

The Cultural History of Los Alamos and Nuclear Matters: A Middle School Curriculum

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Introduction To Curriculum

This curriculum unit is on the history of the atomic bomb and its development at Los Alamos. This curriculum is centered on cultural aspects of nuclear matters in the science, math, and technology fields. The target audience for this curriculum is 7th grade math and physical science students. This can be taught as a thematic unit (Atoms/Matter and Proportions/Scales are the science and math subject areas respectively). This unit can also be adapted for use across all subject areas. Though this unit will focus on the middle school levels, high school educators can modify this unit for use with Physics, Chemistry, and American History courses. I have designed the lesson plans so that they will meet the needs of LEP (Limited English Proficient), bilingual, and special needs students. The next section will detail the academic setting of my host school.

Students need to be made aware of the significance of the atomic age because of New Mexico's and the Southwest's contributions to atomic development. We made more contributions to the World War II effort than any other state on a per capita basis (Thomas ix). In fact, I believe that the Manhattan Project being in New Mexico, served as the turning point for New Mexico to be placed "on the map." Even more interesting, this historical event comes less than 30 years after statehood. If it were not for the Manhattan Project being based in Los Alamos, New Mexico, we would not have high tech laboratories such as Los Alamos National Laboratories, Sandia Labs, and Kirtland Air Force Base. The White Sands Missile Range and the Waste Isolation Pilot Plant are two facilities that came into existence because of nuclear weapons. The paper will first cover the history of the atomic bomb in New Mexico. This will provide the reader with some background information on the people, places, and events that occurred in New Mexico. Although the target audience is science and math teachers, all teachers can follow the historical aspect. The implementation section is designed for the science/math/technology teachers. Here, students will learn about the general structure of the atom through drawings and models, learn about the history of the periodic table and its elements through charts, song, and comic books, understand what fission is through a demonstration, do role playing morals and ethic scenarios that face scientists, and finally learn about the various energy sources that are available through a city building activity.

Academic Setting

Truman Middle School, located at 9400 Benavides Rd. SW, is one of 25 middle schools that make up the Albuquerque Public Schools district. It is one of three middle schools that serve the West Mesa Cluster (John Adams and Jimmy Carter make up the other two middle schools). Truman's enrollment is over 1,000 students; however, that number is expected to drop in the 2000-2001 school year due to the opening of Jimmy Carter Middle School. Hispanics make up more than three quarters (80%) of the total student population. For all APS middle schools, Hispanics make up 48% of all ethnic backgrounds. The rest of Truman's ethnic profile is as follows: Anglo (11%), Black and Indian (4%), Asian (.5%) and other backgrounds (.4%).

Historically, Truman Middle School students generally receive free or reduced cost meals that are provided by APS Food Services.

To qualify for free meals in the 1998-1999 school year, a family of four would have to earn less than \$21,385. To qualify for the reduced cost meals, a family would have had to earn between \$21,386 and \$30,433. The mean income of the Truman community was at \$28,641. Over $\frac{3}{4}$ of the students receive these services. The district average among middle schools is generally less than half of the students.

Truman Middle School has a fairly young staff. The percentage of teachers with 0-5 years and 6-10 years of experience are both 33.3%. The APS middle school average percentages are 27.1% and 23.7% respectively. Only 7.2% of Truman's staff has 11-15 years of experience. The middle school average is double that of Truman's, at 14.7%. There is also a big disparity among teachers with more than 15 years experience at Truman and the rest of APS, 26% to 34.5% respectively. Nearly two-thirds of the staff have a Bachelor's degree. Percentages are roughly the same when comparing the number of male to female teachers at Truman.

The school's mission statement is simple and straightforward: "Truman Middle School is a community of learners dedicated to developing Quality, Character, and Competency for success in the 21st century." Truman has a very large number of support programs and activities aimed at students as well as at the staff and community. Such programs include a school-wide bilingual program, special education, Title I School Wide Literacy Program, intramural sports, and the Middle School Cluster Initiative Activities.

Historical Background Information

Between the 1940's and the 1980's, the world lived in fear of one component that can be made from nature: nuclear weapons. The thought of a nuclear war terrified the world. People imagined the worst-case scenario, a nuclear warhead detonated and the world would come to a sudden end with one big bang. This concern was global but played even a bigger role in the western part of the United States. This background information will trace nuclear history back to Enrico Fermi's discovery of nuclear fission induced by neutron bombardment. We will then follow the path into the development of the atomic bomb from Oak Ridge to Los Alamos to the final detonation at Trinity.

Fermi's Discovery

It was just before the turn of the century when the thought of a form of energy came into existence. The discovery of the X-ray in 1895 by German scientist Wilhelm Röntgen would be the beginning of this new form of energy that would later help shape nuclear science. This form of energy would be called radioactivity. To put the term in laymen's terms, radioactivity occurs when the nucleus of an atom decays thus releasing high doses of energy. (I will discuss the basic atom make-up farther on in this paper). This discovery helped lead to a series of massive studies in physics. More importantly, a long list of names helped pave the way for a whole new world in physics: J.J Thompson, Madame Eve Curie, Ernest Rutherford, Niels Bohr, Max Plank, Albert Einstein, Robert J. Van de Graaff, Ernest O. Lawrence, James Chadwick, and Enrico Fermi (Szasz 8). Probably the most famous name on this list, Albert Einstein, was not the most significant person to help lead to the development of nuclear weapons. Instead this person would be Enrico Fermi.

Enrico Fermi (1901-1954) was perhaps the most important character leading up to the development of the atomic bomb. Fermi was an Italian-born scientist with a great love for science. Once tests with radioactivity were becoming a commonplace and the results became conclusive, Fermi would be doing some of the greatest experiments and discovery in 20th Century physics.

Some of his contributions included the first set of experiments in bombardment of atoms with neutrons, studies of the fission of atoms work on, controlling the fission of atoms, and help in designing a particle accelerator. The bombardment of atoms with neutrons seemed, at the time, unlikely. What this meant was that neutron particles can be used to penetrate any kind of element. Fermi decided to attempt to do just that with uranium. The results were fascinating to him. Fermi thought he had created a new element that is simply heavier than uranium. At the time, uranium was thought to be the heaviest element. Now, here was Fermi who thought he just discovered something heavier. This meant that elements that are not natural to earth could be created but with a much heavier weight. But it turned out that, although Fermi's experiment was a landmark, his theory was proved incorrect. Several years later, Lise Meitner and Otto Frisch discovered that what Fermi actually was doing was that the uranium atoms were actually *splitting* apart, not forming heavier atoms. This became intriguing to the other scientists and the talk about a possible bomb grew closer. Although Fermi's theory was proved incorrect, he still went on to win the Nobel Prize in Physics in 1938 for all his work in atomic science. Fermi, however, did not try to bask in his achievements. He just kept on going with more research. This research would lead to the beginning of the Manhattan Project.

The Manhattan Project – The Early Stages

Once word got out about nuclear bombardment, scientists from all over the world could not help but think of the possibilities of developing a nuclear weapon that would be capable of producing a huge amount of energy. The only thing preventing this from being a reality was the problem of how can one have a nuclear fission reaction, that is the splitting of the nucleus of uranium several times, and actually *control* the release of energy in a chain reaction. This kind of thinking led Albert Einstein, perhaps the world's best-known theoretical physicist, to produce a letter to President Franklin D. Roosevelt in the fall of 1939. In this letter, Einstein warned Roosevelt that enacting these controlled uranium chain reactions, "it is conceivable...that extremely powerful bombs of this type may thus be constructed." Einstein suggested that before the Germans get their hands on this device, the United States Government should do two things. First, set up a task force that would report back to the government on the universities' current research with uranium reactions. He recommended that the government help pay for further research and offer any assistance that may be needed. Secondly, Einstein suggested that the United States look into how to obtain large quantities of uranium ore for security purposes. Einstein pointed out to the president that the United States is not a rich source for uranium ore. Instead, one must travel to Canada, Czechoslovakia, or the Belgian Congo to find an adequate supply of uranium (Williams and Cantelon 13). A couple of weeks later, President Roosevelt authorized governmental studies into the uranium matter.

Over the next three years, committees formed under the government were busy looking into the possibilities of an atomic bomb. The Advisory Committee on Uranium would be the first group to meet and make its recommendations to the President. After much debate and discussion, Roosevelt gave the green light for the production of the atomic bomb in early of 1942. Now the scientists would be working on what would make the bomb a reality. They must be able to make a controlled nuclear chain reaction. Work on this massive project would be done at the University of Chicago's football field, Stagg Field. On December 2, 1942, under the direction of Fermi, scientists achieved the first controlled nuclear chain reaction. This prompted a celebration among the tired physicists, but not all were thrilled. Historian Richard Rhodes, in his book *The Making of the Atomic Bomb*, had one quote that captured this mood. Leo Szilard, another key player in the bomb production, was with Fermi after the chain reaction, remarked, "...I thought this day would go down as a black day in the history of mankind" (442). Thus began the beginning of the atomic bomb project.

The Manhattan Project – Placement and Early Development

Long before President Roosevelt heard about the historic event in Chicago, he appointed General Leslie R. Groves (1896-1970) as head of the Manhattan Engineer District. Groves was assigned to this position because of his ability to get things done. He was the man who oversaw the building of the Pentagon Building in Washington DC in 1943. He knew how to set his priorities. Groves was a tall but stocky man. Add that to his personality, and you get what one person recalls as the "biggest sonovabitch I've ever met in my life" (Rhodes 426). Groves would never settle for less than the best. And so, with that attitude, General Groves went after the best locations and the best men he knew of that would get the United States the atomic bomb.

Groves wasted no time with his first order of business. On September 19, 1942, just two days after being selected as the head of the entire Manhattan Project, Groves selected Oak Ridge, Tennessee, as the site where uranium would be produced in larger quantities. On the periodic table of elements, uranium has an atomic number of 92 with an atomic weight of 238. This would be considered a natural element. There were two problems with uranium being used for the bomb. First, uranium is a rare element. As Einstein stated in his letter to the president, uranium could only be found in remote areas of the world. Naturally, scientists just could not walk into another country and attempt to extract uranium from the earth. The second problem was that once scientists obtained enough uranium, the uranium had to be fissionable. U-238 (natural) is not fissionable but U-235 is. The problem goes deeper. U-235 can be extracted from less than 1% of the natural uranium. The engineers realized this problem. To compensate for this, they would use the bombardment process to separate U-235 from U-238. It would be at Oak Ridge where this process and production would take place.

The next order of business for General Groves was to locate a site that would house the building and design of the bomb. Groves' first priority in selecting this site was security. Being practically married to the army, Groves wanted the site to be isolated from the rest of the world. The exception was that the site had to have some access to outside sources such as electricity, running water, mild climate, and limited access transportation routes in and out of the site. Groves enlisted a fellow army man, Major John Dudley to do a national search for the site that would be the birthplace of the bomb. Dudley searched through several states that included California, Utah, Nevada, Arizona, Colorado, and New Mexico. Dudley recommended to Groves two possible sites: Oak City, Utah, and Jemez Springs, New Mexico. The first site, Oak City, was dismissed because of the huge number of families that would have to be displaced. The Engineers Corps actually approved the second site, Jemez Springs, and the proposal was sent to Groves' desk. The site was later rejected because one young man told Groves that the site did not have enough scenery. This young man was Groves' first and only choice to be the director at this new site, J. Robert Oppenheimer.

J. Robert Oppenheimer (1904-1967) was a theoretical physicist and professor at the University of California at Berkeley. Oppenheimer has a quiet personality. He loved science and always kept himself busy with writings and experiments. He had a great mind but never could match up with the other physicists who would end up receiving the Nobel Prize. Oppenheimer also loved the outdoors. As a child, he loved his family outings that took him out West and to see the backcountry. He once commented that his "two greatest loves are physics and desert country, [and] it's a pity they can't be combined" (Rhodes 451). With the help of Groves, Oppenheimer would soon make this dream a reality.

Oppenheimer was approached by General Groves in the fall of 1942 about being the director of a yet-to-be-named laboratory. Oppenheimer accompanied Groves to the Jemez Spring site and found that it would be inadequate for the lab. Oppenheimer felt that the scientists need more scenery than just a barren desert with hills. However, Oppenheimer knew of another place not too far from

where they were. Just on the other side of the mountains, was a little town called Los Alamos. In the heart of this little town was a small boys school, Los Alamos Ranch School, which had running water, electricity, limited access roads, deep canyons for security, and to Oppenheimer's delight, scenery. On November 25, 1942, Groves selected Los Alamos to be the hidden city that would house the bomb.

General Groves and Robert Oppenheimer worked well together. Groves would handle all the military aspects of the project. Security and getting supplies would be his number one priority. Oppenheimer would oversee the academic and scientific missions of the project. He would help coordinate the scientists' ideas into one. He would travel to other universities and be kept informed of any progress that was made by other scientists not directly involved with the Manhattan Project. Groves and Oppenheimer both had their share of disagreements but nevertheless they got the job done. Ferenc Szasz in his book, The Day the Sun Rose Twice, believed that the project would not have gone well as it did without the leadership of General Groves (Szasz 14). This is probably true, but Groves could not have completed this project without the help of Oppenheimer. Groves did not get along with the other scientists at Los Alamos. He was always very brash and critical of the other scientists. It was Oppenheimer who had to make Groves realize the importance of these highly prized and intelligent scientists.

The End of the Line – Trinity

After a couple of years of predicting, thinking, discussing, and building the bomb was ready to be tested. Jumbo, as the gadget was known, was ready for a test. The scientists really did not know what to expect. Out in the middle of nowhere in the desert of New Mexico, a dropping tower was built. This site would be known as Trinity site. The gadget was hoisted carefully to the top of the tower, a 100 foot steel tower. Now the countdown was ready to begin. July 16, 1945...what would ever become of this day? At 5:29:45am that day, the bomb was released. The world's first nuclear detonation occurred with a brilliant bright light, which caused the whole land for miles to have just seconds less of darkness. The scientists were in awe of what they had witnessed. Once their initial shock was over, they just simply all celebrated. Except for one man, Oppenheimer. Instead, he breathed a sigh of relief but uttered some terrifying words, "I have become Death, shatterer of worlds." The atomic age had begun.

Implementation of the Unit:

This unit can be taught in conjunction with students' social studies class during their study of New Mexico History. This curriculum can be taught over a two-week time period. The following is a list of lesson plans that can be used with this unit. At the end of this paper, I have included selected New Mexico science standards and benchmarks that are used throughout this unit.(For a complete listing of all New Mexico Standards and Benchmarks, go to <http://www.cesdp.nmhu.edu/standards/index.htm>) The order of the lessons will be left up to the discretion of the teacher.

Lesson #1:

"Introduction of the Atom" - Students will receive general instruction as to what an atom is. An atom is the basic building block of matter. Students need to understand what protons (positive charged particles in the nucleus of an atom), neutrons (charged particles in the nucleus of an atom), and electrons (negative charged particles in the nucleus of an atom) are and where they are located within an atom. Besides the standard way of modeling atoms by drawing, students can have more of a hands-on approach to show this concept. To do this, students can use Styrofoam balls and cut-outs of a 3-D atom. Students will paint each part a different color and place

labels identifying each part of the atom. Display the students' models by hanging them from the ceiling all over the classroom. For a LEP modification, students can label the various parts of the atom in their native language.

Lesson #2:

"An Introduction to the Periodic Table" – Obtain a blank periodic table (they can usually be found in the teacher edition of science text books, or I found one on the Web at <http://www.rose.cc.ok.us/faculty/aslagle/>) and make enough copies to distribute to each student. Have the students fill out all the basic information on their charts. Basic information can include the element name, chemical symbol, atomic number, and atomic weight. Make sure that they use a black pen when filling out this chart. This will help distinguish the writing much easier. Once students finish the requested information, take time to explain how these charts were developed. Explain to the students about how the chart is divided up into the various families and periods. There are 18 families on the periodic table. These are the vertical columns on the chart. The 7 horizontal rows are called the periods of the table. Once students are exposed to this information, have them color code all the 18 different families on the table. For example, have students color zinc, cadmium, and mercury the same color because they form group 12 of the periodic table.

Lesson #3:

"Computer Lab Days" – If you have access to a computer lab, spend at least a couple of days looking at web sites devoted to the periodic table. There are so many sites out there where students can find out information about any element on the periodic table. For best results, have students pair up at a computer. It will make the researching easier and students will have more fun working with a classmate. For upper level students, you can have them write a research paper on any element on the table. Have them research when the element was first discovered and where can it be found. Here are a couple of sites that are periodic table games. They both test one's knowledge of placement of the elements on the chart:

<http://chemistry2.csudh.edu/ptablegames/ptablegames.html>

<http://www.ilpi.com/genchem/periodicquiz.html>

Lesson #4:

"Periodic Table and Comic Books" – This is a wonderful activity that many students will enjoy. Comic Books have been around for quite some time but it was in the late 1940's and 1950's that an increasingly large number of new superheroes were developed. This was due to the American's fascination with atoms and nuclear matter. Superheroes with atomic powers or many references within a comic book about nuclear weapons came into existence. Well, a couple of professors from the Chemistry Department at the University of Kentucky, put together a massive web site that is devoted to the elements on the periodic table chart and how they worked their way into comic books. Again, if you have access to computers it would be a wonderful chance for kids to take a look at some of the old comic books and the references inside of them to the elements. The address to the site is

<http://www.uky.edu/Projects/Chemcomics/>.

Give kids a day to look at this site. A follow up activity that would give students a hands on approach would be to have them look through comic books that they own and try to list all the references to any element of the periodic table. If students do not own any comic books, often times a comic book store owner will be more than happy to provide you with some of their discontinued stock.

Ask around, it won't hurt. An alternative to comic books would be just any regular novel or storybook. Have students find at least 10 references to the elements and list them.

Lesson #5:

"The Element Song and Worksheet" – In 1960, musician and funny man, Tom Lehrer, wrote a song that includes all the elements that were discovered up to 1960. I found the lyrics and a downloadable sound file of the song online at this address:

<http://chemlab.pc.maricopa.edu/periodic/lyrics.html>

Last year I played the song a couple of times, and I made a copy of the words and put them on a transparency so that the students could follow along. After they have heard enough of the song, hand out the handout titled "How Well Do You Know Your Elements?" This is included at the end of the paper. (My only wish is that I knew who wrote this up so I can give proper credit where it's due.) Have students try to be the first to guess as many of the chemical symbol names as possible before allowing them to use their periodic table chart. After they finish, have them get into groups of two or three people and let them make up a song, rap, or story about the elements of the periodic table. They must make reference to at least five elements within their song or story. Let them present it to the class.

Lesson #6:

"Fission Dominoes" – As mentioned earlier in the historical background, fission is basically splitting a nucleus into two small nuclei. Setting up a chain reaction can illustrate this. Divide the class into two halves. Get a bin full of dominoes and let the students work together to form two major and massive displays by standing them up. When they are finished, begin watching the chain reaction of the dominoes falling down. Warn students that they are to carefully observe what they see because a couple of paragraphs will be written shortly thereafter on what they saw.

Lesson #7:

"Role Playing Moral and Ethnic Scenarios" – Children today have much to think about and deal with. Drugs, gangs, sex, and violence unfortunately play a large part in our society. If we can educate our children on how to deal with such tough issue, they just might be able to make tough decisions without having their consciences drive them insane. The scientists who had to work with nuclear and biological weapons had to face tough decisions as well. One activity comes from a publication by Harry Furman called "The Holocaust and Genocide: A Search for Conscience." The State of New Jersey Department of Education and the Ant-Defamation League of B'nai B'rith put this out. In this work is a series of questionnaires and ethics scenarios that the scientists under Hitler had to face when they were asked to help produce a biological weapon they knew was deadly and would be used. Students are to work with these scenarios in groups and have a big group discussion as to decisions that they made.

New Mexico Science Standards and Benchmarks

For ATI Unit

Content Standard 2: Unifying concepts and processes
Students will use evidence, models, and explanations to explore the physical world

C. Design and develop models

1. Develop an understanding that models take many forms and have explanatory power.
2. Choose a concept or process and identify a useful model.
3. Use models to explain the concepts or processes at work and the objectives of the experiments.

Content Standard 4: Unifying concepts and processes
Students will understand the physical world through the concepts of change, equilibrium, and measurement

D. Employ mathematics to quantify properties of objects and phenomena.

1. Understand why mathematics is essential to representing, understanding, and predicting the behavior of the natural world (e.g., discuss the difficulty of describing temperature and weight without measurement and mathematical representation).
2. Use measurements in explaining an experiment or process in which the measurements were involved.

E. Relate the contributions of external and internal forces to change in the form and function of objects, organisms, and natural systems.

1. Explore environmental changes that could have a local or global impact. SBE ADDITION 4-97:
2. Describe the general idea of evolution as: a series of more or less gradual changes that account for the present form and function of objects, organisms, and natural and artificial systems, and the present arising from materials and forms of the past.

Content Standard 5:	Science as inquiry Students will acquire the abilities to do scientific inquiry
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<p>B. Employ equipment, tools, a variety of techniques and information sources to gather, analyze, and interpret data.</p> <ol style="list-style-type: none"> 1. Use appropriate math to analyze data such as the mean and median of sets of data, calculate percent and ratios, and determine the units in which values should be expressed. 2. Read analog and digital meters that measure length, volume, mass, time, and temperature; use microscopes, cameras, and tape recorders for capturing information. 3. Use computers to locate, select, identify, collect, store, manipulate, and receive information. 4. Use basic and advanced tools to observe and measure natural and artificial objects and events. 5. Locate, read, listen to, and view forms of information to interpret and evaluate; organize information in text, tables, and graphs; and use methods, forms, and technologies to describe the meaning and implications of information. 	<p>B. Evaluate, design, and use the most appropriate equipment, tools, techniques, and information sources to improve scientific investigations and solutions to problems.</p> <ol style="list-style-type: none"> 1. In a scientific experiment, use computer spreadsheets and graphs in the analysis and presentation of data. Include possible effects of measurement errors in the analysis. 2. Identify and apply appropriate measurement techniques, discuss alternative measurement techniques, and consider possible effects of measurement errors in the evaluation of the techniques.
<p>SBE ADDITION 10-99:</p> <p>C. Understand that scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge). Good explanations are based on evidence from investigations.</p>	<p>SBE ADDITION 10-99:</p> <p>C. 5-8 Explain that scientific theories emphasize evidence, have logically consistent arguments, and use scientific principles, models, and theories. Well-accepted scientific theories are formulations of apparent relationships or underlying principles of certain observed phenomena that have been verified to a very high degree.</p>

Content Standard 6: Science as inquiry
Students will understand the process of scientific inquiry

A. Use different kinds of methods, including observation, experiments, and theoretical and mathematical models to answer a variety of scientific questions.

1. Use various mathematical and investigative procedures to determine patterns and relationships, and make predictions.

B. Use their own understanding of science to guide their scientific investigations.

1. Design an investigation or experiment to answer questions about local community issues that involve science.

F. Describe the results of investigations with teachers, peers, parents, and others.

1. Explain findings of investigations to the class in several ways (individual and group presentation, logbook, etc.).

2. Understand that scientists examine other scientists' work, that scientific findings need to be communicated and confirmed, and that some scientists may develop new or different explanations for the same set of observations

Content Standard 7: Physical Science
Students will know and understand the properties of matter.

A. Identify the characteristic properties of elements and compounds such as density, boiling point, and solubility.

1. Make a model of an atom and explain how the components are related.

2. Explain that each element is composed of a single type of atom.

C. Discriminate between elements based on the characteristic ways in which they react with other elements to form compounds that are different substances with unique characteristic properties.

1. Demonstrate, by using models, an understanding of an atom and its interactions with other atoms.

2. Use laboratory investigations to relate characteristics of elements to their position on the Periodic Table.

Content Standard 14: Technology and the History of Science
Students will know and understand the differences between the interactions of Science and Technology

B. Demonstrate trade-offs in safety, cost, efficiency, and appearance related to technological solutions provided through science.

1. Analyze and evaluate economic, political, social, ethical, and aesthetic constraints affecting progress with specific scientific technological endeavors.

C. Compare and contrast a variety of scientific and technological solutions to problems.

1. Identify and analyze ways the advances in science and technology have affected each other and society.

Content Standard 16: Science in personal, social, and environmental perspectives
Students will know and understand the relationship between natural hazards and environmental risks for organisms.

A. Analyze environmental risks for personal and social costs.

1. Explore the personal risks and costs to society in dealing with environmental hazards (e.g., biological hazards such as groundwater contamination; natural hazards such as floods and tornadoes; chemical hazards in the air, soil, and water; and personal choices such as alcohol, tobacco, and drugs).

B. Determine options for reducing and eliminating environmental risks and for coping with natural catastrophic events.

1. Investigate innovative technology to reduce risks due to environmental problems and coping with natural disasters.

Bibliography

* Some of these resources will not necessarily be used within the contents of the curriculum but rather will serve as additional

resources for the reader.

Books: For Teachers

Badash, Lawrence (1995). Scientists and the Development of Nuclear Weapons: From Fission to the Limited Test Ban Treaty 1939-1963. New York: Humanity Books.

Bartimus, Tad and Scott McCartney (1991). Trinity's Children: Living Along America's Nuclear Highway. Albuquerque: University of New Mexico Press.

Boyer, Paul (1998). Fallout: A Historian Reflects on America's Half-Century Encounter with Nuclear Weapons. Columbus, Ohio: Ohio State University Press.

Feynman, Richard P. (1985). "Surely You're Joking, Mr. Feynman!" New York: W.W. Norton and Company.

Hales, Peter Bacon (1997). Atomic Spaces: Living on the Manhattan Project. Urbana and Chicago: University Of Illinois Press.

Rhodes, Richard (1986). The Making of the Atomic Bomb. New York: Simon and Schuster.

Swartley, Ron (1995). New Mexico's Atomic Tour. Las Cruces: Frontier Image Press.

Szasz, Ferenc Morton (1992). British Scientists and the Manhattan Project. New York: St. Martin's Press.

(1984). The Day the Sun Rose Twice. Albuquerque: University of New Mexico Press.

Thomas, G. Billington, and M., Walker (eds.) (1994). Victory In World War II:

The New Mexico Story. Rio Grande Historical Collections: New Mexico State University Library.

Books: For Students

Beyer, Don E. (1991). The Manhattan Project: America Makes The First Atomic Bomb. New York: Franklin Watts: A 20th Century American History Book.

Crutchfield, James A. (1995). It Happened In New Mexico. Helena, Montana: Falcon Publishing Company.

Stein, R. Conrad (1993). The Manhattan Project. Chicago: Children's Press.

Yep, Laurence (1995). Hiroshima. New York: Scholastic Press.

Web Sites

"Atomic Archive." April 7, 2000. AJ Software and Multimedia. June 2000. <www.atomicarchive.com>.

Selegue, John P. and F. James Holler. "The Periodic Table of Comic Books." 1996-2000. Department of Chemistry, University of

Kentucky. June 2000. <<http://www.uky.edu/Projects/Chemcomics/>>.

Sublette, Carey. "The High Energy Weapons Archives: A Guide to Nuclear Weapons." 1999. The Federation of American Scientists. June 2000. <www.fas.org/nuke/hew/index.html>.

Toreki, Rob. "The Periodic Table Challenge, Version 2.0.2." 1995-2000. Interactive Learning Paradigms Incorporated. June 2000. <<http://www.ilpi.com/genchem/periodicquiz.html>>.

Unknown Author. "Periodic Table Games." <<http://chemistry2.csudh.edu/ptablegames/ptablegames.html>>.



HOW WELL DO YOU KNOW YOUR ELEMENTS?

THE TALE OF THE (Au)_____DUST KID

The Kid mounted his trusty steed, Old (B) _____. His shooting (Fe)_____ strapped to his side, he headed out for the bright (Ne) _____lights of Santa Fe, aiming to rob the stage. There was sure to be a load of precious (U) _____ aboard and probably (K) _____ too. Inhaling a deep breath of (O) _____,he coughed on the (S)_____ from the near by mills. Since the (Hg) _____ was climbing, he quenched his thirst with some

H₂O, tasting the (Cl) _____ all big cities like Albuquerque had. His bones aches as he headed north from (Ca) _____ deposits built up over the years of riding the (Zn) _____ trail. Overhead a (He) _____ filled balloon floated in the breeze; the sun beat down like burning (P) _____. Soon he spotted the stage, guarded only by a sheriff with a (Sn) _____ badge. "Halt", he yelled, "or I'll fill you full of (Pb) _____!" The sheriff drew his gun, but alas, was too slow. The Kid's gun, blazing like flaming (Mg) _____ did the (Cu) _____ in. Anyone who drew on the Kid should know his life isn't worth a plugged (Ni) _____. A (Pt) _____ blonde riding inside the (Al) _____ framed coach ran for her life when the Kid pulled out some (N) _____ compounds, preparing to blow the safe to atoms. Suddenly, a shot rang out, "Hi Ho (Ag) _____!" And a masked man on a white horse raced across the (Si) _____ sands of the blueberry fields like (Na) _____ skittering on water. A (H) _____ bomb would not have stopped the lawman; the Kid had met his doom. The rest of his life was to be spent behind (Co) _____ steel bars. A warning to all: Your first trip to ICU may be the first step in a (C) _____ copy life of the saga of the (Au) _____ Dust Kid.