THE NATIONAL WWII MUSEUM
NEW ORLEANS

Robotics Challenge 2020:

THE MANHATTAN PROJECT

CHALLENGE DESCRIPTIONS AND BACKGROUND

Your team will have 2 minutes and 30 seconds to complete as many of the following challenges as possible. Only 2 team members are allowed at the competition table. They are allowed to tag out during the match.

Challenge 1: Trigger

Part of the problem that the Manhattan Project scientists were trying to solve was that of a trigger. What was the best way to set off the nuclear reaction? In Los Alamos, they worked on a trigger.

A mousetrap sits at the site of Los Alamos on the map. Take your paper ball and drop it on the mousetrap to set it off.

Mousetrap is triggered: **70 points**

Challenge 2: Life in a Secret City

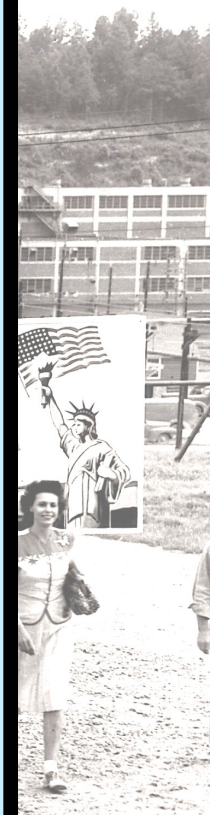
One of the more fascinating parts of learning about the Manhattan Project is learning about the life in the secret cities. Hanford, Washington, Oak Ridge, Tennessee, and Los Alamos, New Mexico, were all secret cities created for the purpose of this secret mission. The workers who lived and worked at these sites had no idea what they were working on. They worked in teams and tended to live with each of these teams. They were discouraged from discussing work with anyone outside of their individual work team in order to ensure that no one could piece together what they were working to build.

If they wanted to receive mail, they had their mail sent to a fake address in the closest large city and that mail was then shipped in to the site.

These towns needed to be self-sustaining. They had community halls with live bands and performances, churches of different denominations, bowling, movie theaters. In Hanford, Washington, workers and their families enjoyed swimming in the local Columbia River for recreation until word got around that the waters were radioactive and a swimming pool was built.

Move the bowling pin to Hanford, Washington.

Bowling pin touching the gray city: **25 points**
Bowling pin touching the red dot: **40 points**



Challenge 3: Underground Science

On December 2nd, 1942, underneath the campus of the University of Chicago, the first nuclear reaction was demonstrated. Up to this point, it was known that the idea of nuclear fission—splitting an atom in half—could work, theoretically, but it had never been done.

A team of physicists set up the first nuclear reaction in an abandoned squash court underneath the University of Chicago's Stagg Field stadium. The first nuclear reaction created enough energy to power one small light bulb. Although it was a monumental scientific breakthrough, the energy in the room was somber. After the experiment was over, the room fell silent, as everyone pondered what this discovery would bring about.

Graphite was used to control nuclear reactions, to keep them from getting out of hand. A graphite rod is lowered into the reaction to slow the reaction and pulled back out to speed it up.

Drop the graphite pencil in the cardboard box: **30 points**

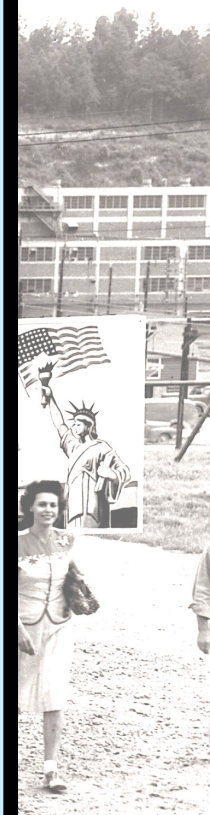
Challenge 4: Mr. Einstein

In late 1938, two chemists, Lise Meitner and Otto Hahn, designed an experiment to see what would happen if you placed a uranium atom next to a radioactive element. When they tried it out, the impossible happened: The tiny radioactive particles hit the uranium and, to their shock, the uranium atom split in two. Meitner developed the explanation for what they had observed and called it nuclear fission.

In 1939, it became clear that nuclear fission had been discovered in Berlin. Eugene Wigner and Leo Szlizard were Hungarian physicists - both Jews who had fled Europe as Hitler rose to power. These two men were disturbed by the idea that Germany had this scientific knowledge, while the US did not. They decided that if they could get Albert Einstein, the world's most famous scientist, to help them warn the President of the US, President Roosevelt would be more likely to take them seriously.

Leo Szlizard wrote out a letter detailing the dangers of nuclear fission, especially in the hands of the Germans, and set out to hunt down Einstein. He agreed to sign the letter. When the letter was finally delivered to Roosevelt, he declared, "This requires action!"

Move the letter so that it touches the red dot on Long Island, NY: **20 points**



Challenge 5: Trinitite

The Trinity Test—the first test of the atomic bomb—was conducted on July 16th, 1945 in Alamogordo, New Mexico. When the blast went off, the power and heat of the blast melted the desert floor. The particular mix of sandy clay particles found at that site melts to create something called *trinitite*—a light green glass.

Trinitite was collected and sold as souvenirs. It is mildly radioactive but safe to handle.

Move the pieces of "trinitite" to Alamogordo, New Mexico.
Cup of "trinitite" touching the red dot of Alamogordo: **50 points**
Cup of "trinitite" touching the gray city of Alamogordo: **30 points**

Challenge 6: Shinkolobwe Mine

Massive amounts of uranium were needed at each of the secret Manhattan Project sites. Most Uranium has 238 neutrons, and referred to as U-238. That type of uranium will not split when hit with radioactive material. There is a special type of uranium with extra neutrons, referred to as U-235, that will split. Natural uranium contains 99.3% U-238 and .7% U-235. A lot of uranium was needed to be able to separate out enough uranium for the Manhattan Project.

Two-thirds of the Uranium used for the Project came from Shinkolobwe Mine in modern-day Democratic Republic of the Congo (DRC), then Belgian Congo.

For a long time, the source of uranium ore was kept a secret and the contribution of the DRC was overlooked. Credit was given instead to the other source of the ore: the Northern Territories of Canada. The effects of the uranium mining on the community of Shinkolobwe was devastating, and caused illnesses and deformities in the Congolese workers, due to lack of any safety measures.

Retrieve the boat filled with DRC Uranium ore from the Atlantic Ocean: **30 points**

Challenge 7: Superfund St. Louis

Mallinckrodt Chemical Works was hired by the Manhattan Project to start the work of refining uranium, prior to the secret cities being built. The radioactive waste created from this chemical plant was illegally dumped in barrels and created harmful contamination in several areas around St. Louis. The clean-up of this waste is still underway and is estimated to cost $236 million.

Remove the barrel of radioactive waste from St Louis and bring it home: 3**0 points**

Challenge 8: U-235

The job of Oak Ridge, Tennessee, was to separate out the U-235. The first method attempted for separating the U-235 was a centrifuge. A centrifuge would use centrifugal force to separate the two types of uranium. The scientists on the Manhattan Project could never get the centrifuge to work and so moved on to other methods, such as electromagnetic separation and gaseous diffusion.

However, after the war, the centrifuge method would become the standard for separating U-235 and remains the standard method today.

Move the fidget spinner completely onto Oak Ridge: **40 points**
Move the fidget spinner partially onto Oak Ridge: **25 points**

Challenge 9: The Plutonium Project

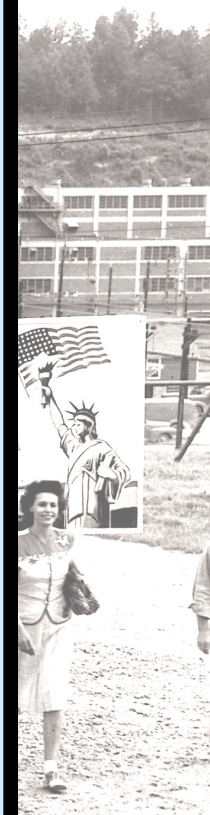
Plutonium was discovered in 1940. The first sample of reactor-produced plutonium was received in Los Alamos and it was discovered that reactor-produced plutonium fissured much faster than expected. This meant that the plutonium atoms would fissure too soon and all of the energy would fizzle out. This was a major setback. The original "gun-type" bomb design for uranium would not work for this reactor-produced plutonium. An entirely new bomb design needed to be created... and they needed more plutonium.

A new plutonium production reactor called the B Reactor was built in Hanford, Washington. This reactor was able to create enough plutonium for the bomb. The plutonium produced in Hanford was sent to Los Alamos, where they designed a new implosion-style bomb.

Bring the "plutonium" (Jenga block) from Hanford, Washington, to Los Alamos, New Mexico.
Plutonium touching the red dot of Los Alamos: **70 points**
Plutonium touching the gray city of Los Alamos: **50 points**

Challenge 10: Heavy Water Wars

The Manhattan Project focused on creating nuclear fission by either separating U-235 out from the more commonly found U-238 or using U-238 to make Plutonium. The Germans were focusing on a different way to create nuclear weapons.



Water is made up of one oxygen molecule and two hydrogen molecules. Each hydrogen molecule has one neutron. Molecules get the majority of their weight from their neutrons. There are particular types of hydrogen molecules that have an extra neutron. This type of hydrogen is called deuterium. It is literally heavier than normal water and so is called heavy water.

When heavy water is applied to U-238, it allows U-238 to undergo fission. During the war, the Germans were focusing on this method to try to create an atomic bomb. Heavy water occurs naturally in nature, however in very small quantities. For every 4000 regular water molecules, there is 1 heavy water molecule.

One of the main sources of "man-made" heavy water in Europe was a heavy water plant in Norway. Germany took over this factory and began shipping heavy water into their labs in Germany. The Allies saw this as a dangerous sign and made plans to take out this factory. The first attempt at sabotaging this factory failed, however the second operation succeeded and the factory was taken offline.

During this time, the US decided to also start making heavy water for their atomic activities. 3 nuclear reactors were built using this heavy water. One of the distillation plants was located in Sylacauga, Alabama.

Retrieve the water molecule from Alabama: **25 points**

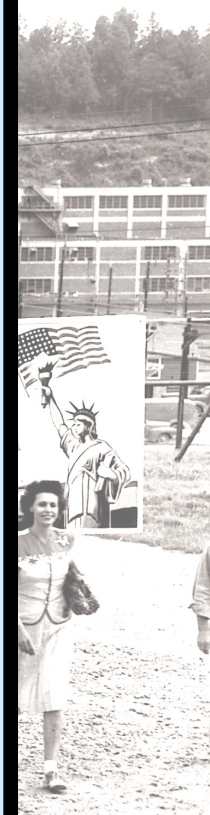
Replace the hydrogen atoms with deuterium atoms and put the heavy water molecule back in Alabama.

The heavy water molecule is touching the red dot of Sylacauga: **25 points**
The heavy water molecule is touching the gray city of Sylacauga: **20 points**
TOTAL POINTS POSSIBLE: 50

Challenge 11: Espionage

Although the Soviets and the Americans were Allies during WWII, they did not like each other. The Americans did not see any reason to share their scientific breakthroughs with the Soviets during the Manhattan Project. The Soviets caught wind of what the Americans were working on and made plans to place Soviet spies within the Project. These spies would send coded messages through their handlers back to the KGB.

Despite the fact that the Soviet Union only had a 20 scientists working towards the creation of an atomic bomb, they were able to use the stolen information to help them set off their own atomic bomb by 1949. This was only 4 short years after



the end of WWII and fueled the escalation of the Cold War and the nuclear arms race between the Soviet Union and the United States.

Steal the KGB folder from Berkeley and decode the Russian message

Folder brought back to base: **35 points**
Message decoded: **35 points**
TOTAL POINTS POSSIBLE 70

<u>The Obstacle: The Doomsday Clock</u>

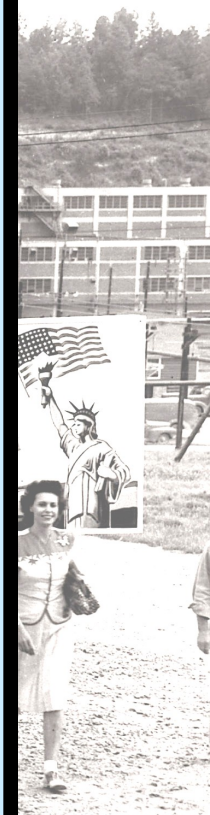
The lasting legacy of the Manhattan Project is the two-sided: the benefits of nuclear energy and nuclear medicine versus the destructive power of nuclear weaponry.

After the end of WWII, former Manhattan Project scientists founded the *Bulletin of the Atomic Scientists of Chicago*, a non-profit organization dedicated to educating the public about science and global security issues. This group also created the Doomsday Clock.

The Doomsday Clock is an internationally recognized symbol for the likelihood of a man-made global catastrophe. After the end of WWII and the first usage of the atomic bomb, the Doomsday Clock was set at 7 minutes to midnight. It has been set backward and forward 23 times since then and now rests at it's most dangerous setting: 2 minutes to midnight.

While you are carrying out your tasks, take care not to bump the Doomsday Clock.

Robot touches the Doomsday Clock: **-20 points**



PROJECT DESCRIPTION AND PARAMETERS:
The Legacy of the Manhattan Project

BACKGROUND: The Manhattan Project culminated in two atomic bombs being dropped on Japanese citizenry and signaled the end of WWII and the start of the Atomic Age.

The technologies developed during this time led to the creation of weapons of mass destruction and a world-wise sense of unease. Who would be the next country to develop an atomic weapon? What would it mean for the world if two countries with atomic weapons went to war with each other?

Not only did the Manhattan Project lead to an entirely new type of warfare, but it also led to science and technologies that could be applied to many other fields like nuclear energy and medicine.

Beyond discovering new applications for nuclear science, humans have had to deal with the environmental ramifications of these types of technologies. Nuclear waste can take thousands of years to become inert. How do you store waste effectively for such a long period of time? What creative solutions have been explored that address nuclear clean up or recycling?

For more background on the Manhattan Project, tune in to the Museum's Electronic Field Trip here: https://www.nationalww2museum.org/students-teachers/distance-learning/k-12-distance-learning/electronic-field-trips/manhattan-project

PROJECT: Create a visual exhibit that explores one of the legacies of the Manhattan Project. ***(20 points)***

Size Requirements	• The overall size of your exhibit when displayed for judging must be no larger than 40 inches wide, 30 inches deep, and 6 feet high. • Measurement of the exhibit does not include the table on which it rests; however, it does include any stand that you create and any table drapes. • Circular or rotating exhibits or those meant to be viewed from all sides must be no more than 30 inches in diameter.
Word Limit	• A 500-word limit applies to all student-composed text that appears on, or as part of, an exhibit entry. • This includes the text that you write for titles, subtitles, captions, graphs, timelines, media devices, or supplemental materials (e.g., photo albums, scrapbooks, etc.) where you use your own words. • Brief factual credits of the sources of illustrations or quotations included on the exhibit do not count toward the 500-word limit. A date (January 1, 1903) counts as one word. ***NOTE**: Be careful that your message is clear on the exhibit itself. Extensive supplemental material is inappropriate. Oral history transcripts, correspondence between you and experts, questionnaires, and other primary or secondary material used as sources for your exhibit should be cited in your bibliography, but not included as attachments to your bibliography or exhibit.*
Media Devices	• Media devices (e.g., DVD players, tablets, mp3 players, video monitors, computers, etc.) used in an exhibit must not run for more than a total of three minutes. • Quotes from another source (e.g., clip from a documentary, primary source music, etc.) are considered quotes. Any student-composed questions, narration, or graphics incorporated within a media presentation are subject to the 500-word limit (Rule B2). • Viewers and judges must be able to control media devices. Any media devices must fit within the size limits of the exhibit.
Crediting Sources	• All quotes from written sources must be credited on the exhibit. • All visual sources (e.g., photographs, paintings, charts, and graphs, etc.) must be credited on the exhibit and fully cited in the annotated bibliography. • Brief, factual credits do not count toward the word total.