportunities for at-risk students to attain high academic standards in measurements, simple machines and solar system astronomy. Academic success will happen when the educator is actively directing students and engaging students in the learning process. The S^2 unit allows students to study models, describe cycles, design machines, and explain the math and science concepts in this unit.

One of the goals of the animated S^2 unit is to use the direct instruction strategy to help at-risk students recognize and explain the limitations of models used in science. Outer Space is filled with many objects that we have models of. Students will create models of different objects within our solar system. This world of space models can provide a

birthplace for the student's imagination to give birth to creative ideas, excitement and adventures illustrating science objectives and concepts. Outer Space is the last frontier left for science fiction and animation to conquer and master.

In the animated S^2 unit students will compare and contrast the planets within our Solar System and use their imagination to study and create animated adventures for superheroes that battle the elements and unknown forces of our solar system. Science fiction has provided an avenue for creative science ideas to be born. The ideas can be real or unreal; however, these ideas provide students with a lively and energetic way to learn science.

The animated S^2 unit was written for at-risk middle school students to learn facts and laws about space and our solar system. These school children are at a crossroad in their education. I believe direct instruction will improve the academic improvement of the disadvantaged middle school student. The educator must use the direct instruction strategy to provide vertical academic movement for the at-risk student. These students need to know what is expected of them to complete every assignment. The teacher must be clear and concise with each objective, concept, project, lab and daily assignment to provide academic success for the student.

> Direct instruction…is based on the assumption that knowing how to learn may not come naturally to all students…Direct instruction has been particularly effective in teaching basic skills to young and disadvantaged children, as well as in helping older and higher ability youth to master more complex materials and to develop independent study skills. (Maryland Dept. of Education)

The animated S^2 unit will highlight another instructional strategy used to improve the level of achievement for at-risk students. The teacher will use this in basic skill-building activities. The old saying, "Practice makes perfect," has some validity. This is illustrated when at-risk students use repetition to learn certain skills and concepts. Drill and Practice is a teaching strategy that can happen by using a classroom computer, cooperative learning groups and individual accountability. Repetitious activities give students the opportunity to practice following directions and achieve mastery. This strategy allows students to improve academically and increases the students' ability to follow directions.

> Peer tutoring is an education strategy used in many classrooms across the country with disadvantaged and at-risk students. However, peer tutoring has two parts. Peer tutoring is an instructional strategy in which students teach other students, who are approximately the same age. The second part of this strategy occurs when an older student tutors a student younger than himself. (Maryland Dept. of Education)

Peer tutoring is used to improve at-risk students' achievement, attendance, attitude and self-esteem. Research has provided data to encourage peer tutoring. Peer tutoring demonstrates that both sets of students (peer and tutor) benefit from this symbiotic relationship. The data shows that the tutor reviews and thus has a greater chance to master the material. In order for Drill and Practice and peer tutoring to be successful teaching strategies, the educator uses must be consistent. The strategies cannot be stagnant: the teacher and the student must visit the strategies on a daily basis. Peer tutoring supports the idea of students working in various cooperative learning groups to improve academic goals and to improve social interaction with peers.

At-risk students may adopt healthier attitudes about school attendance, learning strategies, themselves and their peers when they are successful academically and socially. Therefore I believe that peer tutoring and cooperative learning activities will decrease the dropout rate, increase academic achievement and raise standardized test scores of the at-risk student.

The animated S^2 Unit will couple the animated homework strategy and cooperative learning strategy to promote academic success. Students are given homework assignments to reinforce the concepts learned during cooperative learning actives, hands-on activities and laboratory experiments. Completed homework will improve the academic achievement for the at-risk middle school students.

> Studies have shown that the grades of low-ability students who do one to three hours of homework a week are usually as high as average-ability students who do no homework. (Maryland Dept. of Education)

Cooperative learning teams occur when students are placed in a group of learners to accomplish an academic task. This is different from peer tutoring because the group of learners is usually in groups of four. The groups are put together by the teacher based on the ability of each group member. The individuals in each group should be heterogeneously grouped. When creating cooperative learning groups the educator should include a student with high academic ability, a student with medium high academic ability, a student with average academic ability and a student with below average academic ability. Students are not told by the educator how the group was formed.

The cooperative learning groups are academically balanced with students from four different academic levels; they are also balanced according to gender, ethnicity and race.

> Research on at-risk youth indicates some middle school children eventually drop out of school because they performed poorly academically in schools, had problems with teachers and administrators, and generally "disliked everything." (Maryland Dept. of Education)

Effective educators provide a positive, supportive, and humane environment for learning and academic success to take place in the lives of at-risk middle school children. Therefore, I believe the most important strategy for effective and efficient instruction of at-risk students is the educator. It is the responsibility of the educators to establish a respectful, caring, safe environment for all students. Placing at-risk students in an environment with an effective educator improves the academic, personal and social achievements of the at-risk students.

> Research also shows that staying in school, regardless of the instructional program, student's ethnicity or student's gender, causes increase in academic achievement. In effect, the research says that the first task in promoting learning among at-risk youth is to keep them in school. The second task is to create experiences that maximize the learning that can take place while the students are in school. (Maryland Dept of Education)

Strategies are used to guide teachers as they instruct students, but we must realize that strategies cannot take the place of the effective educator.

Academic success can occur using the world of animation and science fiction. We know that Super Heroes are not real; however, they can provide a rich academic text that promotes academic achievement. The animated, science fiction environment can provide at-risk students with an active way to learn concepts, theories, principles, and laws of science and math. The animated S^2 Unit, will use the life, the action, and the adventures of superheroes to teach a nine-week science and math unit on Metric Measurements, Simple Machines, and Earth's Solar System to at-risk students.

Tell Me, I Forget;
Show Me, I Remember;
Involve Me, I Understand.

-An Anonymous Chinese Proverb

The S^2 Unit is a hands-on science and math unit coupled with science fiction and animation. Effective educators cannot stand in front of a classroom and lecture; the educators need to be active and get the students involved in the process of learning. Animation provides the interaction between educators, students and the subject matter at hand. This interaction has produced high academic test scores and students have a greater understanding of the objectives and concepts. Students using animation to learn the stated concepts and objectives have demonstrated pleasure in learning and completing academic projects. The educators that use this animated unit can enforce high academic standards and help at-risk students acquire a new learning style to help them master difficult concepts and objectives when using models, videos, and illustrations.

Academic success is available for all children. It is not limited to the rich, the gifted or the talented; it is for the at-risk student as well. Academic success should be the

educational reality of all students. To provide academic success for all students, educators must adopt the battle cry and attitude of "By any means necessary!" to guarantee success in the classroom for all students.

I hope this animated science and math unit will serve as a jumping off point for all educators to produce successful academic students. If young people are successful in the classroom they will become successful individuals in society. As primary and secondary educators we can leave no stone unturned.

We must provide a successful education for all students "By any means necessary!" Educators must realize that children are diverse. Children learn at different rates and they process information by using a variety of learning styles. The at-risk students will experience academic success and a boost in their self-esteem. This successful experience will bring about a healthier attitude about school and learning and decrease the dropout rate among at-risk youth. The animated S^2 unit is innovative, creative, active, hands-on unit that brings life to a basic math and science curriculum with an attitude to pursue academic excellent. This attitude is fuel with the desire and passion to provide a successful learning experience for at-risk students "By any means necessary!"

Faster than a "graphing calculator," more powerful than the "pull of gravity!" Able to "teach science and math" in a single unit! Look it's a "theory." It's a "law." No it's "Super Science!"

LESSON PLANS

Lesson One: Introduction to the International System of Units (SI)

Overview
Collecting data is a very big part of science. Measurement is an essential element for students to achieve academic excellence in science. Students will realize the need for scientists to have a universal standard of measurement. This is required if scientists want to study the work of other scientists around the world. The system of measurement scientist use is called the International System of Units (SI) or the metric system. The teacher will use the provided clip art showing Super Science or Square Root measuring something or use the clip art (Appendix 7) and place them around measuring tools or on the worksheets.

Objective
To test prior knowledge of the International System of Units (SI) or the metric system.

Vocabulary
International System of Units (SI), meter, second, kilogram, measurement, standard, prefixes, units, abbreviations

Materials
Pre-Test (Appendix 1), Metric Prefix Sheets (Appendix 2), Metric Unit Sheets (Appendix 3 & 4), Some of the questions (marked with an asterisk) in the pretest require illustrations. Teachers can provide these on the blackboard or overhead or in handouts.

Procedure
Students will take the Metric Pre-Test to assess prior knowledge of the metric system. Once the students have taken the pre-test the teacher will review for some students and instruct others the basic concepts of the metric system. The vocabulary is really important. The teacher must stress that units of measurements can be many things, but you must have a common standard of measurements in order to share data with other scientist.

Lesson Two: Metric Measurement Linear

Overview
Students must understand and demonstrate hands-on measurement using a metric ruler, a meter stick and a meter tape. Students will become familiar with the three instruments of measurement. The first unit is meters. Students will use the metric ruler to practice measuring in centimeters, millimeters and meters. In the prior lesson students learned the prefixes used within the metric system. The students will combine the prefixes with the meter unit of measurement to represent the appropriate linear measurements.

Objective
The learner will be able to know when to use the metric ruler, the meter stick and the metric measuring tape to measure different things.

Vocabulary
Linear, height, distance, width, length, meter, kilometer, millimeter, centimeter

Materials
Linear measurement sheet (Appendix 5), Hands-on Measuring Sheet (Appendix 6), metric ruler, metric measuring tape, meter stick

Procedure
Students will complete the linear measurement work sheet after the teacher has explained the usage of kilometers, millimeters and centimeters. The teacher will demonstrate and explain how to use a metric ruler and allow students to measure different objects placed on their table. The teacher emphasis that the student will measure in millimeters first and when the student has mastered measuring in millimeters they will move on to measuring the items in centimeters. Once the teacher has guided the students and allowed them to practice measuring in centimeters and millimeters the students will complete the Hands-on Measuring Sheet.

Lesson Three (This will take 3 days to complete): Metric Measurement Volume

Overview

In science you can find the volume of a liquid or a solid. Students will measure the volume of liquids, regular and irregular shaped solid objects. Irregular shaped objects do not have perfect straight sides. The regular shaped objects are three-dimensional figures such as tetragons and cubes. Volume is how much space an object takes up.

The learner will be able to use different scientific tools and formulas to find the volume of liquids and solids. The correct unit of volume measurement for regular shaped solid objects is cubic centimeters and the unit of measurement for the volume of a liquid is liters. The volume of an irregular shaped object is measured in milliliters. Students will measure the volume of liquids in milliliters using a graduated cylinder or a beaker. Because of the glass cylinder most liquids will usually have a curved surface. This curved surface is called the meniscus. Students will read the matching line near the bottom of the curved surface, the meniscus; this will give the student the correct measurement.

The volume of solid objects can be calculated by using water displacement and the volume formula. Water displacement is when the object displaces water in a graduated cylinder or a beaker. When you place water in the graduated cylinder, take an initial reading. Tie a piece of thread around the object and lower it into the graduated cylinder or beaker. Once the object is in the cylinder or beaker you will take a second reading. You will then subtract the first reading from the second reading and that will give you the volume of your solid regular or irregular shaped object in mL. To find the volume of a regular shaped item (tetragon or cube) student will measure the height, length and width in centimeters. When the students have the measurement they put them in the formula: L x W x H = Volume or Length x Width x Height = Volume. Once the formula has been calculated the unit of measurement is the cubic centimeter.

Objective

The learner will be able to calculate the volume of liquids and solids using the correct tools and formula.

Vocabulary

Meniscus, regular, irregular, formula, initial, graduated cylinder, height, width, length, volume, cubic centimeters, milliliters, three-dimensional

Materials

16 regular shaped boxes, 8 irregular shaped objects, graduated cylinders, thread, metric ruler, Appendix 7.

Procedure
The teacher will explain the overview to the students and give the students opportunity to practice finding the volume of 16 boxes by measuring the length, width, and height of the boxes. Once the students have the measurements they will calculate the volume of each box. The teacher must stress that the students will use the formula for regular shape 3 dimensional objects. Students will complete a Volume worksheet for regular shaped objects. The teacher can teach liquid volume (see Appendix 7) if the students have mastered finding the volume of three-dimensional regular shaped objects or continue giving guided practice and independent practice worksheets.

The learner will be able to measure the volume of liquids by placing the liquid in a graduated cylinder and reading the meniscus. Students will have guided practice and independent practice finding the volume of different liquids using a graduated cylinder and a beaker. Once the students have mastered finding the volume of liquids they should move on to finding the volume of irregular shaped objects using water displacement (see Appendix 7) The students will find the volume of irregular shaped objects by taking an initial reading of the liquid in the graduated cylinder or beaker. Then tie a piece of thread around the irregular shaped object and lower it into the beaker or the graduated cylinder to take a second reading. The student will calculate the volume of the irregular shaped object by subtracting the initial reading from the second reading.

Lesson Four (2 days): Metric Measuring Mass

Overview
Mass is one of the most misunderstood parts of measurement within the metric system. Students confuse mass with weight. It is important for the teacher to clarify what weight is and what mass is not. The students will learn the difference that mass is the amount of matter in an object and it remains constant; weight changes with the gravitational pull on the object. Mass is measured in grams or kilograms and students will use three types of balances to find the mass of an object. A triple beam balance, a double pan balance and the digital balance are tools used to find the mass of different objects.

Objective
The learner will be able to find the mass of different objects using a triple beam balance, a double pan balance and a digital balance.

Vocabulary
Triple beam balance, double pan balance, digital balance, mass, weight, constant, gravitational pull, masses, pointer, beams, rider

Materials
Triple beam balance, double pan balance, digital balance, masses, objects,
Finding Mass (Appendix 7).

Procedure
The teacher will introduce the learner to parts of the double pan balance and triple beam balance. The learner will have an opportunity to label and identify the parts of the balances by completing The Balance Worksheet and demonstrating the correct identification for the teacher. To use a double pan balance the students will put the measurable object in the left pan and add masses to the right pan until the pointer is perpendicular with the beam. The student will count the grams of each mass and add them up to find the mass of the object in the left pan.

The triple beam balance does not use the masses to find the mass of objects. The beginning step of using the triple beam balance is simple. The balance should be balanced or zero out the balance. The object is placed on the pan and the students will move and manipulate the riders on the beam until the pan with the object in it is balanced. In order to calculate the mass of the object the students will read the beams from back to front. The back beam represents the 100's place. The middle beam represents the 10's place and the front beam represents the 1's place. The riders are pointed to the grams the students will add up to calculate the mass of the object on the pan.

The teacher introduces a digital balance to the students and demonstrates the simplicity of using a digital balance. The students should practice finding the mass of objects using a triple beam balance, a double pan balance and a digital balance.

Lesson Five: Metric Measuring Temperature

Overview
When using the metric system the student will not use a Fahrenheit thermometer. They will use a Celsius thermometer. The two thermometers only differ in scale. Water boils at 100 degrees Celsius and 212 degrees Fahrenheit. Water freezes at 0 degrees Celsius and 32 degrees Fahrenheit. On a Celsius thermometer the degrees above 0 are plus degrees and the degrees below 0 are minus degrees. Students will measure the temperature of the air around them or the temperature of a liquid in a container. The alcohol in the thermometer changes its volume, thereby moving up or down the glass tube when the temperature changes.

Objective
The learner will be able to find the temperature of the air around them and the temperature of a liquid in a container using a Celsius thermometer.

Vocabulary
Fahrenheit, Celsius, heat, temperature, thermometer, column, degrees

Materials
Celsius thermometers, water, food coloring, beaker, hot plate (heat source), and see Appendix 7.

Procedure
The teacher will give the students the Finding The Temperature Worksheet to practice reading Celsius thermometers. The students will determine the temperature by reading the level of the column inside the thermometer. Once the student understands reading the Celsius thermometer the teacher will introduce the actual thermometers to the students. Students will complete the Lab activity designed by the classroom teacher and answer the questions over the lab.

Lesson Six: Metric Measuring – Linear, Volume, Mass and Temperature

Overview
The science teacher has stressed the importance of a universal standard for measurement for scientists around the world. The students understand that accuracy is very important when collecting, recording and storing data. The students will exchange and share data without scientist within their classroom. The SI system will be used by the student scientist.

Objective
The learner will use the skills acquired in this Metric Measuring Unit to complete a lab station activity designed by the classroom teacher for each process skills.

Materials
Graduated Cylinders, Metric Rulers, Metric Tapes, Meter Sticks, Beakers, Triple Beam Balances, Double Pan Balances, Masses, Celsius Thermometers, regular shaped objects and irregular shaped objects, Metric Measuring Tools Worksheet.

Vocabulary
Review Unit vocabulary

Procedure
The learner will complete the Metric Measuring Tools Worksheet. The teacher sets up stations around the classroom for students to use the science process skills of this unit. The stations are Finding volume using three-dimensional regular shaped objects, Finding volume using water displacement, Finding the liquid volume of different liquids, Linear Measurements, and reading the Celsius thermometer.

Lesson Seven: Science and Storytelling

Overview
Animation is a fascinating art and a life long hobby of many Americans, young and old. Children who indulge in cartoons and comic books usually grow up to become successful adults that enjoy collecting comic books and other articles of animation. However, animation and comic books are not just American pastimes; they are teaching tools and

role models that teach difficult concepts to young children in Middle and Elementary Schools.

This lesson will use the art of storytelling and writing coupled with animation and cartooning. The students will write a superhero action story that explains one or more of the concepts they learned in the metric measuring unit. The students will create and illustrate the story in an eight-panel storyboard.

Objective
The learner will be able to write a short adventure story of a superhero explaining or demonstrating one or more concepts they learned in the metric measuring unit. The learner will illustrate the short adventure story in an eight-panel comic strip.

Vocabulary
Storyboards, panel, animation, illustrate, cartooning, reinforce, concepts, adventure, action

Procedure
The student will write a short adventure story about a Super Hero explaining and demonstrating one or more concepts learned in the metric-measuring unit. The short story is two double-spaced pages in length.

The student will illustrate this adventure in a comic strip. The comic strip is eight panels in length. The storyboard must be logical and the illustrations must convey measurement concepts taking place in the comic strip. Students will have little class time to work on this project. This project is independent practice for the student.

APPENDICES

Appendix 1

Note to teachers: You will have to provide a somewhat detailed diagram for questions 15 –18. For question 15 include a picture of a thermometer; question 16, a picture of a scale with a rock on one side and labeled weights on the other; question 17, a diagram of a beaker indicating the volume of liquid inside it; question 18, draw a line 5 cm long; question 19, show a close up of the side of a beaker with liquid inside it.

METRIC SYSTEM PRE-TEST

The purpose of the Metric System Pre-Test is to see what knowledge the student has. The teacher will use the results of the pre-test teach students what the do not know; yet need to know in order to master the objectives of the Metric System with 90% to 100% accuracy.

Please answer each question carefully and to the best of your abilities. Please mark the answers on the provided answer sheet.

1. The purpose of learning the Metric System is
    a. because it is a good system to use in math and science
    b. because all scientific measurements are recorded using the Metric System universally
    c. because everyone in the United States uses it
    d. because it is the customary unit of measurement
2. The three units of measurement used in the Metric System are
    a. meter, kilogram, and second
    b. inches, feet, and miles
    c. length, volume, and mass
    d. kilo, deka, and milli
3. The three units of measurement in the Metric System measure
    a. meter, liter and gram
    b. inches, feet and miles
    c. length, mass, and time
    d. kilo, deka and milli
4. Which prefixes are in order from larger to smaller
    a. milli, centi, deci
    b. kilo, hecto, deka
    c. centi, milli, deci
    d. kilo, deka, hecto
5. Which prefixes are in order from smaller to larger

a. milli, deci, centi
b. deci, deka, hecto
c. centi, milli, deci
d. centi, deci, milli

6. The unit meter is used to measure
   a. volume
   b. mass
   c. length
   d. density
7. The unit liter is used to measure
   a. volume
   b. mass
   c. length
   d. density
8. The unit gram is used to measure
   a. volume
   b. mass
   c. length
   d. density
9. Linear measurement is
   a. the amount of space an object takes up
   b. the amount of matter in an object
   c. the density of an object
   d. the length, width, height and distance
10. Volume is
    a. the amount of space an object takes up
    b. the amount of matter in an object
    c. the temperature of an object
    d. the length, width, height and distance
11. Mass is
    a. the amount of space an object takes up
    b. the amount of matter in an object
    c. the density of an object
    d. the length, width, height and distance
12. The Celsius Scale is used to measure
    a. the amount of space an object takes up
    b. the amount of matter in an object
    c. the temperature of an object
    d. the length, width, height and distance
13. Which of the following are the correct abbreviations for millimeter, decimeter, and centimeter?
    a. m, dc, cc
    b. m, d, c
    c. mm, dm, cm

d. milli, deci, centi

14. Which of the following is the correct abbreviations for dekagram, hectogram and kilogram?
    a. dag, hg, kg
    b. d, h, k
    c. dkg, hcg, klg
    d. deka, hecto, kilo
15. Record the temperature shown on the thermometer below
    a. 25^0C
    b. 30^0C
    c. 20^0C
    d. 35^0C
16. Record the mass of the boulder on the balance below
    a. 400 kg
    b. 40 kg
    c. 4 kg
    d. .4 kg
17. Record the volume of the liquid below
    a. 40mL
    b. 30 mL
    c. 20 mL
    d. 10 mL
18. Record the length of the line below
    a. 5 cm
    b. 10 cm
    c. 5 mm
    d. 10 mm
19. Record the volume of the liquid below
    a. 35 mL
    b. 33 mL
    c. 40 mL
    d. 45 mL
20. Record the mass of the object on a triple beam balance
    a. 155 g
    b. 154 g
    c. 156 g
    d. 153 g
21. Record the length of the pencil below
    a. 10 mm
    b. 15 mm
    c. 20 mm
    d. 25 mm
22. Record the temperature of the air on the thermometer below
    a. 75^0C

b. 65^0C
c. 70^0C
d. 60^0C

23. What is a meniscus?
    a. the lines on a glass beaker
    b. the curved surface of the liquid in a graduate cylinder or beaker
    c. the volume of a liquid
    d. the volume of a sphere
24. Water displacement is used to find the volume of
    a. regular shaped objects
    b. liquids
    c. irregular shaped objects
    d. solids
25. Convert 20 millimeter to centimeters
    a. 0.02 cm
    b. 0.2 cm
    c. 2.0 cm
    d. 20.0 cm
26. Convert 1.5 centimeters to millimeters
    a. 0.015 mm
    b. 0.15 mm
    c. 15 mm
    d. 150 mm
27. Convert 1000 meters to kilometers
    a. 1.0 km
    b. 10.0 km
    c. 100 km
    d. 1000.0 km
28. What is the length of this paper in centimeters
    a. 28 cm
    b. 2.8 cm
    c. 280 cm
    d. 0.28 cm
29. What is the width of this paper in millimeters
    a. 0.215 mm
    b. 2.15 mm
    c. 21.5 mm
    d. 215 mm
30. 100 centimeters is equal to:
    a. 1 kilometer
    b. 1 decimeter
    c. 1 meter
    d. 1 hectometer

Appendix 2a

SUPER SCIENCE METRIC PREFIXES

PREFIX	MEANING	ABBREVIATONS
KILO	1,000	k
HECTO	100	h
DEKA	10	da
DECI	0.1	d
CENTI	0.01	c
MILLI	0.001	m

Students will remember:

King	Henry	Danced _____	Down	Center	Main
i	e	e	e	e	i
l	c	k	c	n	l
o	t	a	i	t	l
o	o			i	i

Students will remember that King Henry could dance three different ways down center main.

Merrily	Gracefully	Lively
e	r	i
t	a	t
e	m	e
r	s	r
s		s

STUDENTS FILL IN THE METRIC PREFIXES ON THE WORKSHEET BELOW.

Appendix 2b

SUPER SCIENCE METRIC PREFIXES

PREFIX	MEANING	ABBREVIATONS

Students please write the sentence that will help you remember the metric prefixes in order from largest to smallest

K_____ H_____ D_____ D_____ C_____ M_____

Please write the three adverbs that describe how King Henry Danced Down Center Main.

M_____ L_____ G_____

Appendix 3

SUPER SCIENCE METRIC UNIT

UNITS:	LITERS	measures volume
	GRAMS	measures mass
	METERS	measures linear measurements

PREFIXES: Kilo; hecto; deka; deci; centi; milli

UNIT	**ABBREVIATIONS**
Grams	g
Liters	L
Meters	m

MEASURES	**ABBREVIATIONS**					
MASS	kg	hg	dag	dg	cg	mg
LINEAR	km	hm	dam	dm	cm	mm
VOLUME	kL	hL	daL	dL	cL	mL

Appendix 4

SUPER SCIENCE METRIC UNIT

Name: _____ Date: _____

STUDENTS WRITE THE NUMERIC VALUE AND ABBREVIATIONS FOR THE FOLLOWING WORDS.

WORD	NUMERIC VALUE	ABBREVIATIONS
Gram		_____
Liter		_____
Meter		_____
Kilogram	_____	_____
Centiliter	_____	_____
Milliliter	_____	_____
Hectometer	_____	_____
Decigram	_____	_____
Dekameter	_____	_____
Millimeter	_____	_____
Kiloliter	_____	_____
Centimeter	_____	_____
Hectoliter	_____	_____
Dekagram	_____	_____
Decimeter	_____	_____
Kilometer	_____	_____
Milligram	_____	_____
Hectogram	_____	_____
Dekaliter	_____	_____
Deciliter	_____	_____
Centigram	_____	_____

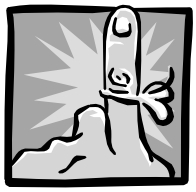
Appendix 5

SUPER SCIENCE LINEAR MEASUREMENTS

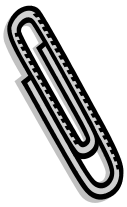
Students will use the metric ruler to reinforce that the meter is the primary unit of length in the metric system. It is used to measure the length of an object or distance between two objects. However, you must know when it is appropriate to measure length in kilometers, centimeters, millimeters or meters to measure the length of an object or the distance between two given points.

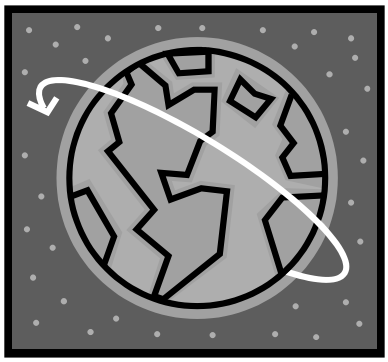
Look at the pictures below? Which of these words would you use to measure the length of the object depicted? Use the words METER, KILOMETER, MILLIMETER or CENTIMETER and write the correct word below each picture.

1._____ **2.**_____ **3.**_____



4. _____ **5.** _____ **6.** _____





Appendix 6

HANDS-ON MEASURING WORKSHEET

USE THE METRIC RULER TO MEASURE THE FOLLOWING OBJECTS IN THE CLASSROOM. YOU WILL MEASURE SOME OBJECTS IN CENTIMETERS AND SOME OBJECTS IN MILLIMETERS.

1. The height or your desk. _____ cm
2. The length of your right foot. _____ cm
3. The width of your science book. _____ cm
4. The length of your pencil. _____ cm
5. The width of your left palm. _____ cm
6. The length of a small paper clip. _____ mm
7. The width of your pencil. _____ mm
8. The length of your left foot. _____ mm
9. The length of a small paper clip. _____ mm
10. The width of your right foot. _____mm

USE THE METRIC RULER TO MEASURE THE FOLLOWING OBJECTS IN THE CLASSROOM. YOU WILL MEASURE SOME OBJECTS IN CENTIMETERS AND SOME OBJECTS IN MILLIMETERS.

1. The height or your desk. _____ cm
2. The length of your right foot. _____ cm
3. The width of your science book. _____ cm
4. The length of your pencil. _____ cm
5. The width of your left palm. _____ cm
6. The length of a small paper clip. _____ mm
7. The width of your pencil. _____ mm
8. The length of your left foot. _____ mm
9. The length of a small paper clip. _____ mm
10. The width of your right foot. _____mm

Appendix 7

METRIC MEASURING TOOLS: STUDENT NOTES

DOUBLE PAN BALANCE:

1. SECURE BALANCE ON A FLAT SURFACE.
2. ZERO (balance) OUT THE BALANCE.
3. PLACE OBJECT TO BE MEASURED IN LEFT PAN.
4. PLACE MASSES IN RIGHT PAN UNTIL THE NEEDLE IS POINTING STRAIGHT UP AND THE RIGHT AND LEFT PAN ARE BALANCED.
5. COUNT THE NUMBER OF GRAMS OF EACH MASS IN THE RIGHT PAN.
6. ADD THE NUMBER OF GRAMS OF THE MASSES TOGETHER AND YOU HAVE CALCULATED THE MASS OF THE OBJECT IN GRAMS.

TRIPLE BEAM BALANCE:

1. SECURE BALANCE ON A FLAT SURFACE.
2. ZERO (balance) OUT THE BALANCE.
3. PLACE THE OBJECT TO BE MEASURED ON THE PAN.
4. ADJUST THE RIDERS ON EACH BEAM UNTIL THE PAN IS BALANCED.
5. READ THE NUMBERS THE RIDERS ARE POINTED TO FROM BACK BEAM TO FRONT BEAM.
6. BACK BEAM IS THE NUMBER IN THE HUNDRED'S PLACE.
7. MIDDLE BEAM IS THE NUMBER IN THE TEN'S PLACE.
8. FRONT BEAM IS THE NUMBER IN THE ONE'S PLACE.
9. ADD THE NUMBERS OF EACH BEAM TOGETHER AND YOU HAVE THE MASS OF THE OBJECT IN GRAMS.

MEASURING TEMPERATURE BY USING A THERMOMETER:

1. PLACE THE THERMOMETER BULB COMPLETELY IN THE LIQUID YOU ARE TRYING TO FIND THE TEMPERATURE OF.
2. DO NOT LET THE BULB TOUCH THE SIDES OR THE BOTTOM OF THE CONTAINER.
3. READ THE THERMOMETER WHILE THE BULB IS STILL IN THE LIQUID IF POSSIBLE.
4. IF YOU MUST READ THE THERMOMETER WITH THE BULB OUT OF THE LIQUID YOU MUST READ IT QUICKLY BECAUSE THE TEMPERATURE WILL BEGIN TO CHANGE.
5. WATER FREEZES AT 0^0 CELSIUS AND BOILS AT 100^0 CELSIUS.
6. MOST THERMOMETERS ARE MARKED IN WHOLE DEGREES AND EVERY TENTH DEGREE IS NUMBERED. NUMBERS BELOW ZERO ARE MINUS DEGREES OR NEGATIVE DEGREES AND THE NUMBERS ABOVE ZERO ARE PLUS DEGREES.

MEASURING LIQUID VOLUME:

1. PLACE THE GRADUATED BEAKER, GRADUATED FLASK OR GRADUATED CYLINDER ON A FLAT SURFACE.
2. POUR THE LIQUID INTO THE MEASURING CONTAINER.
3. ONCE THE LIQUID HAS STOPPED MOVING, THE SURFACE OF THE LIQUID HAS A CURVED LINE. THIS CURVED LINE IS CALLED THE MENISCUS.
4. THE MOST ACCURATE MEASUREMENT IS THE BOTTOM LINE OF THE MENISCUS. THEREFORE YOU MUST BEND DOWN TO GET A HORIZONTAL VIEW OF THE MENISCUS TO GET AN ACCURATE MEASUREMENT OF THE VOLUME OF THE LIQUID.

WATER DISPLACEMENT (FINDING VOLUME OF IRREGULAR SHAPED OBJECTS):

1. PLACE THE GRADUATED BEAKER OR GRADUATED CYLINDER ON A FLAT SURFACE.
2. POUR WATER (10 mL OR 20 mL) INTO THE GRADUATED CYLINDER OR GRADUATED BEAKER. USE ENOUGH WATER TO COVER THE IRREGULAR SHAPED OBJECT.
3. WRITE DOWN THE ACCURATE AMOUNT OF WATER POURED INTO THE GRADUATED MEASURING CONTAINER.
4. TIE A STRING AROUND THE IRREGULAR SHAPED OBJECT AND LOWER IT INTO THE GRADUATED MEASURING CONTAINER.
5. THE WATER LEVEL WILL RISE ONCE THE OBJECT IS IN THE CONTAINER BECAUSE THE OBJECT HAS TAKEN UP THE SPACE THAT THE WATER ONCE OCCUPIED. THE OBJECT HAS DISPLACED THE WATER.

FIND THE ACCURATE AMOUNT OF THE NEW WATER LEVEL ONCE THE OBJECT IS IN THE CYLINDER. WRITE THIS NEW LEVEL DOWN. TO CALCULATE THE VOLUME OF THE IRREGULAR SHAPED ITEM YOU MUST: SUBTRACT THE NEW LEVEL OF WATER FROM THE OLD LEVEL OF WATER YOU WROTE DOWN BEFORE YOU PLACED THE IRREGULAR SHAPED OBJECT INTO THE GRADUATED CONTAINER.

ANNOTATED BIBLIOGRAPHY

Note: Many times in this unit I used quotes from the Maryland Department of Education Web Site. However, since using them, the site is no longer available online.

Animation

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This book gives students instructions about drawing and creating funny animated animals by combining different animal body parts

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