"Don't Tell Me, Show Me!''
Balancing the Tools: In Words and Pictures

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INTRODUCTION

Educators across this country are experiencing sleepless nights trying to create lessons that will make a lasting impression on their students. Teachers have been trained to use traditional educational techniques and resources. However, I challenge them to "think outside the box." Basic educational concepts using pictures to teach children have been used since the beginning of education. Many children begin the learning process by pointing to objects and pictures and then attach words and meaning to these objects and pictures at a later date. When children are learning how to read, they usually start with graphic images that tell the story. Once a child has learned the basic principles of reading pictures, he or she can begin the process of leaning concepts to give more meaning to the content. Reading is a vital skill in global education. However higher order thinking skills are needed to learn how to create and design new technology to add to the advancement of society. In this unit I will use the higher level thinking skills concept and images to the concepts of simple machines.

MY SCIENCE BACKGROUND

The last two decades in my science classroom have confirmed several questions I first thought about as a small child. These questions were about animals in nature, how things worked, and how to build things. During that time in my life, I did not know I was questioning the concepts and facts of Natural Sciences.

I grew up in a small rural town in Texas. This rural environment provided me with a hands-on laboratory in the wooded area behind my grandmother's house. I spent hours and hours exploring nature; my days were filled with collecting bugs, toads, snakes, and rocks. I would take my collections to school and ask my teachers questions about the items I had collected, and they, in turn, would send me to the library to research the specimen or collection I had brought in for show and tell.

My love for sciences expanded when my eyes were opened to the world of Physics. This new adventure was sparked when I watched my grandfather work as a shade-tree mechanic. He would open his large metal tool box to repair his automobiles or cars that belong to other people. He would also build and repaired things around the house. He provided opportunities for me to watch him in action, ask questions about what he was doing, and experiment with the tools I found in his large tool box.

One example of my grandfather's ingenuity involved my grandmother. She was only four feet tall. This posed a problem for her in her own kitchen. She could not retrieve her kitchen utensils to cook lunch or bake her famous pound cake because her tools were out of her reach. My uncles and aunts would assist my grandmother by reaching into the tall cabinets to get what she needed. One day my grandfather opened his tool box once again to solve a scientific problem. He gathered his materials as any scientist would to solve my grandmother's reach problem. He precisely measured and cut away all unwanted pieces of wood. He used his rusty hand saw, iron claw hammer, wooden measuring tape, and penny nails to assemble the simple machine he created for my grandmother. I watched him design and construct a mobile incline plane (a step of steps) for my grandmother to use anywhere in her kitchen to reach those utensils needed to perform experiments in her laboratory.

MY HANDS ON SCIENCE

Watching my grandfather made me want to use his tools to build things. He had so many tools; I was inspired to learn the names and how to use each tool in his metal tool box. I soon learned the names and the purpose of the simple hand tools that I was allowed to use; however, there were many without names or purposes that I could not use.

On one occasion I took two pieces of wood and nailed them together in the shape of a cross; however, it was not a cross; it was my airplane. I would spend hours tinkering with scrap materials and simple hand tools to construct different kinds of contraptions. My first accomplishment that I designed and built was a wagon made with scrap pieces of wood and old lawn mower wheels to haul my younger brothers and sister around the yard for hours at a time or until the wheels fell off. I also took household items apart and tried to put them back together; however, sometimes my grandfather would have to intervene and repair the damage I caused by dismantling a household appliance.

Some components of physical science were introduced to me under the shade tree and in the wooded area supervised by the watchful eyes of my grandparents. I had hands-on experience with Natural Sciences. However, my students have limited hands-on background in the Natural Sciences and a lack of relevant application of science in their everyday life experiences. It is my goal to find an innovative way to teach the foundations of the Natural Sciences, simple machines, and the abstract math of simple machines. I want to provide them with facts and concepts that are relevant to their everyday life situations.

SCIENCE ILLITERACY

Many people in our society believe that illiteracy, the inability to read and write, is the major problem in education. Illiteracy is a condition or quality of being ignorant or unknowledgeable in a particular subject or field such as science. The biggest problem is the inability of students to analyze and comprehend the facts and concepts presented to them in context. Illiteracy in science can be eliminated by teaching students to use "H.O.T.S"; Teaching Higher Order Thinking Skills to students would decrease content illiteracy. Science illiteracy also comes from the limited science background information that students retain and the inability to make science concepts relevant to everyday life situations by applying higher order thinking skills. Some teachers only ask questions that are simple and basic, such as "What is a simple machine? and "What is work?" These basic questions do not require the students to analyze or evaluate the information given to them. I believe that most test questions asked by teachers are knowledge level questions. These types of questions only require the student to repeat the information given to them. The knowledge based questions do not require the students to analyze, synthesize, nor evaluate concepts presented to them. Comprehension is a part of mastering science concepts; therefore, teachers must use higher order thinking questions that require students to extensively answer and elaborate science concepts on daily experiments and tests. This will increase the student's knowledge of Natural Sciences.

BLOOMS TAXONOMY

In 1956 Benjamin Bloom developed a system or steps that classified levels of intellectual behavior. He organized six levels from the lowest level, recall, to the highest level, evaluation, on Bloom's intellectual pyramid. As you move up on Bloom's pyramid, each level becomes more complex and abstract. Students have difficulty conceiving abstract information. Therefore, educators must form questions that require the students to go beyond recall and knowledge-based answers. Each assignment and project must challenge the student to evaluate information given to them as they resolve controversies and analyze differences of opinions. Every educator pushes their student to successfully master each level as they pursue the highest level of intellectual behavior of Bloom's Taxonomy.

OUTSIDE THE BOX

As an educator I work hard to create lessons that will make a lasting impression on my students and guarantee their success on the standardized state science test. To come up with innovative lessons, I must lay aside traditional educational techniques and resources that I have acquired over the last two decades. I must think "outside of the box" to teach Integrated Physics and Chemistry to reluctant freshmen who lack background knowledge of physical science and do not know how to apply science concepts of physical science to everyday living situations. In this unit: "Don't Tell Me, Show Me! Balancing the Tools: In Words and Pictures," students will acquire background knowledge of physical science by the use of images and photographs that they have taken. This idea of using pictures and images is a basic educational concept that has been used in science since the beginning of science. In this unit the students will provide the pictures and images while they apply the concepts of simple machines to everyday life situations. In order for the concepts to remain with the students, each lesson and experiment must be relevant to each student.

MY URBAN STUDENTS

The students I teach are form the inner city of North Houston. Ninety percent of them are in the free and reduced lunch program. Many of the students are at risk of dropping out of school. Their socio-economics status, cultural barriers, and, of course, the language barrier are risk factors that I must take into special consideration when I prepare lesson plans to meet the needs of all of my students.

The large Hispanic population at my high school deals with a unique cultural issue. The students observe their hard working parents providing for their family with little or no formal education. My students conclude that they do not need an education to make it in life because their parents are successful with a limited education. Therefore, they drop out of high school usually during their freshman year of high school. Nevertheless, it is my goal to create lessons to illustrate the importance of science and the advantages of education in the job market of the future.

VISUAL LEARNERS

All students are different. Students learn at different paces, and they process information from different learning styles. "The visual learner learns through seeing, the auditory learner learns through hearing and the tactile/kinesthetic learner learns through, moving, doing and touching" (*Learning Styles Explained*).

Every person processes information differently and that process is based upon the things that happen in each person's brain. The brain is a very complex organ, and researchers are constantly finding out new information about the brain and how this information benefits the students in the classroom. The three basic learning styles: visual learners, auditory learners and tactile/kinesthetic learners. This unit will meet the needs of all learners; however, the visual and the tactile/kinesthetic learners will benefit greatly from the lessons in this unit.

This unit will address the learning style of the visual learner by using images, photographs, and graphic organizers. The visual learner will show great progress when learning the mathematical formulas and scientific concepts by seeing pictures and images of simple machines.

My lessons must include pictures, graphs, and other visuals to help my students to understand the basic concepts of simple machines. "They may think in pictures and learn best from visual displays including: diagrams, illustrated text books, overhead transparencies, videos, flip charts and hand-outs" (*Learning Styles Explained*).

I believe by using photographs in teaching simple machines it will allow the students to use hands-on techniques to acquire knowledge of a subject matter that is hard to understand the content alone. When student take pictures or view pictures of simple machines, they will begin to see the principles of work and energy in the simulated lessons that are relevant to real life situations. "With their enormous capacity to contain, compress, and symbolize events or ideologies photographs become the signs and signpost of modern society" (Goldberg 135).

If pictures can be used for advertisement in the business world to capture the attention of potential clients, photographs and images should be used to stimulate the intellectual ability of students in the classroom. Pictures of common machines used in real life occupations can symbolize mathematical concepts students encounter in the physics classroom.

VISUALS AND GRAPHICS

Most children by the age of two can associate the letter M to the McDonald's restaurant and sign. Therefore, I believe students in the science classroom can use the same skills to associate a crane as a pulley and the see-saw as a first class lever. Images are the signpost of our society and they are the foundation of the visual learner. Education for all children began with pictures; therefore, reverting back to an early learning style the science students possessed in their early days of learning will improve their ability to understand content concepts:

> From billboards, newspapers, magazines and television, movies, video games, junk mail and the internet, we are constantly bombarded with images demanding immediate attention: "Look at me! React! Get my message!" (Murphy)

Science students have the ability to connect science pictures to concepts and science concepts to pictures. Through the dynamic combination of words and pictures this curriculum unit will present the concepts and facts about simple machines in a format that is diverse and thought provoking for all types of learners.

Charts and graphs are images that provide important statistics about science concepts. In my classroom students will use photographs and illustrations created by students to explain the concepts of simple machines. Simple machines have physical and mathematical concepts that students can learn from by viewing photographs, diagrams, and illustrations. Teachers convey mathematical concepts by using charts, graphs, and tables that represent the statistics of simple machines. Most of my students need visuals to solidify basic concepts of Natural Sciences and Simple Machines.

> Through visuals, children are able to compare quantities easily, and figure out which items belong in a set and which don't. They can learn about area and symmetry. And they can develop strategies for everything from estimating, to counting money and making change. Indeed, many important mathematical concepts—such as comparison, scale, dimension, direction, shape, and perspective—are first experienced visually. (Murphy)

IMAGES IN SCIENCE

> From earliest times, people have used visual displays to communicate. Drawings on cave walls could convey information better than words alone. Later, civilizations developed sophisticated systems to record data and express ideas. And throughout history, painting

> and sculpture have been used to teach and reinforce cultural and religious traditions. (Murphy)

Astronomers have pointed to images of stars and planets in the sky that reflect Greek mythology and the prediction of scientific events, such as the comets' cycle, the life cycle of stars and the rotation of planets. Geologists have used images of fossils to construct prehistoric life forms and prehistoric images. Geologists and artists were not on Earth to see dinosaurs and other prehistoric life forms; however, they learned from images on caves from the cave people. Geologists and artists use illustrations of the same dinosaurs seen on walls of caves. These images have allowed geologists to understand the diet and habitat of dinosaurs. These pictures were not the only images used in the study of geology. They used real life images such as fossilize bones, chalcopyrite, and imprints that were left behind:

> From earliest times, people have used visual displays to communicate. Drawings on cave walls could convey information better than words alone. Later, civilizations developed sophisticated systems to record data and express ideas. And throughout history, painting and sculpture have been used to teach and reinforce cultural and religious traditions. (Murphy)

Images have been used to teach science from Galileo's first primitive telescope to the Hubble space telescope, from Hook's basic microscope to the most advanced electron microscope. The use of the instruments to capture images has lead many famous scientists to great discoveries throughout history. Using basic cameras to take photographs of simple machines will bring understanding to the concepts and mathematical equations associated with simple machines. The use of cameras, illustrations, diagrams, and images from the Internet will bring the virtual construction site into the classroom. Therefore, put on your virtual hardhat and grab your digital camera to capture images that will reinforce concepts of simple machines. While the students are examining the photographs and images that they have collected, they will approach physical science with a new attitude and with curious minds. Students will begin to understand when simple machines are joined together they become compound machines.

UNIT PURPOSE

In this unit I will follow the same educational concepts that scientists have used for decades; use of photographs to teach scientific concepts of simple machines. Therefore, the techniques of teaching simple machines to ninth graders will bring the virtual construction site into the classroom. So put on your virtual hard hat and grab your digital camera to capture the images and concepts of simple machines. "You tell a compelling worth story with words and sounds, the same way you tell it with images. You capture emotions; you get close to your subject. You approach things from a new angle with a curious mind" (Ganter and Ganter).

I will use images to capture the interest of my ninth graders as they photograph or illustrate simple machines and the Nature of Science. Approaching the task of teaching simple machines from a new angle will motivate the minds of freshman students in my classroom.

The unit will last for three weeks using the ninety-minute block schedule. The students will create a power point presentation: to identify the six simple machines, their history, and how they are used in their everyday lives; to design a series of events using the concepts of Rube Goldberg; and to use cartoons to identify the six simple machines. The students will also work traditional mathematical formulas and equations to solve math problems that explain the work that is produced by a simple machine.

The unit will consist of innovative lesson plans to help the reluctant student understand the mathematical and physical concepts of simple machines. Students will utilize digital cameras, computers, common tools, simple machine, and playground equipment. Students will engage in lessons in the classroom and in the field to gather information about simple machines and how they work in everyday life.

The photographs and images of simple machines will help students understand the mathematical components of Mechanical Advantages. Students will also use the photographs and images to participate in day to day discussions in order to dismiss obvious misconceptions of simple machines.

SIMPLE MACHINES

There are six simple machines used in modern day society to make all kinds of complex machinery and technology in the world. These machines were created to make work easier for mankind. They are the inclined plane, the screw, the lever, the wheel and axle, the pulley, and the wedge. "Simple machines were developed by ancient civilizations sometime before recorded history. The simple machine can not do more work than the force applied to the machine is capable of doing" (Falls and Payne 27).

The Lever

A lever is constructed when a straight board or stick pivots around a fulcrum, has a resistance arm and an effort arm. There are three types of levers: the first class lever, the second class lever, and the third class lever. For example, when you move the fulcrum on a see-saw in different positions, more or less force is needed to lift the load. The types of levers are based upon the position of the fulcrum, the effort arm, and the resistant arm. Students will take photographs of each type of lever and construct diagrams of the levers and label the fulcrum, the resistant arm, and the effort arm. Several photographs will be taken of some different types of levers. Some types of levers will be obvious for the students to recognize, and some levers will be hidden.

The Wheel and Axle

The invention of the wheel is one of man's greatest inventions; the wheel and axle has proven over and over again to make work easier from the past to the future. Examples of the wheel and axle are conveyor belts, escalators, car wheels, and complex turbo engines used in airplanes and jets. The wheel and axle is a combination of the lever and the wheel.

The Incline Plane

The incline plane is a simple machine hidden from people. The incline plane is not seen as a machine. It is usually viewed as a ramp. It is a machine because it conducts work by moving an object from one place to another. The incline plane raises a load to a higher level. It is a myth that the incline plane is not a machine. It accomplishes work by moving objects from one place to another. The incline plane assists people loading heavy boxes, and it increases the mobility for those who are physically challenged. Moving boxes and wheel chairs using inclined planes require less effort over longer distance. Lifting heavy objects using an inclined plane makes work easier for the worker. The slanted board, the gangplank, and stairs are examples of the inclined plane.

The Wedge and the Screw

The wedge and the crew are the combination of the same simple machines. The wedge is a form of the inclined plane. Wedges are used to split things apart. Common examples of wedges are knives, doorstops, and chisels.

The screw is also another form of the inclined plane. Screws are used to fasten things together. The drill bit of a power drill and the bit that is used to drill for oil are examples of screws. Students will use photographs to show the difference in the simple machines composed of the inclined plane.

The Pulley

The pulley is a simple machine that is used as a common tool to raise the flag of the United States of America, to rod and reel fish, to raise painters and window washers, and to play with a yo-yo. The pulley is a combination of a lever and an axle. The simple pulley changes the direction of force and more weight can be lifted. Pulleys are added together to accomplish more work. When four pulleys are combined, one more pulley would increase the friction, and additional effort would be needed to lift the load. The work load is increased and the simple machine is not making work easier for mankind.

THE PRINCIPLES

The principle of these six simple machines is to make work easier for mankind. Photographs and illustrations will be used to show the mechanical advantages of the simple machine. The principles of work, energy, power, and friction are abstract concepts that will have a concrete meaning at the end of this unit. “A machine helps us lift, pull, increase elevation of heavy things, change the direction of the force, increase the force, split things, fasten things and cut things” (Johnson).

We use simple machines everyday. You ride in your automobile to and from work everyday. Your car is a combination of simple machines; it is a compound machine. The tires are examples of a wheel and axle. The engine has a fly wheel and it is an example of a pulley. The door handle is a lever used to open the car door. If your seat can tilt back it functions as an inclined plane. Many screws are used to keep your car together. The wedge is used to pry things a part or to stop some thing from moving; the brake pads on your car is the example of a wedge.

HISTORY OF MACHINES

Simple machines have been used throughout history from the invention of the wheel to invention of the IPOD today. Mankind has progressed through the ages from the stone-age to the space age. The ancient Egyptians built the great pyramids using brute strength and simple machines. The industrial revolution used simple machines to build compound machines by combining two or more simple machines. These compound machines were used for mass productions in factories around the world. “It was a great step forward for mankind when machines were devised for doing heavy back-breaking labor that had formerly been done by muscular effort” (Poppy and Wilson 188).

Students will use the Internet as a source to research the prehistoric days of simple machines to the complex compound machines of today’s technology. All machines need energy to accomplish a task or to do work. There are several forms of energy used by simple machines to produce work. Electrical, mechanical, chemical, and solar energy are types of energy used to operate simple machines. These forms of energy may be abstract to the average student, but they can see the product of the energy when used by a simple machine.

PHOTOGRAPHY

Physical science can be taught using a number of innovative learning aids. This unit begins with identifying and classifying simple machines. The students will put on their virtual hard hats and grab their digital camera to embark upon a new adventure to capture images and photographs of simple machines in everyday life situations. Using the cameras and computers will stimulate them to become curious about the concepts and physical properties of simple machines. The surroundings of the students possess obvious examples of simple machines and not so obvious examples; therefore, the students will find examples of simple machines in hardware stores, play grounds, and amusement parks:

> Many applications of the simple machines are found in the modern home. All of us benefit from their various uses…Students often fail to recognize the simple machines, due in part to the varying forms of complexity they assume in household appliances. (Falls and Payne 25)

The objectives of this unit are to solidify the mathematical concepts of simple machines, to acquire the ability to identify simple machines, and to explain the abstract production of the simple machines. Taking and observing photographs of simple machines in everyday life will bring text book concepts and foreign words from the abstract to the concrete for freshman students in the Integrated Physics and Chemistry course. With the photographs and images students will be able to discuss the intangible concepts about simple machines with great confidence. The students will be able to use everyday language to refer to the properties and concepts of the simple machines as they observed them in relevant situations. "With their enormous capacity to contain, compress, and symbolize events or ideologies photographs become the signpost of modern society" (Goldberg 137).

IN THE FIELD

The majority of science investigations are conducted in the field. Field studies are important for student to observe simple machines in relevant life situations. However, student safety is the most important responsibility of the science teacher. Therefore, the sources of the photographs must be in a controlled environment. Students can not be sent to the local construction site. The safety of the construction workers and students will be in question if one hundred and twenty-five freshman students invaded the work site of the average construction worker. Nevertheless, photographs need to be taken.

Therefore, students must obtain permission from local merchants and hardware store owners to take pictures of simple machines in their stores. The field studies of simple machines do not end here. The neighborhood play grounds possess a plethora of simple machines that are hidden from the eyes of ninth grade students. When students enter the playground, they only see toys, not simple machines. With their photographs the students will observe and discuss the physical properties of these toys/simple machines. Students will begin to recognize and discuss the major principles of these toy machines. Amusement parks and theme parks would provide a buffet of toy/machines that provide the knowledge of how machines do work. While students are learning how machines work, they are also having fun as they play among the simple machines at the amusement Park. These the students can use their photographs and acquired references to make conclusions about simple machines.

IN THE CLASSROOM

The students will use their photographs to make presentations to their classmates. Students can make their class presentation in the form of a narrative scrapbook. The narrative scrapbook must include a description of the simple machine, the real life environment, or the setting of the photograph. The tool must be identified correctly as one of the six simple machines. The narrative must include an explanation of how the simple machine works and one photograph showing the simple machine at work.

The second classroom presentation will be a time line of simple machines throughout history. This chronological time line must consist of at least two pictures of each of the six simple machines placed on a time line when they were introduced, invented, or improved. The student must construct this time line from prehistoric man to the present. The students can use their photographs, the Internet, magazines and other resources to collect pictures, images, and facts about six simple machines. Students must include a picture, a date, and a brief history of the simple machine on the time line.

The third classroom presentation is another time line; however, this time line is the progression of one simple machine over time. The student must choose a simple machine and chronologically place pictures and progression of the simple on the time line with the correct dates. Students can use the Internet, personal photographs, and illustrations to place on their time line to present to the class. A short narrative about the history about the simple machine and the eras as the simple machine progressed.

The fourth classroom presentation is a power point presentation. This presentation consists of students' personal photographs. The power point presentation includes twelve to fifteen slides. The slides must have between seven and eight pictures of the six simple machines and five to seven narrative slides. The pictures should show how the simple machine is used to make work easier for mankind and a photograph showing the simple machine in detail. The narrative slides must explain the working concepts of the simple machines and what profession uses the tool. This power point presentation should have a narrative slide follow a picture slide. The narrative can tell the place and date the photograph was taken.

THE CALCULATIONS

In this unit the identification and the physical properties of the simple machine are very important concepts for the students to understand. However, the mathematical formulas are abstract concepts illustrated by the photographs and images created and used by the students in their presentations. The mathematical formulas explain how simple machines conduct work to make it easier for mankind or how work is converted to a different form of energy. The mathematical formulas have different vocabulary words. Students must make themselves familiar with these words. These vocabulary words explain what simple machines do and how they do it. Students may use several of these words daily, but the meaning is not the same for example work, energy, machines, force, and mechanical advantages are just a few of the vocabulary words. Students may ask the questions: What are machines? What is energy? Or what is work?

"Work is the transfer of energy that occurs when a force makes an object move" (Poppy and Wilson 126).

"Machines are designed to lift or apply a heavy load by the applications of a small force to move objects very rapidly or to cause work to be done more conveniently than it could be done by a force applied directly to a load" (Poppy and Wilson 30).

The ability to do work is a concept conveyed by words and numbers. When force is increased you calculate work. We can define force as the push or pull on an object.

The formula used to calculate work is Work is equal to force multiplied by distance: When using variables W = work, F = force, D = distance; therefore, $W = F \times D$. Work is measured in joules. Force is measured in Newton's and distance is measured in meters. Students do not need to get bogged down in his definition of a Joule or a Newton. We must remember that work is a concept represented by words and numbers, and it is measured in a unit. The unit of measurement is just a standard unit with in the science world. Therefore, students should concentrate on working the formula and not fix their concentration on what a joule is or what a Newton is. The students can worry about the definition in upper level physics and physical science courses. Students must understand that work only occurs when an object is moved, and simple machines are used to make the object move.

Formulas are used to calculate several things in physics, such as force, power, speed, and mechanical advantages. Power is an abstract force that many students have a hard time understanding because they usually think about strength. They do not associate power with work. "Work and power are similar in that both involve the product of a force exerted on an object and the distance the force moves. Power, involves the length of time the force requires performing the work" (Poppy and Wilson 27).

Power or the rate in which work is done can be calculated by dividing time into work. The formula used to calculate power is P=w/t, p=power, w=work, t=time. Power is measured in watts. You can also calculate power using electricity. Electricity produces heat and light; it is the transferring energy to power using the equation P=e/t. P=power, e=energy and t=time. Work is not a part of this equation because an object is not moved; energy is being transferred.

We must remember that force is a major part of work and every machine uses force to accomplish work. Simple machines use force to produce work; however, if there was a perfect machine the law of energy conservation would be demonstrated because no energy would be given off by friction or heat. There are two types of forces involved when simple machines uses force to accomplish work.

F_e stands for effort force and F_r stands for resistance force in the calculations. "The force applied to the machine is called effort force and force applied to the machine to overcome resistance is called resistance force" (Poppy and Wilson 28). In order for machines to work, energy must be applied to the simple machine—this is the input work and the work accomplished by the machine is called the output work. "In much energy transformation there is some energy loss, but no energy is destroyed. The part lost is simply dissipated, and thus made unavailable for useful work" (Poppy and Wilson 188).

The law of energy conservation is demonstrated when machines accomplish work. The energy applied to the machine is equal to the energy the machine produces because energy can not be created or destroyed. When energy is put into a machine, the exact amount of energy is received by the object. This will only occur when a perfect machine is invented. This machine will not have outside forces acting upon the machine nor the object. Friction and gravity reacts upon all parts of the machines and the object. Whenever a machine is used, the work out put will always be smaller than the work in put because of outside forces. "Friction and heat are similar in that both results when one object moves relative to another. When friction is present, the heat that results accounts for the energy loss" (Poppy and Wilson 27).

Formulas are use to calculate effort force, mechanical advantage, applied force, efficiency, and the Idea Mechanical Advantage of simple machines. Teachers must introduce formulas and concepts of simple machines at the rate in which students can understand and manipulate each formula. Examples of different formulas for different simple machines are listed below:

To calculate mechanical advantage of a simple machine one would use the following formula: Mechanical advantage equals resistance force divided by effort force.

MA = Fr/Fe. When calculating the mechanical advantage, one must remember if only the direction of the force changes and the effort force and the resistance force are equal, the mechanical advantage is one. A fixed pulley has the mechanical advantage of one because the direction is the only thing that is changed. Therefore, a fixed pulley does not multiply force; however, movable pulleys do.

To calculate the mechanical advantage of a lever one would use the Idea Mechanical Advantage formula below. The Idea Mechanical Advantage equals length of the effort arm divided by the length of the resistance arm. IMA = Le/Lr.

These simple machines are just what the name implies—simple. Do not let using mathematical formulas to calculate mechanical advantages, efficiency, force effort, force resistance, power, work, force, distance become complicated. Students should not panic when formulas are needed to solve problems of simple machines. When students solve equations, they are using process skills, measuring, interpreting data, and manipulating numbers to calculate how simple machines make work easier.

MATH REVIEW

Once the students can recognize, photograph, illustrate, and construct the six simple machines they will master the abstract math concepts. Some students can repeat the definitions of work, energy and power, but can not calculate work, power, and energy:

> Through visuals, children are able to compare quantities easily, and figure out which items belong in a set and which don't. They can learn about symmetry. And they can develop strategies for everything from estimating, to counting money and making change. Indeed, many important mathematical concepts—such as comparisons, scale, dimension, direction, shape, and perspective-are first experienced visually. (Murphy)

In order for simple machines to work, they must move. Students will use the math formula: work equals force times distance. In this formula force is measured in Newton and distance is measured in meters.

The formula used to calculate power: power is equal to work divided by time. Power is calculated in watts and time is measured in seconds. There are other math concepts associated with simple machines.

Mechanical advantage of a machine is calculated by knowing the number of times a machine multiplies the effort force. The mechanical advantage formula: mechanical advantage equals resistance force divided by effort force.

All machines perform work or they move; but, how efficient are these machines? There is a formula to calculate the efficiency of simple and compound machines that measures the efficiency of a machine. The formula is efficiency equals output work divided by input work multiplied by one hundred percent. The efficiency of a machine is determined by the amount of work put into the machine verse the output of work from the machine. The efficiency can never be one hundred percent because of friction. Friction reduces the output of work. A machine with one hundred percent would be a perfect machine. However, friction does occur; therefore, we try to eliminate some friction by using lubricants. Using lubricants reduces the friction and this makes the machine more efficient.

CONCLUSION

We have covered the concepts of simple machines. Now it is time to put our knowledge to work by creating lessons. The following lessons are only examples of the projects mentioned in the narrative of this curriculum. You can create and personalize the remainder of the lessons to fit the needs of your students. The lessons will take more than three days. Students will need access to a digital camera, a computer, and resources from the library and the Internet.

LESSON PLANS

Lesson One: Fred Flintstone and the Simple Machines of Bedrock

Purpose

The student will be able to view cartoon clips of the Flintstones

Length of the Lesson

One ninety minute class period

Materials

Several episodes of *The Flintstones* on DVD
A DVD player
A Television
An LCD Machine.
Simple Machines of Bedrock Worksheet
A Computer
Access to the Internet

Teacher Instructions

1. View the Ultimate Flintstone Site "Animal Tools" at <http://i-flintstones.tripod.com/tools.htm>.
2. Review several episodes of *The Flintstones* and make sure there are pictures of the animal tools sited in the Animal Tools page of the Ultimate Flintstone Site or on The Fred Flintstone and the Simple Machines of Bedrock Worksheet.
3. Create your personal Simple Machines of Bedrock Worksheet
4. Allow students to watch the episodes of *The Flintstones* that have the animal tools on their worksheet

Student Instructions

1. Watch episodes of *The Flintstones*.
2. Look for the animal tools listed on your worksheet.
3. Describe the animal tool in your own words in the section provided.
4. Identify the simple machines used in the animal tool.
5. Remember the six simple machines: lever, incline plane, pulley, screw, wedge, wheel and axle.

Fred Flintstone and the Simple Machines of Bedrock

Animal Tools	Description of the Animal tools	Simple Machines Sited
Bird Record Player	The tip of the long, pointy beak of the bird follows the groove of the record that spins on the back of a turtle.	Wheel and Axle Lever Wedge
Bird Airplane		
Bird Alarm Clock		
Bird Camera		
Dinosaur Crane		
Dinosaur Drawbridge		

Animal Tools	Description of the Animal tools	Simple Machines Sited
Dinosaur Elevator Lift		
Monkey Traffic Light		
Pelican Garbage Can		
Turtle Car Jack		
Turtle Wagon		
Fred's Car		
Bird Automatic Door Opener		

Lesson Two: Simple Machines: Power Point Presentation

There are six simple machines used in modern day society to make all kinds of compound machinery and complex technology in the world. These machines were created to make work easier for mankind. They are the incline plane, the screw, the lever, the pulley, the wedge, the wheel and axle. "Simple machines were developed by ancient civilizations sometime before recorded history. The simple machine cannot more work than the force applied to the machine is capable of doing" (Falls and Payne 27).

Your Powerpoint Presentation Must Include:

1. Four students to a group with a digital camera with 12 exposures.
2. Pictures or photographs of six simple machine used in everyday life situations from your camera or internet (6 slides).
3. A description and explanation of how each simple machine works (6 slides).
4. A history of each simple machine (6 slides).
5. Pictures of colored illustrations you created or colored illustrations from the Internet (6 slides).

Resources

1. You can use books, newspaper, magazines and the Internet at the library.
2. Pencils, paper and markers used for your illustrations.
3. Internet sites:
   - http://www.mikids.com/Smachines.htm
   - http://www.sirinet.net/~jgjohnson/simple.html
   - http://www.mos.org.sln/Leonardo/inventorsWorkshop.html
4. Use the following search engines: ask.com, yahoo, and google

SIMPLE MACHINE POWER POINT PRESENTATION

Place the description, picture, illustration and history of the Simple Machines in the table.

Simple Machine	**Describe Each Simple Machine**	**Picture of Simple Machine**	**Illustration of Simple Machine**	**Short History of Simple Machine**
LEVER				
PULLEY				
WEDGE				
SCREW				
INCLINE PLANE				
WHEEL & AXLE				

Lesson Three: The Virtual Hardware Construction Site and Hard Hat Worksheet

Construction sites are dangerous places for any student. Therefore, the students will visit hardware stores and big machinery companies to take pictures of simple machines and compound machines.

Purpose of Lesson

The learners will take 12 pictures of simple TOOLS (6) and compound machines (6) at hardware stores of large machinery company, OR the learner will go to the Internet to gather pictures of tools and large machinery. The learners will then label the simple machines with the correct tool names used by construction workers. The hardware store pictures can be found on the Internet if students do not have a camera.

Student Instructions

Grab your camera or computer, put on your virtual hard hat, and gather 12 pictures (6 tools and 6 compound machines).

Place your 12 pictures on a poster board; label the pictures with the construction site and simple machine name. Label the different parts of the compound machines with the construction site and simple machine name.

Materials

- camera
- film
- poster board
- glue
- paper, pen, and markers

Resources

- science textbook
- magazines, newspaper
- Internet
- web site

Lesson Four: *A Bug's Life* and Simple Machines!

What is a Simple Machine?

> Well, believe it or not, we use simple machines everyday! Simple machines can include common tools like bottle openers, axes, or even door handles. On the other hand, they can be part of complex devices like automobiles and airplanes. The simple machines are divided up into six basic types, which include incline plane, lever, pulley, screw, wedge, wheel and axle.

In *A Bug's Life w*hile the other ants work away, Flik spends the harvest inventing ways to do things better.

Purpose

The learner will recognize simple machines in action while viewing Disney's *A Bug's Life*.

Materials

- DVD Player
- DVD of Disney's *A Bug's Life*
- Television
- LCD projector
- Bug's Life and Simple Machines worksheet
- Drawing paper
- Markers and colored pencils

Instructions

1. You are to view the movie *A Bug's Life* for the educational purpose of recognizing simple machines in action.
2. As a group discuss the six simple machines before you watch the video.
3. After the DVD is over, you are to draw to the best of your abilities the most impressive simple machine that you saw in use in the days of a bug's life.
4. If you feel that your artistic talents are not up to the capabilities of accomplishing this task, then you are to write a one-page description of this special machine that has impressed you from the DVD.

You will be graded on the quality of your work as well as the inclusion of simple machines in your drawings.

Other Lessons Suggestions

1. Simple machines formulas and problems.
2. Classroom Activity: Be Inventive! http://www.mos.org/sln/Leonardo/BeInventive.html
3. Lesson Plans: Simple Machines, Odd Machine www.Edheads.org
4. The screw http://sln.fi.edu/qa97/spotlight3/screwdemo.html
5. Rube Goldberg
   http://www.iccsd.k12.ia.us/Schools/Wickham/links/elp/stu_work/03.04cartoons/rube.html
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