Science and Technology: Catalysts for Change in Society

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Academic Setting

School Setting and Students

I will be teaching five sessions of 8th grade language arts at Belen Middle School in Belen, NM during the 2001-2002 school year. Belen is located along the Rio Grande, 32 miles south of Albuquerque. It has a population of about 6,600 with an additional populace of about 7,000 living in the mainly agricultural area surrounding the town. An additional 3,300 people live in Rio Communities, which is located to the east of Belen and is served by Belen Consolidated Schools.

Belen Middle School is the only middle school in the district and is comprised of 7th and 8th grades. There are about 800 students at the school which operates on an interdisciplinary team concept. Demographics of the school are as follows: 67% Hispanic, 29% Anglo, and 4% "Other", with 73% of the school population receiving free or reduced lunches.

Class for Which This Unit is Designed

This unit is designed for use in an 8th grade team consisting of language arts, reading, social studies, math, and science. Teachers within a team can teach their own specific subject area content while using the key concept of "Science and Technology as an impetus for change in Society" as the unifying theme throughout the school year. Some sample lesson plans have been designed for use in the language arts class and are included in this unit.

Goals and Objectives of the Unit

Key Concept

- Science and technology as an impetus for change in society

This is the conceptual theme and focus of the unit. It serves to integrate the students' learning across the disciplines. Essential understandings that will be taught in all curriculum areas include:

- Science and technology affect changes in society.
- Society affects changes in science and technology.
- Everyone needs to know how science works.
- Technological innovations are occurring exponentially.
- To be successful one must be able to use the new technology of the future.
- As citizens of a democracy, we must be literate, knowledgeable, and have a social conscience.

Some of the possible essential questions for each discipline follow. These are not exhaustive, but serve merely as suggestions. Teachers should develop their own essential questions that will allow them to relate the content of their disciplines to the key concept, thus enabling the student to relate patterns and make connections across the different curriculum fields. The goal is for the students to be able to answer the essential questions at the end of the lesson or series of lessons.

Language Arts

One of the primary goals in a Belen 8th grade language arts class is to prepare the students for the New Mexico Writing Assessment. This is given to Belen students in the 4th, 6th, and 8th grades. For this reason, lesson plans are geared towards allowing the students to become comfortable with the writing process and helping them view themselves as competent writers. Some essential questions for teaching in this area are:

- What is technology, and how does it affect our lives?
- How have recent advancements made in science and technology changed our lives?
- What are some specific examples of technological innovations that we take for granted? What are their histories?
- How have new technologies affected society positively and negatively?

Literature

Literature allows students to explore past, present, and possible future worlds. Viewing these worlds through the unifying concept of how technology and science affect society allows us to make connections and see patterns across times. Some essential questions for teaching in this area could be:

- What are ethics, and how do they relate to science and technology?
- How have the different technologies available at different times in history affected people's lives?
- What are some future trends in technology? How will they affect us?

Science

Life science is taught at the 8th grade level at Belen Middle School. Students are also responsible for participating in the Science Fair. Some essential questions for teaching in this area could be:

- How did the scientific method reflect a new world view, and how does it affect what we know as science today?
- How does science work, and what do we need to know about science?
- How do advancements in science influence advancements in technology?
- What is the human genome? What possible advantages/disadvantages

does this new knowledge present?

- What is nanotechnology, and does it promise new medical treatments?
- How should ethics be applied in the field of science? Who is responsible for the bad that can result from new discoveries?

Math

Although math has been more difficult to integrate into multi-disciplinary units, there are aspects of math that students must understand and be able to use in developing a Science Fair project, in analyzing data in social studies, and in analyzing data and dealing with problems that are encountered in everyday life. Some essential questions for teaching in this area could be:

- What are the metric measurements that are used in Science Fair projects, and how do we use them?
- How do we gather, analyze, and display data in graphs and charts?
- How can the display of data influence how it is interpreted?
- How can we use and interpret statistics?
- What does probability mean to us in our everyday lives?

Social Studies

Science and technology have had profound influence upon the development of the U.S. and continue as catalysts for change in our society today. Democracy is based upon having an informed populace. Decisions are being made about science and technology which affect our lives. How much should we be involved in these decisions and how much of the decision process should we hand over to the experts? In order to make informed decisions, we as citizens of the U.S. must become better informed about science and technology. Some essential questions for teaching in this area could be:

- How have different technologies influenced the growth of the U.S.?
- How has our society influenced the development of science and technology?
- How should ethics be applied to the fields of science and technology? Who controls science and technology, and who is responsible for seeing that science and technology are used for the good of society?
- What are the responsibilities of the citizens of a democracy? Who is ultimately responsible for what the government does?

Context and Background

Rationale

Why should we teach a unit that spans the entire school year and all its subject areas? When teaching on a middle school team, we have an opportunity to utilize a concept-based approach to curriculum design. This allows teachers to continue to teach their individual discipline's objectives

while at the same time providing students with a "conceptual lens that forces thinking above the fact base." (Erickson 65). This goes beyond the topic-centered approach normally used in thematic units, since the unifying factor in a concept-based approach is an idea, rather than a topic. Using this approach, students are able to recognize patterns and make connections across the various content areas. The unifying theme relates the subject matter to their personal lives, so it holds their attention by making it relevant to them, while also allowing them to build upon previous conceptual schema. As Neil Postman sees it, "perhaps the most important contribution schools can make to the education of our youth is to give them a sense of coherence in their studies, a sense of purpose, meaning, and interconnectedness in what they learn."

Advancements in science and technology have provided the conditions needed for advancements in Western civilization. The world in which we live in today is a sum total of those progressions. New discoveries in the fields of nanotechnology, genetic engineering, and artificial intelligence have placed us on the cusp of yet another monumental change in society, one that our students will experience within their lifetimes. Whether they will be able to profit from this new-found knowledge in their careers or be left by the way-side depends upon their understanding of how science and technology work, how these fields affect their lives, and how they can use them to their advantage. Science is the driving force behind technology. Throughout history, those who understand and are able to use technology wield power within society that is denied to those who do not understand.

In order to be prepared to deal with the "complicated scientific and technology aspects of society today," Laurel Singleton tells us that students must understand "that science, technology, and society have interacted throughout human history and that scientific investigation and technological developments do not occur in isolation from human values." (127). Just as science and technology affect developments in society, so too does society affect science and technology. Western societies have been built upon the precept that science and technology offer us ways to improve our lives. However, we are now seeing that uncontrolled technological growth has resulted in unanticipated side effects such as pollution and depletion, and society is now asking for more social responsibility on the part of science and technology. Whether or not this happens depends on the actions of concerned individuals.

Subject Background

Often today, the term technology is used to refer to what may be more clearly defined as information technology. However, information technology is just a portion of what the word technology had encompassed before the advent of computer technology. David Lindberg sets forth many different approaches to a definition for the terms science and technology. For the purposes of this unit, his definition of science as being a "body of theoretical knowledge" and technology as being the "application of theoretical

knowledge to the solution of practical problems" (1) will suffice. Rudi Volti makes the distinction between the two by stipulating that "whereas science is directed at the discovery of knowledge for its own sake, technology develops and employs knowledge in order to get something done." (57).

Technology, traditionally, has been developed through trial and error and predates science. The first tools created and used by early man would look so simple to our technologically jaded eye that many, if not most, of us would walk past an early stone tool lying on the ground without noticing it among the other rocks. It would probably take the practiced eye of someone trained in the field of archaeology, or at least someone whose interests bend in that direction, to be able to discern it from the many other rocks and stones. However, some believe that it was the making and using of these stone tools that created homo sapiens; that is, that turned early man into what we are today. Arthur C. Clarke reminds us that it is through repeated practice of a skill or set of actions that our brain actually reorganizes itself so as to get better at doing the job at hand (228). Thus, he saw the very use of stone tools as being the impetus for the further development of early man's brain. James Burke looks at this in a slightly different light. He saw the mental prerequisite for the making of stone tools to be the ability to think sequentially. Those who were thus able to think sequentially (and thus able to make stone tools), received power within the group. These early technology creators became the "winners." With this power came a greater chance of survival for them and their offspring. Because they were more apt to survive, they and their offspring were more apt to pass on their genes (and the ability to think sequentially) to the next generation (16-17).

Technological Determinism vs. Interplay Between Technology and Society

This view of technology as the driving force behind episodes in history is known as "technological determinism" (Pool 10). In addition to the scenarios outlined above, those who espouse this view also see the development of the printing press as being the impetus that spurred forth the Reformation, the adoption by Western man of the magnetic compass from China as being the cause of the Age of Exploration and the discovery of the New World, and the invention of the cotton gin as having created the conditions that eventually led to the Civil War.

However, we can see that technology not only influences the course taken by society, but also that society has a direct bearing on technology. Decisions about technology depend on varied nontechnical factors. First, there are political forces. Having said this, the pictures that immediately come to my mind are those of the polluted landscapes in Soviet held countries that we in the Free World were allowed to see only after the end of the Cold War and the dissolution of the Soviet Union. These atrocities had not been allowed to happen, at least not on such an immense scale, in Western countries due to governmental regulations set down at the insistence of their concerned citizens. Political forces also control governments' purse strings. According to Volti, decisions about which technologies will be sponsored are made by

congressional committees, government agencies, and special interest groups: "Today, technology makes heavy use [of] the products of scientific inquiry", and 70% of pure scientific research is financed by federal and state governments (298).

Other nontechnical factors that determine a technology's fate are business and economic considerations. Whereas science operates on a premise that knowledge must be shared in order for it to be verified or disputed by other members of the scientific community, and thus either accepted or refuted, business strives to keep their technology as secretive as possible in order to keep a competitive edge over their rivals. Furthermore, businesses make their decisions about which technological innovations to pursue and develop based upon whether or not there is a market for a particular product, meaning that there are enough people with enough money and desire to buy it. Historically, what is one man's trash (or lack of vision) is another man's treasure. For example, in 1959 Haloid Company developed a copy machine that used plain paper. Before this time, copiers required a special type of heat sensitive paper. Haloid did not have enough money to take the product to market, however, so proposed selling it to IBM, who was unable to see how it would fit into the office world of the time and so declined it. Haloid, undefeated, chose to raise enough capital on its own by offering more stock in its company and began selling their copier in 1960. We know Haloid today by the name of Xerox (Pool 54). Here, Haloid had the vision to perceive the possibility of the development of a market that would need and buy its product. IBM could not. Imagine a world without Xeroxing. It has become such an important part of our world that the very name of the company has entered our language as both a noun and a verb.

Yet another nontechnological factor that bears upon the development of technology is historical coincidence. The most interesting example of this, in my mind, is how Bill Gates managed to get the contract from IBM for writing the operating system to be used in IBM's personal computer, the PC. Microsoft was a small company at the time and, one could say, also unproven. How was it that Bill Gates, a relative unknown, was able to finagle this important contract that launched him on the track that has led him to being the richest man in the world today? The answer is serendipity. Bill Gates' mother, Mary Gates, had been on the Board of the United Way along with John Opel, the Chairman of the Board of IBM, and when he was given the opportunity, "thought it would be nice to do business with her son." (20). Bill Gates just happened to be in the right place at the right time, along, of course, with having the know-how needed to get the right people together to get the job done.

An Overview of the History of Science

So how did we get from the making of simple stone tools to the making of technology capable of developing, supporting, and using not only computers, but worldwide networks of computers? Let us return to our stone tool brandishing groups for a moment. Remember that the ability to create stone

tools, according to Burke, required a sequential thinking process. This type of thinking process is also needed for the development and use of language. Following Burke's reasoning, stone tools encouraged the survival of this sequential thinking process in man, and so this stone tool technology also encouraged the survival of the ability to develop language. Thus, those who were better able to use language were at a distinct advantage over those who were not, ensuring a higher survival rate for them and their offspring.

Language itself can be seen as "our most fundamental technology" (Postman 14), although it is an invisible technology. "What we think of as reasoning is determined by the character of our language." (124) Those who do not speak more than one language do not normally consider how different the world may appear to someone who speaks a language radically different from their own. Just as science and technology influence a society, so, too, does a society influence its science and technology. Within every society, there is a mindframe that is taken for granted and which determines how we see the world. A language is very much a part of that mindframe.

Early man developed technologies as the need arose. Now that he had language, he also had the ability to coexist with a greater number of people. The development of agriculture allowed the hunter-gatherer using stone tools to settle down in one place, and civilization was born. Domestication of animals and crops, along with the development of irrigation, allowed for a surplus of food to be grown, which in turn led to specialization. Technological innovations were on the rise.

As societies grew and became more complex, commerce also expanded and some form of keeping track of everything became necessary. Out of this necessity, writing was born and although simple at first, writing systems were improved in order to meet the demands of keeping track of more and more complex empires. However, as with many technologies throughout the ages, the technology of writing was also one that conferred power upon those who knew how to use it. Therefore, complex systems of writing, such as hieroglyphics, were not seen as requiring simplification by those who knew how to use them (Burke 50-51). However, with the eventual advent of a phonetic alphabet in Phoenicia, the technology of writing was made available to more people. Because a phonetic alphabet has letters corresponding to sounds which can be joined together to create words, instead of different pictures corresponding to different words, a phonetic alphabet is much easier to learn. The difference is between having to learn an alphabet consisting of a small number of letters and their corresponding sounds, such as in English, and having to memorize thousands of different ideograms and the corresponding words they represent, as in early Egyptian hieroglyphics.

This alphabet made its way to Greece, and the Greeks used this technology to develop the Western way of thinking that we now take for granted. Burke tells us that writing allowed for more complex thought. A person could now chop up his thoughts by writing them down and be able to ask more complex

questions, because he would not have to worry about forgetting something and getting lost in the process (72).

Up to this point, man had technology, but he had not yet developed the concept of science in the Western world. Anything that could not be explained by technology was thought to be controlled by the gods. Greek mythology, however, was peopled by a set of gods and goddesses who were not all-knowing. This, plus the fact that they were a seafaring culture (due to their mountainous and hilly terrain which extended over many small islands) had developed in them an independent and inquisitive nature. They felt that a free citizen should concern himself mainly with politics and the pursuit of knowledge. Now, with the arrival of writing, which allowed them to contemplate more complex questions, Greek philosophers began to look at the world itself for explanations as to why things were the way they were. They looked for natural causes, rather than supernatural cause (as exemplified by Aristotle, who insisted that theories be confirmed by observed facts). Just as important, they developed a system of logic (82, 87).

Their successors, the Romans, were less interested in science (which for our purposes you will recall can be seen as knowledge for the sake of knowledge) and more interested in the technologies needed to keep a large empire operating. They were great builders, but not scientific innovators.

After the fall of Rome in the 6th Century, further developments in science came to a standstill. The scholars of the Middle Ages translated works from the old Greek manuscripts, making a wealth of knowledge more accessible. However, some subject areas threatened to clash with the theological precepts of the Catholic Church. It took Thomas Aquinas and his love of Aristotle to reconcile Christian theology and Greek philosophy by espousing that "there can be no true conflict between theology and philosophy, since both revelation and our rational capacities are God-given." (Lindberg 233). In this manner, the Church was able to welcome the knowledge of the Greek natural philosophers. However, by accepting the knowledge of the Greeks, the Church also effectively put a hold on new-found knowledge. Scholars of the Middle Ages were more interested in finding classical Greek authorities' views on the natural world than in looking to the natural world itself and making their own observations. Rather than be controversial, it was much safer to look to the Greek philosophers for answers.

In the 15th and 16th Centuries, we see the adoption of foreign inventions and knowledge, mainly from China (paper, the magnetic compass, and gun powder) and Arabic cultures (especially in the fields of medicine and math). It was at this time that people began to question what had heretofore been considered knowledge. Remember that this had been derived from the ancient natural philosophers, but was not supported by mathematical computations (which were now made possible by their acquisition of Arabic mathematical knowledge) and by their own observations. Up to this point, it had been thought that the earth was the center of the universe, a thought upheld by the Church. However, Copernicus (1473-1543) developed the

theory that the earth revolves around the sun. This new world view began an intellectual revolution.

The 17th Century ushered in more advances in scientific thinking and we see the rudimentary appearance of what we now term the scientific method. Here are the workings of a mechanistic philosophy where everything in the universe can be seen as mere objects over which man is master. Descartes (1596-1650) wanted to see a separation between the natural world and the spiritual world. Bacon (1561-1626) came up with the adage that "Knowledge is power" and laid the foundations for the scientific method. He thought that observations of nature should be made based on experiment using uniform measurements. He also felt that science could bring a better life to man through technology. Newton (1642-1727), who discovered the law of gravity, saw the world as a great self-perpetrating machine governed by natural, rather than divine, laws. He acknowledged the debt that he owed to those who had gone before him and upon whose knowledge he had built.

The Western world continued building upon this knowledge in science. However, science (the pursuit of knowledge) and technology (putting that knowledge to use) was still separated in the 18th Century. In the 19th Century, we see them working together in scientists like Pasteur (1822-1895) who began using science to solve practical problems, instead of seeing the role of science as being solely for the pursuit of knowledge. It is from his name that we get the word pasteurization which resulted from the work he did for the wine industry. By warming the wine to 55 degrees Celsius, he found that the micro-organism that soured the wine could be killed, and the wine kept from spoiling (Mason 517-518).

So now Western man has the scientific method which provides a framework within which he can view and question the natural world. This represents a cultural change in the way that man looks at the world and what is considered to be knowledge. Rather than being satisfied with relegating inexplicable phenomena to the realm of theology, Western man, using the scientific method, began to delve into these questions about the world seeking knowledge for the sake of knowledge, using science to answer the question, "why?"

Contrary to what people outside the scientific community believe, scientific work is not a neat and tidy business. It is fraught with winding paths and dead ends, which scientists must navigate without the help of a road map that would lead them straight to the answers they seek. When you and I study science from a textbook, we are usually only told about the great discoveries made by people whose discoveries made them famous. Seldom are we told about the numerous trials it took them to get from their first insightful questioning and hypothesizing to their conclusion based upon the data gathered from their experiments. Yet having reached this point, the scientist's journey is still not ended, the prize not yet won. For now, the scientific community must agree upon the content of this new scientific claim for it to be accepted. We need to understand that "no experiment on its

own can settle anything; to settle things, the interpretation of an experiment has to be agreed by all parties", meaning the scientific community. Too many of the American public not only do not understand how science works, but know too little about science to understand the revolutionary breakthroughs occurring today (Rensberger 61). To compound this problem, many journalists do not themselves understand how science works, so what information we do receive from the news media can be misleading if not inaccurate.

The Future of Science and Technology

The United States has been built upon the Baconian view of the world in which technology is seen as making life better for man. However, this optimism towards technology and the concept of technology being able to solve society's problems is increasingly being replaced by a pessimism which includes a view of technology as being part of the problem rather than the solution (Pool 7). Postman postulates that man has developed three types of culture: tool using cultures, technocracies, and technopolies (22). Let us look at these individually so that we may see where this feeling about technology may have arisen.

"Technopolies"

The first cultures that man developed were the tool using cultures. We can still find some in existence in the world today. For Western man, tool using cultures continued through the Middle Ages. In these cultures, tools did not keep their members from believing in their god and did not undermine the social structure. This is easy to understand when we remember that these earlier cultures used technology to arrive at solutions to everyday needs; the inexplicable aspects of nature they relegated to the spiritual realm. Most men led a pitiful life while on earth but believed that they would achieve heavenly bliss after death.

Tool using cultures were replaced with the technocracies, in which the expansion of technology was rampant. These began in the 17th Century with the invention of the steam engine and continued through the 19th Century. In technocracies, society is concerned with the plight of the average man, and technology is regarded from the Baconian view, in which technology is seen as progress which helps alleviate man's suffering, creating a better life for him while on earth. Technology exists in cooperation with and is loosely controlled by religion and social custom.

In contrast, the third type of culture, the Technopolies, began in the 20th Century with Henry Ford's empire. Here, we have a total dissociation between technology and religion, because in a Technopoly that which cannot be measured is considered to be without value. We also see conflict with social custom, for now machines are valued more highly than human labor because efficiency is the ultimate goal. Output is measured by the amount of production relative to the number of workers. If production is working at capacity, the only way to increase output is to lower the number of workers

which means turning more work over to machines. In addition, decisions based upon calculations made by machines now are considered superior to mere mortal judgment. The world is seen as being so complex that decisions are best left to experts in their respective fields, since the average man cannot be expected to know as much about everything as an expert can know about his own field. In a Technopoly, technology now promises us the good life here on earth; we no longer have to wait until we die to achieve it.

"Modern Day Luddites"

Computer technology has strengthened bureaucracies, wherein decisions are made based upon efficiency without regard to how these decisions will affect the human element (Postman 115). Thus, a growing number of people today are feeling disenfranchized by the large-scale technological systems that have been developed by technocrats (Florman 3). The average citizen is seeing his world changed through increased pollution of the environment and depletion of natural resources (Pool 57), which many see as changes orchestrated by big business whose almighty mantra is profit. Although we live in a democracy, the average citizen is feeling increasingly powerless against big business, who has government in its pocket and keeps science and technology as its handmaiden. Decisions are made by congressional committees and government agencies based upon financial considerations from special interest groups, not in order to find solutions to social problems (Volti 303).

The average citizen experiences the loss of traditional jobs due to technological advancements, and sees the dissolution of the middle class in our country while the separation between the haves and the have-nots continues to widen. It is apparent that Technology's bounty has not been distributed evenly amongst the entire population. A backlash towards technology has been inevitable (Florman X).

We have in our midst "modern day Luddites," whose frustration towards the inequities and hardships imposed upon them by our economic system is taken out on the most obvious symbol of that system - the technology that it employs (or the inventors of that technology). The original Luddites of early 19th Century England received their name from Ned Ludlum who worked in a stocking factory and is said to have smashed his stocking frames with a hammer in answer to criticism from his supervisor. Actions such as these spread throughout England as workers acted out their feelings of frustration by attacking the very machinery upon which they earned their meager livings (Volti 21-22).

Our modern-day Luddites can be dangerous, especially when they take their rage out on people, as Theodore Kaczynski, the Unabomber, did. How much more dangerous he could have been if he had been knowledgeable in genetics or nanotechnology is of concern, at this point, only to those who are themselves knowledgeable in these fields and so know how hazardous it could be if they were used for evil purposes. Yet, there is real danger that

this knowledge could, and someday will, fall into and be used by the wrong hands. The difference between the destructive forces of this new technology and that of nuclear weapons is not that they are on different scales. They are both as potentially destructive, but this new technology is not limited to large-scale military institutions as nuclear technology is and which is therefore more easily controlled, but is in the purview of smaller commercial enterprises which makes it more difficult to control (Joy 4).

A Need for Educating the Public

One may remain optimistic about the future, but with reservations. A select elite made up of scientists, businessmen, and government officials are making decisions about the development and use of science and technology today (the complexity of which goes far beyond the comprehension of the average citizen). Our founding fathers set up our country's government to be answerable to a well-informed and educated citizenry. Yet without citizens who can understand the high stakes (the potential losses as well as the possible pay-offs) we are defenseless against the greed factor of big business and government officials outweighing the social good. We cannot trust that scientists and inventors will keep the world's welfare at heart either, for their ultimate goal is the pursuit of knowledge and technological innovation.

We, the American public, need to be able to understand what choices are being made about our collective future and be able to weigh the advantages and disadvantages for ourselves. In order to be able to do so, we must have a citizenry that is technologically savvy and that understands how science works, possesses sufficient critical thinking skills to be able to apply that acumen to real-life problems, and, just as importantly, be socially responsible.

Implementation

Although language arts teachers will want to assign a reasonable time limitation for each of the following assignments, there are always those students who complete a writing task faster than others. In order to see that all students are kept occupied, on task, and learning, a very few suggested Workshop Activities are included. These are activities that can be worked on as students finish the whole class assignment. Only five lesson plans are included with this unit. It is hoped that teachers will take advantage of other lesson plans developed on this topic by other teachers in this seminar.

Lesson Plan #1

Have the students come up with their own definitions of key terms "science" and "technology" and write them in their notebooks. Use "think, pair, share" strategy, then write a suitable, consensus definition on the board (see paragraph 1 under Rationale above). Have students write these definitions in their notebooks. Exhibit some technological items that you have numbered and that we use everyday (bring some from home as well as using some from the classroom. Use your imagination. Be sure to include a newspaper

or a book since these utilize the technologies of writing and printing). Have the students make entries in their notebooks including what the item is and what it is used for. Then discuss so that students understand how each item demonstrates the use of technology. Then have students make a list of technologies that they use every day. Homework: Keep a diary for one day of all technologies that they use in 24 hours. Underline those items that were not on the original list.

Materials
Students' writing notebooks, board and chalk (for definitions), butcher paper and marker (for list), items that demonstrate the use of technology (numbered).

Objectives
The student will define key terms.
The student will analyze why certain items are of a technological nature.
The student will generate a list of technologies that they use in one day.

Essential Question
How does technology affect our lives?

Standards
New Mexico Language Arts Content Standard 1A: Listen to, read, react to, and interpret information; 2A: Use speaking as an interpersonal communication tool.

Lesson Plan #2

Exhibit some numbered items from obsolete technologies (examples: a coffee percolator, a tea strainer, an old mechanical adding machine, a record player with an old 45, an 8 track tape player with a tape, a manual typewriter, a shaving brush, a wash board. Again, be imaginative. Ask friends and relatives for old items that they might have in their garages). Have students tour the displays and write down what they think each item is and what it was used for. Now review what the items actually are and what they were used for. Have students make corrections in their notebooks as these are discussed, crossing out any incorrect guesses and writing in the correct information.

Tell students that they are going to interview an older person (preferably over 50) about technologies that had not been invented when that person was a child. The object will be to find out 1) what technologies did they not have? 2) how did they manage without those technologies? 3) does that person feel that new developments in technology have made life better or worse and why does that person feel that way?. Brainstorm questions to ask. Use think, pair, share. Review interviewing techniques. Have students organize and rewrite the page of questions that they will use in their interview.

Materials
Group of numbered items representing obsolete technologies, students' writing notebooks.

Objectives
The student will deduce an item's use based on its appearance.
The student will produce a list of questions to be used in an interview.
The student will choose a person to interview.
The student will plan and conduct an interview.

Essential Question
How have advancements in technology changed people's lives?

Standards
New Mexico Language Arts Content Standards 1A: Listen to, read, react to, and interpret information; 1B Gather and use information for research and other purposes; 2A: Use speaking as an interpersonal communication tool; 2B: Apply grammatical and language conventions to communicate.

Lesson Plan #3

In groups have students discuss the findings from their interviews. As a group, have them answer the three questions posed in Lesson Plan #2. Then, individually they are to write a compare/contrast essay on Technology Then and Now, and How it has Changed our Lives. You may want to set a minimum word count for this. Note that Lesson Plan #4 requires that the essay be at least 100 words.

Materials
Interview notes generated in lesson #2, list of technologies generated in lesson #1, writing notebooks.

Objectives
The student will analyze the information obtained in the interview.
The student will write a compare/contrast essay.
The student will compare and contrast obsolete and modern technologies.

Essential Question
Are our lives better or worse because of recent advancements in technology?

Standards
New Mexico Language Arts Content Standards 1B: Gather and use information for research and other purposes; 1C: Apply critical thinking skills to analyze information; 2B: Apply grammatical and language conventions to communicate; 2C: Demonstrate competence in the skills and strategies of the writing process.

Lesson Plan #4

Hand out instructions and graph for Fry's Readability Test and review with students. Have students apply this test to their compare/contrast essay. When they have finished, have them answer the following questions: What have I learned about my writing? Was this surprising? Will this affect my writing in the future? What changes do I think I will make?

Materials
Compare/contrast essays generated from Lesson #3
Fry's readability test directions and graph obtainable from <http://school.discovery.com/schrockguide/fry/fry.html>

Objectives
The student will determine at what reading grade level they are writing.

Essential Question
How can I use technology to help me know at what level I am writing?

Standards
New Mexico Language Arts Content Standards 2C: Demonstrate competence in the skills and strategies of the writing process.

Lesson Plan #5

Hand out teacher - made scavenger hunt worksheets. Create these in three sections pertinent to your school and classroom: one including research materials to be found in your classroom, one including research materials that you have bookmarked on your classroom computers (see other units from this seminar for ideas and suggested sites), and one including research materials in your school library. Ask the librarian for assistance in locating and including research materials that pertain to the development and history of science and technology. Divide the students into three groups and have them rotate among these areas.

Materials
Research materials in classroom, classroom computers with internet access, library.
Teacher - made scavenger hunt sheets highlighting sources for research in these areas.

Objectives
The student will locate necessary research materials.

Essential Question
How can I utilize technology to learn more about a topic?

Standards
New Mexico Language Arts Content Standards 1B: Gather and use information for research and other purposes

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Lesson Plan #6

In groups, have students decide what the three most important inventions or scientific discoveries of the 20th century were. Groups will present these choices to the class and defend their decisions. They will then write their own research paper on an invention and inventor of their choice, explaining how this invention was/is important. They will also construct a visual display for presentation to the class, including the invention, its uses, and its importance.

Materials
Classroom and library research materials, computer with internet access, writing notebooks, poster board.

Objectives
The student will decide which inventor and invention they consider most important.
The student will explain and defend this choice.
The student will locate necessary research materials.
The student will differentiate between useful and superfluous information.
The student will paraphrase and summarize important information.
The student will illustrate an invention and will show its uses.
The student will compose a research paper and revise it for clarification.
The student will summarize the paper for presentation to the class.

Essential Question
What characteristics make a successful scientist or inventor?

Standards
New Mexico Language Arts Content Standards 1A: Use speaking as an interpersonal communication tool; 1B: Gather and use information for research and other purposes; 1C: Apply critical thinking skills to analyze information; 2B: Apply grammatical and language conventions to communicate; 2C: Demonstrate competence in the skills and strategies of the writing process.

Assessment
In preparing students for the New Mexico Writing Assessment, there are six aspects of good writing that 8th grade students must internalize and habitually apply to their own writing. These are: topic, organization, opening and closing, mechanics, word usage, sentences, and topic. Those who are familiar with the Six Trait Writing will recognize all of these (Six Trait combines the opening and closing with organization) and will notice that the sixth trait of "voice" is missing. A conceptual map is an excellent means of reinforcing these aspects as they are taught. See illustration 1. You can enlarge this house structure to poster size and add the descriptions in a room as each aspect is taught. If you utilize Six Traits in your classroom, you can include the opening and closing under organization, and use the stairwell to show "voice." Create rubrics that correspond to these aspects and which fit your students' needs and your expectations.

Workshop Activities

Activity #1 Spelling Practice and Tests

Students write words that they need to study in their spelling notebooks. These are words that students take from their own writing, recognizing that they need to learn each particular word, as well as words recognized by the teacher as being problem words for individual students. Students practice five words each week. A partner gives them a test once each week. The object is mastery of each word.

Activity #2 Vocabulary

During independent reading in their reading class or during nightly reading, students find a word each day that they have not seen before, do not know the meaning of, or do not know how to pronounce. These are written in their vocabulary notebooks along with the sentence in which it is found. During the vocabulary activity and with the aid of a dictionary, the student writes the word, its phonetic spelling (pronunciation), its part of speech, and the correct definition for the way that the word was used in the sentence (not necessarily the first one shown in the dictionary).

Activity #3 English Exercises

Here is a fun way for students to learn about grammar. The following web site provides interactive English lessons FREE: <http://www.EnglishGrammar101.com>.

Activity #4 Technology ABC Book

Exhibit some examples of ABC books. Have the students create ABC books based upon the theme of science and technology. They should provide a clear introduction and conclusion to their books. Many approaches are possible: early to more modern forms of technology, scientific breakthroughs to resulting technologies (two pages per letter), show and explain an example of technology for each letter, find as many examples of technology for each letter as possible, etc…. Materials needed: old magazines, construction paper, scissors, glue, stapler.

Activity #5 Writing Contests/Writing Submissions

Announcements about writing contests are continuously going across your principal's desk. Ask that they be routed to you or that you be allowed to see them. Make these available to your students. In addition, here are a few web sites for magazines that solicit submissions from students:

- Blue Jean <http://www.bluejeanmedia.com>
- Merlyn's Pen <http://www.merlynspen.com>
- Stone Soup <http://www.stonesoup.com>
- Writes of Passage <http://www.writes.org>

- MidLink Magazine <http://longwood.cs.ucf.edu/~MidLink/>
- HiP Magazine <http://www.hipmag.org/>
- Word Dance <http://www.worddance.com>
- Student Bylines <http://studentbylines.com>

Documentation

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Burke, James, and Robert Ornstein. *The Axemaker's Gift: A Double-Edged History of Human Culture*. New York: G.P. Putnam's Sons, 1995.

> This book is definitely a good read, as one would expect from James Burke. In this book he tells us that throughout man's history those who have power are those who understand and can use technology.

Clarke, Arthur C. *Profiles of the Future: An Inquiry into the Limits of the Possible*. New York: Holt, Rinehart and Winston, 1984.

> Here, Clarke uses his science fiction background to give us a glimpse of what science and technology have in store for us in the future. It is amazing how many of his predictions have come to pass since this book was published in 1984.

Collins, Harry, and Trevor Pinch. *The Golem*. Cambridge, UK: Cambridge University Press, 2000.

> Although it is dry reading in some places, feel free to skim where you must. It is a must read, however, for understanding the workings of science. This book contains concepts which we must get across to students so that they may understand the importance of science in their world.

Erickson, H. Lynn. *Concept-Based Curriculum and Instruction: Teaching Beyond the Facts*. Thousand Oaks, CA: Corwin Press, Inc., 1998.

> We all know about thematic units. So why don't they work better than they do? Yes, they are fun, but are they really helping the kids learn? Read this book in order to turn those cutesy thematic units into real learning opportunities for your students.

Joy, Bill. "Why the Future Doesn't Need Us." *Wired* April, 2000. <http://www.wired.com/wired/archive/8.04/joy.html>.

Coming from someone who was on the cutting edge of the computer revolution and has worked all his life in this field, his warnings about the dangers we could soon face from new and revolutionary technological innovations are thought provoking.

Lindberg, David C. *The Beginnings of Western Science*. Chicago: University of Chicago Press, 1992: 1-13.

This is an excellent reference book chronicling the history of science starting with the ancients and going through the middle ages.

Mason, Stephen F. *A History of the Sciences*. New York: Collier Books, 1962: 513-526.

This is a good reference book to have outlining the developments in science from the ancients through the mid-20th Century.

Pool, Robert. *Beyond Engineering: How Society Shapes Technology*. New York: Oxford University Press, 1997.

This book is brimming with examples of how society and circumstance have shaped technology, not only by influencing what technologies have gotten off the drawing board, but by the increasing social responsibility demanded of technology by society.

Postman, Neil. *Technopoly: The Surrender of Culture to Technology*. New York: Vintage Books, 1992.

For those of you who feel technology is moving too fast for you to keep up, this book is a must read.

Rensberger, Boyce. "The Nature of Evidence." *Science Magazine* 7 July 2000: 61.

The author is a science journalist who writes about science because he loves it. Knowing science as he does, he sees the short shift that the American public receives in the usual science coverage they receive from most newspapers and television stations.

Singleton, Laurel R. "Out of the Laboratory: Teaching About the History and Nature of Science and Technology." *The Social Studies* May/June 1997: 127-33.

This article provides six conceptual themes that

can be used across the curricula in planning instruction that integrates the history and nature of science and technology and their affects upon society. This is an excellent article.

Volti, Rudi. *Society and Technological Change*. New York: Worth Publishers, 2001.

This is another excellent book outlining the give and take between society and technology, and how technology has affected our lives.

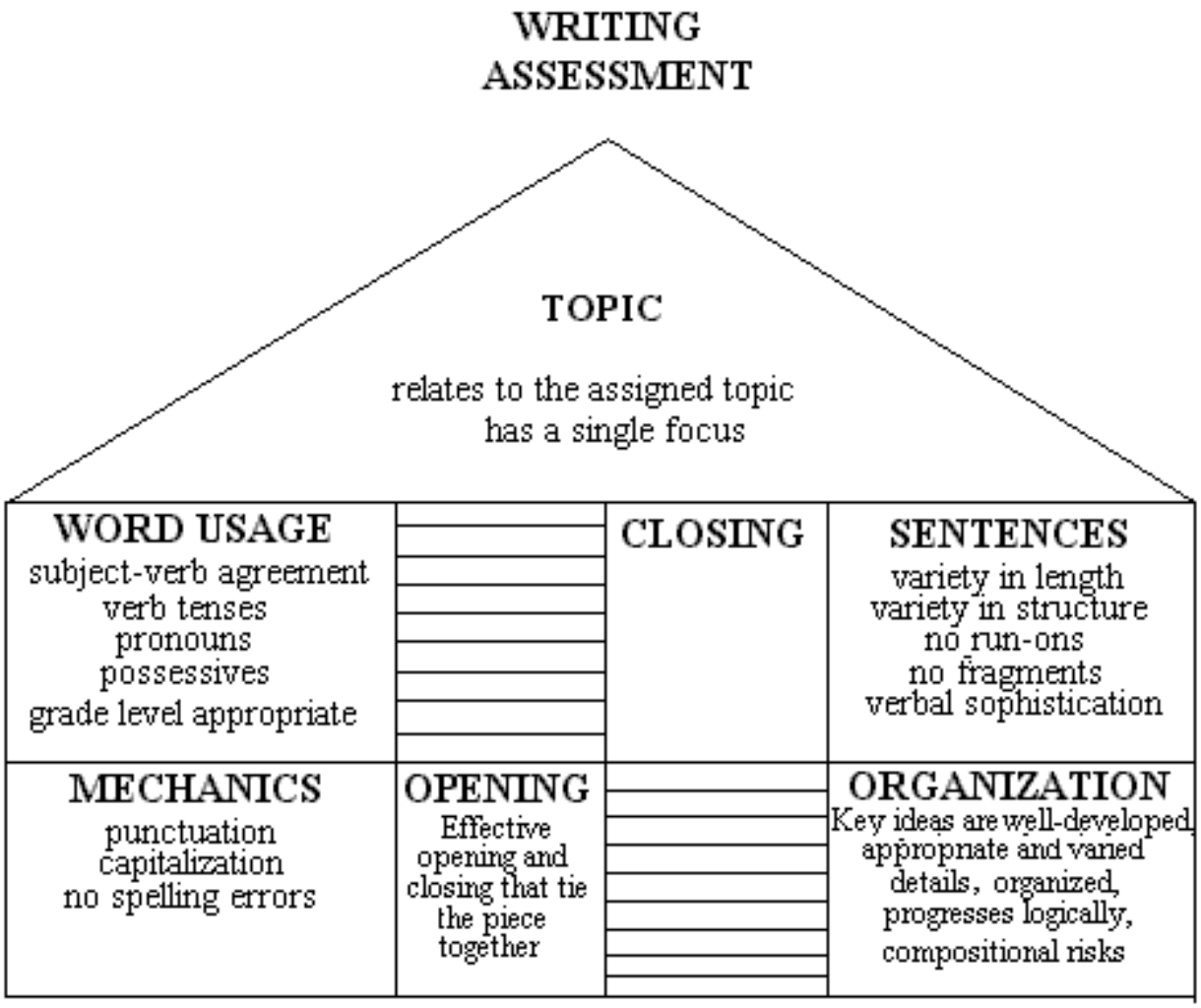

Illustration 1.