THE MANHATTAN PROJECT

Support for the classroom guide generously provided by Boeing.

WWII
THE NATIONAL WWII MUSEUM
NEW ORLEANS

CLASSROOM GUIDE
Grades 7-12

ACKNOWLEDGMENTS

THE MANHATTAN PROJECT: Electronic Field Trip

Classroom Guide

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Picture of warning signs at Hanford, WA.
(Image: Personal photo, Chrissy Gregg.)

ABOUT THIS GUIDE

The National WWII Museum has created this classroom guide to accompany *The Manhattan Project* Electronic Field Trip, presented by The Lupo Family Charitable Fund and The Dale E. and Janice Davis Johnston Family Foundation.

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Front Cover: Physicist Norris Bradbury stands next to the partially assembled Gadget atop the tower at the Trinity test site.
(Image: Science History Images / Alamy Stock Photo.)

Back Cover: Front face of the B Reactor at the Manhattan Project site in Hanford, WA.
(Image: Courtesy of United States Government, public domain.)

(Image: Courtesy of United States Government, public domain.)

INTRODUCTORY ESSAY

"DESTROYER OF WORLDS": THE MAKING OF AN ATOMIC BOMB

At 5:29 a.m. (MST), the world's first atomic bomb detonated in the New Mexican desert, releasing a level of destructive power unknown in the existence of humanity. Emitting as much energy as 21,000 tons of TNT and creating a fireball that measured roughly 2,000 feet in diameter, the first successful test of an atomic bomb, known as the Trinity Test, forever changed the history of the world. The road to Trinity may have begun before the start of World War II, but the war brought the creation of atomic weaponry to fruition. The harnessing of atomic energy may have come as a result of World War II, but it also helped bring the conflict to an end. How did humanity come to construct and wield such a devastating weapon?

Models of Fat Man and Little Boy on display at the Bradbury Science Museum.
(Image: Courtesy of Los Alamos National Laboratory.)

> **WE WAITED UNTIL THE BLAST HAD PASSED, WALKED OUT OF THE SHELTER AND THEN IT WAS ENTIRELY SOLEMN. WE KNEW THE WORLD WOULD NOT BE THE SAME. A FEW PEOPLE LAUGHED, A FEW PEOPLE CRIED. MOST PEOPLE WERE SILENT.**
>
> *J. ROBERT OPPENHEIMER*

EARLY NUCLEAR RESEARCH

Achieving the monumental goal of splitting the nucleus of an atom, known as nuclear **fission**, came through the development of scientific discoveries that stretched over several centuries. Beginning in 1789, when German scientist Martin Klaproth discovered the dense, metallic element he called **uranium**, exploration of atomic energy and radiation came to fascinate scientific minds. As Marie Curie was conducting her groundbreaking research on **uranium** in the late nineteenth century, she found that the element was naturally radioactive. Curie created the term “radioactive” to describe the emission of electromagnetic particles from disintegrating atoms. Curie’s discovery of radioactivity in elements forever changed the nature of atomic science. Building from this research, British physicist Ernest Rutherford in 1911 formulated a model of the atom in which low-mass electrons orbited a charged nucleus that contained the bulk of the atom’s mass.

GERMAN DISCOVERY OF FISSION

The 1930s saw further development in the field. Hungarian-German physicist Leo Szilard conceived the possibility of self-sustaining nuclear **fission** reactions, or a nuclear **chain reaction**, in 1933. The following year, Italian physicist Enrico Fermi unknowingly split neutrons within **uranium** while conducting his own experiments. On the heels of these developments, Austrian-Swedish physicist Lise Meitner, working with German chemist Otto Hahn, was among the first to achieve the successful **fission** of **uranium**. However, the anti-Semitism of the Nazi party forced Meitner, who was Jewish, to flee and settle in Sweden. While in Sweden, Meitner identified and named the process of nuclear **fission**.

Meitner's findings became a tipping point in the development of nuclear weapons, but as the world once more moved into war, it was the Germans who held the potential key to nuclear power. While Hahn chose to remain in Germany and continued to develop his research throughout World War II, scientists across Europe steadily fled. Szilard, a Jewish man, migrated to the United States in 1938 to avoid persecution. Fermi and his wife, Laura Capon, also left Europe at the end of 1938 to escape growing Fascism in Italy. Capon, who was also Jewish, traveled with Fermi to New York City where both applied for permanent residency.

THE UNITED STATES TAKES ACTION

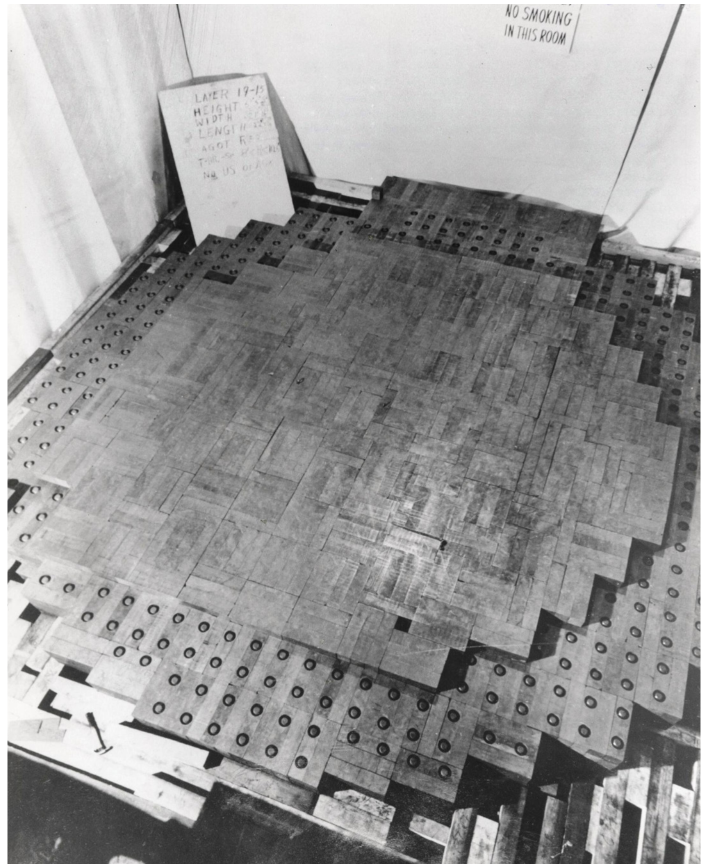
When news of Hahn and Meitner's discovery of **fission** reached Szilard in his New York City home in early 1939, Szilard began work to confirm their findings. Szilard found help in collaborator Walter Zinn, and together they recreated Hahn's experiment. Recognizing the significance of that moment, Szilard stated, "That night, there was very little doubt in my mind that the world was headed for grief." Szilard began to work with Fermi to construct a nuclear reactor at Columbia University, but as they did so, Szilard feared that scientists in Germany, who were aiding the Nazi war effort, were similarly constructing their own reactors.

In July 1939, Szilard contacted the prominent Jewish German theoretical physicist Albert Einstein at his home on Long Island, New York, to discuss German advances in nuclear development. Together, Szilard and Einstein drafted a letter to US President Franklin D. Roosevelt. In the letter, dated August 2, 1939, the warning was clear: "This new phenomenon would also lead to the construction of bombs, and it is conceivable — though much less certain — that extremely powerful bombs of a new type may thus be constructed." The letter did not reach Roosevelt until October, but once he learned of the potential risks presented by nuclear weaponry, he responded by forming the Advisory Committee on **Uranium**, which held its first meeting on October 21, 1939.

THE MANHATTAN PROJECT

Although formed in 1939, the Advisory Committee on **Uranium** moved slowly at first. However, Japan's attack on Pearl Harbor on December 7, 1941, pushed the Committee into action. With the United States formally at war, the question of **uranium** development and the potential construction of an atomic bomb gained renewed interest. This interest rose even higher as a report issued by British scientists in March 1941 confirmed the possibility of building a **uranium**-based bomb, giving American scientists the validation they sought. In spite of this enthusiasm, the limitation of resources quickly became evident and prompted committee leaders to turn to the military for help.

As the United States began its island-hopping campaign in the Pacific, the Army Corps of Engineers took over the effort to produce atomic weaponry on the Home Front. On August 13, 1942, the Army Corps created the Manhattan Engineer District, named for the location of its offices in New York City. The following month, on September 17, Colonel Leslie R. Groves was appointed to head the project and received a promotion to Brigadier General. Within two days of his appointment, Groves made quick decisions to move the project forward, selecting three primary sites for the manufacture of an atomic bomb.



Overhead shot of Fermi's Pile-1 experiment constructed beneath Stagg Field the University of Chicago.
(Image: Courtesy of Los Alamos National Laboratory.)

Groves first selected Oak Ridge, Tennessee, as the site for **uranium** enrichment. Also among the primary project sites was Los Alamos, New Mexico. Designated "Project Y," Los Alamos was the site of the Manhattan Project's weapons research laboratory. This Los Alamos site would become the location for the construction of the atomic bombs. The last primary site Groves selected was Hanford, Washington, which he designated to produce **plutonium** from the **uranium isotope** U-238. Though **plutonium** is not a naturally occurring element, scientists discovered its production within **uranium reactors**. **Plutonium** proved to be a more radioactive metal and had a higher possibility of achieving nuclear **fission**.

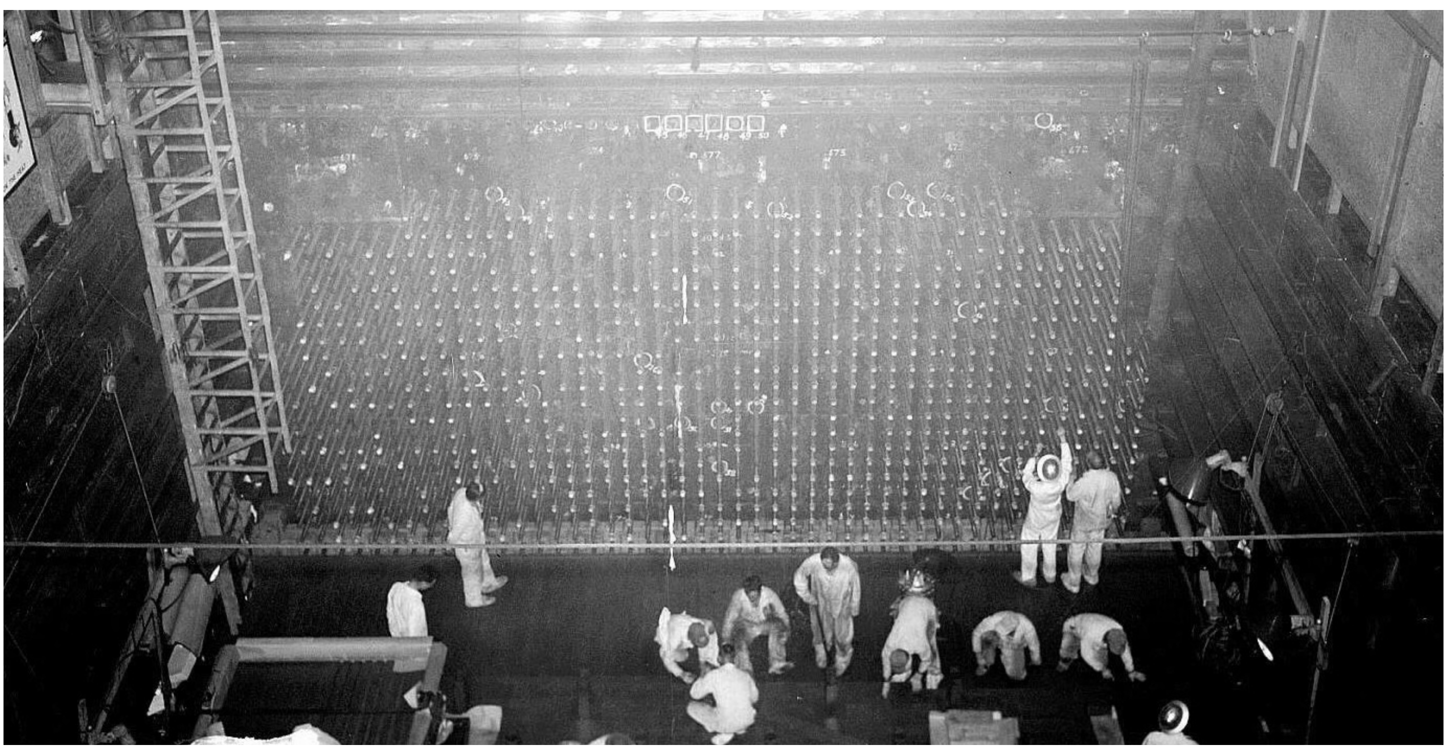
As Groves made these moves, a breakthrough in nuclear research beneath the squash courts at the University of Chicago created a model for the future production of atomic weapons.

Early in 1942, Fermi and Szilard, who had been working to build a reactor at the University of Columbia, moved their effort to Chicago. After construction was complete, on December 2 of that year, the scientists began removing the calcium control rods from the **uranium** pile. Following the removal of the final control rod, the pile went critical. The resulting **nuclear reaction** became self-sustaining and continued at an increasing pace for a few minutes until Fermi ordered the reactor shut off. Although the **reaction** only produced enough energy to power a light bulb, this moment marked the first instance in history of a self-sustaining **nuclear reaction**. The event also gave nuclear scientists a model for the production of large amounts of **plutonium**, which would eventually become the basis of the B Reactor built at Hanford.

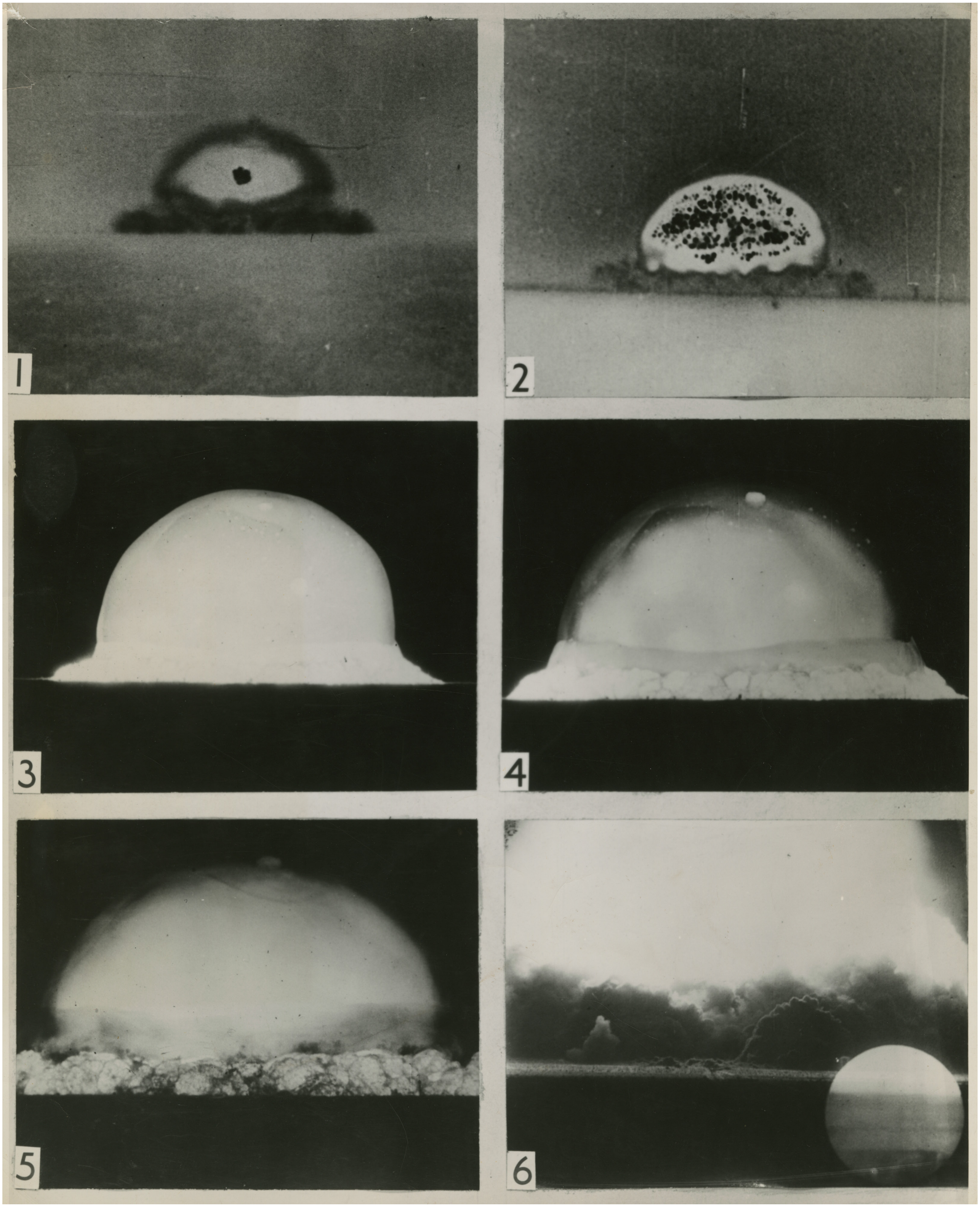
After receiving formal approval from President Roosevelt on December 28, 1942, the Manhattan Project developed into a massive undertaking that spread across the United States. With over 30 project sites and over 100,000 workers, the Manhattan Project came to cost approximately $2.2 billion. Even though encompassing such a massive scale, the project largely remained a secret, and many of the people working on the construction of the atomic bomb did not fully know the purpose behind their jobs. Following Fermi's successful experiment in Chicago, there appeared to be two possible paths toward building atomic bombs: **uranium** and **plutonium**. The Manhattan Project built both kinds of bombs, ultimately resulting in the construction of Little Boy, a **gun-method uranium** bomb, and Fat Man, an **implosion-method plutonium** bomb.

The responsibility of bringing these bombs into existence fell to the man Groves selected to head the secret weapons laboratory at Los Alamos: J. Robert Oppenheimer. A theoretical physicist and professor of physics at the University of California, Berkeley, Oppenheimer became involved early in the scientific research that ultimately led to the Manhattan Project. Under Oppenheimer's direction, Manhattan Project workers constructed a **plutonium** bomb. The **plutonium** bomb relied upon the implosion of the reactive plutonium rather than on the piercing of the plutonium with a bullet, which was common in **gun-method** bombs and which worked better with **uranium**. While the **gun-method** was a more familiar method conceptually to its creators, the **implosion-method** was not. Due to the unprecedented nature of such a bomb, Oppenheimer felt a test was necessary. Groves initially hesitated because **plutonium** was both expensive and rare. However, Groves relented and approved moving forward with a test.

> **"THE STUFF WILL APPARENTLY BE MORE POWERFUL THAN WE THOUGHT, THE AMOUNT NECESSARY APPEARS TO BE LESS, THE POSSIBILITIES OF ACTUAL PRODUCTION APPEAR MORE CERTAIN.**
>
> *VANNEVAR BUSH TO PRESIDENT ROOSEVELT, MARCH 9, 1942*



Front face of the B Reactor at the Manhattan Project site in Hanford, WA.
(Image: Courtesy of United States Government, public domain.)



Expanding explosion from the Trinity Test in Alamogordo, New Mexico.
(Image: The National WWII Museum, 2012.019.741_1.)

> **NOW I AM BECOME DEATH, THE DESTROYER OF WORLDS.**
>
> *J. ROBERT OPPENHEIMER REFERENCING A VERSE FROM THE BHAGAVAD GITA.*

THE TRINITY TEST

Inspired by the seventeenth-century poet, John Donne, Oppenheimer came to call the test "Trinity." Oppenheimer had been reading Donne's Holy Sonnets before the test and found inspiration in the line from "Sonnet XIV," which opens with the line, "Batter my heart, three-person'd God." The test took place at Alamogordo, New Mexico, rather than at Los Alamos. Hundreds of Manhattan Project workers moved in to prepare the Alamogordo site which was located 200 miles south of the Project Y site. The test bomb, nicknamed Gadget, contained 13 pounds of **plutonium**, as well as the **implosion-method** of detonation. Using a steel tower, scientists hoisted and suspended Gadget 100 feet into the air, and at 5:29 a.m. on July 16, 1945, the Trinity Test began. The test proved far more successful than Oppenheimer anticipated. He had expected an explosion equivalent to .3 kilotons of TNT; instead, the resulting blast equated to roughly 21 kilotons of TNT. The flash from the bomb was so bright that it temporarily blinded observers standing 10,000 yards away. The heat from the bomb was so intense that it evaporated the steel tower, left a crater five feet deep by 30 feet wide, and melted the sand in the area, creating a mildly radioactive green glass called "**trinitite**." Upon witnessing the blast, Oppenheimer famously uttered a line from the Bhagavad Gita, "Now I am become Death, the destroyer of worlds."

CONCLUSION

The success of the Trinity Test exceeded the expectations of Groves and most of the scientists involved in the Manhattan Project. The day after the test, Roosevelt's successor, President Harry Truman, traveled to the Potsdam Conference where he received word of the Trinity Test's success. Truman used the results as leverage to demand Japan's unconditional surrender, which Japanese officials opted to ignore. The discovery and harnessing of atomic energy not only served to bring World War II to a rapid and fiery end, but it also placed the United States in a position of global power not held by any other nation following the war's end. From the race to keep such power out of Nazi hands and to the use of atomic bombs on Japan to end the war, the Manhattan Project pushed humanity across the threshold into a new atomic age that forever altered the nature of conflict and the fear of global warfare.

The B-29 bomber, *Bockscar*, flies over Nagasaki as a mushroom cloud rises in the background.
(Image: Courtesy of Los Alamos National Laboratory.)

(Image: The National WWII Museum, 2018.233.512_1.)

WHO'S WHO IN THE MANHATTAN PROJECT

LESLIE R. GROVES

An officer in the United States Army Corps of Engineers, Lieutenant General Leslie R. Groves headed a number of large-scale projects, including the construction of the Pentagon in Washington, D.C. Groves developed a reputation for intense organization and a relentless drive, which made him well suited to head the massive undertaking of the Manhattan Project. After receiving his orders in 1942, Groves took immediate action to organize and delegate the necessary tasks required to achieve the monumental feat of constructing an atomic bomb. By designating the three primary sites to develop specific aspects of manufacturing the materials for the atomic bomb and by working closely with leading scientists such as J. Robert Oppenheimer, Groves helped guide the successful completion of the Manhattan project within three years.

(Image: Los Alamos National Laboratory.)

ROBERT OPPENHEIMER

A theoretical physicist and professor of physics at the University of California, Berkeley, J. Robert Oppenheimer took a leading role in the Manhattan Project, specifically overseeing the construction of the atomic bombs. Before meeting Groves and taking charge of "Project Y," the site at Los Alamos, Oppenheimer was already working with leading scientists exploring theories of a potential atomic bomb. Oppenheimer came to head the manufacture of the world's first nuclear weapons at Los Alamos, a site he selected. Through his leadership, the Manhattan Project came to produce three atomic bombs. His significant role and scientific insight gained Oppenheimer the credit for being the "father of the atomic bomb."

(Image: Los Alamos National Laboratory.)

ENRICO FERMI

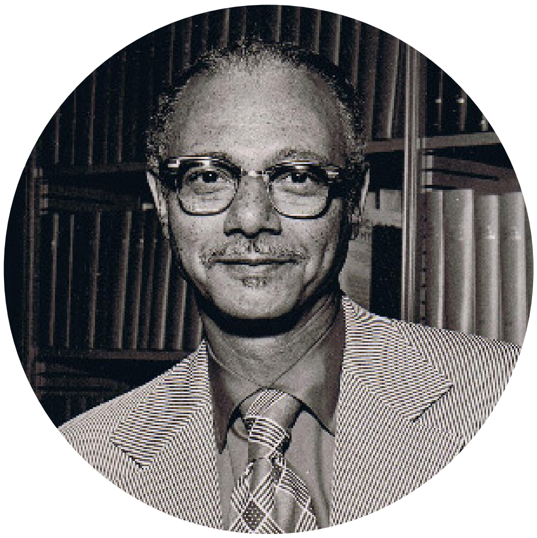
Enrico Fermi, an Italian physicist and recipient of the Nobel Prize in Physics, helped create the world's first nuclear reactor. Fermi led the successful experiment at the University of Chicago, called Chicago Pile-1, which resulted in the first ever self-sustaining nuclear **chain reaction**. The success of Fermi's experiment provided scientists working on the Manhattan Project with a model for the large-scale production of **plutonium**. For this reason, Fermi received recognition for being the "architect of the atomic bomb," and he remained actively involved in the construction of atomic bombs throughout the course of the Manhattan Project. Fermi was on hand when the reactor at Oak Ridge went **critical**, and he was in Hanford to insert the first **uranium** fuel slug into the B Reactor. Fermi was also present at the Trinity Test where he speculated whether or not the bomb would ignite the atmosphere. Following World War II, Fermi remained at the University of Chicago as a Distinguished Professor of Physics.

(Image: National Archives and Records Administration, 558578.)

CHIEN-SHIUNG WU
(COLUMBIA)

Chinese American physicist, Chien-Shiung Wu is among the few individuals (and possibly the only individual) of Chinese descent to have worked on the Manhattan Project. Born near Shanghai, Wu studied physics at university in Shanghai and then migrated to California to complete her PhD at the University of California, Berkeley, in 1940. She became a physics instructor at Princeton University before joining the Manhattan Project in 1944. Working with a team of scientists at Columbia University, Wu specialized in the study of radiation detectors. Wu also identified the xenon poisoning that occurred in the B Reactor at Hanford, which temporarily shut down **plutonium** production. After World War II, Wu remained in the United States as travel to China became increasingly difficult with the outbreak of war between Chinese Nationalist and Communist forces. She remained at Columbia University for the remainder of her career.

(Image: Smithsonian Institution Archives, SIA Acc. 90-105.)



EDWIN R. RUSSELL

(CHICAGO/OAK RIDGE)

African American chemist Edwin R. Russell participated in the Manhattan Project by first working at the University of Chicago's Metallurgical Laboratory and later moving to Oak Ridge. Russell attended the University of Chicago to pursue a PhD in surface chemistry, and while there he became involved in the Manhattan Project. Russell researched the best methods for isolating and extracting **plutonium**-239 from **uranium**. In developing techniques for purifying **uranium** ore, Russell's research helped expedite the production of **plutonium**. Following World War II, Russell returned to his home in Columbia, South Carolina, where he served as Chairman of the Division of Science at Allen University. He also earned 11 patents through his research on atomic energy processes.

(Image: Atomic Heritage Foundation.)

ELIZABETH RIDDLE GRAVES

(LOS ALAMOS)

Known as "Diz," Elizabeth Riddle Graves was an American physicist who received her PhD in physics from the University of Chicago where she conducted experiments on the detection and measurement of fast neutrons. She also worked with Fermi on the study of nuclear **chain reactions**, and her research helped contribute to the Chicago Pile-1 experiment. In 1943, after moving to Los Alamos to join the Manhattan Project, Graves selected the neutron reflector used to surround the bomb's core and became one of the top-ranking female scientists to work on the construction of atomic bombs at Los Alamos. She attended the Trinity Test while seven months pregnant and even completed a series of experiments while in labor. After World War II, "Diz" Graves continued to research nuclear physics at Los Alamos.

(Image: US Army.)

VERONICA TAYLOR
(NEZ PERCE/DISPLACED-HANFORD)

A member of the Nez Perce tribe, Veronica Taylor grew up near the location that became Hanford, off the Columbia River in Washington. When she was still a child, US military personnel began arriving in the area, preparing the site for the construction of Manhattan Project facilities. The construction of Hanford pushed Taylor and her tribe from the area on the Columbia River, which they relied on for a source of food. Moving to a new location disrupted many tribal practices. As tribal members continued to use the river for sustenance, Taylor bore witness to the rising cases of cancer that began to affect her community. Taylor herself battled breast cancer as a young woman. The sharp rise in cases of cancer caused many neighboring tribes to become wary of visiting the Nez Perce. Taylor would go on to speak out publicly about the effects of the Manhattan Project on her community. She also participated in restoration efforts, but fear of the land still keeps many tribal members from the area.

(Image: Atomic Heritage Foundation.)

KLAUS FUCHS
(SPY/LOS ALAMOS)

A German theoretical physicist, Klaus Fuchs became one of the most infamous spies to work on the Manhattan Project, secretly passing on information about the atomic bomb to the Soviet Union (USSR). Fuchs, who had fled Nazi Germany in 1933, went to England where he received a PhD in physics and another in science. Fuchs became a British citizen in 1942, and the following year he traveled with a team of British scientists to Columbia University in New York to work on the Manhattan Project. In New York, an agent nicknamed "Raymond" for the KGB—the main security agency for the Soviet Union—approached Fuchs and recruited him to spy on behalf of the Soviet Union. In 1944, Fuchs transferred to Los Alamos where he worked on imploding a **fissionable plutonium** core. He was also present at the Trinity Test. The entire time he was at Los Alamos, Fuchs passed on intelligence to Soviet agents. Awareness of Fuchs's espionage did not come to light until 1949. He initially denied the charges but ultimately confessed in 1950. After trial proceedings that lasted a total of 90 minutes, Fuchs received a sentence of 14 years in prison and lost his British citizenship.

(Image: National Archives UK.)

(Image: The National WWII Museum.)

INTERACTIVE GLOSSARY

ONLINE RESOURCES

Find visual presentation of the glossary terms with this symbol on ww2classroom.org.

CHAIN REACTION
When a single **nuclear reaction** leads to additional and ongoing **reactions**, with the possibility of becoming self-sustaining.

CRITICAL MASS
The amount of atomic material required to sustain nuclear **fission**.

ISOTOPE
Variants of chemical elements that have the same number of protons but different numbers of neutrons, which means that different **isotopes** can have the same atomic number (based on number of protons) but have a different mass number.

IMPLOSION-METHOD
A detonation method in which explosive devices surround a core of nuclear material, such as **plutonium**, that is near the point of **critical mass**. With the triggering of the devices, the imploding force squeezes the **plutonium** pit, forcing **critical mass** and resulting in an external explosion.

FISSION
A **nuclear reaction** in which an atom's nucleus splits into smaller parts.

GUN-METHOD
Fission-based weapons designed to detonate when a piece of sub-critical material shoots into supercritical material and ignites an explosion.

NUCLEAR REACTION
When, through the process of **fission** or radioactive decay, the nucleus of an atom changes into a different element.

PLUTONIUM
A radioactive element with the atomic number 94, produced in **uranium** reactors.

TRINITITE
The green-colored, lightly radioactive glassy residue created during the Trinity Test, in which the heat of the nuclear blast melted the sand within the bomb test site.

URANIUM
A naturally-occurring radioactive element used for the production of nuclear energy. The most common **isotope** used is U-235.

(Image: The National WWII Museum.)

MANHATTAN PROJECT BY THE NUMBERS

2.2 BILLION	Overall cost in dollars of the Manhattan Project.
2 MILLION	Square feet under the roof of the K-25 Gaseous Diffusion Complex at Oak Ridge, Tennessee, used for the production of fissile **uranium** and was at the time the largest building on Earth.
140,000	Estimated number of people in Hiroshima killed by Little Boy.
130,000	Approximate count of people who worked on the Manhattan Project.
70,000	Estimated number of deaths caused by dropping Fat Man on Nagasaki.
50,000	Population at Hanford, Washington, by 1944.
21,000	Tons of TNT, or the equivalent strength of the explosion caused by detonating Gadget at the Trinity Test.
5,000	People assigned to the single P.O. Box 1663 at Los Alamos, New Mexico.
13	Pounds of plutonium in Gadget.
1	Number of tests conducted on atomic bombs before use against Japan.

SELECTED CHRONOLOGY

DECEMBER 21, 1938
German discovery of fission through the work of Lise Meitner and Otto Hahn.

AUGUST 2, 1939
Einstein's letter to President Franklin Delano Roosevelt (FDR), who responds noting creation of the Advisory Committee on **Uranium**.

JULY 2, 1941
MAUD report from the British, confirming possibility of an atomic bomb.

DECEMBER 7, 1941
Japan attacks Pearl Harbor; the United States enters World War II.

DECEMBER 18, 1941
Advisory Committee on **Uranium** restructured into the S-1 Committee, which meets for the first time.

JUNE 17, 1942
US Army Corps of Engineers takes over atomic bomb development

AUGUST 13, 1942
The Manhattan Project formally created, initially with Colonel James C. Marshall in command.

SEPTEMBER 17, 1942
Col. Leslie R. Groves appointed head of the Manhattan Engineer District; promoted to Brigadier General six days later.

SEPTEMBER 19, 1942
Oak Ridge selected for **uranium** production.

NOVEMBER 25, 1942
Groves selects Los Alamos for site of bomb production. He appoints J. Robert Oppenheimer to head "Project Y" at Los Alamos.

DECEMBER 2, 1942
The mass pile at Chicago goes critical, creating the first self-sustaining **nuclear reaction**.

JANUARY 16, 1943
Groves designates Hanford, Washington, for location of **plutonium** development.

AUGUST 7, 1944
General George C. Marshall receives briefing that states a **uranium** bomb will be ready by August 1, 1945

SEPTEMBER 27, 1944
The B reactor at Hanford goes **critical** for the first time, but struggles to maintain consistent chain **reactions**. Scientists manage to achieve consistent **reactions** by December and begin producing **plutonium** by January 1945.

APRIL 12, 1945
FDR dies; Harry S. Truman becomes President. Truman briefed on Manhattan Project on April 25.

APRIL 27, 1945
The Target Committee meets for the first time and selects seventeen target sites for atomic bombing. The list includes both Hiroshima and Nagasaki.

MAY 7, 1945
A "100-ton test," held 800 yards away from the Trinity Test site in Alamogordo, New Mexico, included the detonation of 108 tons of TNT and 1000 curies of reactor **fission** products. This explosion is the largest in history conducted up to this date.

JULY 11, 1945
Assembly of the test bomb, "Gadget," begins.

JULY 14, 1945
Scientists install the detonators and hoist Gadget to the top of a 100-foot tower. Final test preparations begin.

JULY 16, 1945
At 5:29 a.m., the Trinity Test occurs, detonating Gadget at Alamogordo, New Mexico. It is the first atomic explosion in history. The explosion vaporizes the 100-foot steel tower.

JULY 17, 1945
President Truman attends the Potsdam Conference and calls for Japan's unconditional surrender, warning the Japanese that they face "prompt and utter destruction." Japanese officials ignore the demand.

JULY 26, 1945
Parts for "Fat Man" and "Little Boy" arrive at Tinian Island for assembly.

AUGUST 6, 1945
A B-29 bomber called the *Enola Gay* departs Tinian and flies to Hiroshima, Japan. At 8:16 a.m., Little Boy explodes, destroying five square miles of the city.

AUGUST 9, 1945
The B-29 bomber, Bockscar, departs Tinian and heads toward the initial target, Kokura. Poor visibility leads the pilot to move to the secondary target, Nagasaki. At 11:02 a.m., Fat Man explodes. Six days later, on August 15, the Japanese Empire announces its surrender.

(Image: The National WWII Museum, 2012.019.567_1.)

ESSAY

"WHAT YOU SEE HERE": LIFE IN A SECRET CITY

Security billboard on display at Oak Ridge, TN promoting silence from all who lived in the secret city.
(Image: US Army, public domain.)

The Manhattan Project relied upon the research and labor of over 100,000 people across the United States. While many were scientists, the scope and scale of the project required construction laborers, secretaries, security guards, cooks, janitors, along with any other occupation necessary to run an entire city. Unlike other cities, however, these project sites maintained strict security. People writing letters home could not disclose details of the work they did. To receive letters, workers lived at generic addresses, such as "Barracks Area" at Oak Ridge, or in the case of Los Alamos, thousands of residents shared the same P.O. Box address. Oftentimes, people became involved in the Manhattan Project without having any knowledge of where they were going or of what kind of work they might have to do. The secrecy of the project meant that many contributors to the Manhattan Project only learned what they had participated in after the United States dropped an atomic bomb on Hiroshima, Japan. To offer brief glimpses into the lives of those who helped make the Manhattan Project possible, here is a look at the profiles of four individuals who lived and worked in the secret cities of Oak Ridge, Hanford, and Los Alamos. Each came to participate in the Manhattan Project in different ways, and yet each of their efforts led to the construction of the world's first atomic bombs.

No two workers shared the same experience while living in a secret city, but their participation in the Manhattan Project had an enduring effect on their lives. As shown in the profiles of Robert Garber and Lawrence Denton, workers often continued to work at the sites after the Manhattan Project came to an end. For others, like Wilma Gray, moving to Oak Ridge helped her to meet her future spouse. To Esequiel Salazar, the nature of the work, while difficult, remained a point of pride, as he and hundreds of other Hispano workers helped make the construction of the bombs and the end of World War II possible. The effort to build the atomic bomb encompassed far more than the military project that rested at the center of life in a secret city. While workers kept what they saw, heard, and did within the confines of those work sites, the rhythm of life continued, even if steeped in secrecy.

Wilma Betty Gray headshot.
(Image: The National WWII Museum, 2018.044.009_1.)

STAFF SERGEANT WILMA BETTY GRAY
(WAC)

OAK RIDGE, TENNESSEE

Wilma Gray born in Akron, Ohio, attended Kent State University before the start of World War II. Gray’s older sister, Hannaleen, was in China with her husband, who was working with B.F. Goodrich in Shanghai. Hannaleen fled to Manila in response to Japanese aggression. Both Hannaleen and her husband ended up imprisoned by the Japanese as prisoners of war. Hannaleen spent her incarceration at Santo Tomas until December 1943.

Wilma Gray became involved in the war effort in response to what happened to her older sister and in a desire to serve the United States. She enlisted in August 1944 at age 23. Following her enlistment in the Women’s Army Corps (WAC), she ended up on a train not knowing her destination. The secrecy surrounding the Manhattan Project work sites meant few on the train knew where they were going. The destination proved to be Oak Ridge, Tennessee. After arriving, Wilma moved into a large dormitory with other WACs. At Oak Ridge, Gray was the general secretary for the Safety, Security, and Fire Prevention Office at the K-25 building at the Oak Ridge Gaseous Diffusion Plant, which was the site and project codename for the production of enriched **uranium**. She handled classified reports and correspondence related to the project. While there, Wilma received a promotion to Staff Sergeant.

Gray found Oak Ridge a less than appealing place to live, missing her life in Akron, Ohio. She did not particularly enjoy living in a dorm with several other women, and she found Oak Ridge itself to be a “a bit dusty, and a bit muddy.” While she found life and work in the secret city to be akin to living in a big cage surrounded with barbed wire, Gray still found ways to make a life for herself. Gray met her future husband, John H. Gianos, at Oak Ridge while Gianos worked in the Special Engineering Detachment in the K-25 building. Wilma Gray participated in the Manhattan Project at Oak Ridge until the war’s end, and she later left the WACs in August 1946.

(Image: Wilma Betty Gray Collection, The National WWII Museum, 2018.044.)

Robert Garber headshot.
(Image: The National WWII Museum, 2018.233.538_1.)

ROBERT GARBER, CHEMICAL ENGINEER
(US ARMY)

OAK RIDGE, TENNESSEE

In January 1944, Robert “Bob” Garber completed his training as a chemical engineer through the Army Specialized Training Program at Purdue University. In March of that year, Garber received orders to report to the Clinton Laboratories at Knoxville, Tennessee, where the Army Corps of Engineers worked on the Manhattan Project. Upon arrival at Clinton Laboratories, Garber received an assignment to the Special Engineer Detachment TSU 9812 to work as a chemical engineer, although the exact work remained unclear. From Knoxville, he went to Oak Ridge, where he worked in a lab running tests on a small atomic pile. Inserting slugs of **uranium** into the pile, Garber helped create small, concentrated amounts of **plutonium**.

In frequent letters to his parents, as well as other friends and family members, Bob Garber offered brief glimpses into life at Oak Ridge. He described the housing arrangements as living in barracks. He stated that workers received $1.80 per day to pay for meals at a cafeteria located across the street from the housing. A swimming pool on site proved to be a popular attraction for Bob and his friends at Oak Ridge, and they often took trips to the pool on hot days after work. He and his friends also took occasional trips into the Tennessee wilderness to visit areas around Big Ridge, hitchhiking or taking buses in and out of the secret city.

> “
>
> **I SUPPOSE YOUR INTEREST HAS BEEN AROUSED BY THE SENSATIONAL HEADLINES ABOUT ‘ATOMIC BOMBS.’ WELL, SECURITY PERMITS TO SAY THAT WE ARE CONNECTED WITH THE MANHATTAN ENGINEERING DISTRICT.**

Unlike many who contributed to the Manhattan Project, Garber knew of his efforts to help construct the atomic bomb. In a letter home to his parents on August 7, 1945, he wrote, “I suppose your interest has been aroused by the sensational headlines about ‘Atomic Bombs.’ Well, security permits to say that we are connected with the Manhattan Engineering District.”

Garber continued to work at Oak Ridge until later discharged in February 1946. He then continued to work as a chemical engineer at the University of Michigan.

Main gate at Los Alamos Manhattan Project site.
(Image: Courtesy of Los Alamos National Laboratory.)

ESEQUIEL SALAZAR

("VOICES OF THE MANHATTAN PROJECT," ATOMIC HERITAGE FOUNDATION, WILLIE ATENCIO/DAVID SCHIFERL COLLECTION)

LOS ALAMOS, NEW MEXICO

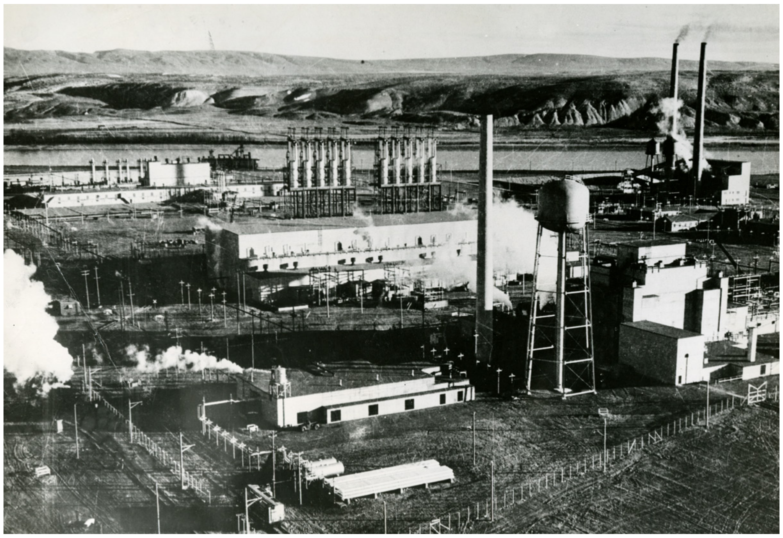
Born in Pojoaque, New Mexico, Esequiel Salazar became involved in the Manhattan Project as a teenager after taking a job with the Robert E. McKee Company. Salazar began working with the Manhattan Project at Los Alamos in the early days of the project site's development. Working first as an apprentice carpenter, he made $.56 per hour. After completing his apprenticeship, Salazar became a "carpenter helper," making $.86 per hour. Full carpenters made $1.25 per hour. He later began working as a rod-man assisting surveyors working at Buildings 1, 2, and 3. Building 2 was where **plutonium** testing occurred and Salazar helped dispose of contaminated fluids produced in the weapon manufacture process. Salazar recalled his work there, stating, "I got acquainted with the project. Of course, we didn't know what they were really doing. It wasn't up to us. But it was strange materials that we were using."

> **OF COURSE, WE DIDN'T KNOW WHAT THEY WERE REALLY DOING. IT WASN'T UP TO US. BUT IT WAS STRANGE MATERIALS THAT WE WERE USING.**

Esequiel Salazar had to have his blood tested on occasion if dosimeters indicated high levels of radiation. Security was also a constant presence on site at Los Alamos. He described four different military police stations where he had to have his badge checked for verification. Salazar was in Los Alamos the day of the Trinity Test, and he described the celebration that followed the test. Some of the workers even traveled to Santa Fe to celebrate.

It was only after the end of World War II that Salazar learned of the nature of the work he assisted with at Los Alamos. He stated, "I think that we should all take credit for that, because we all took a part in it. I think it's important that people realize that the scientists couldn't do their jobs if it wasn't for the cement workers that are putting the slabs and building their laboratories. Doing what is necessary to get rid of the contaminated fluids and liquids and all the chemicals that were being used."

Esequiel Salazar later joined the US armed forces and went to Japan as a part of the US occupation force. While there, he saw the destructive effect of the use of atomic bombs on Japan. Even so, he maintained that the use of the bombs "was something that had to be done when they did it."



Overhead view of the Manhattan Project site at Hanford, WA.
(Image: The National WWII Museum, 2012.019.567_1.)

LAWRENCE “LARRY” DENTON

("VOICES OF THE MANHATTAN PROJECT,” ATOMIC HERITAGE FOUNDATION)

HANFORD, WASHINGTON

Born in Northern Idaho, Lawrence “Larry” Denton became involved in the Manhattan Project at Hanford through his father, who recruited him to work on the B Reactor. Denton had previously worked at a lumber yard, but he found the work at Hanford more steady and safe than work in lumber mills. Initially working as a shipping clerk at Hanford, he helped bring in roughly a million containers of helium and oxygen gases.

The B Reactor at Hanford today.
(Image: Personal photo, courtesy of Jeremy Burson.)

Larry Denton lived in the barracks at Camp Hanford where he roomed with a professional welder from New York City named Otto Lowers. His roommate helped teach others how to weld parts onto the reactor. Living in Hanford at the Manhattan Project site put Denton into contact with African Americans for the first time in his life. He commented on the segregation enforced at Hanford stating, “I’d never been around black people, and they had black people segregated from the whites. That didn’t make sense to me… But that was a fact and they accepted it and the whites accepted it.”

Denton’s work moved from bringing in shipments of gas to shipping off construction materials used for milling graphite for the B Reactor. He stated that no one knew what was going on or what the nature of their work entailed, but he knew the materials brought in for the project were exceptional.

Denton described life in Hanford as an amazing experience. The site had a theater, a recreational hall, large mess halls, and the work brought in consistent pay. He continued to work on site at Hanford into the 1960s.

(Image: The National WWII Museum, 2018.233.520_1.)

COVERT OPERATORS

GRADE LEVEL: 7-12 TIME REQUIREMENT: 1-2 CLASS PERIODS

INTRODUCTION

Over 100,000 people from across the United States participated in the Manhattan Project, whether they supervised safety measures in the reactors, helped build the roads and buildings that made up the secret cities, or worked on the construction of the atomic bombs directly. In this lesson, students will read excerpted quotes from oral histories given by those who participated in the Manhattan Project, as a part of the “Voices of the Manhattan Project” conducted by the Atomic Heritage Foundation. Reading the quotes, students will extract context clues to determine the primary site where each individual worked, the kind of jobs each individual did to contribute to the building of atomic weapons, and whether or not the students think each individual was aware of what he or she was building. By piecing together these context clues, student will use critical and analytical thinking skills to create a profile of a Manhattan Project worker and how that person’s efforts led to the making of the world’s first atomic bombs.

MATERIALS

+ Copies of the of the Introductory Essay, “Destroyer of Worlds”

+ Copies of the essay “Life in a Secret City”

+ Copies of the Student Worksheet

+ Map of primary Manhattan Project sites

+ Videos of Secret Cities – Clip from “Critical Past” video

OBJECTIVES

In assessing the details featured in quotes from oral histories, students should be able to apply critical thinking and analytical skills to determine information about Manhattan Project workers. Using the included essays to provide necessary background information, students will produce a critical assessment by pairing primary and secondary sources. By combining source materials, students should be able to provide a general sketch of each worker, who that worker was, and what role that worker contributed to the Manhattan Project.

COMMON CORE STANDARDS

CCSS.ELA-LITERACY.RH.6-8.1
Cite specific textual evidence to support analysis of primary and secondary sources.

CCSS.ELA-LITERACY.RH.6-8.9
Analyze the relationship between a primary and secondary source on the same topic.

CCSS.ELA-LITERACY.RH.9-10.2
Determine the central ideas or information of a primary or secondary source; provide an accurate summary of how key events or ideas develop over the course of the text.

CCSS.ELA-LITERACY.RH.11-12.2
Determine the central ideas or information of a primary or secondary source; provide an accurate summary that makes clear the relationships among the key details and ideas.

ONLINE RESOURCES

ww2classroom.org

Secret Cities Video Clip

Map of Manhattan Project Sites

NATIONAL STANDARDS FOR HISTORY

HISTORICAL THINKING STANDARD
The student conducts historical research; therefore, the student is able to demonstrate the following:

- Identify the gaps in the available records and marshal contextual knowledge and perspectives of the time and place in order to elaborate imaginatively upon the evidence, fill in the gaps deductively, and construct a sound historical interpretation.

- Support interpretations with historical evidence in order to construct closely reasoned arguments rather than facile opinions.

PROCEDURES

1. Before beginning the lesson, have the students read the included essays in the curriculum guide, "The Destroyer of Worlds" and "Life in a Secret City." Start the lesson by showing students the video clip of footage from Hanford and Oak Ridge. Have students briefly outline in a full-class discussion the key points they understand about the Manhattan Project, the primary project sites, and the kind of work people who participated in the Manhattan Project did.

2. Break the class up into small groups and give them copies of quotes from two different Manhattan Project workers and copies of the Student Worksheet. Instruct the class to read through the quotes and extract context clues about that person. Using the essays as a reference guide, have the students piece together important details about that individual.

3. As the students fill out the worksheet, remind them that is not always clear whether an individual knew about the construction of the atomic bombs. Some workers knew outright, while others had an idea of the work they were doing. Some did not bother to find out at all. Ask the students instead to make an informed guess when answering the final question, and you can provide the full details once the exercise is complete.

4. After the students complete their worksheets, have them discuss in a full-class discussion the workers the students read about and what the students thought of the work that was done. Through this discussion, the instructor and students together can place these individual stories into the broader narrative of the Manhattan Project.

ASSESSMENT

Through both class discussion and reading of the assigned materials, students should demonstrate the ability to think critically about details presented out of context. In extracting key details, students should show how they can identify and apply important details to form a historical narrative and make informed guesses about the individuals they study. Written responses should feature the inclusion of specific examples to illustrate and support the arguments they present. The concluding discussion should bring forth an ability to place individual stories in history within the larger historical narrative of the Manhattan Project.

EXTENSION/ENRICHMENT

1. Have the students compare the profiles featured in the essay "Life in a Secret City" to the Manhattan Project workers highlighted in this lesson plan. In written responses, have the students outline the similarities or differences that stand out to them when analyzing the individual stories of those who contributed to the building of the atomic bomb. Ask the students to address why certain similarities emerge and what larger conclusions they may be able to draw about the nature of work conducted in specific secret cities or within the Manhattan Project overall.

2. Have the students access additional oral histories featured on the "Voices of the Manhattan Project" database (https://www.manhattanprojectvoices.org) offered through the Atomic Heritage Foundation. What other stories are students able to find that change their understanding about the Manhattan Project and the people who contributed to it? In a short paper, have each student present a profile of the worker, where that individual worked, and how that individual participated in the Manhattan Project, making sure the student cites direct quotations from the oral histories.

EXCERPTED QUOTES FROM MANHATTAN PROJECT WORKERS

1. ROGER ROHRBACHER

Oral History Interview, *Voices of the Manhattan Project*, Atomic Heritage Foundation, (2003).

Clues from the Interview:

"I had helped mostly in B, D, and F. I came out here in April '44 and worked on instrumentation, mostly flow and temperature and pressure, and then later on radiation monitoring. Matter of fact, that was one of the clues of what was going on. None of us really knew, except maybe a dozen or so scientists."

"Matter of fact, in the early days, B—well, all the reactors were given only a fifty-sixty percent chance of operating, which brings up another question I'm surprised you didn't ask: how come there's no A reactor?"

"You know, because this whole project, Manhattan Project, was going full speed and all of the answers were not known—and when the B Reactor was first started up, things went quite smoothly. They started pulling out the control rods and the power level went up, you know, fifty, one hundred megawatts and so forth."

"I don't think any of my acquaintances figured out. I was under the impression that most people did not realize that what they were doing would end up in the atomic bomb. I think they were just kind of guessing and stuff along the way. You got the impression there was something other than a chemical plant and other than anything else, and it concerned something to do with physics."

2. VIRGINIA COLEMAN

Oral History Interview, *Voices of the Manhattan Project*, Atomic Heritage Foundation, (2018).

Clues from the Interview:

"The chemistry department had a notice one day that there would be a recruiter there if anybody wanted to be interviewed. I signed up for that. It was a woman interviewer from here, and she just wanted to interview people who were graduating in March. She described **[Redacted]** as this 90-square mile place with free buses running night and day. If I wanted to come out for an interview between Christmas and New Year's, I could do that, which I did. I had never been on a train before. I had a friend from Chapel Hill who came down from New York and met me in Asheville, and we traveled together after that."

"I decided to switch over to the chemistry, and that's when I got into the lab, and I was working under Dr. [Clarence] Larson… He was very smart. He had a lot of engineers who had come down from Yale and Harvard, new graduates. They were chlorinating **uranium**, trying to work out the right temperature and length of time and everything that you do for that. I was analyzing the chloride to see how completely they had chlorinated the **uranium**."

"I was really much more interested in the social life, you know. The cafeterias were open 24 hours a day. We had dances on the tennis courts. I was in Tennessee Eastman's, on their [tennis] team, and we had regular competitions. The rec hall with a library, and we just walked everywhere."

Wilma Betty Gray works alongside two women at Oak Ridge, TN.
(Image: The National WWII Museum, 2018.044.007_1.)

3. RAYMOND SHELINE

Oral History Interview, *Voices of the Manhattan Project*, Atomic Heritage Foundation, (2009).

Clues from the Interview:

“But let me back up and tell you a little bit about this project. It was supposed to be absolutely super-secret. Of course, all the people in our group were guessing what was going on, trying to understand why we would be working with **uranium** hexafluoride. We didn't know really very much about it.”

“But when I got there, I was put on a project working on the second method of exploding an atom bomb. It was the so-called ‘snowball mechanism’ in which you put pieces of **uranium**, pieces of a chemical explosive around a central **fissionable** material, which is not critical. By exploding it, you squeeze the **fissionable** material until it becomes critical and explodes.”

“Our part in that project was to take very large radioactive sources of the order of three or four thousand curies—which is a huge amount of radioactivity and very dangerous—and put it at the center of a ball of **fissionable** material. We used just ordinary **uranium** to [sic] in place of the **plutonium**, which would be the thing that would really be there.”

“The head of our group, the guy by the name of Homer Price said ‘Look, it's foolish for you guys just to keep speculating about this. I'll tell you what it's about. I'm not supposed to, so you keep quiet about this.’ But he told us that we were working on a project to make a superbomb, something with a tremendous energy release, and told us a little bit about it.”

4. DIETER GRUEN

Oral History Interview, *Voices of the Manhattan Project*, Atomic Heritage Foundation, (2018).

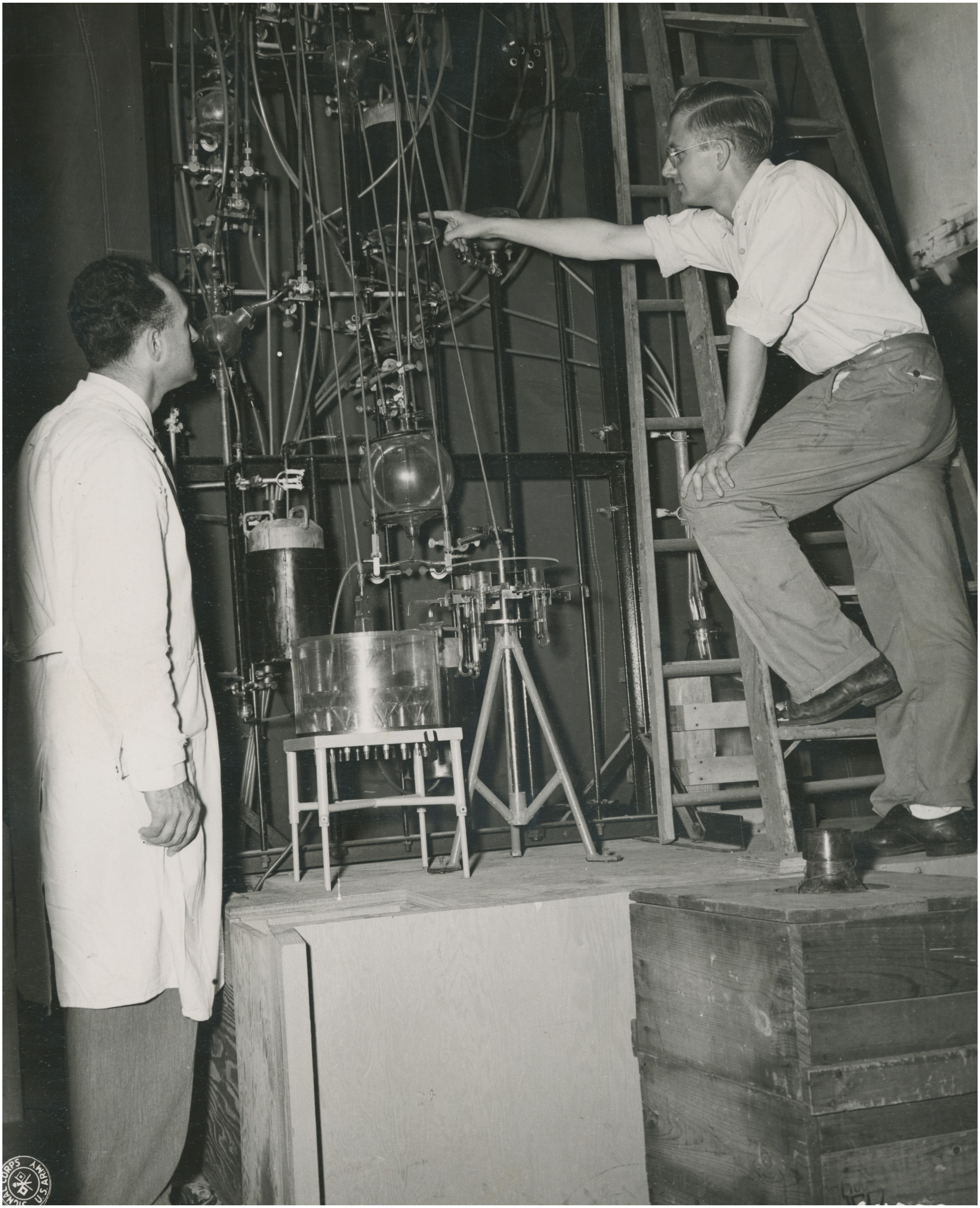
Clues from the Interview:

“Then I took a train to Knoxville, and stayed overnight… and then boarded a bus from Knoxville to **[Redacted]**. I arrived on that bus. When I got off the bus I was knee deep in mud, because **[Redacted]** was just really getting going. It was under construction, the town was under construction. That was quite an experience.”

“I did talk about the work that I did in connection with the electromagnetic separation of **uranium isotopes**, which was the work of **[Redacted]**, was to prepare **uranium**-235. When I arrived there, there was not a gram of **uranium**-235 available, and within six months, we had produced 50 kilograms using mass spectrometric separation techniques, enough material for the Hiroshima bomb.”

“I was assigned to the Chemical Research Division of Y-12. That was headed by a man by the name of Clarence—he later became director of the Oak Ridge [National Laboratory]—Larson. Dr. Clarence Larson was the director of the Chemical Research Division… But he was my boss there in the Research Division. All of the time that I was at **[Redacted]**, I was in that research division.”

“But since I talked about it before—I don’t think I said very much about what happened after the dropping of the bomb, and the reaction of the scientists to the fact that we now have nuclear weapons in the world.”



Robert Garber points out chemical separation unit used for preparing fissionable materials, at Clinton Laboratories in Oak Ridge, TN.
(Image: The National WWII Museum, 2018.233.516_1.)

5. WILLIE DANIELS

Oral History Interview, *Voices of the Manhattan Project*, Atomic Heritage Foundation, (1986).

Clues from the Interview:

"The barracks were segregated. Lots of black people were out there, in construction, and lots more were just out there, not doing nothing. We would go to work and come back and some guy had been there ransacking our room. Once we came back to the barracks, and there were some guys in there scuffling."

"Some of the guys went swimming, but I did not attempt to go swimming because they said you better not get in that Columbia River, so I was stubborn about getting in that. Me, no, see that river does not give up the dead. So, I said no, no place for me, not in that river. No, sir."

"Where I was working was up at various places, pouring concrete flooring where they stored the trucks. We pushed wheel barrows through there and put matting down. Some of those guys didn't know how to push a wheel barrow. Boy, they was in trouble. That was hard work, yes, it was. I worked common labor when I wasn't in concrete. We worked at 2-East. My brother and I poured the first mud [concrete] there, and spread it out of the mixer truck. I also worked at the 100 Areas, all three of the reactors."

"A lot of people, well, none of us did not know what we were doing. We were just working. Durant would tell us, 'If anybody asks you what are you doing? Tell them you're working. What are you building? You're working.' That is what he would tell us. So, we did not know what we was building."

6. FLOY AGNES LEE

Oral History Interview, *Voices of the Manhattan Project*, Atomic Heritage Foundation, (2017).

Clues from the Interview:

"It was 1945. The bomb was being developed at that time. My assignment was to collect the blood from the research men, scientists, who were working on the atomic bomb. I had to learn how to take blood, how to read the blood cells, what type of blood cell, and all that's connected with the hematology. I got along real well in that area. They sent me to go to different sites where the production was being done, and I would draw the blood from individuals."

"I don't know if at the time when I was there, that there were any other Indians working in the same capacity I was. I almost didn't get hired at **[Redacted]** the second time, because I was a minority. It was one of the reasons. The head of the division I was to be in did not like minorities. Because I was an Indian. I just didn't ever realize why he had it against me. But that's the way the world is sometimes."

"**[Redacted]** was a very, very interesting place. We were sort of like in a prison, but you could get in and out if you had the right cards. We could go to Santa Fe, which we did on certain occasions. There were recreations like ice skating and the tennis and all kinds of activities that went on. I lived in the dormitory where several other women lived."

"I think the worst effect of **[Manhattan Project]**—not just on the pueblo, but all the surrounding area—is the radiation that has caused leukemia. I have four relatives, two are my sister and my brother, died of leukemia."

LESSON KEY FOR TEACHERS

1. ROGER ROHRBACHER: HANFORD, WASHINGTON

Work in the Manhattan Project:
Instrument Engineer at the B Reactor. Rohrbacher monitored flow, temperature, and later radiation levels within the B Reactor.

Contribution to the Bomb:
Helped with the manufacture of **plutonium** that went into the construction of Gadget and Fat Man.

Did They Know about Building an Atomic Bomb:
Not completely.

"When the official news came out that it's the bomb, as the local papers said, it's kind of a surprise and a relief and I halfway said, 'Oh, I suspected something like that.' But I think most of us really didn't, and that's most surprising."

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2. VIRGINIA COLEMAN: OAK RIDGE, TENNESSEE

Work in the Manhattan Project:
Chemist in the Y-12 Plant at Oak Ridge. Coleman worked with **uranium** yellowcake, analyzing chlorine levels in **uranium**, as well as different methods to absorb **uranium** from different solutions.

Contribution to the Bomb:
Helped with the manufacture of **uranium** that became the basis of further **plutonium** production, in addition to its use in the construction of Little Boy.

Did They Know about Building an Atomic Bomb:
Yes, but Coleman didn't ask questions due to tight security. From her oral history, she hinted at her knowledge of the bomb:surprising."

"The next day, we were leaving on a ferry to go to Norfolk to visit my sister. We get on the ferry and everybody's talking about this. One woman says, 'Nobody knew about it.'

For the first time, I said, 'Well, I knew about it.'

She said, 'You did not! The paper said nobody knew about it.'

I thought, 'Hmm, I wonder how she thinks it got made,' but I didn't argue with her."

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3. RAYMOND SHELINE: LOS ALAMOS, NEW MEXICO

Work in the Manhattan Project:
Chemist at Columbia University and member of the Special Engineer Detachment at Oak Ridge and Los Alamos. At Los Alamos, Sheline worked on the trigger for the **plutonium** bomb,

Contribution to the Bomb:
Sheline helped with the manufacture of the **implosion-method** for **plutonium**-based bombs, featured in the test bomb Gadget and in Fat Man.

Did They Know about Building an Atomic Bomb:
Yes. The head of the group Sheline worked with, Homer Price, informed Sheline about the project.

LESSON KEY FOR TEACHERS

4. DIETER GRUEN: OAK RIDGE, TENNESSEE

Work in the Manhattan Project:
Assigned to the Chemical Research Division of Y-12.

Contribution to the Bomb:
Assisted in the production of **uranium** for use in atomic weapons, like Little Boy.

Did They Know about Building an Atomic Bomb:
His interview suggests he did know, but he was upset about its use on civilians.

He stated, "There were four of us who got together. Just that small group of colleagues, we were all about the same age. We were fully aware that there was no secret, in the sense that one could keep how you make an atomic bomb a secret. You cannot defend against it. It should never be used again, and how do you prevent it from ever being used again?"

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5. WILLIE DANIELS: HANFORD, WASHINGTON

Work in the Manhattan Project:
Poured concrete to build the reactor buildings at Hanford.

Contribution to the Bomb:
Assisted in the production of **uranium** for use in atomic weapons, like Little Boy.

Did They Know about Building an Atomic Bomb:
No. Daniels discovered his participation in the Manhattan Project after the war.

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6. FLOY AGNES: LOS ALAMOS, NEW MEXICO

Work in the Manhattan Project:
Tested blood of scientists working with radioactive materials to try and protect against radiation poisoning. Agnes specialized in the study of how radioactive elements affect blood cells.

Contribution to the Bomb:
Acted to preserve the health and safety of scientists building the bomb and handling **uranium** and **plutonium**.

Did They Know about Building an Atomic Bomb:
No. She stated, "We didn't know that we were working on the atomic bomb, except for the physicists. We thought they were doing chemical warfare."

NAME: **DATE:**

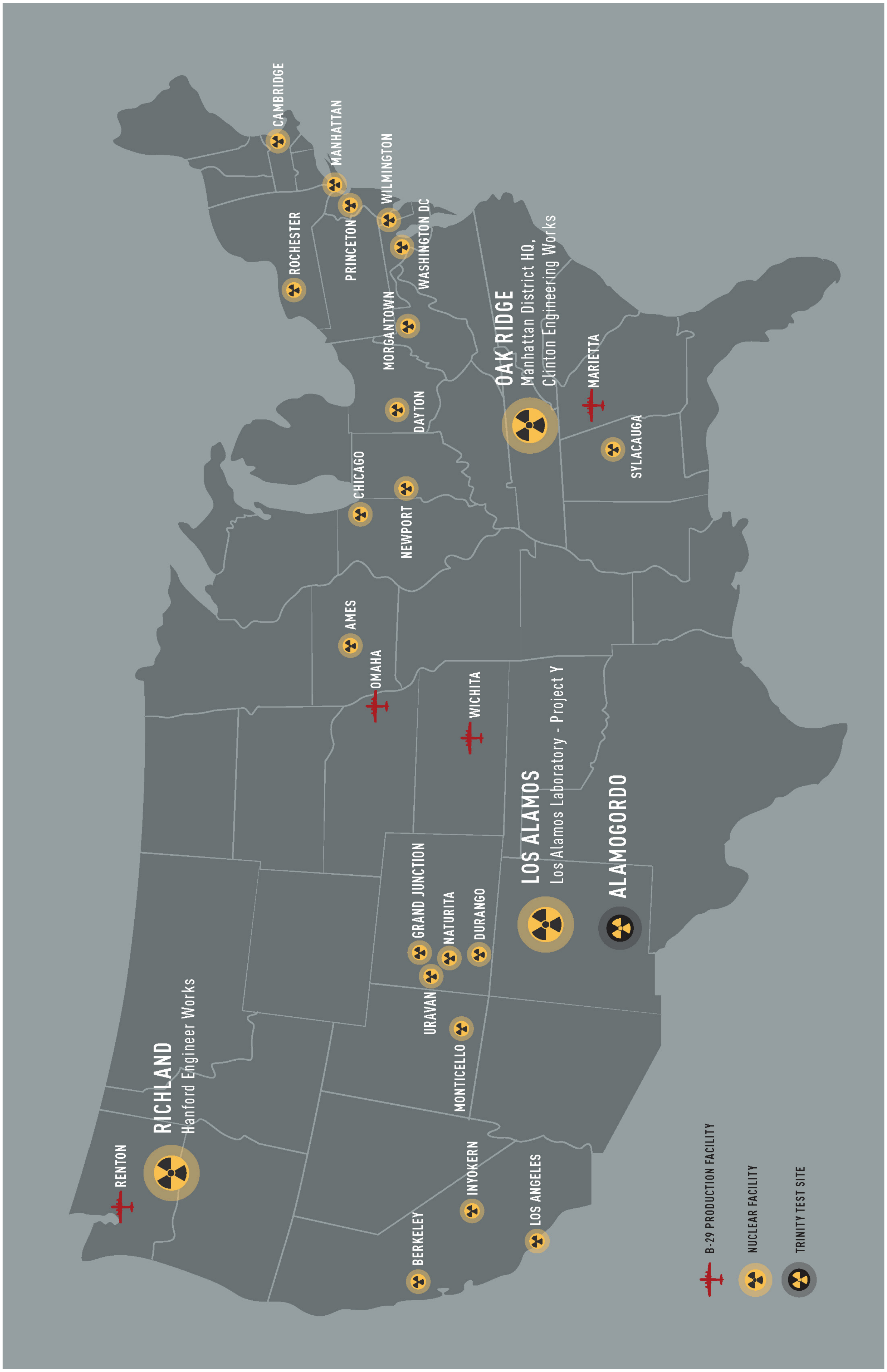
Directions: After reading the context clues for one of the people who participated in the Manhattan Project, answer the questions below to the best of your ability. Include specific examples from the clues to explain your answer.

NAME OF MANHATTAN PROJECT WORKER:

1. Based on information gathered from the quotations, what do you think was the primary Manhattan Project site where this person worked? What clues suggested that location?

2. From descriptions included in the interview quotations, what kind of work did this person do, and how do you think the work related to the construction of atomic bombs?

3. After gaining a sense of the work this person did in the Manhattan Project, do you think this person was aware of his or her role in helping to build atomic bombs? Using evidence from the quotations, explain why you think this person did or did not know about construction of the bomb.


CAMBRIDGE
MANHATTAN
WILMINGTON
PRINCETON
WASHINGTON DC
ROCHESTER
MORGANTOWN
OAK RIDGE
Manhattan District HQ,
Clinton Engineering Works
MARIETTA
SYLACAUGA
DAYTON
CHICAGO
NEWPORT
AMES
OMAHA
WICHITA
LOS ALAMOS
Los Alamos Laboratory - Project Y
ALAMOGORDO
GRAND JUNCTION
NATURITA
DURANGO
URAVAN
MONTICELLO
RICHLAND
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RENTON
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LOS ANGELES
BERKELEY
B-29 PRODUCTION FACILITY
NUCLEAR FACILITY
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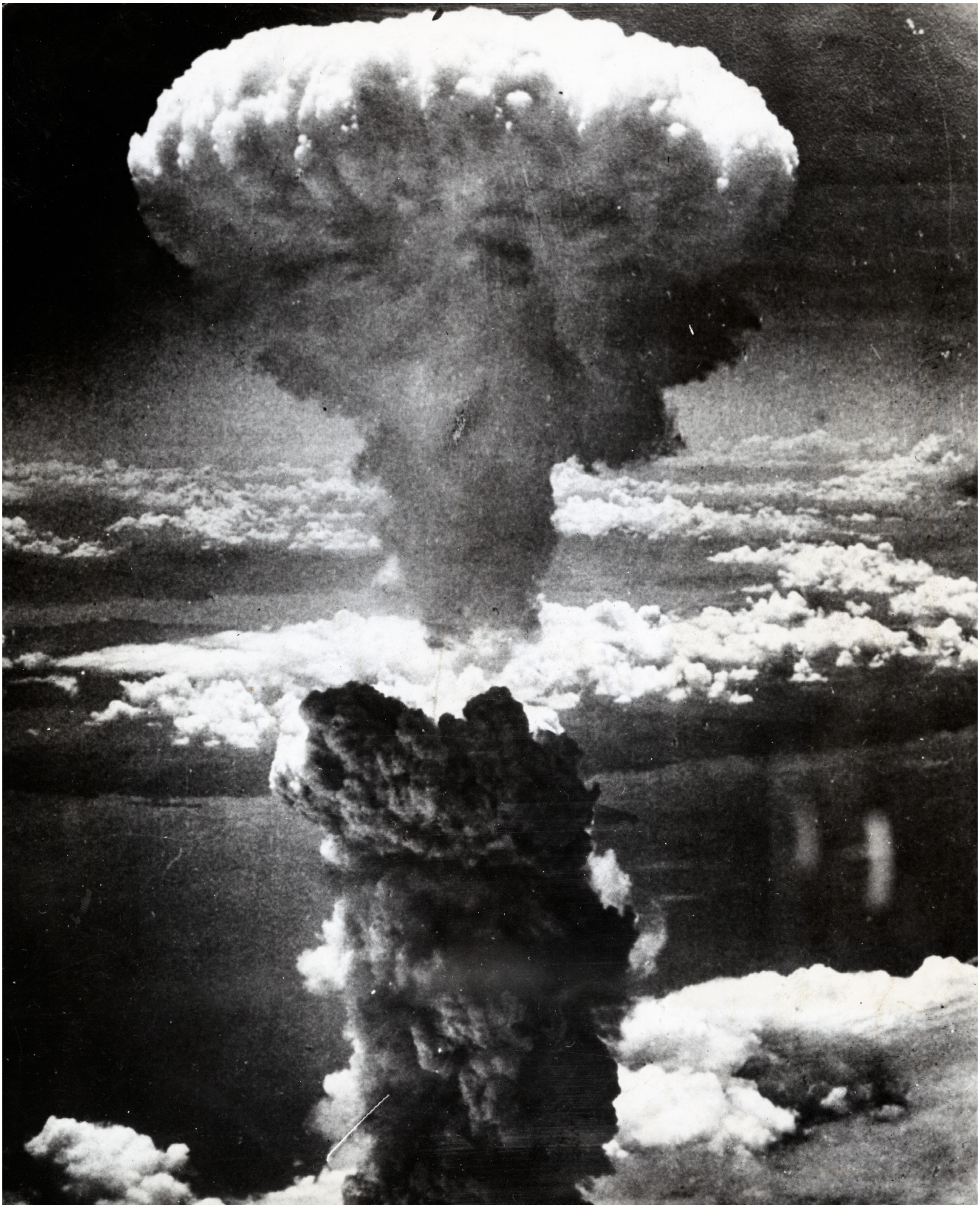

A mushroom cloud rises over Nagasaki, Japan on August 9, 1945, following the detonation of the Fat Man bomb.
(Image: The National WWII Museum, 2012.019.489_1.)

(Image: US Army/Air Force, public domain.)

A SECRET REVEALED

GRADE LEVEL: 7-12   TIME REQUIREMENT: 1-2 CLASS PERIODS

INTRODUCTION

After the United States dropped Little Boy on Hiroshima, Japan, the morning of August 6, 1945, the world learned of the great secret behind the Manhattan Project. Even with thousands of people involved in the construction of atomic bombs, the secrecy around the manufacture of nuclear weapons remained tightly held. Outside of limited cases of espionage, news of the atomic bomb went unnoticed among the general public until after the bombing of Hiroshima, and the dropping of Fat Man three days later on Nagasaki. As knowledge of atomic weapons reached the general public, reactions varied widely. In this lesson, students will examine primary source materials from The National WWII Museum's collection in which differing responses to the atomic bomb appear. Looking at the letters of civilians living near Alamogordo, New Mexico, of a participant in the Manhattan Project, and of a servicemember stationed in the Pacific theater of operations (PTO), students will see how people perceived the atomic bomb, as well as the extent to which the general public understood the significance of that moment.

MATERIALS

+ Copies of the essay "Life in a Secret City"

+ Transcriptions of letters from The National WWII Museum's collection

+ Copy of Student Worksheet

+ Videos of Secret Cities – Clip from "Critical Past" video

OBJECTIVES

In reading different letters about the atomic bomb sent to and from a worker in the Manhattan Project, students should be able to determine how people from various backgrounds reacted to the news of its existence and its use in combat. Students should also assess how the differing perspectives affected the way certain individuals reacted to the dropping of such bombs on Japanese cities. By contrasting the views preserved in these primary sources, students will be able to see how limited the knowledge of nuclear weapons was in 1945, how debates on use of the bomb emerged in the aftermath of the war, and how even those who participated in the Manhattan Project had concerns about the existence of such weapons.

COMMON CORE STANDARDS

CCSS.ELA-LITERACY.RH.6-8.1
Cite specific textual evidence to support analysis of primary and secondary sources.

CCSS.ELA-LITERACY.RH.6-8.2
Determine the central ideas or information of a primary or secondary source; provide an accurate summary of the source distinct from prior knowledge or opinions.

CCSS.ELA-LITERACY.RH.9-10.6
Compare the point of view of two or more authors for how they treat the same or similar topics, including which details they include and emphasize in their respective accounts.

ONLINE RESOURCES
ww2classroom.org

Fallout Protection guide

CCSS.ELA-LITERACY.RH.9-10.9
Compare and contrast treatments of the same topic in several primary and secondary sources.

CCSS.ELA-LITERACY.RH.11-12.2
Determine the central ideas or information of a primary or secondary source; provide an accurate summary that makes clear the relationships among the key details and ideas.

NATIONAL STANDARDS FOR HISTORY

HISTORICAL THINKING STANDARD 2
The student conducts historical research; therefore, the student is able to demonstrate the following:

- Identify the author or source of the historical document or narrative.

- Identify the central question(s) the historical narrative addresses and the purpose, perspective, or point of view from which it has been constructed.

- Appreciate historical perspectives.

HISTORICAL THINKING STANDARD 3
The student conducts historical research; therefore, the student is able to demonstrate the following:

- Consider multiple perspectives of various peoples in the past by demonstrating their differing motives, beliefs, interests, hopes, and fears.

- Compare competing historical narratives.

PROCEDURES

1. Before beginning the lesson, have the students read the included essays in the curriculum guide, "The Destroyer of Worlds" and "Life in a Secret City." Start the lesson by showing students the video clip of footage from Hanford and Oak Ridge. Have students briefly outline in a full-class discussion the key points they understand about the Manhattan Project, the primary project sites, and the kind of work people who participated in the Manhattan Project did.

1. Before starting the lesson, have the students review Robert "Bob" Garber's profile included in the essay, "Life in a Secret City." Have the students discuss where Garber worked and his connection to the Manhattan Project.

2. Move the discussion to the end of World War II and the use of atomic bombs on Japan. Remind the students that, before the bombing of Hiroshima, knowledge of the atomic bomb remained highly limited. Ask the students how they think people in the United States reacted to the bomb? How might someone affiliated with the Manhattan Project react?

3. Through a study of letters from the Robert Garber Collection from The National WWII Museum, students will gain insight into the differing perspectives that emerged following the bombing of Japan. In letters to and from Garber, friends, and family members, students will gain insight into how family members living near the Trinity Test site, a servicemember stationed in the Pacific, and a chemical engineer working at Oak Ridge reacted to knowledge of atomic bombs. Either have the students read the segments in advance of the class meeting, or have the students break up into small groups to read and present to the rest of the class what the letter covers.

4. In written and group discussions, have the students consider the different perspectives captured in the letters. Ask them how the different letters discuss the bomb itself, the kind of tone used, as well as how much detail the author appears to include. To what degree do the authors share their personal views? Why do the students think some express more personal views than others? What can students decipher from what the authors do not say, in addition to what they do say?

5. Conclude the discussion by asking the class whether people at the time understood the significance that came with the development and use of the atomic bombs. What examples from the letters indicate this awareness, or lack of awareness? Do the letters seem to indicate that the world had entered a new atomic era? Why or why not?

ASSESSMENT

By reading and discussing this collection of letters, students should demonstrate critical thinking and assessment of primary source materials. Analyzing the different perspectives of the bombing of Japan that emerged in the immediate aftermath of the war, students should draw conclusions about the debate over the use of such weapons and why these contrasting views emerged so soon after news of atomic bombs became public. In the discussion, encourage students to connect the emergence of such debates to the continued historical analysis over the use of atomic bombs against Japan and the enduring legacy of the atomic weaponry post-World War II.

EXTENSION/ENRICHMENT

1. The revelation of nuclear weapons and the power that certain nations came to possess, forever changed the way people lived in the decades that followed the end of World War II. As the Soviet Union developed their own nuclear weapons and the Cold War between the United States and the Soviet Union (USSR) began, life across the United States changed in a multitude of ways. Have students consult the **Fallout Protection guide** available on ww2classroom.org to find examples of the way the Atomic Age altered daily life. Ask students to find additional examples, including "duck and cover" drills in schools. Students should then create a multimedia presentation that illustrates the ways news of nuclear weapons affected daily life in the post-war United States.

2. In the immediate aftermath of use of the atomic bombs to end the war, the general American public did not yet have a full understanding that they had entered a new atomic age. Have students explore other major current events that may have greater historical significance than people anticipate. Ask students to examine current headlines and see if there are any stories that receive some attention, but whose importance people today may underestimate or question. What new forms of technology or pressing issues directly affect the way people today live? Is the public today fully aware of these changes? Some examples can include the creation of "smart" technology, climate change, or even present-day debates over nuclear weapons.

LETTER TRANSCRIPTIONS FROM ROBERT GARBER COLLECTION

Courtesy of The National WWII Museum

FROM: D.W. GARBER, ALBUQUERQUE, NEW MEXICO
TO: ROBERT GARBER, OAK RIDGE, TENNESSEE

[Excerpts from a 12 page letter]

Robert Garber headshot.
(Image: The National WWII Museum, 2018.233.538_1.)

This letter from Robert Garber's brother includes descriptions of the Trinity Test, indicating that people living in the area in New Mexico had an idea of the testing, described here as "the big experiment," but did not fully understand the implications of the test. Garber's connection to the Manhattan Project may have helped his family have greater insight into the work conducted, but that is not fully clear.

Dear Long Lost Brother

This is to advise you that your long delayed communication has been received and the content noted. Was beginning to think that you had us at the top of the list (and started at the bottom). No foolin though was sure glad to hear from you and how that the ice is again broken, sure hope you can spare a few moments soon to repeat.

[...]

Well I guess I had better bring you up to date on the History of the Great Southwest Garbers, so here goes.

[...]

We didn t hear or feel the big experiment but there were a lot in town that did. You boys sure got something there. I also get a bang out of the commentators and their expert explanations. Did you hear the one that was wondering where it got its oxygen supply from? Los Alamos isn t so far from here (north toward Santa Fe). Any chances of you getting transferred down here? Alamogordo is quite a bit south of here, near El Paso.

Well I guess I sure outdid myself this time.

Love,

Alice, Gary, & Don

In this letter, postmarked August 7, 1945, Garber writes to his parents and finally discusses his role in the Manhattan Project, as well as news reactions to the atomic bomb. He refrains from discussing his personal views in depth, but he does detail the way people at Oak Ridge responded to news of the bombing of Hiroshima.

Hi Again Folks,

But you re surprised to hear from me again so soon. I suppose your interest has been aroused by the sensational headlines about Atomic Bombs. Well, security permits to say that we are connected with the Manhattan Engineering District. And the papers aren t kidding, that is, where you can crawl through all the stuff spread by characters who don t have any idea what they re talking about. Anyway you won t have to try to pump me anymore. No, Mom, it wasn t ame throwers or poison gas!

I heard the news on a radio out at work at about 11:00 this morning. Everybody got sorta worked up about it. I couldn t even buy a paper tonight. Not a one left.

I can t tell about our part in it or anything else for now. There was quite a splurge on the local radio & papers (Knoxville) about actual facts & gures of Oak Ridge (Pop. 75,000).

It s been a cloudy drizzly day. I got dampened when I went to dinner.

Well, read all about it in the papers. I gotta get to sleep.

Bye now.

Love,

Bob

In this follow-up letter Garber sent to his parents, postmarked August 13, 1945, the war is near its end, and he feels free to discuss his work at Oak Ridge in further detail. Since his arrival at Oak Ridge in March 1944, this is the first time he has been able to share with his family what he had been doing while stationed in Tennessee.

Hi Folks,

Well, the war is almost over (9:30 pm). Everybody started whooping it up after that false report came through. That is, until the denial came through. Let s hope it s over before you receive this. By the way, don t expect me back in civies [civilian clothing] within a couple of weeks after it s over. I ve grown to love the army & Tennessee (it says here).

Well, anyway I can tell you that since I ve been down here, I ve been af liated with Clinton Laboratories, one of the plants on the project. Perhaps it has been mentioned in your papers. I can t seem to nd mention made in the papers of the work our plant does, so I can t go on from there. Later, maybe. Todays [sic] paper released a lot of material that we all thought would never be publicized. I ll bring all the papers along with me or send them.

[...]

It s been a pretty interesting & exciting week, hasn t it. Hope it will calm down to peace. Well, that s all for now. Write soon.

Love,

Bob

[In postscript]

Atomic Bombs! Plutonium! I can write them now.

In the final letter in the series sent by Garber to his parents, postmarked August 20, 1945, he speaks even more about the end of the war, which officially came with the announcement of Japan's surrender five days earlier.

Hi Folks,

Well, looks like it s all over but the shouting, doesn t it. The people around here sure carried on like mad. We heard the news Tuesday night, or evening rather. We were swimming in the new pool, when sirens started blowing & long lines of cars started running all over the place honking like mad. After supper we decided to go down town & see the fun. Almost everybody had a bottle & those who didn t sponged. If I drank, that sure would have been a time for it. As it was, I watched everybody else hang a good one on. I didn t get back until after midnight.

[...]

I ve saved all the papers from the extra on the atomic bomb to V-J day (the real one which hasn t come yet. I ll bring or send them all along.

I got a 12-page letter from Don & Alice telling all about New Mexico.

Well, write soon, & Bye for now.

Love,

Bob

This letter to Robert Garber came from Lyle Foster, who went through boot camp training with Garber at Camp White. Foster went on to serve in the Pacific theater of operations and wrote to Garber after use of two atomic bombs forced Japan to surrender. Foster's letter appears written in response to a letter sent by Garber; however the original letter is missing. Foster's response, however, reveals not only his own views of the atomic bomb, but also hints at Garber's apparent reservation.

October 19, 1945

Dear Bob,

I got your letter for Sept. 10 yesterday and was surprised to hear from you but glad at the same time.

[...]

The last time that I heard from you it seems you were in the infantry, so it was indeed good to hear that you got a break to go into something as good as you did. I am eager to hear what you think about the Atomic Bomb. In X-Ray we were studying a little about the atom so I have a slight idea what it s all about and the make-up of it. You can understand that I didn t learn what I did in chemistry in high school about it. Boy, those marks I use to get --- Wow. We had a pretty sharpe [sic] boy that taught us X-Ray an hour each day while we were working in New Guinea. It was a little chemistry, physics, electricity, anatomy, etc. so we covered a lot of ground.

[...]

I see that you held sort of a reserve opinion about the atomic bomb. You hinted that it was a little rough. True! True! But it don t hurt the dog less to cut it s [sic] tail off by little pieces. If anybody seen the hell that the boys over here had to go through they would surely approve of it. I was lucky compared to some of them so don t feel sorry for me. But this can be a good subject for us to talk about when I get back. What did I say? That s a bad subject over here. When you expect to get home, I mean.

[...]

I have high hopes to be home by Christmas. It depends largely on how lucky you hit it. I could be on my way by the time this letter reaches you and again it might be after Xmas. We are closing down in about ten days and no good rumors have come out as to what will happen after then.

[...]

Till I write again and hear from you --- of I get home --- I am hoping to see you in the not too distant future. How do you stack up on getting out?

As ever,

Lyle

NAME: **DATE:**

Directions: After reading an assigned letter from the Robert Garber collection, answer the following questions below to complete your analysis of this primary source. Cite specific examples to support your analysis of the letter, showing how it captures an individual's perspective of the atomic bombs.

LETTER INFORMATION (TO/FROM):

1. Describe the overall context of the letter, addressing the following questions: who wrote the letter, when was it written, to whom was the letter written?

2. In what ways does the author of the letter describe the atomic bomb? What level of detail does the author include in descriptions of the bomb? Are there any notable omissions in the descriptions?

3. How do you think the author's perspective affected a personal view of the atomic bomb? In what ways did the author's experiences during the war influence this perspective and the way the author describes the bomb?

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www.nationalww2museum.org/manhattan-project