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Las Maquinas y Nosotros: Machines and Us

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by Abie L. Benítez

Introduction

Mankind's fascination with machines goes beyond everyday use. It impacts the quality of life in positive and not so positive ways. Throughout my tenure as an educator I have tried to convey the importance of technology, but not at the expense of lack of awareness of its potential pitfalls. Living in an industrialized country poses a challenge for educators. We must introduce technology; at the same time we are helping students develop a sense of responsibility towards the environment. When I want to convey this concept my charge is to enable students to perceive themselves as part of a global community that has the responsibility to protect the resources available.

Young children very seldom understand the concept of future. Thus, it is impossible for me to instill in them the responsibility they have towards future generations. Yet, if I can convey that the resources we utilize to power machines are non-renewable, perhaps they will grasp the importance of conservation. Do I want to return to an agrarian society? Do I want conservation at the expense of modernization? No. I want them to enjoy as I do the advantages of industrialization but with a consciousness that what we enjoy and use must involve responsibility towards the rest of mankind and ultimately for the preservation of our planet.

Today we have many resources available to us to power engines and to develop technology that will allow us to achieve work that otherwise would be impossible. This unit intends to explore the intricacies of the harnessing of energy, how is energy utilized in engines and how it affects the environment. This exploration will allow me and my students to formulate questions about complex concepts and to find ways to seek answers.

As a dual language program coordinator I need to develop and implement curricula. The main purpose of the curricula is to model effective instruction for the benefit of the teachers and students involved in the program. The other reason to engage in an instructional endeavor is to continue my contact with the students. This will keep me in touch with the most critical aspect of education: sharing with and facilitating learning for children. The classroom experience also helps me engage in situations that allow for student observation.

In terms of modeling curricular and instructional techniques I have chosen to use an integrative science approach to create a curriculum unit that focuses on the environment. In terms of observing students I have chosen to integrate instruction on the scientific- method to observe their development and organizational skills in this area.

The second grade curriculum framework for the New Haven Public Schools calls for an emphasis on teaching students about the properties of air and water and how they are preserved. Thus, I want to develop a unit that will show how energy sources affect these previously mentioned environmental resources. In addition, I would like to explore with my students how the use of machines and the energy sources needed for a technological society has impacted our lives and our environmental resources.

The Students

My students for this unit are second graders who have been involved in a dual language program since kindergarten. The philosophy of the program is to develop linguistic and academic skills in two languages through the content areas of math and science.

Working with Hispanic students in New England has been a challenge. Materials in Spanish are often not available. Programmatic restrictions may preclude educators from utilizing best practices. Yet, I must say that it promotes reflective practice and teacher development of research skills. Teaching in a dual language program removes some of the constraints I have encountered when teaching either in English or in Spanish alone. My students have the opportunity to develop linguistically and academically in two languages and best of all their self esteem is improved. The majority of our students are Hispanics from Mexico, Puerto Rico, Guatemala, Honduras, Dominican Republic, and the United States. Among this majority some of our students are predominantly English or Spanish speaking (dominant) and others are balanced bilinguals. In addition, we have some students who are from either European or African-American descent. When these children reach the second grade they will have been together for three years helping each other develop their academic knowledge and language. We have observed that for these students sharing of information has come to be natural. Although the program encourages students to engage in cooperative learning their willingness and eagerness to help each other goes beyond the academic realm. This is great when we are trying to include new curricula because they help each other in the acquisition of new vocabulary and concepts.

The Program and the Classroom

Working in the dual language project has given me the opportunity to associate with remarkable educators who believe that our students can attain high levels of achievement. In this environment of providing access to the mainstream curriculum for students who have linguistic and/or socio-economic barriers we have to be reflective educators. Every utterance or movement we make is part of our teaching. Students are keen to our body language and pay close attention to what and how we say things (Nieto, 1999). All of the above evidently makes teaching a cultural, linguistic, and academic endeavor, to say the least. This is now clear, my practice must be reflective and I have to plan for implementation. Moreover, I also have to reflect on it to improve it.

We have to align the curriculum to national, state and local standards. In addition, we want to follow standards for effective pedagogy. Due to the nature of scheduling we have chosen to prepare integrated science thematic units that permeate throughout the curriculum. This means that I have to integrate the science theme in all aspects of the curriculum. The language arts, social studies, and math must somehow relate to the science topic. The other important aspect is that we must secure teacher and students materials both, in Spanish and in English. Materials in both languages must be similar in content and quality. Indeed, this is a major challenge.

The Instructional Approach

The discussion on the instructional approach could be the subject of a lengthy academic paper yet for the purpose of this unit I am going to be succinct. Working with second language learners poses a challenge for teachers. I want to utilize an approach that is supported by research on learning and on pedagogy.

What does research tell us about learning science? Brain research translated into classroom practice gives us guidance on how one could learn efficiently new scientific concepts. Wolfe (2001) posits that concrete experience provides the learner with the information necessary to understand the concept as the information becomes more complex. The brain functions in ways that it utilizes connections to reinforce learned concepts and hands-on activities may be the way to provide these experiences to young learners. What are the implications of these facts about learning? Teachers must make a conscious decision to change their role from a direct transmitter of knowledge to a facilitator helping students develop their own meaning from experiences (Loucks-Horsley, 1998). I plan to provide my students with the experiences they need to understand abstract concepts in science such as: heat or work.

Trying to reach my students I have developed a repertoire for teaching that includes standards for effective pedagogy. These standards are well related to practice as well as to research. Five standards have been issued by a group of researchers and educators: joint productive activity, language and literacy across the curriculum, contextualization, challenging activities and instructional conversations (Tharp, 1999). These research-based pedagogical principles must be present in the instruction of second language learners and indeed will enhance the learning of all students.

Content Rationale

After reading the preface of Fenn's book: Engine, Energy and Entropy I am convinced that given the opportunity, my students and I can acquire some knowledge on thermodynamics. For Fenn this is a concept that is critical to understand many underlying concepts in science. According to Professor Gomez (2004), the secret is not to be intimidated by the sometimes abstract language of science.

A statement that should remain true even today is that:

> "1) To be considered liberally educated, one should have some understanding of the laws of thermodynamics; and 2) any reasonably intelligent person, even with little or no background in science and mathematics, can achieve such understanding with a modest expenditure of effort." -

Fenn , 1989, p. xiii-

I must say that for me it is a challenge to understand the physics of the world that surrounds me. Yet, it is encouraging to know that to understand concepts of energy we only need to be reasonably intelligent. Finally, my intent is to help my students comprehend the importance of energy and the machines in our lives and its impact on the environment.

The Unit

The seminar that I have chosen to guide me in the process of writing this unit will help me learn how machines work and how they affect the environment. Furthermore, I hope to learn how energy sources are used for machines and how this usage affects the environment.

Energy is a very abstract concept for me. I dare to say that I understand how energy works in the human body with lots of hesitation. But for me concepts such as heat or work, remain a mathematical and scientific enigma. On the one hand I am inclined to use technology and admire engineering ingenuity; on the other hand I have not dedicated time until now to understand how machines work. Moreover, I have not been able to clearly understand how energy sources are transformed for machines to work.

The Outline of the Unit

I. Energy
A. What are heat, work and energy?
B. Energy Sources
II. Machines
C. What is a Machine?
1. Simple machines
2. Compound machines
3. Others
D. What is an engine?
1. How does it function?
III. The Environment
E. Current Impact
1. pollutants
2. consequences

Terms and Discussion on Thermodynamic Principles and Challenges

I would like to define and explain some of the terminology that is relevant in teaching about thermodynamics to our students. The first step for me was to understand what thermodynamics means. Of course because of my language background I like to figure out what words mean before I actually look them up. I started by processing through a frequently utilized mental exercise: I was able to discern that it had to do with temperature or heat because of the excerpt of the word “thermo”. Then I thought about dynamics and realize that there was some sort of movement that must be study or observed. This is how I usually process new vocabulary and in my work with my students I try to model this process for them. Now, what thermodynamics does study is the nature of heat and its conversion to or from mechanical, electric and chemical energy. It also is concern with the ability of a system to produce work.

What is energy?

When I think of energy, it is in terms of my desire or capacity to do something. Yet, in physics it is very clear that energy is the ability or capacity to do work or produce change. What do I mean by this? Energy can be measured by studying the interaction that occurs in a system designed to produce work. Forms of energy comprise heat, light, sound, electricity and chemical energy. Therefore, energy is a conserved system property the existence of which is asserted by the first law of thermodynamics (Fenn, 1982). The first law of thermodynamic simply states that for any system there exists a property called energy that is conserved and that can be transferred into or out of a system by either heat or work interactions.

What do you mean by work?

In physics when we talk about work we must make the distinction between work and effort. One may exert effort to do something but in physics terms that effort may not produce work. Then, what is work? It is the capacity that a system has to move a desired object; it is proportional to force and the distance through which is exerted. As with many other physics terms one must be able to mathematically calculate work by placing a value to force and distance and calculating the product of their interaction. Thus, work implies movement as a result of effort. Yet, we could use a tremendous amount of effort by pushing a truck but if we do not move it we have done absolutely zero work.

Heat

Another way of producing change is utilizing heat. What do I mean? One has to take into consideration both the system and its environment. But what is a system? It is a portion of the universe that can be analyzed in terms of thermodynamics. For example, a cloud, an engine or a planet can be considered systems. A system is that which we identify as the object of our attention. Heat is not equal to temperature; heat refers only to energy that is being transferred from one body or mass to another. Thus, heat is what happens between two communicating objects at different temperatures and as the result of the interaction of the system and surroundings that is not work. It is also clear that some objects may act as heat insulators therefore giving us a tool to determine if heat is involved in the interaction. Again, it is in fact the interaction between a hot object and a cold object that are in contact with each other (Fenn, 1982). If we think about objects that are hot such as an iron, the heat from the iron transfers to the cloth making it hot, thus, the heat is transferred to the colder object. The same with a fireplace or a space heater, the heat from the unit transfers into the room air warming it up gradually until it reaches a higher temperature. My understanding is that heat transfers from the hotter object to the colder producing change. According to Fenn (1982) this happens until both objects have achieved the same hotness. Scientist, engineers, and inventors have been able to utilize heat to create the conditions to produce work. The second law of thermodynamics indicates that there has to be a particular direction for all spontaneous processes that produce change, where the flow of heat goes from a higher temperature source and requires the ejection to a lower temperature reservoir. In other words for a system to continue to produce work there must be a sink or reservoir where we can dump some of the heat.

Sources of Energy

All forms of energy are stored in different ways and in a variety of energy sources some of which we use everyday. For the purpose of clarification these sources are classified in two different categories: renewable and non-renewable. I found that when we talk about renewable energy sources we mostly refer to a source that we can use over and over again without permanently depleting the planet's supply of those sources. On the other hand, a non-renewable source of energy is that which we can use but we cannot recreate in a short period of time.

Renewable Energy

Renewable energy sources include solar energy, wind, geothermal, biomass and hydropower. Solar energy comes from the sun and can be turned into electricity and heat. To convert sunlight into electricity requires a solar cell such as the ones you can see in calculators which are also called photovoltaic cells or modules. Through a group of cells electrically connected in one frame they convert sunlight (photo = light) directly into electricity (voltaic=electricity).

The wind power has been used for hundreds of years. Who has not heard of or seen the wind powered grain mills of Holland? It seems that other pre-industrial societies utilized the wind too. But, what about today: How do we use wind power? We utilize wind to convert it into electrical power through horizontal axis wind turbines. These turbines consist of three parts: the tower, the blades, and a box behind the blades, called the nacelle. Inside the nacelle is where motion is turned into electricity. This is in fact a fairly easy process if you have constant wind and you can control the conditions of wind speed. Although a fairly clean process, cost and wind conditions pose a challenge for this technology.

The geothermal energy resources from inside the earth seem to be steadily available underground, in some cases it is used to heat and cool individual homes, but it can be used to power buildings with multiple dwellings. It seems to be a resource fairly easy to harness with the right geological conditions and necessary fiscal resources.

Another source of renewable energy is the biomass which utilizes solar energy stored in plants. In the past and still today many people utilize wood as a source of energy. In addition, sugar cane is squeezed and the liquid is fermented to produce alcohol that is then burned to generate power. In some cases sugar cane plants utilize the "bagasse", the pulp of the sugar cane after squeezing the liquid to be burned and generate power to boil water to create steam. Some of our garbage could be used to be converted into biomass energy. Even though this source is available to some extent and could help with reduction of landfills, the burning of material releases heat into the atmosphere and other pollutants as well, contributing to the augmented pollution of our planet Earth's environment.

Many of us have seen and enjoyed the waterfalls created for the purpose of generating hydraulic power. The damns are usually engineering wonders that many visit in sightseeing trips. Yet, do we ever think of a damn as stored energy? Or do we see the falls as part of the mechanism in generating electricity? I am sure if you are scientifically or technologically inclined that comes to mind. But how does it work? Hydraulic plants capture the energy of falling water and convert it into electricity. A turbine actually takes the kinetic energy of falling water and converts it into mechanical energy. Then a generator converts the mechanical energy into electrical energy. This electrical energy is then fed into electrical grids to be used in homes, business and industry.

Non-Renewable Energy Sources

An interesting fact is that we get most of our energy from non-renewable energy sources. These sources include fossil fuels such as oil, natural gas, and coal. Fossil fuels are called such because they are the remains of dead plants and animals that have been formed over millions of years by the action of heat from the Earth's core and the pressure of rocks and soil. Other researched non-renewable energy sources are uranium and hydrogen.

Oil

"In January 2001 alone, the United States produced an estimated 181 million barrels of crude oil and imported 273 million barrels from other countries"-- How stuff works, 2004. We know that petroleum or oil, one of the fossil fuels, is utilized to manufacture many different items. The best known is gasoline which for industry and business constitutes a precious liquid that generates the combustion to power transportation devices critical in the operations of our economy. Also we can get heating oil, jet fuel, and kerosene which are good generators of combustion that we utilize for personal use as well as for industry or business. In addition, there are other things that we can obtain from oil such as crayons, plastics, synthetic fibers, and tires.

Natural Gas

Natural gas is pumped out of the ground it is found in the same deposits where we find oil. Although natural gas was once considered a waste product of oil production the increased need for less carbon emission energy sources and increased technology for the utilization of natural gas has made it a viable source of energy. We should keep in mind that this is a fossil fuel that does emit greenhouse gases. However, according to the World Energy Council (2001), natural gas compares favorably against oil and coal in terms of global warming potentials. Apparently, oil can contribute for 20% more carbon dioxide and coal can contribute 50% more than natural gas. This factual information makes natural gas a fairly cheaper and cleaner source of energy when compared to oil and coal.

Coal

Coal is a type of organic rock that contains concentrated amounts of carbon. Some forms of coal can generate as much as 24 million BTUs (British thermal units) per ton. Although this is a highly available source of fossil fuel it constitutes a high risk to the environment. Usage of coal has contributed to global warming which makes it a challenge for business, the government, scientist, and environmentalists as well.

Machines

Humankind has used machines for centuries, many of which we would only consider tools today. The fact remains that machines, whether simple or compound, serve the purpose of aiding us to perform work in an easier or more efficient way. Machines transform energy sources into other kinds of energy to make them useful to us. For example, in a hydroelectric power station the kinetic energy that is contained in the water movement drives a turbine that powers a generator, thus turning kinetic energy into electricity.

To produce any action a machine needs a source of energy. In the past, many machines were powered by human and animal muscle power. Energy transferred to a screw by the action of muscle on a screw driver continues to be kinetic energy. There are other natural renewable sources that were used such as: wind and water. Who would not be impressed by the windmills in Holland or the Romans' waterwheels? Although cleaner, non-renewable energy sources may not be as abundant as other sources which result from the work of scientist, inventors and engineers. Today the energy may come in the form of movement or electricity. For instance, the engine of a car converts heat energy into kinetic energy in such a way that it contributes to a more complex economy and has revolutionized the transportation systems.

Nowadays we find many machines powered by steam, gasoline and diesel engines which transform heat energy to mechanical energy. Although electricity is not a primary source of energy it has become a much used source of energy both at home and in industry, one that derives from other sources of energy such as coal or hydraulic power. An efficient machine gets the right amount of energy to the right place by using mechanical parts such as levers, gears, or pulleys. Machines can perform tasks that are beyond are physical power, thus the fascination we have with them.

Simple Machines

In order to understand how more complex machines work we must understand how simple machines have aided humans in performing tasks. The fact is that machines help us gain mechanical advantage, which is the factor by which a machine multiplies the force we put into it. The simple machines are easily identified by most people as tools that you may use in the day-to-day operation of a household.

The screw, the wedge and the lever are very common simple machines. For example, screw jack utilized to lift cars to change a flat tire. It is a lifting device that uses the principle of the screw and the lever by a small amount of effort to produce a large amount of force. The levers work under the principle that a small effort applied a long way from the fulcrum can lift a large load that is close to the fulcrum. Over two thousand years ago Archimedes, a Greek scientist explained how levers work and he said: "Give me a leverage point and I will move the world." An ax that many utilize for wood cutting is a good example of a wedge but if you need an example of a more common wedge you can always show how a knife can cut through vegetables.

The inclined plane, another simple machine has aided civil engineers in building mountain roads that allow for us to travel with less effort than if we tried to climb straight up which would be almost impossible for our cars. Many of us have seen tow trucks lift and pull cars across town by using a pulley which is another simple machine and an axel and a wheel. For the purpose of this unit I am not going to expand on simple machines yet I want to show my students the advantages simple machines add to technological advances.

Compound machines I have discovered are a combination of more than one simple machine to perform a task such as: scissors. Because compound machines have more parts to it they have more mechanical advantage when compared to simple machines. Of greater advantage is a compound machine that is powered by an engine whether electric or mechanical these machines have changed our style of living. Such machines as cars, trucks, sewing machines, and others have made life more complex yet providing access to good or experiences we could not enjoy in the past.

Engines

Engines, the power agent of machines, are engineering wonders that transform energy into movement. There are several types of engines with a variety of efficiency level. The most commonly used engine utilized in cars and trucks are those that use the Otto cycle.

These engines are also known as spark ignition engines which operate in most cases with a four stroke cycle. First, these engines operate allowing a mixture of air and fuel to be drawn into a cylinder during the intake stroke. At which point the temperature and pressure of the mixture is increased by a compression stroke, this is the second step. Third, when the mixture is at near maximum compression a spark initiates combustion, raising the temperature and forcing expansion. The increased temperature makes the gases expand to the point that they work on the piston during what is called the power stroke. Finally, burnt gases are flushed out in what is known as the exhaust stroke which is the fourth of a series of four strokes. The mechanical work is possible because as the piston moves it pushes a connecting rod that moves a crankshaft connected through a rod bearing.

The process described for the four stroke engine denotes how engineers have taken the principles of thermodynamics and have applied it technology that converts chemical energy to kinesthetic energy and finally to mechanical work.

Lessons

Lesson 1 Energy

Lesson Goal

In this lesson students explore the concepts of energy and work. They examine themselves, common objects and toys that use energy.

Subject Area :

Science

Grade Level and Course Title :

Second Grade/ Scientific Observation/Classification

Unit of Study :

Machines

Outcomes :

Students can describe ways in which energy is present in everyday life

Students are familiar with the use of different types of energy and how they are transformed into work

Students can manipulate simple mechanical devices powered by electricity and engines

Key Concepts :

effort

energy

force

thermo

dynamics

work

Instructional Resources - Equipment/Manipulative:

Action figure with moveable arms/legs powered with a battery

Water turbine

Balloon for hot air expansion demonstration

Candle

Sequence of Activities and Advanced Preparation:

On card stock glue pictures that help explain the key concepts and sources of energy, on the back write a simple definition. On separate cards write, thermo and dynamics.

Procedure:

Teacher with the students define the term energy. Ask the students to work in pairs to brainstorm about different types of energy they use at home or at school. Say: “Does anyone know what do we need for us to move around?”

“Can they think of any source of energy that they may use to help them do their chores at home?” List any answers they come up with in addition to those above. Tell students that energy is all around us and we use it in many ways. Talk about the first law and second law of thermodynamics in simple terms. “Energy is conserved, it can’t be created or destroyed, only transformed.”

On the internet find a site such as virtual lab (http://jersey.uoregon.edu/vlab/) that shows students some of the thermodynamic principles encourage them to observe the graphics and try to explain what they see. You need to model for them and interact with them as they are working with the computer.

The Instructional conversation with teacher, who engages in a 10 minute discussion in small groups on the words thermo and dynamics, will be a center. Meanwhile distribute the cards to student small groups. (Divide your groups by the number of objects you have set at stations. Groups of four work well.) Let them know that each card has a definition on the back. Have students read the definitions aloud to their group. When they can say that everyone in their group understands the simple machines, they should be provided with one of the demonstration. The small group's challenge is to predict/find what type of energy is used and share it with the class. In their sharing with the class they should include reading the definition of the energy they think their object uses.

Once each small group shares their predictions, challenge the class to explain why they agree or disagree with the group's presentation. You may have to model appropriate ways to do it, both conceptually and socially.

Journal entry: have students draw one or more sources of energy and write the definition also write how they may use it in everyday life.

Assessment

Use the completed journal entry as a formal assessment.

Application Beyond School

Students can make a list of energy sources they encounter and they may use in a single day.

Connections - Social Studies and Literacy

The lives of people who live in different parts of earth may be affected depending on energy sources available to them and the technology they have. Have students find out how different groups of people use the sun, water and air as energy resources.

Lesson 2 Machines

Lesson Goal

In this lesson students explore the use of simple machines and how simple machines can be combined to produce compound machines. They examine common objects and toys to find several simple machines in each.

Subject Area :

Science

Grade Level and Course Title :

Second Grade/ Scientific Classification and Measurement

Unit of Study :

Machines

Outcomes :

Describe ways in which simple machines are used in everyday life

Identify and use simple machines and describe how they change effort

Manipulate simple mechanical devices and explain how their parts work together

Key Concepts :

effort

energy

force

thermo

dynamics

work

Instructional Resources - Equipment/Manipulative

Bicycle or tricycle

Corkscrew (with corked bottle)

Doorknob with striker

Eggbeater

Fishing pole

Hot wheels or other car with ramp (downhill) track

Toy dump truck with moveable bed

Sequence of Activities and Advanced Preparation:

On card stock glue pictures of simple machines and their name on the front and a simple definition on the back.

Procedure

Teacher with the students creates a chart that describes simple machines. Ask the students to work in pairs to brainstorm about different types of simple machines they use at home or at school. Say: “Did you find any tools with more than one simple machine inside?”

Ask students what would happen if you put more than one simple machine together. “How might that be useful?” “Can they think of any other tools that combine more than one simple machine?” List any answers they come up with in addition to those above. Tell students that a machine that contains more than one simple machine is called a compound machine.

Distribute the simple machine cards to student groups. (Divide your groups by the number of toys or other objects you have set at stations. Groups of four work well.) Let them know that each card has a definition on the back. Have students read the definitions aloud to their group. When they can say that everyone in their group understands the simple machines, they should be provided with one of the toys/compound machines on the list. The group’s challenge is to find all the simple machines in the toy or tool, and to prepare a presentation for the class. In their presentation, they should explain the toy or tool, reading the definition of each machine.

Once all groups have presented, as a class emphasize what makes a compound machine. [They should indicate that a compound machine contains two or more simple machines.]

Assessment

Use the completed Student Presentation as a formal assessment.

Application Beyond School

Students can make a chart showing the number of simple machines and compound machines they use in a single day.

Connections - Social Studies and Literacy

When people multiply the work they can do, they increase productivity. This allows a higher standard of living (in economics). As a group write story about how some people’s lives have changed by the use of machines.

Lesson 3 Engines

Lesson Goal

In this lesson students explore the concepts of engines and gas expansion. They examine different types of engine kit (e. g. pop-pop boats or water vapor engine boat) and its function.

Subject Area :

Science

Grade Level and Course Title :

Second Grade/ Scientific Observation/Predictions

Unit of Study :

Machines

Outcomes :

Students are familiar with ways in which energy is used in engines

Students are aware about the use of different types of energy and are familiar with how they are transformed into work in engines

Students can manipulate simple models of engines

Key Concepts :

effort

energy

force

thermo

dynamics

work

Instructional Resources - Equipment/Manipulative

Engine kit

Sequence of Activities and Advanced Preparation:

On card stock glue pictures that help explain the key concepts and sources of energy, on the back write a simple definition. On separate cards write: **First Law** : You don't get something for nothing. **Second Law** : You can't even break even.

Procedures

Teacher explains how engines work in four simple steps. Have students explain to each other each step at a time with the help of the teacher. Let students generate questions. Utilizing the questions generated create a skit with the class.

Let students in small group look at engine pistons models on the internet. Ask them to explain to each other what they see. Ask them to draw what they saw so they can explain it to someone else. Make two circles of students one will explain their drawing and the other will rephrase what they were told and may share their own understanding. Instructional conversations (while they are the computer the teacher rotates from group to group for a 10 minute discussion in small groups) the discussion helps the students deepen their understanding of the models.

Once each group shares; challenge the class to recreate the skit about the engine. You may have to model appropriate ways to do it, both conceptually and socially.

Journal entry: have students write how they think engines have changed the lives of people.

Assessment

Use the completed journal entry as a formal assessment.

Application Beyond School

Students can make a list of machines that have engines and how are they used.

Connections - Social Studies and Literacy

Engines have change the nature of work in many places have students research how are engines used in different types of work? Ask them to interview their parents to write a about their country and how they use machines there.

Conclusion

The students with the help of the teacher will compose a song helping them remember all the key concepts and their definition.

Content Standards

Scientific Inquiry- Content Standard 1.0

Students will develop abilities necessary conduct scientific inquiry, including posing a question, stating a hypothesis, developing an investigation, observing and documenting the process and recording and determining the results.

Performance Standard 1.1 - Students will acquire and practice the ability to do scientific inquiry.

Performance Standard 1.2 - Students will understand the process of scientific inquiry.

Physical Science - Content Standard 2.0

Students will develop an understanding of properties of objects and matter, position, motion and forces of objects including light, heat, electricity, and the transfer and conservation of energy.

Performance Standard 2.1 - Students will identify objects and materials with rich verbal description.

Performance Standard 2.3Students will understand the fundamental concepts of the transfer of energy .

Technological Science - Content Standard 5.0

Students will develop abilities necessary to distinguish between naturally occurring objects and those of human design, and they will develop understanding of the roles of science and technology in contemporary society.

Performance Standard 5.1 - Students will develop understanding of technological designs which solve problems and improve the quality of life.

Performance Standard 5.3 - Students will develop abilities to distinguish between natural objects and objects made by humans.

Reading List for Teachers

Ardley, N. (1995). *How things work: 100 ways parents and kids can share the secrets of technology.* Dorling Kindersley Ltd.: London. This is a well illustrated book with pictures and clear explanations.

Brain, M. (2004). *How Power Grids Work.* [On line]: http://www.howstuffworks.com/power.htm This is a website that allows to read about a variety of topics in science and technology, here I am specifically providing the address for power grids.

Butti, K., and Perlin, J., (1980). *A golden thread: 2500 years of solar architecture and technology* . Palo Alto, Cheshire Books; New York. A good book for those interested in solar energy and technology related to this resource.

Columbia Encyclopedia [On line]: http://education.yahoo.com/reference/encyclopedia/entry?id=15519 This is a good reference resource on-line and accessible both for teachers and students.

Kerrod, R., and Holgate, S. A., (2002). *The way science works: Discover the secrets of science with exciting, accessible experiments.* Dorling Kindersley Ltd.: London. This book is a must have for any aeducator who wants to create a hands-on learning environment in the classroom.

Knapp, B., (1991). *How things work.* Grolier, Ltd.: New York. This resource is an amazing tool for the teacher who is a physics novice, it is well illustrated and has a cd that allows fro not only to see the graphics but the motion too.

Energy Information Administration, (2004). *Electricity* [On line]: http://www.eia.doe.gov/cneaf/electricity/page/prim2/chapter1.html#sources This is a factual resource that teachers can utilize to gather government information about electricity consumption and usage.

Energy Information Administration, (2004). *Official energy statistics from the U. S. government.* [On line]: http://www.eia.doe.gov/ This is a factual resource that teachers can utilize to gather government information about energy consumption and usage.

Fenn, John B., (1982). *Engines,* energy, and entropy : a thermodynamics primer. W.H. Freeman.: San Francisco. This is a book that is out of print. Yet, this was the text on thermodynamics that we used in our seminar and I found it useful to explore the engineering concepts and the lexicon.

Flagg, A. Ory, M. and Ori, T. (2002). Teaching Science With Favorite Picture Books: Grades 1-3. Instructor Books: New York. The author give creative ideas to utilize children books in teaching students science.

Frankel-Hauser, J. and Kline, M.P. (1998). *Gizmos and Gadgets: Creating Science Contraptions That Work (and Knowing Why)* . Ideals Publications: New York. Gives directions for making gadgets, gizmos, and contraptions with things often found in cupboards, closets, garages, and “junk” drawers. Materials such as plastic soda bottles, marbles, buttons, straws, and cardboard tubes are cut, trimmed, shaped, and bent in order to be glued, stapled, sewn, and taped. They are formed into objects to demonstrate various principles of physics.

Loucks-Horsley, S., Hewson, P. W., Love, N., and Stiles, K. E. (1998). *Designing professional development for teachers of science and mathematics.* Corwin Press: Thousand Oaks: CA. This is a technical resource for teachers and school staff developers who want to improve the teaching of science.

McDaniels, D. K. (1991). *The sun, our future energy source* . 2nd ed. Krieger Pub. Co.: Malabar, Fla. A manual on how to utilize solar energy.

Nieto, S. (1999). *The light in their eyes: creating multicultural learning communities.* Teachers College Press: NY. This is a book on how to teach multicultural children and be effective and sensitive to diversity.

Parker, P. (1994). *How the body works: 100 ways parents and kids can share the miracle of the human body.* Dorling Kindersley Ltd.: London. This book is excellent to show how the body works and gives ideas on experiments that help kids understand it.

Science made simple educational magazine. [On line]: www.sciencemadesimple.com On line publication that is great for kids, parents and teachers to get factual information.

Sklar, S., and Sheinkopf, K. G., (1991). *Consumer guide to solar energy: easy and inexpensive applications for solar energy* . Bonus Books: Chicago.

Tharp, R., (1999). *How the standards came to be?* [On line]: www.crede.ucsc.edu On line publication on the standards for effective pedagogy. These standards are for teacher performance that addresses students' needs to meet the content standards.

Reading List for Students

Berry, G. (2004). *Asombrosas máquinas : Amazing Machines, Spanish-Language Edition.* Silver Dolphin en Espa–ol: New York. Here are four machine bodies waiting for young engineers and mechanics to build them. The simple text explains what the machines are, and readers can then snap on the required tools each one needs to do its job. The machines include a space lander, a submersible, an excavator, and a rescue vehicle. Using the 42 snap-on gadgets and gizmos bundled in, young readers can transform powerless shells into wonderful and wacky vehicles.

Bridgman R. F. and Dennis, P. *1000 Inventions & Discoveries* This book is a practical guide to inventions with terrific illustrations useful to both teacher and student.

Burton, V. L. (1939). Mike Mulligan y Su Máquina Maravillosa. Translated by Yanitzia Canetti in 1997. Hougton Mifflin: New York. This book is a story about a talking machine that becomes outdated and its operator moves her into a small town. It is an old story that still makes lots of sense.

Burton, V. *Mike Mulligan and his steam shovel* . See description above for the Spanish title.

Davis-Jones, M. and Gay-Kassel, D. (2004). *Maquinas Grandes* . Children's Press : CT. This is a pretty book on machines that provides vocabulary and beautiful illustrations for children.

DK Publishing Inc. (2004). *Maquinas Duras/Tough Machines.* Diggers and tractors are hard at work in this little bilingual first word book. Busy, tough, speedy, and rescue machines fill these little board book. Each spread features vivid photographs of a different type of vehicle, accompanied by a simple bilingual label. Building a vocabulary in Spanish and English is fun with these little books of things that go.

Feldman, J. R. (2002). Complete Handbook of Indoor and Outdoor Games and Activities for Young Children. Jossey-Bass: New York. This is a handbook of activities that teach science concepts through everyday life. Teachers, parents and students can enjoy fun activities while they learn new vocabulary and science concepts.

Retan, W., *The Easy-To-Read Little Engine That Could.* All Aboard Books. This is a picture book that can serve to facilitate discussion about machines and engines.

Silver Dolphin (2003). *Grandes Maquinas* . Silver Dolphin En Espa–ol: New York.

Tractors, front loaders, dump trucks, cranes, and big rigs are grinding, smoothing, shaking, reaching, wrecking, and loading throughout the pages of this colorful book about making things move. This book provides new vocabulary to second language learners and reviews vocabulary for Spanish speaking students.

U.S. Department of Energy http://www.eere.energy.gov Web site that can help children understand concepts of energy more readily.

U.S. Department of Energy http://www.eia.doe.gov/kids/whatsenergy.html Same as above.

VanCleave, J. (1991). *Janice VanCleave's Physics for Every Kid : 101 Easy Experiments in Motion, Heat, Light, Machines, and Sound (Science for Every Kid Series)* . John Wiley and Sons: New York. This is an excellent book that provides teachers and students with fun and easy activities to understand physics concepts.