URANIUM MINING
And Its Impact On
LAGUNA PUEBLO

A Study Guide
for an Interdisciplinary Unit

Philip Sittnick

for Laguna Middle School

July, 1998

ACKNOWLEDGMENTS

I wish to acknowledge the help and support of several people and organizations who have contributed to both the creation of this study guide, and also to the development of an interdisciplinary curriculum for Laguna Middle School about the Jackpile/Paguate Mine. My grateful thanks go to: my wife and colleague, Mrs. Lauren Sittnick, for her help in designing and implementing the curriculum, and for taking up the challenge of teaching this subject; Mr. Nicholas Cheromiah, for his continuing support of interdisciplinary teaching, and especially culturally relevant projects such as this one; Mr. Floyd Solomon, for his invaluable contributions in the area of Laguna history; Mr. Marvin Sarracino, Jackpile Reclamation Technician, for his generous gift of time and knowledge to our study; the Bread Loaf School of English, and especially Professors John Warnock and Dixie Goswami, for their encouragement and critical feedback; the Childhood Cancer Research Institute, and the Nuclear Risk Management for Native Communities Project, for their financial support and technical assistance; Mr. Paul Robinson, of the Southwest Research and Information Center, for sharing his wealth of knowledge and resources about the impacts of uranium mining on our communities; Dr. Manny Pino, for sharing his expertise both about mining-related issues, and curriculum development; and, Ms. Dorothy Purley, former Jackpile miner and cancer survivor, whose courage to tell her story is an inspiration. Lastly, special thanks go to Mr. Alvino Waconda, whose tireless crusade for environmental sanity and justice for uranium miners, and the people of Paguate and Laguna Pueblo, is an example for us all.

We all share the hope that through education, we can teach the children to make wise decisions, and so ensure the safety of the people and the land for generations to come.

TABLE OF CONTENTS

INTRODUCTION

Why study the Jackpile/Paguate Mine?

For thirty years, from 1952 until 1982, Laguna Pueblo was home to the world's largest open pit uranium mine, the Jackpile/Paguate mine. How did this come about? What effects did the mine have on the people and land of the tribe during its operation? Why did the mine close down? How will it continue to impact the tribe? These are questions we will examine and try to answer in our unit about the mine. They are important and difficult questions; in order to understand them, we will have to make our study ***interdisciplinary***. That means that we will study the mine in several subjects, namely Science, History, Mathematics, and Language Arts. Each of these subjects will contribute to your understanding about the mine and its impact on Laguna Pueblo.

Few activities or events have had as much influence on Laguna Pueblo as uranium mining, especially in modern times. The mine created tremendous changes in the environment, culture, and society of the pueblo, and impacted the lives of virtually everyone in the tribe. These changes will continue to have their effects for generations, even though the mine itself has been closed for many years.

If you want to know about your history, and you're concerned about living in a healthy environment, it is important to learn about the mine. Today's young generation of Lagunas will soon have to make decisions related to the tribe's land and how it is used. If you know the history of the mine, and understand how it impacts your life, you'll be more able to make good decisions that will insure your health and safety.

A Complicated Issue

Whether or not the mine was a good or bad thing for Laguna is a subject that is open for debate. Some people think the changes it brought were positive; others disagree. Most people think that the mine created both good and bad changes. The mine is a ***controversial*** subject at Laguna. In other words, there is disagreement among the people about whether or not it had a positive or negative effect. A case can be made for both sides of the argument. The mine clearly benefited the tribe in some ways, but it had its negative effects, too. Hopefully, after studying about the mine and uranium, you will be able to make up your own mind about the issue.

To understand why the mine had such a big impact on Laguna, and why it continues to affect the environment and people here, requires an understanding of several different subjects. If you don't know anything about uranium itself, what it's used for, and what its properties are, then you really can't make an informed opinion about the mine. And in order to understand about uranium, you'll have to learn something about atomic physics, too, which is a very complicated science. So, in your study about the mine, be prepared to explore a range of topics, so you can comprehend all sides of the issue.

NUCLEAR SCIENCE AND URANIUM

Atoms and Elements

To understand what uranium is, and why it's so valuable to some people, let's begin by briefly studying two branches of science: chemistry and physics. In order to understand what makes uranium different and special, you have to begin by learning about ***atoms*** and ***elements***.

To a scientist, everything in the universe is made up of atoms. An atom is a unit of matter so tiny that you can't see it, not even with a powerful microscope. Even a grain of dust is made up of so many atoms that you would never be able to count them all--even if you could see them. Atoms are so tiny, that it would take some 300,000 atoms lined up side-by-side to equal the thickness of one strand of human hair!

An object like this study guide is made up of far more atoms than a grain of dust. These atoms are held together by powerful forces, which is why this book doesn't just crumble into a pile of atoms when you pick it up. Still, you could rip its pages into little pieces. If you did, you would be tearing the atoms apart from one another. However, you would not be dividing the individual atoms themselves.

Under ordinary circumstances, there is no way to break apart an atom. In fact, the word "atom" comes from an ancient Greek word that means "indivisible," or "can't be broken apart." Atoms were given this name because they are the smallest units of matter which can be identified as different elements. Elements are what we call the different kinds of atoms that make up everything in the universe. Uranium is an element, and so are other metals you know, like gold, silver, copper, and lead. Still more elements are substances like hydrogen, helium, oxygen, chlorine, and neon. Each of these is a different element because its atoms are unique--meaning that they have individual properties and are different from the atoms of any other element. Scientists have identified 103 different elements. Most of these are found in nature combined with other elements, but a few of them have been artificially created by scientists.

Even though under most circumstances atoms can't be broken up, they are made up of even smaller particles! These particles are called electrons, protons, and neutrons. All atoms contain these particles. The different number of electrons, protons, and neutrons in each atom determines what element it is. The periodic table of the elements shows all them arranged according to their atomic number, which corresponds to the number of protons in the atom. The proton and neutron particles form what is called the nucleus of the atom. The electrons orbit around the nucleus, kind of like the moon orbits around the earth. Powerful forces hold the electrons, protons, and neutrons together in an atom.

Atoms of different elements combine to form what are called ***molecules***. Rarely are elements found in nature in their pure form. Usually they combine at a molecular level. Molecules can contain just two elements, like water: "H_20." Water is made up of the elements of hydrogen ("H") and oxygen ("O"). The number "2" after the "H" means that each molecule of water has two hydrogen atoms for every one oxygen atom. Molecules can be simply constructed of two elements, or they can be very complex, and contain many different atoms of several elements.

Uranium: the Heaviest Element In Nature

So, what makes uranium different from the other elements, and why would people want to mine it?

Uranium is a silvery-white, ***radioactive*** metal. A chunk of pure uranium looks about the same as a piece of silver or steel. But, it is never found in nature in its pure form. It is always found combined with other elements into different chemical compounds. These compounds are highly poisonous, which is one of the properties of uranium. Geologists and miners call these different chemical compounds ***ores***. Uranium can be found in over 100 different ores. Many rocks contain very small amounts of uranium. These rocks are fairly common, and can be found all over the world. However, deposits of minerals that include large amounts of uranium--large enough to make mining them worthwhile--are rare.

The area where the states of Arizona, Colorado, New Mexico, and Utah come together, called the “Four Corners” area, has some of the richest deposits of uranium ores in the world. Over the years, especially from the 1950s to the 1980s, many uranium mining operations took place in this area. Within this territory there is a region called the Grants Mineral Belt, which stretches from east of Gallup all the way to Laguna. This area has especially rich uranium deposits. The Laguna reservation contains some of the most abundant sources of uranium ore in this region. Other areas of the world where significant deposits of uranium ores are found include the states of Wyoming and South Dakota here in the U.S.; Saskatchewan, Canada; Australia; and Africa. One interesting fact about uranium ore deposits is that for some reason they are often found on the lands of native people, not just in this country, but all over the world.

Uranium is the heaviest element that is found in nature. In fact, uranium weighs almost 19 times as much as an equal volume of water. In other words, if you filled two identical glasses with the same amount, one with uranium and the other with water, the one with the uranium would be 19 times heavier!

The most unusual characteristic of uranium is that some of its atoms are ***fissionable***. This means that they can be made to explode and break in two, releasing atomic particles and giving off huge amounts of energy in the process. The energy released by this process, called ***nuclear fission***, is the energy that makes nuclear weapons so powerful, and that enables nuclear power plants to produce electricity. A single pound of uranium can produce about as much energy as 3 million pounds of coal!

What is Uranium Used For?

The most important use of uranium is for nuclear energy. Small amounts of uranium are used for medical, industrial, and research purposes. However, the two main uses for uranium are: to make material for nuclear weapons; and, to make fuel for nuclear power plants. Nuclear bombs are the most destructive weapons human beings have created. Nuclear power plants make electricity, which we all use for everything from lights to televisions, to appliances, to computers.

How Do We Get Nuclear Energy From Uranium?

The particles that make up atoms (electrons, protons, and neutrons) are held together by powerful forces. Under most conditions, they don’t come apart. Still, it is possible to split an atom, though scientists did not know how to do it until a little more than fifty years ago. The easiest atoms to split apart are the ‘big’ ones--the ones with the most electrons, protons, and neutrons. Uranium is the heaviest naturally-occurring element; that means its atoms have more of those particles than any other element. So, uranium atoms are the easiest (naturally occurring) atoms to split apart.[1]

---

[1]Using uranium, scientists have been able to make new elements in the laboratory, that do not exist naturally in the universe (as far as we know). Some of these man-made elements are heavier than uranium, and even easier to split apart. Among these elements is ***plutonium***, which is used to make nuclear weapons, and also fuel for nuclear reactors. Plutonium is one of the most poisonous, or toxic, substances known.

When a big atom splits apart, some of the particles that make it up come shooting out of it, like invisible, high-speed bullets. These particles can then shoot into other atoms next to them and knock them apart, too. So, when one atom breaks apart, other atoms around it tend to come apart as well. To use the scientific term, the atoms undergo ***fission***; that is, they break apart into smaller atoms.

If you take a lot of large, unstable atoms and put them together, like uranium atoms, they'll start knocking each other apart. This creates what is called a ***chain reaction***. In fact, if you put enough uranium atoms atoms together quickly enough, they'll actually create an explosion! This is the secret behind the atomic bomb. If you put the atoms together more slowly, in a more controlled way, they'll produce a lot of heat. The heat produced by creating a controlled nuclear chain reaction (in a ***nuclear reactor***) can drive a steam engine and run and electric generator. This is how a nuclear power plant works.

Why doesn't uranium found in nature create a chain reaction? Because it is not concentrated enough to get the atoms to knock each other apart. Nuclear chain reactions can only be created by humans by concentrating enough uranium (or other fissionable elements) together so that the atoms continue to knock each other apart as they split up. Concentrating the uranium found in uranium ores is the biggest challenge in building an atomic bomb, or creating a nuclear chain reaction.

Obviously, uncontrolled nuclear reactions, like those produced by nuclear weapons are extremely dangerous. But what about controlled nuclear reactions, like those made in a nuclear power plant? Are they dangerous, too? Why? The answer is that they can be very dangerous, because when an atom undergoes fission, it gives off more than just heat.

What Is Radioactivity?

Some elements are said to be unstable. This means that the particles that make them up have a tendency to come apart. Uranium is one such unstable element. When an atom of an unstable element comes apart, it causes some of its energy to be shot out, much like bullets from a gun. This energy that shoots out from unstable atoms is referred to as ***radioactivity***, or, ***radiation***. The atoms of most elements are stable and don't give off radiation, but the ones that do will keep releasing their energy until they finally become stable. This process is called ***radioactive decay***. As an atom undergoes radioactive decay, it can change into a new element, because the energy it loses as it breaks apart comes out in the form of one of its particles. (Remember: the number of particles an atom has determines what element it is.) This energy that comes out takes one of three forms: ***alpha particles***, ***beta particles***, and ***gamma rays***. What would happen if you were standing in the way of one of these tiny radioactive 'bullets' when it shoots out of an atom? You wouldn't even notice it. They are much too small for you to see or feel. But, that doesn't mean that it wouldn't cause damage to your body.

Radioactivity can damage the body's cells, especially dividing (new) cells. Chances are that if one of these particles shoots into or through your body, it won't cause serious damage. And, even if it does, the cells in your body have ways of repairing themselves if they get damaged. But, if enough of these particles hit you all at once, they can overwhelm our cells' repair mechanisms. When this happens, the cells can die immediately, or, over time, they may start growing in unusual ways. When cells divide and grow without regard to the other cells around them, they can cause a disease called cancer. If you get exposed to too much radiation, one of the things that can happen to you is that you can get cancer.

The three types of radioactivity have different effects on the body. ***Alpha*** particles are the largest type. A piece of paper is enough to stop them, and so is your skin. However, they can be harmful if you swallow them or inhale them. ***Radon*** gas is a common source of alpha radiation. ***Beta*** particles are smaller and more penetrating than alphas. A thin sheet of aluminum can stop a beta particle, but people can be harmed by inhaling them, too. Beta radiation can also contaminate water and food, and get into your body that way. Beta radiation can cause immediate damage inside your body, or effects that show up years later as cancer. ***Gamma*** rays have so much energy, and are so penetrating, that only a thick shield of lead, or concrete walls several feet thick can stop them. These rays can vitally damage bone marrow, where blood cells are produced, and the digestive system. They can also damage your DNA, the genetic code that determines the nature of every cell in your body, so ***mutations*** can occur from gamma radiation.

Radioactivity is dangerous in large amounts. But how much radioactivity is a large enough amount to hurt you? Radioactivity is measured in units called ***rems***. One rem is so much radiation that usually when discussing radiation and its effects on the body, we use the term ***millirem***, or ***mrem***, which stands for one-thousandth of a rem.

A few mrems of radioactivity won't hurt you. In fact, the average person absorbs about 4-5 mrems of radioactivity every week! 80% of this radioactivity comes from natural sources, like the uranium ore that is found in rocks. Some of it also comes from outer space, in what are called cosmic rays. The 20% that comes from man-made sources we get from things like medical x-rays. The average x-ray contains about 10-15 mrems. That's probably not enough to harm you, but you wouldn't want to be x-rayed all the time! You'll notice that when a medical technician takes your x-ray, they protect themselves by either going in another room or behind a lead shield--that's because they take many x-rays every day, and it's not good for them to get exposed to all that radiation.

Exposure to low levels of radiation probably isn't dangerous to people. Radiation has always been a part of our environment, and so life has evolved on Earth with radiation. One of the biggest problems with radioactivity, though, is that no one, not even our smartest scientists, is really sure what dosage of radiation is safe. It seems to be different for different people. Lifestyle factors, like diet and smoking, can influence how harmful a radiation dose may be. Some nuclear authorities claim that a dosage of up to 5 rem a year is safe, but there is strong evidence to prove that for most people, it is not. Long-term studies of over 600,000 nuclear workers since 1974 show high cancer death rates. Also, hundreds of people who lived downwind from nuclear bomb testing in Nevada in the 50s later developed cancer. They were effected by radiation distributed by weather, called nuclear ***fallout***. Some of the first uranium miners in this country (mostly Navajo people) have also died from cancer. All of these people received what was thought to be a "safe" dosage of radioactivity.

Much of what we do know about the harmful effects of radioactivity come from studies of the people who were exposed to radiation from the only wartime use of nuclear weapons--the bombs that the U.S. dropped on Hiroshima and Nagasaki, Japan in World War II. Half of the more than 100,000 people killed by those bombs died after the blast from radiation. Some did not show effects from the bomb until 40 years later, when they ended up getting cancer. We do know that radiation exposure can cause damage that doesn't show up for 10-40 years. We also know that pregnant women are at risk of having children with birth defects or miscarriages if they are exposed to too much radiation. No level of radiation can be considered completely safe for all people.

While no one knows what a 'safe' exposure level is, exposure to several rems is definitely dangerous. It probably won't kill you right away, but it could cause you to get cancer in time. Exposure to more than 50 rems can cause radiation sickness, which kills in a few days. And exposure to 1,000 or more rems is always fatal, sometimes within hours of the exposure. Nuclear weapons create high levels of radiation like this, and that is one of the reasons they are so extremely dangerous and deadly.

Nuclear power plants use radioactive substances to operate. If these substances get released into the environment, they can cause terrible problems. Incredible precautions are taken at most nuclear plants to insure that this never happens, but still, these precautions aren't always enough. Nuclear accidents have occurred. The Chernobyl accident in the Ukraine (a former Soviet republic) released radiation that was detected all over the world. Many thousands of people were harmed and even killed by that accident.

THE NUCLEAR FUEL CYCLE

What Is the Nuclear Fuel Cycle?

The nuclear fuel cycle is the process of creating usable material for nuclear weapons or nuclear power plants from raw uranium ore. The first steps in the process, finding the ore and mining it, are what occurred on the Laguna Reservation. The second step, milling the ore, was done in the Grants area, and in other locations. The other steps, enriching the uranium and turning it into bombs or nuclear fuel for reactors, happen at other sites around the country. The final step, the storage and disposal of nuclear wastes, occurs at various places around the country. Currently, nuclear wastes in the form of mill tailings are being stored near Grants. The WIPP site near Carlsbad, New Mexico, is one of the places where the government and nuclear industry want to store nuclear wastes.

Finding Uranium

The nuclear fuel cycle begins with the process of finding the ore. This is called prospecting or exploration. Geologists look for uranium using special instruments called Geiger counters, which detect radiation. The presence of radiation in rocks indicates that there is uranium in them. They look both on the ground and using airplanes with Geiger counters mounted in them. This is how uranium close to the surface (like at the Jackpile Mine) is found.

To find ore deep in the earth, geologists drill test holes down into the area where they suspect uranium ore might be located. Then they analyze samples taken from the test holes to see if there is uranium ore in them.

In the early days of uranium mining in the Grants Mineral Belt, surface exploration was mostly used. Once all the big deposits near the surface had been found, then they started using underground test drilling to find more deposits.

Mining Uranium

The second step in the nuclear fuel cycle is getting the ore out of the ground, or mining the ore. This is what was done at the Jackpile/Paguate Mine. Uranium ores are mined in one of three different ways: underground, in an open pit, or by a process called in-situ leaching. Back in the boom days of the Grants Mineral Belt, and at Laguna, only underground and open pit mining were used. What type of mining will be used to extract a certain deposit is determined by how deep in the ground it's located, and how big the deposits are.

Open pit mining is used when the ore is close to the surface, usually within 0-500 feet. The first step in open pit mining involves removing the top layers of soil and rock that cover the ore. This is called the ***overburden***. At the Jackpile Mine (and other open pits), the overburden was blasted and scraped away, and hauled off to be stored in huge piles. This material was stored near the mine to be used in the future reclamation. Most of the earth-moving at Jackpile involved taking off the overburden. Some 400 million tons of earth were moved at the mine. Only 24 million tons were uranium-bearing ores; this means that about 94% of the total earth moved was overburden.

All of the mines in the Grants Mineral Belt besides the Jackpile were underground mines. In underground mining, ***shafts*** are drilled, blasted, and dug into the earth to get to the ore. All the waste rock and ore must be brought to the surface using elevators. A mine with one entrance at the surface may have many different shafts into the earth, These shafts are called ***drifts***. Holes are often drilled down from the surface into the shafts to bring in fresh air. This is especially important in underground mining, because one of the elements that uranium breaks down, or decays, into is a radioactive gas called radon, which is very dangerous to breathe. Radon can build up in underground mines causing serious health problems for the miners.

Underground uranium mines have been dug very deep into the earth--up to 4000 feet, or close to a mile deep. Sometimes underground water can be a problem. If the mine is wet, then the water must be pumped out to keep the mine shaft from collapsing. Underground mining is a very dangerous business--even if it's not a radioactive mineral like uranium that's being mined. Mine shafts sometimes cave in on the miners, even though they install support beams and reinforce the drifts as they go along. Underground blasting with high explosives can be very dangerous, too.

Very little uranium is mined in the U.S. these days. Most of the uranium mining going on today is in Canada, Australia, and Africa. This is not because there isn't much uranium left in the U.S. It is because it is cheaper to mine it in other places. Since the 80s, the price of uranium has gone down. Now that the U.S. and Russia aren't building so many nuclear weapons, nor are there any new nuclear power plants being built in this country, the demand for uranium in the U.S. has gone down. So, the price has gone down, too, and most U.S. mines, and all the mines in this area, have shut down.

There is a third way to mine uranium--and a company wants to start using this method near Crownpoint, N.M. It is called ***in-situ leaching***. Using this method, the miners drill down to where the ore is, then pump an acid solution into the ore body. The acid dissolves the ore, and it is then pumped back up as a liquid. On the surface, the liquid must be processed like other mine ores to remove the uranium. Many people are concerned about this type of mining, because by making the uranium into an acid solution, it increases the chance that it could pollute the groundwater.

Milling Uranium

Uranium ore taken from the ground usually contains from about ½ % to 2% of the valuable uranium oxide. This means that for every ton of ore mined (1 ton = 2000 pounds), only about 5 pounds of ore is extracted. The process of removing the valuable mineral from the mined ore is called ***milling***. Milling is the process by which the ore is broken down and treated to remove the valuable stuff. The milling process begins with crushing the rock. At the Jackpile, this step was done at the site, to be able to fill the railroad cars that hauled the ore away to their fullest capacity. Next, the crushed rock is mixed with water to form a ***slurry***. The slurry is pumped into special tanks where it is mixed with certain chemicals (often sulphuric acid) that separate out the uranium ore from the rest of the rock. This process is called ***leaching***. Then the liquid that contains the uranium ore, called the ***leachate***, is filtered from the rest of the slurry. The leachate is further concentrated by a process called precipitation. The final steps of the milling process involve removing the water and drying the uranium precipitate, called ***yellowcake***. The yellowcake then is packaged, usually into 55 gallon steel drums, for shipment to an enrichment plant. One drum holds about 1000 pounds of yellowcake, or half a ton. The yellowcake contains about 96% uranium oxide (uranium + oxygen).

So, if the rock they start out with at the mill is only about 1% uranium oxide, what happens to all the rest of the 99% that they don't want? The material that's left over from the milling process is called ***tailings***. Of the 24 million tons of ore shipped from the Jackpile/Paguate Mine to the Bluewater mill, about 23,700,000 tons were left there as tailings. Tailings are still dangerous because they do have radioactive elements in them. When uranium decays, it breaks down into a whole bunch of other unstable elements that continue to decay, too, giving off more radiation as they become stable. The tailings contain all these other radioactive elements. The process of radioactive decay lasts for thousands, even hundreds of thousands of years, so these tailings are dangerous for a long, long time.

Milling also uses a lot of water, and this water gets contaminated, too. Usually the water is pumped into big ponds where it is left to evaporate away. Then the radioactive material that gets left behind becomes more mill waste. On July 16, 1979, near Church Rock, New Mexico, a dam broke that was holding back this kind of contaminated water, and released some 1100 tons of toxic, radioactive mill wastes into the Rio Puerco. The wastes contaminated the river for hundreds of miles downstream, making it unsafe for humans and animals. This was one of the worst nuclear accidents in our country's history.

Enriching Uranium

The end product of the milling process, uranium oxide, or yellowcake, must be further refined to get the useable uranium out of it. In fact, even though the ore from the mines has been processed down to just 1/100th of its original weight, the amount of usable uranium in the yellowcake is an even smaller fraction of that material. Enriching the uranium is a very complicated industrial process that requires huge factories and equipment. Until recently, only the governments of the world's biggest countries had enough resources to do it. That's why there aren't more countries with atomic bombs. In the U.S., there are just a few places where the government built these massive factories to enrich uranium. The first site was the Oak Ridge National Laboratory in Tennessee. The government made another plant, in Hanford, Washington, to turn uranium into plutonium, which like uranium, can be made into nuclear weapons. The construction of both of these factories was a monumental achievement for our country. Today, private companies also participate in the enrichment process.

Nuclear bombs need highly enriched uranium to make explosive chain reactions. Because the chain reactions that power nuclear reactors aren't nearly as intense, they use less highly enriched uranium.

Power from the Atom

Once the uranium has been enriched, it is further processed depending on what it will be used for. Atomic bombs require almost pure uranium metal. Nuclear power plants use less concentrated uranium processed into fuel rods, which power their reactors. A small amount of enriched uranium is also used for medical and research purposes. After going through all these processes and refinements, the uranium is finally put to use.

Nuclear Wastes

Probably the biggest problem facing the nuclear industry is how to safely get rid of the huge quantities of radioactive wastes that have built up over the years. Nuclear waste has been called the "ultimate pollution," because it is so dangerous, and because it stays dangerous for so long. At every step in the process of creating useable uranium, wastes are also created. Everything that comes into contact with uranium gets contaminated with radiation and becomes radioactive, too. The tailings left over from milling, which look like a greyish sand, still contain hazardous radioactive elements. Uranium mill tailings account for about 95% of all the radioactive waste in the country. Usually they're just left outside to blow around, or where rain passing through them can carry these contaminates into the groundwater. There are still huge piles of tailings west of Grants, that you can see if you look to the north while driving west on I-

40. Nobody really knows yet how to get rid of them or make them safe.

As uranium ore is processed, everything that comes into contact with it gets contaminated. All of this stuff--from workers' clothing to tools to machines--becomes ***low-level nuclear waste***. "Low-level" doesn't mean "not dangerous." This type of waste can still give off radiation for tens of thousands of years. Right now, most of it is being stored in 55 gallon drums at all the places around the country where there are nuclear processes happening. The government has built a facility deep underground near Carlsbad, New Mexico, called the WIPP site (Waste Isolation Pilot Plant), where they want to bury this waste. They say that it is deep enough underground that the radioactivity will never get into the environment in a way that could hurt people or other life. But "never" is a long time, and no one can be sure that it will be safe for tens of thousands of years. Another problem is that they will have to ship all the waste to WIPP in trucks, and these trucks will pass right by places like Laguna on Interstate 40. There is the possibility that one of these trucks could have an accident, and the radiation could be released that way.

When nuclear fuel gets used up in a reactor, it leaves behind highly radioactive waste. Spent fuel rods from nuclear power plants, and materials taken out of bombs that get dismantled, are called ***high-level nuclear waste***. This high-level waste will give off radiation for hundreds of thousands, even millions of years! This is longer than people have even been around on the planet, so we simply do not have the technology at this time to say for sure that we can store it safely for so long.

Radioactive Threats to the Environment

Many people, including scientists, have suggested that we just put the waste back into the ground where it came from. Others have suggested blasting it into outer space. What's wrong with these ideas? Well, anyone who remembers the Challenger disaster can tell you why it's not a good idea to blast it into space. If a rocket blew up that was carrying nuclear waste, it would spread it all over the area below, creating a major radioactive disaster. But why not just bury it back in the earth? The main problem with underground disposal comes from trying to keep the waste from getting back into the environment, especially the groundwater. Much of the Earth's fresh water supply comes from underground. This is what we call groundwater. The water you drink here at Laguna is pumped up from underground wells. We also use this water to irrigate crops. Radiation from waste can travel through rock and earth to contaminate these fresh water supplies.

There are other ways radiation from buried wastes could enter the environment, too. What if ten thousand years from now, long after the 'official' monitoring of a waste site had ended, people were to drill down into the waste looking for oil, water, or some other mineral? And since nuclear waste stays dangerous for so long, natural geologic processes, like earthquakes, could also cause problems at waste sites in the future. Right now, even our best science can't predict exactly how the earth will behave hundreds of thousands of years in the future.

While the nuclear industry has generated millions of tons of waste over the years, nobody knows how to dispose of it safely. Scientists are trying to come up with ways to deal with this problem, though. But in the meantime, the wastes just keep piling up. So far, the safest ways that science has invented are too expensive to be used on a large scale basis. We can only hope that more research into the problem will find a solution.

At Laguna, you don't have to worry too much about having a nuclear bomb explode nearby, or about a major accident at a nuclear power plant (the nearest one is in Arizona). But, the people here do face radioactive threats to their health and environment. The greatest threat for Lagunas is from the mine.

The miners who worked at the Jackpile/Paguate Mine were exposed to radiation.

Whether or not it was enough to harm their health has not been proven. Because it was an open pit mine, many experts say that the radioactivity never built up to dangerous levels (like they could in underground mines). However, there were underground mines at Laguna, too, but not as many people worked in those as the big open pit mines. Workers could have breathed in radon gas, or inhaled radioactive dust. The people of Paguate also had to deal with dust from the mines. Sometimes when they blasted the ore, it would spread the dust over the village. This could have been breathed in, or sometimes it got in the people's food, like when they were drying meat or fruit outside, or when the dust got on their vegetable gardens. If you breath in or eat radioactive dust it can harm you from the inside.

Another danger from the mine is water contamination. Both the Rio Moquino and Rio Paguate flow right through the mine, and they can become contaminated from radioactive elements. Water can carry the radiation to the Mesita dam, or beyond. Rain coming down into the mine can carry radioactive elements into the groundwater, too.

Why are radioactive wastes dangerous for so long? Because the process of radioactive decay takes a very long time. Unstable radioactive elements like uranium give off radiation as the become stable, but this can take thousands, and even millions of years. Scientists use the term ***half-life*** to describe how long it takes for an unstable element to decay into a different element. A half-life is the time it takes for half of a certain amount of a radioactive element to break down and change into a different element. For example, if you start with one pound of uranium, after one half-life, only half a pound will be left. For uranium-235, one half life equals 704 million years! Then, after another half-life, half of the remaining half will have changed (1/4 of the original amount), and so on. So, you can see that it takes uranium a long time to break down!

Different elements have different half-lives. In comparison, radon decays much, much more quickly--its half-life is only 3.8 days.

URANIUM MINING
IN THE GRANTS MINERAL BELT

Why Did Uranium Mining Get Started in This Area?

To understand why the uranium mining boom started in this area, it's important to know some of the history behind the "nuclear arms race," and what is known as the "Cold War." These were the global political events that changed history in this area.

A Short History of the "Cold War"

During World War II, scientists in different countries began working to invent an atomic bomb. During this time, the United States government established Los Alamos National Laboratory, here in New Mexico, so the scientists working for our country would have a place where they could develop a bomb in secret. Because there was a world war going on, the government made it a top priority to develop the bomb. America's enemies in the war, Germany and Japan, were also working to make an atomic bomb. So was the Soviet Union. Each country wanted to be first to make the bomb, because they knew that with such a powerful weapon, it would make a big difference in who would win the war.

The Americans were the first to make a successful atomic bomb. The first atomic bomb was exploded in the desert east of Socorro, New Mexico, at a place called the Trinity site, on July 16, 1945. The bomb was exploded at about 5:30 in the morning, shortly before dawn, and the light from the blast was so bright that people saw it all over New Mexico. It was easily seen at Laguna, even though it was blown up over 100 miles away. It was so bright when it blew up, that the event is sometimes called "the day the sun rose twice." This event signaled the beginning of the nuclear age.

The effort to build the atomic bomb was one of the greatest scientific and industrial achievements in the history of the world. It took billions of dollars and thousands of people to build a huge complex of factories that was necessary to make the materials for an atomic bomb. At that time, many scientists around the world knew how to make an atomic bomb, but the United States was the only country able to construct the giant factories that were required to turn uranium ore into the enriched uranium 235 that makes an atomic bomb work. In fact, even today, over 50 years later, there are less than 10 countries in the world that have been able to make an atomic bomb. This is not because the way to make them is such a secret, but because it is so hard to produce the material that makes the bombs work.

After the U.S. exploded the first atomic bomb at Trinity, they continued to build more bombs. In 1945, President Harry Truman made the decision to use atomic bombs against Japan. This was one of the hardest decisions a president has ever had to make. Because its destructive effects are so horrible, very few of the people that knew about the bomb wanted to have to use it. But the President and the military also did not want to have to invade Japan to get them to surrender, either. The people in the military and the government thought that if we had to invade Japan, many thousands of Americans would die, so they decided to use the atomic bomb to get the Japanese to surrender, instead of having to invade.

The first atomic bomb used in a war was dropped on the city of Hiroshima, Japan, on August 6, 1945. It exploded with a force that human beings had never before known, equal to blowing up 25 million pounds of TNT. It destroyed the city, and eventually killed over 140,000 people. Still the Japanese didn't surrender. So, on August 8, the Americans dropped another atomic bomb on Nagasaki, Japan. This one was even more powerful, and exploded with the force of 44 million pounds of TNT. After these horrible bombings, the Japanese did finally surrender on August 15, 1945. The atomic bomb was successful at ending the war, but still today, the United States has the reputation for being the only country in the world that has ever used an atomic bomb on another country.

For a few years after World War II, we were the only country in the world to have an atomic bomb. But the Soviet Union (Russia) was working hard to develop one, too. In 1949, they tested their first atomic bomb. Now, two countries had the super-weapon of the 20th century. Even though the U.S. and the Soviet Union had fought on the same side as allies in World War II, after the war they became enemies. This is because the Soviet Union had a different form of government, called "communism," and they wanted the whole world to be communist. The United States, as the most powerful democratic country in the world, saw it as their mission to stop the Soviets from taking over the world. This began what was called the "***Cold War***." It was called a "cold" war because we never actually fought against them in a battle (which is called a "hot" war). But, we put so much of our country's resources into trying to stay more powerful than them, that it was like we were in a war with them.

During the Cold War, both the United States and Russia pushed to be the most powerful country in the world. That meant that both countries tried to have more atomic bombs than the other. In 1952, the U.S. tested an even more powerful kind of nuclear bomb, called a hydrogen bomb. The first hydrogen bomb blew up with a force 1000 times greater than the bomb dropped on Hiroshima. Modern hydrogen bombs are many thousands of times more powerful than the first atomic bombs. A hydrogen bomb is to an atomic bomb, like a stick of dynamite is to a firecracker. Atomic bombs are used as the 'trigger' for a hydrogen bomb, or "H-bomb." Three years later, in 1955, the Soviet Union tested a hydrogen bomb. This made the already scary possibility of a nuclear war even more frightening.

During the second half of the 20th century, the U.S. and Russia became known as the world's "superpowers," because they had the biggest stockpiles of nuclear bombs. Each country tried to outdo the other, to have the most and the biggest bombs. This became known as the "***nuclear arms race***." The nuclear arms race lasted from the end of World War II, until the fall of the Berlin Wall in 1989, when the communist governments in Russia and Eastern Europe (Russia's allies) collapsed. One reason these governments collapsed was because their economies were not strong enough to keep up with the United States and its allies in the arms race.

During the Cold War, the entire world lived with the threat of a nuclear war between the superpowers. This was a very scary situation, because both sides had enough nuclear bombs to destroy all life in the world, if they ever used them against each other. The only thing that kept them from using them was knowing that an all-out nuclear war would be so horrible, that neither side could have won. It would have been too devastating to the entire planet.

Nowadays, there are ten countries that admit they have nuclear weapons: the United States, Great Britain, France, Russia*, Ukraine*, Belarus*, Kazakhstan* (*all former republics of the Soviet Union), China, India, and Pakistan. Two other countries are suspected of having nuclear weapons, but they've never admitted it: South Africa and Israel. There are more countries that are probably trying to make atomic bombs, too, like North and South Korea, Iran, Iraq, and Libya. Even though the Cold War between the U.S. and the former Soviet Union is over, the threat of nuclear war hasn't gone away. Nowadays the danger is that one of the less powerful countries, like India or Pakistan, will use nuclear weapons against one of their enemies. The U.S. is working to stop the spread of nuclear weapons around the world. This is known as nuclear ***non-proliferation***.

So, what effect did the Cold War have on Laguna? Because of the Cold War, the government wanted as much uranium as it could get to build-up its stockpiles of nuclear weapons. This is what led to the uranium mining boom which started in the late 1940s.

The Uranium Boom Hits the Grants Region

Some of the first uranium mines in the U.S. were located on the Navajo reservation, in the Four Corners area. These mines had been worked since before World War II, but not to get uranium. In its natural state in the ground, uranium is usually found mixed with other radioactive minerals. One of these minerals is called vanadium. Vanadium is used to make steel harder, and it had been mined on Navajo lands since the turn of the century. When the demand for uranium hit, these same mines were worked to get the now precious uranium ore.

These early mines on Navajo land were very dangerous to work in. Back in those days, nobody told the miners about the dangers of radioactivity, so they worked in the mines without any safety precautions. Many of them ended up getting health problems from their exposure to radioactivity. Many of them have already died from those exposures.

A Navajo rancher named Paddy Martinez is credited with starting the uranium mining boom in the Grants area. In the spring of 1950, he found some interesting-looking, yellowish rocks out near where he herded sheep, by Haystack Mountain, about 15 miles west of Grants. He showed the rocks to some geologists who worked for the Santa Fe Railroad. These geologists identified the rocks as containing uranium ore. They knew that the government wanted to buy uranium, and so, they asked him to show them where they came from. They discovered rich deposits of uranium ore in the area, and the boom was underway. The discovery of uranium brought a flood of geologists and prospectors to the Grants area, all looking to strike it rich on a big uranium deposit. Today there is a park in Grants named in honor of Paddy Martinez, the man who started Grants on the road to becoming the "Uranium Mining Capitol of the World." There is also a fountain in the park in front of the City Hall that is topped with a model of an atom, another tribute to Grants' boom days.

Grants wasn't much of a town in those early days. The streets were all unpaved, and there wasn't enough housing for all the miners who were flocking to the area from all over the country. The schools were overcrowded. There was no hospital, and the grocery stores were inadequate. But as more and more people and money came in from the mines, the town grew, and slowly the quality of life improved for the residents. Between 1950 and 1980, the population of Grants increased five-fold. There were predictions Grants would become one of the largest cities in New Mexico, but the uranium bust killed that possibility.

THE JACKPILE/PAGUATE MINE

The History of the Mine

The Anaconda Copper Company was one of the biggest companies that came to the Grants area looking for uranium. In 1951, Anaconda obtained a permit to look for uranium on the reservation from the Laguna tribe. One way they would look for uranium was to fly around in a plane that had a special radiation detector (called a Geiger counter) mounted in the nose of the plane. If they flew over an area that had a lot of uranium ore, the Geiger counter would pick it up. On November 8, 1951, one of their pilots, named Woodrow House, flew over the area near Paguate, and the Geiger counter went wild. He knew that meant there were big deposits there. He went back to the mining company's offices and told his boss, Jack Knaebel, about the find. They came back to the reservation to do a check from the ground, and took some ore samples from the area. They tested them, and proved there was high grade uranium ore on the reservation. In fact, these deposits turned out to be the richest concentrations of uranium ore in the entire Colorado Plateau region!

The story of how the Jackpile Mine got its name is pretty unusual, if not gross. When Jack Knaebel went out to the reservation to check out the find his pilot had made, he had a very painful stomach ache. He went behind a bush and threw up to try to relieve himself. The next day, when the pilot was going to fly back to the site, he told everyone at the mining office, "I'm heading for Jack's pile!" So, the mine was named after this man's (Jack Knaebel) pile of vomit.

Mining operations at the Jackpile started in 1953. The tribe leased almost 8000 acres of the reservation to the Anaconda Company. Leasing means that they could use the land, but they didn't own it. In exchange for the ***leases***, and the rights to mine the uranium, the company had to agree to pay the tribe ***royalties*** from the money they made off the mine. At that time, the tribe had no official offices or tribal building, and the contract paperwork was stored in a trunk.

Anaconda's original lease with the tribe was signed on May 7, 1952, for 4,988 acres. The company later negotiated the lease of additional acres, 2,560 in 1963, and 320 more in 1976. The Jackpile Mine began as an underground mine, which is how the mines west of Grants were operated. But when Anaconda realized how big the deposits were, and how hard it would be to provide the proper ventilation for the miners underground, they decided to make it an open pit mine. To get to the ore, that meant that they had to first strip away the overburden.

By the end of 1958, the Laguna district was producing about 70% of all the uranium ore being mined in northwestern New Mexico. This percentage went down over the years, not because mining at Laguna went down (it actually went up), but because more and more other mines opened up west of Grants and elsewhere in the Four Corners area. Up to 1975, Laguna provided about 14% of the country's entire uranium supply. The mine closed in early 1982, not because there wasn't any more uranium left, but because the price for uranium ore dropped so low that the company couldn't make money off the mine anymore.

Over the 29-year life of the Laguna uranium mines, three open pits and nine underground mines were made on the Anaconda leases. The underground mine shafts were sunk into the mesa west of Paguate. Ventilation holes were drilled down from the top of the mesa into the underground mines. Besides the Jackpile Mine, the other two pits were called the North and South Paguate Mines.

Approximately 400 million tons of earth was removed from the open pits over their life span. How much is 400 million tons? Let's try to put in perspective. If the average LMS student weighs 100 pounds, that's the equivalent of 4 million students put together! That's more than two times the weight of the entire human population of New Mexico! Thinking about it in another way, if the average truckload of ore out of the mine was 50 tons, that's 8 million truckloads. Even if each truck had to drive only one mile to unload their ore, the total mileage would be the equivalent of almost 3100 trips across the United States, or almost 34 trips to the moon! About 24 million tons of this material was uranium ore rich enough to be shipped to the Bluewater Mill west of Grants to be processed into yellowcake. A special spur line off the main Santa Fe railroad line was built to the mine to transport the ore to the mill.

In the open pits, the ore was mined mostly with big front-end loaders and haul trucks. The early trucks could carry 25 tons of ore at a time. Later, bigger trucks that could carry 50 and even 75 tons of ore, were put in use. The biggest haulers, the 75-ton trucks, had tires almost twice as tall as a regular pickup truck! Bulldozers were used to move the overburden and ore. To get to the ore, the overburden was blasted off with high explosives, and hauled away to storage piles. Then the ore bodies were blasted loose. Finally, the front-end loaders would scoop up the ore, and load it into the haul trucks, which would take it to be crushed, and then loaded into railroad cars for shipment to the mill. Blasting was done 2-3 times a day. At its peak, the mine was operated around the clock, 24 hours a day, 7 days a week.

The Jackpile Mine was the deepest of the three open pits. It was excavated down 625 feet into the earth. This is deep enough to put a 70-story building into! The other two mines were dug down to 325 feet (South Paguate) and 200 feet (North Paguate). A total of about 2700 acres were disturbed by the mines over their lifetime. This is equal to more than 4 ½ square miles, or an area big enough to put over 4000 buildings the size of our school in!

The Anaconda Company was eventually taken over by another company, Atlantic Richfield, or ARCO. The Anaconda Company and ARCO did pay the workers good wages and paid the tribe the royalties they negotiated, but they weren't in the mining business to help out the Lagunas. They were in the business to make money. Even though the tribe received millions of dollars in royalty payments, this was less than 1% of the total profits that Anaconda and ARCO made off the mine! At one point, the company even asked the people of Paguate if they'd be willing to move their entire village, because they thought that some rich deposits of ore were right underneath it. Of course, the people refused to move.

Some 800 people worked at the mines during the 29 years they were in operation. About 70% of these people were Lagunas. Lagunas worked in every area of the mine: as probers (the workers that looked for the ore with Geiger counters), drillers, heavy equipment operators, truck drivers, crushers, maintenance personnel, and in clerical jobs in the mine offices. The jobs were high paying, but the conditions weren't always good. Sometimes the miners had to work in unsafe conditions, or with equipment and vehicles that weren't properly maintained. The miners were never really informed that working around uranium might be hazardous to their health. They carried the dust from the mines home with them to their families on their clothes, too.

Effects on Laguna Culture, Society, and Environment

Before the mine, most Lagunas made their living from ranching and farming. They worked when they needed to, but they weren't locked into a regular work week schedule. When lots of people started working at the mine, regular 40+ hour work weeks, they couldn't participate in traditional activities in the same way as they could when they were earning a living from ranching and farming. Many workers couldn't just take 4-5 days off from their jobs to participate in the longer traditional ceremonies. Some activities had to be changed to be on weekends to accommodate the new workers. However, other activities died out because the people couldn't get the time away from work that they needed to maintain them. Many people gave up the agricultural way of life, growing crops and tending their herds of animals. Farming and ranching both declined dramatically at Laguna over the life of the mine. The change from a land-based economy to a wage-earner economy disrupted the traditional ways of the people.

Before the mine, unemployment on the reservation was around 70%. During the mining days, it dropped down to 20%. But when the mine closed, it shot back up again to over 70%. The mine provided lots of jobs for Laguna people. Almost everyone of you has relatives that worked at the mine.

For the first time, large numbers of Lagunas had money to buy cars, television sets, and other consumer goods. The standard of living on the pueblo increased dramatically. With money to spend and cars to drive, people started going shopping in Grants and Albuquerque a lot more. They also had money to spend on alcohol and drugs, and the new standard of living increased these problems on the reservation. Along with more wealth also came more crime. Because there were good jobs to be had in mining, that didn't require a lot of education, many people dropped out of school to go work in the mines, too.

The village of Paguate was the most affected by the mine, because it was so close. The blasting at the mine caused many of the old stone houses in the village to crack apart. Plus, they had to live with the dust from the mine, which got on their homes, crops, and clothes. Before the mine, the area near the Rio Paguate was used for farming. There were orchards of fruit trees there and fields of corn and wheat. Other land was used for grazing animals. When the mine came, the people lost those fields and grazing lands, probably forever.

Over the years, the royalties from the Jackpile/Paguate Mine made the Laguna tribe the richest of all the pueblos. The tribe used this money to modernize the pueblo, doing things like building and paving roads, and installing water lines and indoor plumbing throughout the reservation. Before the mine, most people didn't have bathrooms and kitchen sinks in their homes; they had to use outhouses, and haul their water from wells.

The tribe did many good things with the money they made from the mine. One thing they did was to invest the money, so that even after the mine closed down, the tribe would still be able to have income to support the people and their needs. Other things they did include starting the Tribal Scholarship Fund, and building the Tribal Building. The royalty money also enabled the tribe to start other businesses, like Laguna Industries and the Commercial Center. When Laguna Middle School was built, the money to make our gymnasium so big came from the money the tribe earns off its investments from the mine royalties.

Reclamation of the Mine

When a mine is reclaimed, that means trying to put the land back to the way it was before the mining activity took place. But in regards to the Jackpile/Paguate Mine, Jim Olsen, the Reclamation Project Director, said, "There's not enough money in the world to put the thing back the way it was." As part of the agreement that the Anaconda Company made with the tribe, they had to pay to reclaim the mine when they stopped work there. It took seven years for the tribe to come to agreement with ARCO (the company that took over Anaconda) and the government about reclaiming the mine. Even though ARCO had made so much money from the mine (hundreds of millions of dollars), they didin't want to have to pay for the reclamation. Finally, in 1989, after many years of negotiations, ARCO paid the tribe almost 45 million dollars to do the reclamation work themselves. With this money, the tribe started the Laguna Construction Company. There were already a lot of people who knew how to operate the heavy equipment they needed for the reclamation job on the pueblo from the mining days. Many of these people were hired to work on the reclamation project.

No one had ever tried to reclaim an open pit uranium mine before they started on the Jackpile/Paguate Mine. Because it was a uranium mine, and so, it gives off radiation, it was different from any other reclamation done before. Little scientific and engineering knowledge existed to help determine how to successfully reclaim the mine. The tribe had to decide what the best way was to make it safe.

The overburden that had been stripped away to get to the uranium ore had been stockpiled around the mine. This material was put back into the pits to cover them up. It was specially sloped and terraced to try to keep it in place, and prevent wind and rain from making it wash away. Then a layer of rock, called shale, was put into the pits. This layer was made up to 12 feet thick, and is supposed to keep radiation from coming up into the air. Another 1 ½ feet of topsoil was placed over that. Then the area was seeded with grasses and other native plants. If you visit the mine today, you can see that plants are starting to grow back over the land. You can also see how the land was shaped by the reclamation project--the earth bears the mark of human construction--it was impossible to make the site look completely natural.

It took five years to complete the reclamation project, from 1989 until 1994. Now, the project is in the monitoring phase, which will last for 15 years. The reclamation technician takes samples of the water, air, soil, and plants from the reclaimed mine and checks them for the presence of radioactive elements. So far, these tests show that the levels of radiation are almost back down to what they were before the mine, and they are considered safe.

When the 15-year monitoring period is over, then the land will be turned over to the tribe's own Natural Resources Department. Whether or not the people will ever be able to use this land again is unknown at this time.

One of the positive outcomes of the reclamation project was that the tribe formed the Laguna Construction Company with the money they got for the reclamation. This company provides jobs for some tribal members, and gives Laguna the ability to work on other construction projects, both here on the reservation, and in other parts of the country. Because the Jackpile Reclamation project was so unique, LCC has experience that no other company like it in the country has. Before, the tribe had to hire outside companies to do work on the reservation, like road building and maintenance, and construction. Now, LCC can do those jobs. Two examples of their work are the Laguna Library and the recreation areas here at LMS.

THE LEGACY OF THE MINE

Evaluating the Success of Reclamation

How will you know whether or not the reclamation has been successful? Will the land ever be able to be used again? If so, how? These are some of the most important questions that the Laguna people--you included-- will have to answer in the days and years ahead.

Several aspects effecting the reclamation will need to be evaluated to determine its success. One is erosion. Already, rain is starting to erode the big sloped hills and terraces built up over the mine. One danger that must be watched is to see if the erosion will get down to the uranium ore. If that happens, then there is an increased possibility that radiation could get released into the air, soil, and water. The plants that grow back in the mine area will have to be monitored to see if their roots get down into the uranium ore. If that happens, then they could bring radioactive material up from underground, where it could contaminate the surface soil or be eaten by animals. Also, the groundwater in and around the mine will have to be checked to see if radiation is seeping into it from the uranium ore still left behind. Plus, the air around the mine will have to be checked to see if dangerous levels of radon gas are coming up through the layers of protective cover.

Future Use of the Land

Will Laguna ever be able to use the land where the Jackpile Mine was again? Is there a possibility that the mine could ever open back up? These are some of the questions that your generation will have to answer. It is still possible to mine uranium again at Jackpile. First, the material that is covering it up would have to be taken off--a second time. But then, the ore could be mined once again. Even though the price of uranium has come back up from the low that it hit in 1982, the tribe does not want to reopen the mine at this time.

So, will the land ever be able to be useful? At this time, no one is allowed on the land. Not even grazing is permitted. In fact, farming and ranching will probably never be allowed because of the threat of radioactive contamination. People will never be allowed to live on the land, either. But the tribe does think that some industries might be allowed to operate there some day. This is one possibility for the future use of the land that is not being ruled out and will require more study to see if it is acceptable. For the time being, the mine will remain closed to any human activity at least until the monitoring phase is over.

FUTURE OUTLOOK

The Future of Nuclear Energy

What is the outlook for nuclear energy? Could the demand for uranium ever get so big again that the mine might be reopened? Fortunately, our government is not building nuclear weapons like it used to. Both our country and Russia are trying to reduce their nuclear stockpiles. This makes the world a safer place to live. It reduces the demand for uranium, too. At the present time in this country, the outlook for nuclear energy isn't very good. Because of concern about nuclear waste, and accidents like Three Mile Island and Chernobyl, the American public isn't very supportive of nuclear energy. No new nuclear plants have been built in the U.S. since the 70s. That position could change, though. Right now we're using up more and more fossil fuels, like oil and natural gas, which create pollution that contributes to other environmental problems like global warming. Maybe if these problems grow, and the price of fossil fuels goes up, nuclear power may seem like a better choice. Also, scientists may discover safe ways of handling and disposing of nuclear waste. They might also be able to design safer nuclear power plants. Developments such as these could make nuclear power seem more attractive. But for the time being, our country isn't very high on nuclear energy.

That doesn't mean that other countries aren't, though. Some countries, like France, Belgium, and Sweden, are pushing forward with nuclear energy in a big way. These countries get over half of their electricity from nuclear power, or "nukes," as they're sometimes called. In comparison, the U.S. gets only about 20% of its electricity from nukes.

Alternatives to Nuclear Energy

The demand for electricity, both here in this country and all over the world, is increasing. We will have to meet this demand somehow. What are the alternatives to using nuclear energy? One of the best alternatives is to use the energy we do produce more efficiently; that is, to conserve energy. Turning off the lights when you leave a room, and keeping the temperature in your house lower during the winter, are simple ways you can conserve energy. Making buildings more energy efficient, by insulating them, is another way. Not wasting resources, like paper (which takes energy to make), is something else you can do.

One energy source, that we are not using as much as we could, is the sun. Every day, the sun shines abundant energy on our planet. This energy can (and does) provide heat for buildings, and can be used to make electricity. Right now, the technology to turn sunlight into electricity is too expensive to compete with the burning of fossil fuels, like coal, oil, and natural gas. However, as these sources of energy become more scarce (and more expensive), and cause more pollution, we can turn to solar energy to meet more of our needs. More research must be done to make solar power more economical and available.

When people build houses and other buildings, they can take advantage of the sun's power to heat them. Especially here in a sunny climate like New Mexico, energy from the sun can go a long ways towards fulfilling our heating needs.

Other alternatives to nuclear energy and burning fossil fuels are available, too. The wind is another source of energy that we haven't fully tapped. Windmills are often used to pump water here in this area, but they can be used to run a generator and make electricity, too. We can try to invent vehicles and appliances that use less energy; in other words, that are energy efficient. All of these things can help us to build a nuclear-free world. All of us have a part to play in making sure we take care of the Earth, for ourselves, and for future generations.

SELECTED REFERENCES AND BIBLIOGRAPHY

Acceptable Risk? Living in a Nuclear World (study guide for slide show). NARMIC. 1980.

Boom To Bust. George Dannenbaum. Creative Designs, Inc., Albuquerque. 1994.

If You Poison Us. Peter Eichstadt. Red Crane Books, Santa Fe. 1994.

Jackpile-Paguate Uranium Mine Reclamation Project Environmental Impact Statement. U.S. Bureau of Land Management. 1985.

Nuclear Risk Management for Native Communities: Community Trainers Workbook. Center for Technology, Environment, and Development, Clark University and Childhood Cancer Research Institute. 1997.

Radiation Risks and Realities (booklet). U.S. Environmental Protection Agency. 1993.

The Making of the Atomic Bomb. Richard Rhodes. Simon & Schuster. 1986.

Uranium: Exposure Pathways and Health Effects (booklet). Doug Brugge for the Nuclear Risk Management for Native Communities project. 1997.

Uranium Mining and Milling: A Primer. Southwest Research and Information Center. Reprinted from: The Workbook, Vol. IV, Nos. 6 & 7, Nov./Dec. 1979.

APPENDICES

1) Excerpts from *Poison Earth Sacred Fire*, selected testimonies of American Indian people from the World Uranium Hearings, Salzburg, Austria, 1992.

2) Excerpt from *Prairie Island Coalition*, testimony of Dorothy Purley, 1996.

3) Excerpts from *Voice of Hibakusha*, eyewitness accounts of the bombing of Hiroshima, 1990.

4) *Nuclear Age Timeline*, reprinted from the U.S. Dept. Of Energy website (*www.em.doe.gov/timeline/*), 1993.

5) *The Effect on the Inhabitants of a City of the Explosion of a Nuclear Bomb*, reprinted from the “Nuclear Weapons” website (*www.geocities.com/Area51/Vault/5862/Nuclear.html*), 1995.