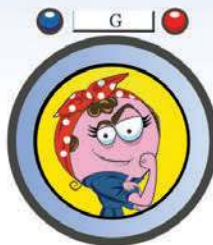
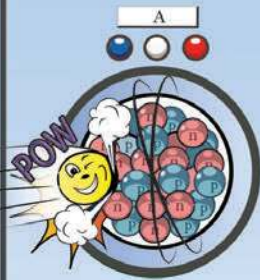




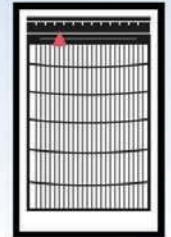
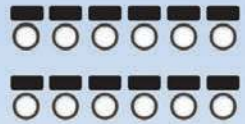
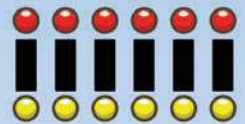
JUNIOR RANGER

Manhattan Project National Historical Park
at Hanford, Washington

LEGACY	PLACES	PEOPLE	HISTORY	SCIENCE
Big Science	Lalok	Leona Ubbly	Nuclear Age	Neutrons
International Relations	Tapitat	African Americans	Establishing Hanford Site	Nutria
	Hanford, WA	Women	1940s	Atoms
Nuclear Weapons	Nagasaki	Unanilla	Segregation	Transmutation
Atomic Bomb	Japan	Chemists	Trinity Test	
Nuclear Power	T Plant	Sadako Sasaki	Women in Careers	Plutonium
	Oakridge, TN	Enrico Fermi	WWII	Oranium
National Labs		Physicists	Displacement	Fission
	Hanford, WA	General Laborers		
Nuclear Waste	Nu Wana	Farmers	Bombing of Nagasaki	Isotopes
	Columbia River	Nez Perce	Aug. 9, 1945	Elements
Nuclear Medicine	Alphabet Homes	Wagnam	Bombing of Hiroshima	Nuclear Chain Reaction
	B Reactor	Yakama	Aug. 6, 1945	
	Los Alamos, NM	Secretaries	Relationship with Japan	Health Physics
	White Bluffs, WA	LTC Matthias		Shielding



BEGIN JUNIOR RANGER MISSION

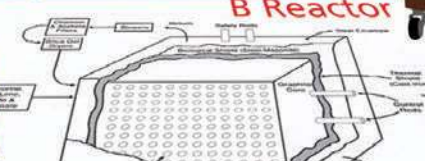


TURN THE PAGE TO ACCEPT THIS MISSION

CONTROL ROOM



TOP SECRET
B Reactor



Welcome friends!



MY NAME IS ATOM U235 FISSION. I WILL BE YOUR GUIDE AS WE EXPLORE THE HANFORD SITE OF THE MANHATTAN PROJECT NATIONAL HISTORICAL PARK TOGETHER. THIS PROJECT WAS SO BIG IT CHANGED THE WORLD!

How to earn points

This junior ranger book is for all ages. You may find some activities harder than others. That's okay. You choose what activities to complete by earning enough points for your age.

Points needed
to earn a

badge

4 points
6 points
8 points
10 points

— ages 6-8
— ages 9-11
— ages 12-14
— ages 15 and older

ACTIVITIES	POINT VALUE	YOUR POINTS
Complete activities in the Junior Ranger Book.	1 activity = 1 pt	
Join a docent tour or ranger program.	1 pt	
Watch a park film.	1 pt	
Download the park's app. Learn about our other locations.	1 pt	
		Total:



This QR code will take you to the free National Park Service app. Once you have the app, search for the Manhattan Project to explore the entire park including sites in New Mexico, Tennessee, and Washington.

WHEN FINISHED: Return your book to the visitor center and be sworn in as an official junior ranger.

PARENTS: Participate with your aspiring junior ranger to learn about this park as a family.

NEED MORE TIME? Mail your book to Manhattan Project National Historical Park, 2000 Logston Blvd. Richland, WA 99354 for a ranger review and to receive a badge or a patch.

Before you start

We'll learn about many different people and places today. Before you start:

Learn the code

Learn how to find the topics you want to explore. We coded this booklet by shape and color. The shapes are around the page numbers.

**Life before the
Manhattan Project
< 1943**

Find out what life was like before the Manhattan Project.

**A global war,
a global effort,
1939-1946**

Take a trip around the world to learn about this big story.

**The Manhattan
Project
1939-1946**

Explore the people and places of the Manhattan Project.

**Nuclear Science
1939-Today**

Learn about the making of Hanford's secret "product."

**Legacies &
Reflection
Today**

Reflect on the many legacies of the Manhattan Project.

Make a badge

Every worker at Hanford needs a badge. Make your own. Zero points... but a priceless keepsake.



Draw yourself or perhaps a pet

**HANFORD
OPERATION**

Write your name

Life in all seasons

The Nez Perce, Umatilla, Wanapum, and Yakama tribes have called the Hanford area home since ancient times. This land provided everything the Native peoples needed to survive and thrive. They lived according to the seasons in an annual cycle of

gathering, fishing, hunting, trading, and preparing for the next season. Elders taught the children the ways of their people. Today, tribal people continue to follow these traditions by hunting, gathering, and processing subsistence foods in a seasonal cycle.

FALL - Tribal people hunt wild game in the mountains and return to the Columbia River to fish the last salmon runs.

SUMMER - Tribes head towards the mountains to gather plants and fruits for food and medicine. In past times, they harvested tule reeds near the rivers to build their homes.

WINTER - Native people teach life lessons through storytelling. In past times, they moved to villages near the Columbia River and lived in tule reed longhouses. They socialized, traded and made and repaired tools.

SPRING - Tribal people stay close to the rivers to fish for salmon in the Columbia, Yakima, and Snake rivers. They use digging sticks to harvest plants and roots for food and medicine.



ACTIVITY: Write the name of the season in the boxes below that matches the description of each activity. Any activity may happen in one or more season.



Pick huckleberries and harvest tule reeds for lodges.

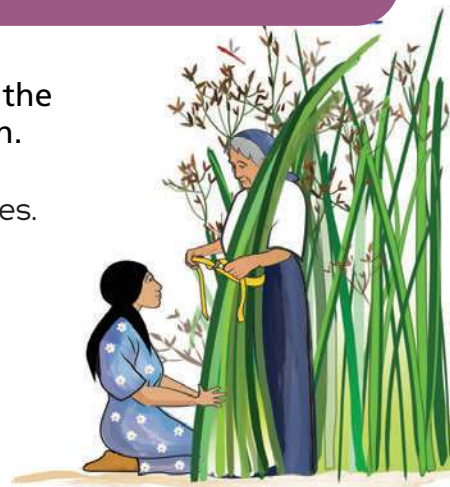
Use digging sticks to harvest plants and roots for food and medicine.



Hunt deer and elk for food, clothing, and tools.

Fish salmon with dip nets in the powerful Columbia River.

Teach life lessons through storytelling in the slower times of the year.



Special places

Place names pass knowledge of the land, culture, and ancestors from one generation to the next. The place names in this area tell us that the Native peoples who live here have a deep connection and understanding of the land. These names tell stories of special places and traditional uses.

ACTIVITY: The pictures below share the Native American place names of important natural features around Hanford. Read the descriptions below. Write the letter of the correct drawing in the circle next to each description.

Táptat (TOP-tot) - Yakima River

Táptat is the traditional place name for the Yakima River. Táptat refers to a type of haircut: long hair in front with short hair on the sides. Lewis and Clark called the Táptat the "Tapteel River."

The Yakima River begins in the Cascade Mountains in WA. The river runs over 150 miles to reach the Columbia River at Richland, WA. A winter village known as Čamná (Chum-NAH) was located where the Columbia and Yakima rivers meet.

A



Lalı́ik (Law-LEEK) - Rattlesnake Mountain

Lalı́ik, meaning land above water, is a sacred place to area tribes. Oral tradition says the remnants of humanity were saved from the Ice Age floods by climbing up to the top of Lalı́ik, which is the highest point in the area.

Rising to a height of 3600 feet, Rattlesnake Mountain is the highest treeless mountain in the lower 48 states.

B



Nčí Wána (Inchy-WAH-nuh) - Columbia River

Local tribes called the Columbia river Nčí Wána, meaning big river. The Nčí Wána supplies abundant salmon, a transportation route, and a reliable source of water. Many seasonal, permanent, and fishing villages dotted the banks of the Nčí Wána.

The Columbia River is the largest river in the Pacific Northwest. It is over 1200 miles long, which is about the same distance from here to San Diego, California!

C





Water you doing here?

Eastern Washington is very dry with little rain, making farming very difficult. Irrigation companies pumped water from the Columbia River into canals and ditches to move water from the river to the farms. This was a lot of work because the farms were **UPHILL** from the river!

RIVER WATER
HELPS ME GROW
THESE APPLES!



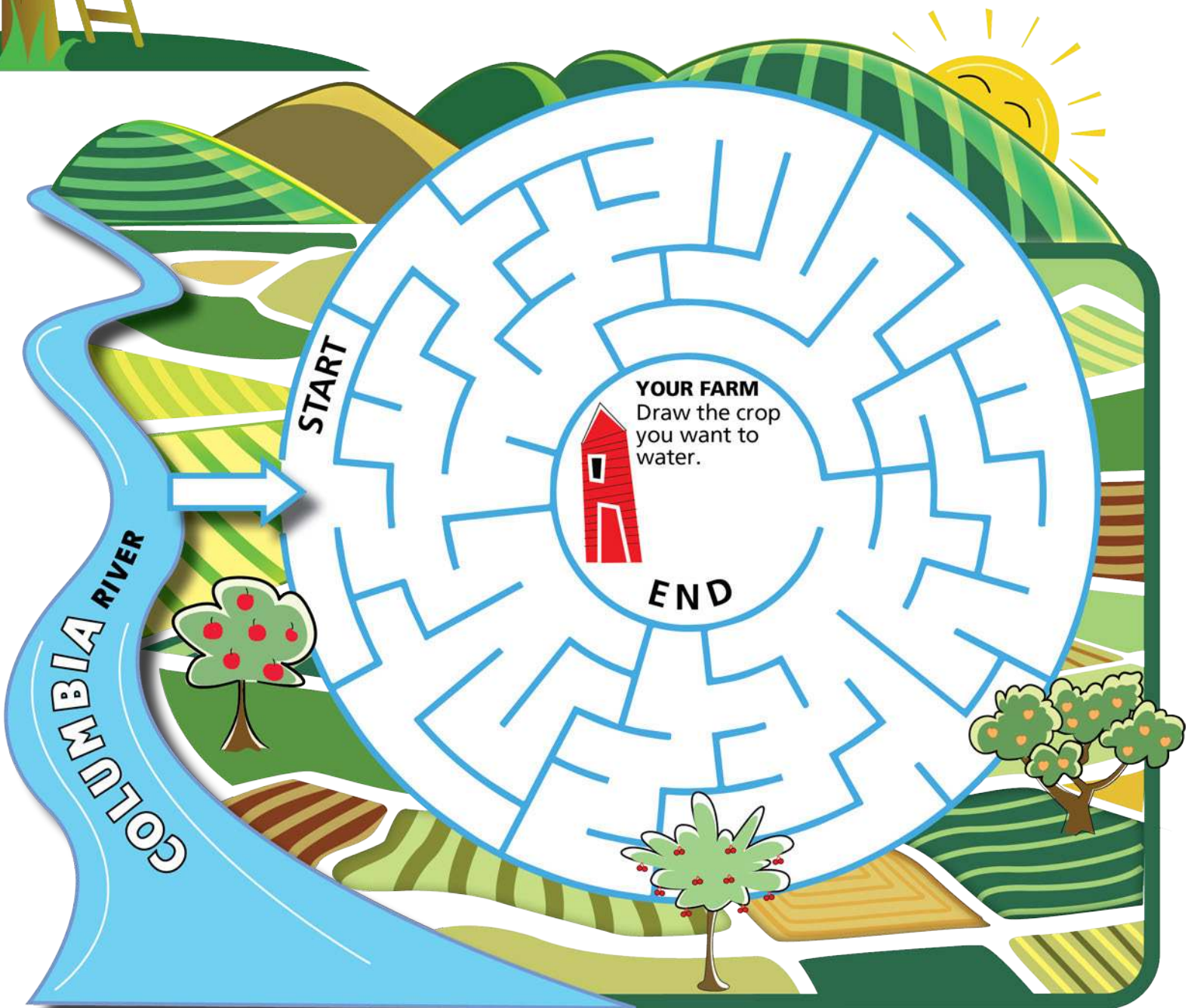
Western Washington

VS



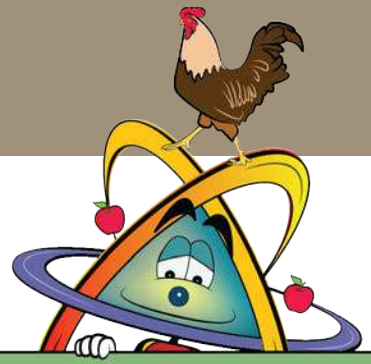
Eastern Washington

ACTIVITY: Move the water from the river to your farm in the maze below.



Dear Diary

ACTIVITY: Imagine you live here on a farm before the Manhattan Project when small towns and farms were the only thing around. Fill in the blanks and circle your answers in the diary page below.



Jan. *My Diary* 1942

A. My name is _____ and my age is _____

B. I live in White Bluffs on a(n)



cherry orchard



apple orchard



ranch



pig farm

C. Today, I went to downtown White Bluffs by riding



a sheep

a horse



a bike

D. While there I went to



a parade



the general store



the river to swim

E. Mom and dad told me that there is a war going on. Soon, people from out of town will take down the buildings and houses of White Bluffs to build a factory that supports the war effort. We will have to move.

This makes me feel _____ because

F. What I will miss most about White Bluffs is



my sheep



my home



you decide

The world takes sides

World War II began in 1939 when Germany invaded Poland.

The Allied Powers and the Axis Powers fought each other during the war. The Axis powers grew powerful by taking other countries' lands and resources. The Allied Powers fought to stop the Axis Powers from gaining more power and land.

The European Axis Powers practiced fascism. Fascism is a form of government where individual citizens cannot choose their leaders. Most Allied countries were representative democracies, where the people choose their leaders.

In 1941, the United States entered WWII after Imperial Japan bombed Naval Base Pearl Harbor in Hawaii. Imperial Japan was angry with the United States for cutting off their supplies in the Pacific Ocean.

In 1942, the US government created a top-secret program called the Manhattan Project to build the world's first atomic bombs. In August 1945, the United States dropped two atomic bombs on Japan. The US bombing of Japan helped to bring an end to World War II in Asia on September 2, 1945.

World War II ended in Europe on May 9, 1945 when Germany surrendered to the Allied Powers.

1939 World War II begins

1941



DEC. 7, 1941: The Imperial Japanese Navy Air Service led a surprise attack on a US naval base in Honolulu, the Territory of Hawaii. The attack prompted the United States to enter WWII the next day.



DEC. 11, 1941: Adolf Hitler, a German dictator and leader of the Nazi Party, announced a declaration of war against the United States. Hitler began WWII in 1939. Photo by Bild Bundesarchiv.

1945



FEB. 1945: The three Allied Powers met to discuss the post-war fate of defeated Germany. (L-R): Winston Churchill (Great Britain), Franklin D. Roosevelt (US), and Joseph Stalin (Soviet Union).



SEPT. 2, 1945: Imperial Japan surrendered to the United States. This formally ended WWII.



ACTIVITY: Label each country as Axis or Allied. Write your answers on the line above the flag for each country.

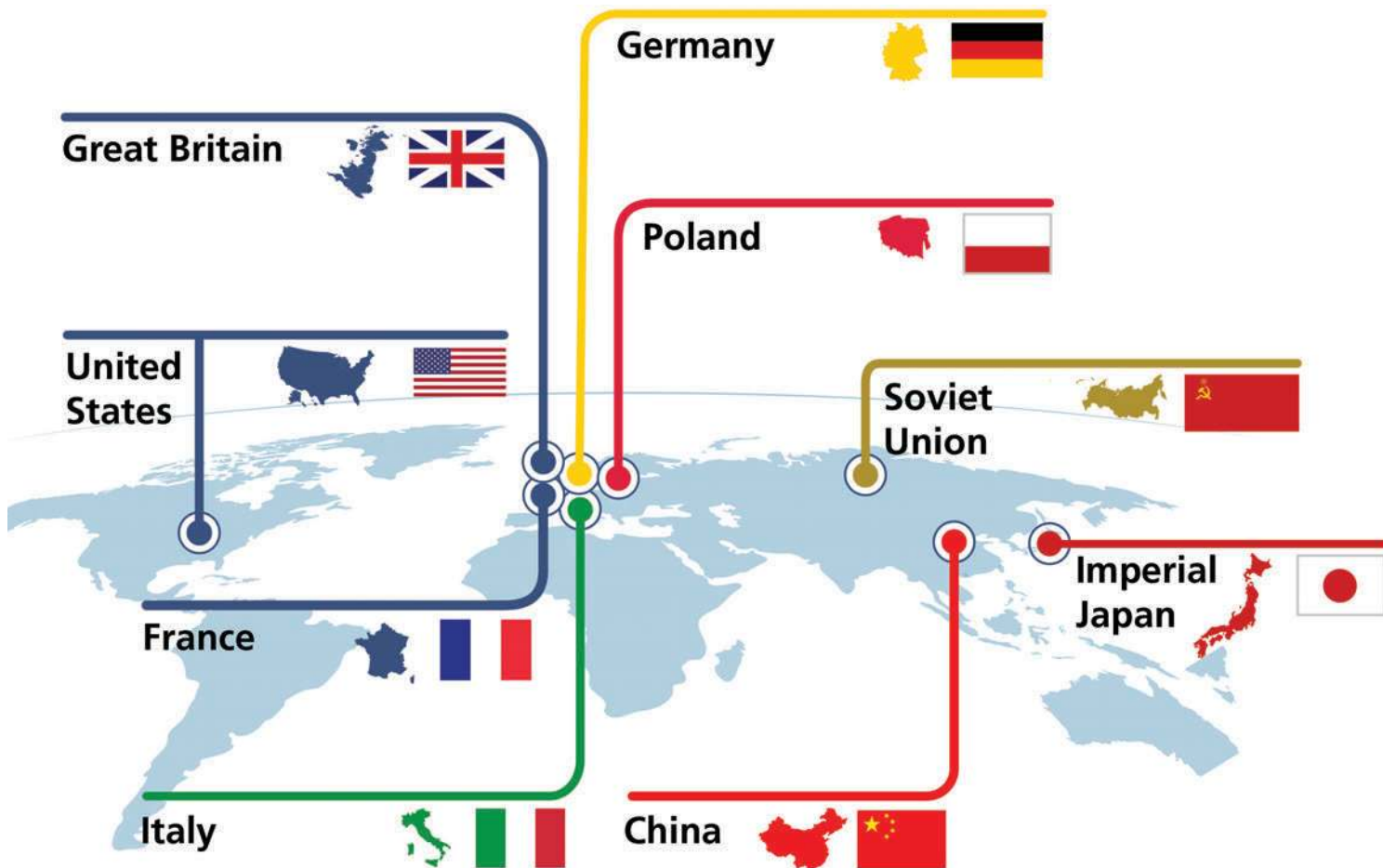
NEED HELP? UNSCRAMBLE THE LIST TITLES TO FIND OUT WHICH COUNTRIES ARE **AXIS POWERS** AND WHICH ARE **ALLIED POWERS**.

SXAI SEWROP

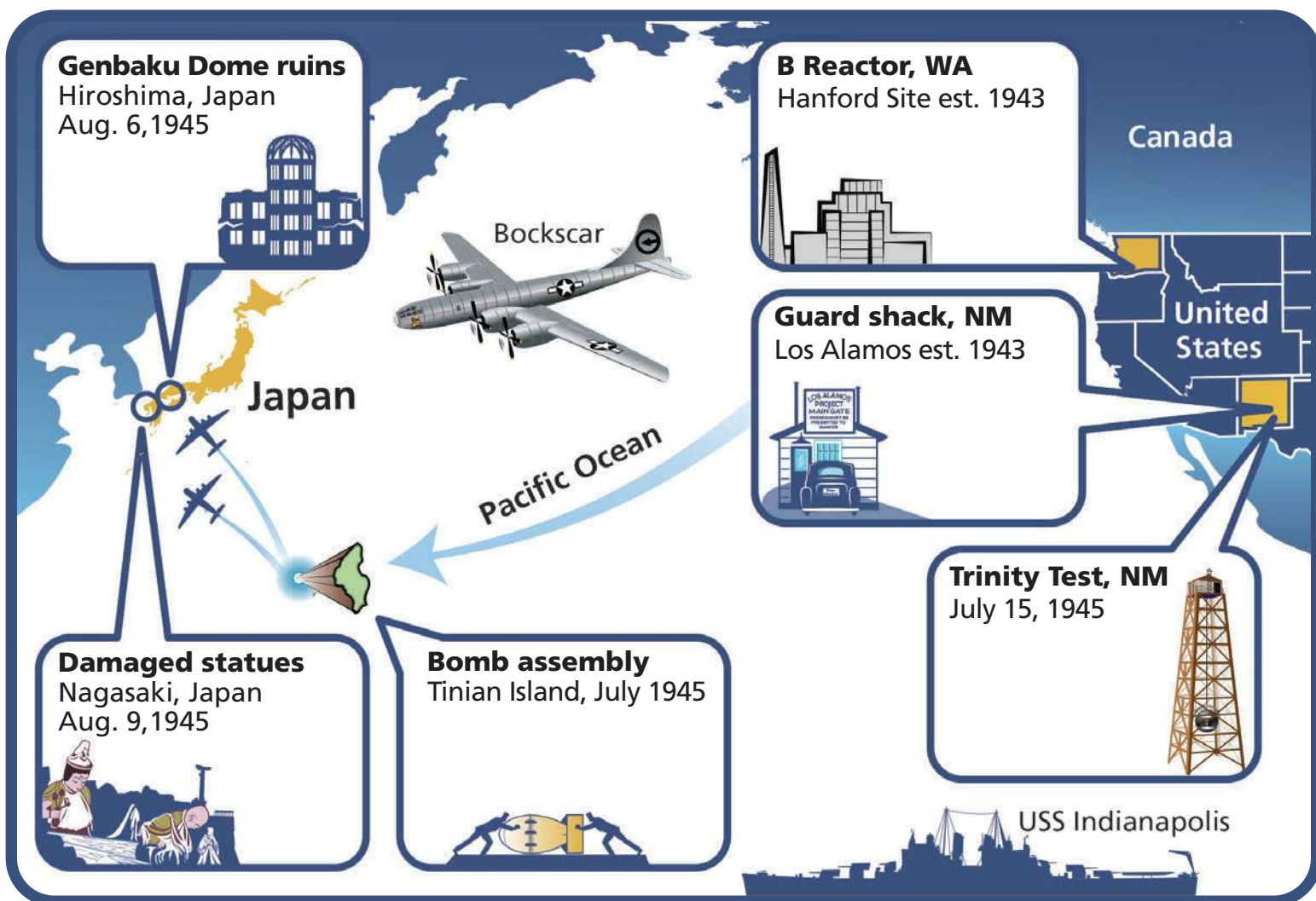
Germany, Imperial Japan, Italy

EILLAD PWORSE

China, France, Great Britain, Italy, Soviet Union, United States

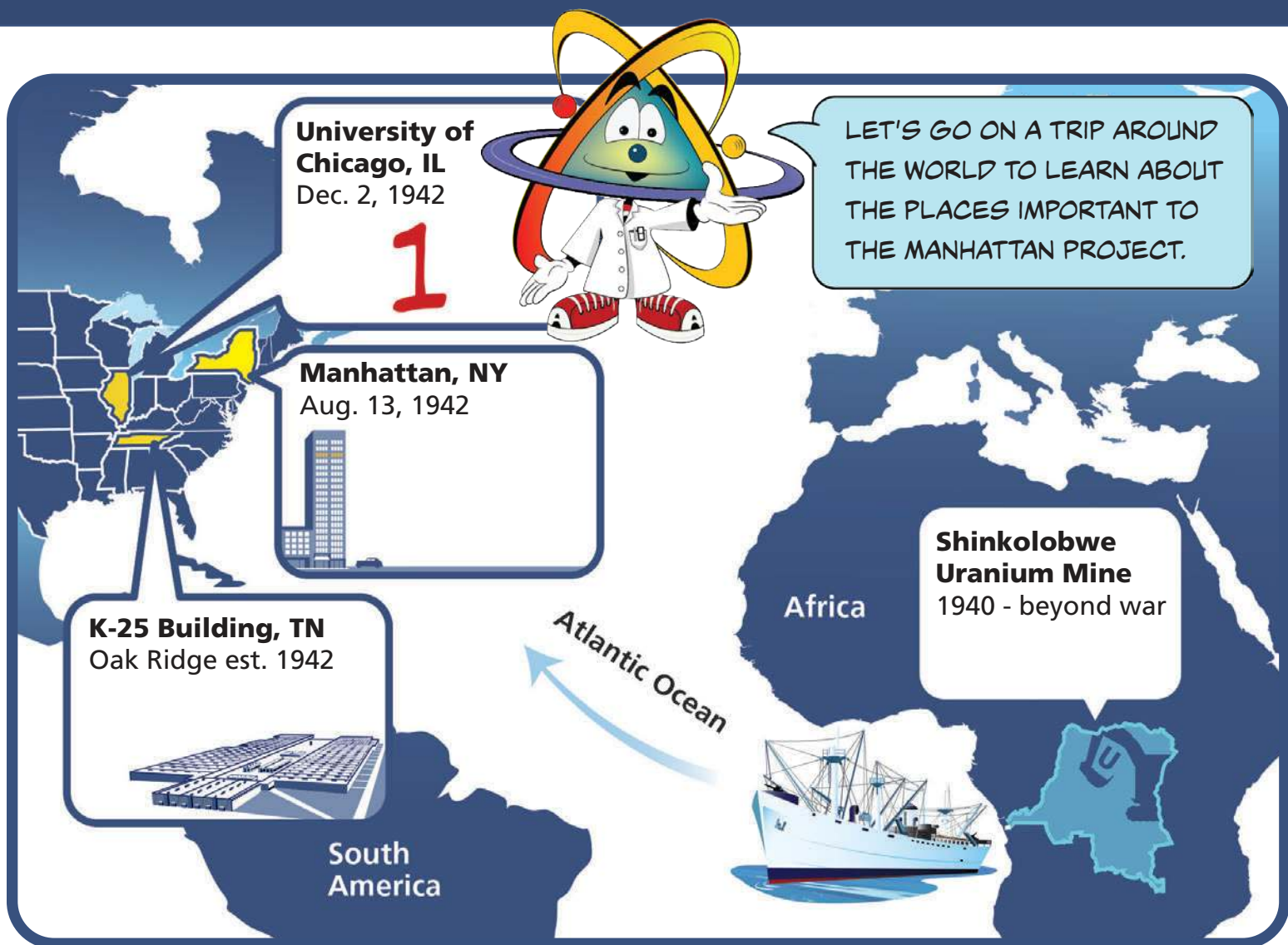


Manhattan Project around the world



ACTIVITY: Match the description to its place by writing the correct number in the squares above.

- 1. EXAMPLE:** In 1942, in Chicago, Illinois, scientists created the first nuclear reactor. Some of these scientists rushed to other Manhattan Project sites like Hanford to help build the first atomic weapons.
- 2.** To make the atomic bomb, scientists needed a naturally occurring metallic element called uranium. Most of the uranium for the Manhattan Project was mined in the Belgian Congo in Africa.
- 3.** The Manhattan Project was established on August 13, 1942. The project's first headquarters was in Manhattan, New York.
- 4.** At a large industrial site at Hanford, Washington, workers made plutonium for the Trinity Test and the Fat Man atomic bomb.
- 5.** Shortly after the start of the Manhattan Project, the project's headquarters moved to Oak Ridge, Tennessee where workers made the enriched uranium for the Little Boy atomic bomb.



The squares on the map over the next two pages represent important places and have a matching numbered description below.

6. Many scientists worked at a Manhattan Project lab in Los Alamos, New Mexico, to build the two atomic bombs dropped on Japan.
7. Testing their weapon design, the Los Alamos scientists set off the world's first atomic explosion on July 16, 1945, at the Trinity Site in southern New Mexico.
8. The USS Indianapolis carried the atomic bombs to Tinian Island in the Pacific Ocean for final assembly.
9. The US dropped the Little Boy atomic bomb on Hiroshima, Japan on August 6, 1945. This was the first time an atomic bomb was used in war.
10. On August 9, 1945, the US dropped the Fat Man bomb on Nagasaki, Japan, which is the last time an atomic bomb was used in war.

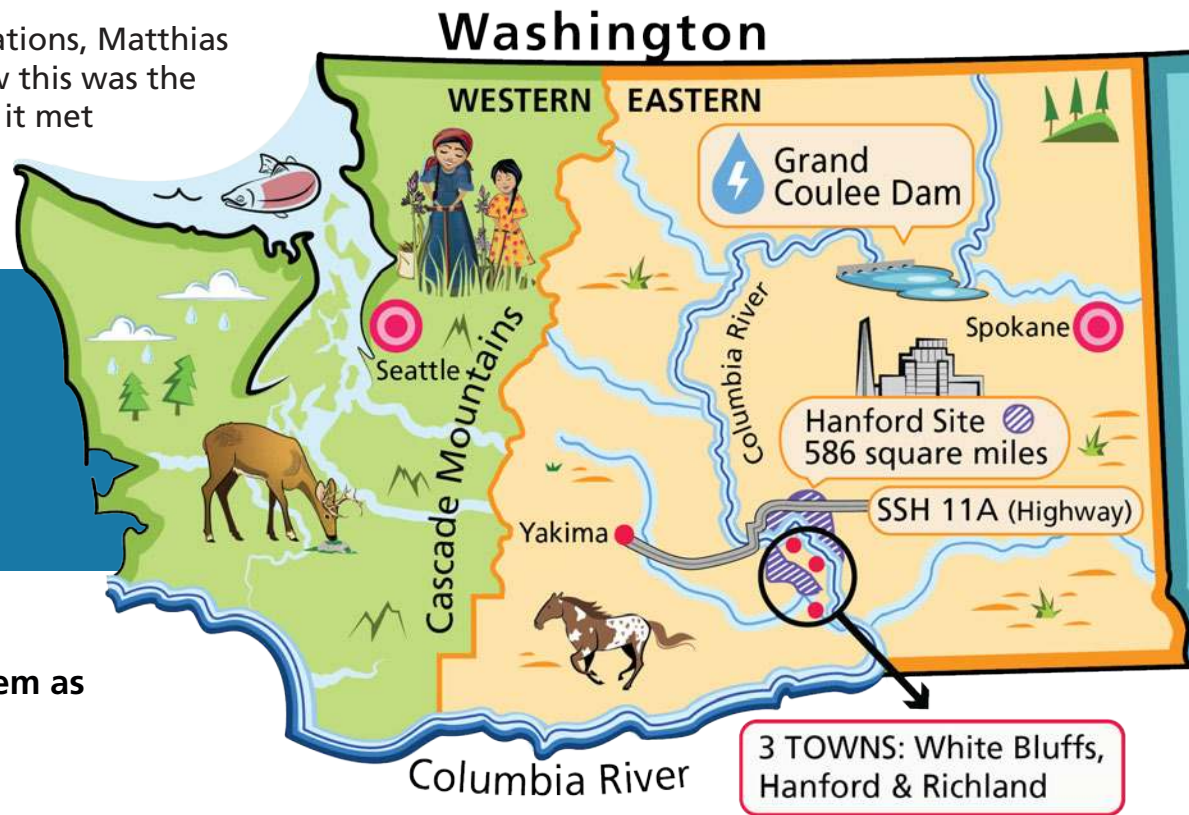


Matthias' checklist

General Leslie Groves of the Army Corps of Engineers was in charge of the Manhattan Project. Lieutenant Colonel Franklin T. Matthias worked for General Groves. Groves directed Matthias to search the United States for the perfect location to produce plutonium.

After visiting several locations, Matthias visited Hanford. He knew this was the perfect location because it met all of the requirements on his checklist.

ACTIVITY: Use this map to fill in the missing words on Matthias' checklist.



Check each item as you finish it.

☐

A large area of land. The Hanford area is _____ square miles.

☐

No large cities nearby. There were only three small towns near the Hanford site: _____, _____, and _____.

☐

No major highways close by. Highway _____ was close, but it was a small state highway with little traffic.

☐

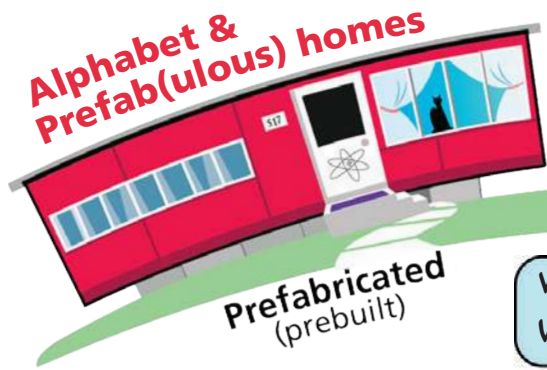
A large source of water. The _____ flows by the site.

☐

Access to large amounts of electricity. The Hanford site could get electricity from the _____.

MOVING IN MEANT MOVING OUT: Native Americans, farmers, and residents of Hanford, White Bluffs, and Richland were forced to move when the military arrived to build the Hanford Site. The government paid the farmers for their homes and land. Many thought the government did not pay enough for everything lost.

H is for home



WHICH HOME WOULD YOU WANT TO LIVE IN?



The selection of Hanford for plutonium production changed Richland almost overnight. It turned from a small village into a secret city for scientists, engineers, and Army officials. In the 1940 census, 250 people lived in Richland. In 1945, about 15,000 people lived in Richland.

The Army hired architect G.A. Pehrson to build homes for the workers. He planned the entire community of Richland in less than 90 days. He named his easy-to-build homes for letters of the alphabet. The streets of Richland were named for famous engineers like George Washington.



ACTIVITY: Pick a letter and design the floor plan of an alphabet home.

LETTER _____

B Actual house
Part of floor plan



TIP: You can find a "B House" in Richland at the intersection of Atkins and Comstock.



Separate, not equal

Not everyone who worked at Hanford during the Manhattan Project was treated fairly or equally. During this time, African Americans in many states lived under laws that separated White and Black people.

Workers at Hanford were separated by race. Black workers were assigned different housing and worked in separate groups. Black people rode separate buses from the White people. Black and White workers ate in different



cafeterias. Black and White workers also had separate sports teams, dances, and holiday celebrations.

Black workers were only allowed to work at general labor jobs. They were not allowed to work as scientists or engineers even if they were qualified for the job. But they did earn the same pay as White workers for the same jobs. Even though Black workers were treated unfairly, they were proud of the work they did and their contributions to Hanford's success.



ACTIVITY: Use these images and what you learned about how Black and White workers lived and worked in the above paragraphs to mark the statements below as TRUE (T) or FALSE (F).

T F African American workers were only allowed to have jobs in general labor, even if they were qualified for other jobs.

T F Black and White workers ate meals together.

T F African American workers received the same pay for the same job as white workers.

T F Social activities at Hanford were not segregated by race.

T F Black and White workers rode on the same buses.

CHRISTMAS 1944		
CLASSIFIED SCHEDULE		
TUES.	WED.	THUR.
2 WHITE 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL	13 WHITE 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL	14 WHITE 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL
9 WHITE 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL	20 WHITE 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL	21 WHITE 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL
26 WHITE 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL	27 WHITE 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL	28 WHITE 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL
31 WHITE 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL	COLORED 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL	SU 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL 8:00PM-10:00PM-BINGO GAME 11A-REC HUTS-YOUTH CENTER 12:30PM-1:30PM-GRAND BALL

New rules for Hanford women



Leona Woods
Marshall Libby
Nuclear Physicist

During World War II, more women began working outside the home because many men were away at war. Women did not have as many job options as men and were often paid less than men for the same job.

At Hanford, women made up nine percent of the workforce and one percent of the supervisors. Dr. Jane Hall, a physicist, supervised the building of the B Reactor. She was one of the few female supervisors at Hanford. Dr. Leona Woods Marshall Libby was the only female scientist at Hanford.

Most Hanford women worked traditional “women’s jobs” including nurse, teacher, secretary, clerk, food service worker, and maid. Some women at Hanford also worked as lab technicians and lab assistants.



You are in charge.

Below is a list of rules and norms Hanford women were supposed to follow during World War II. A norm is how you are expected to behave. Saying please and thank you is an example of a norm.

ACTIVITY: Read the Rules and Norms for Women list below. Rewrite the list for the way you want women to be treated.



Out with the Old

OLD Rules and Norms for Women

1. Women cannot be soldiers.
2. Women should only work at women’s jobs.
3. Women should not supervise men.
4. Women should not make more money than men.
5. Women should take care of all the children and do all the cooking and cleaning.

In with the New

NEW Rules and Norms for Women

- 1.
- 2.
- 3.
- 4.
- 5.

TOP-SECRET science

Can you handle

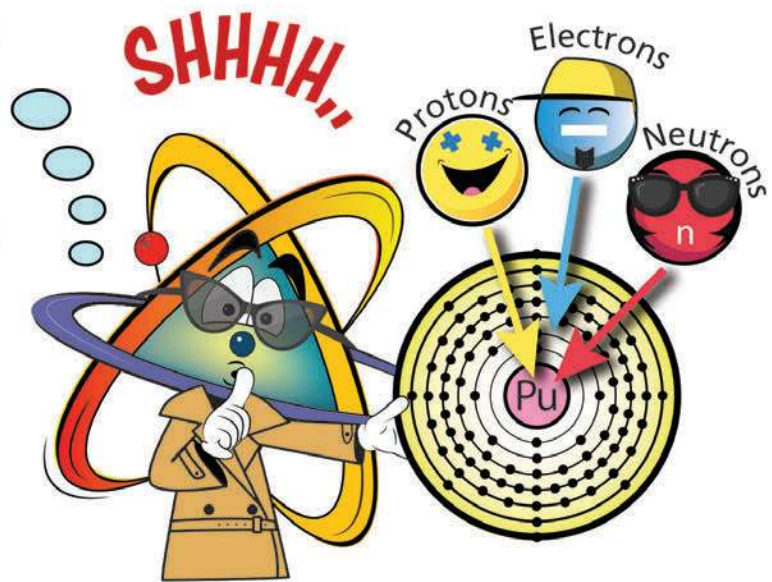
TOP-SECRET

science? →

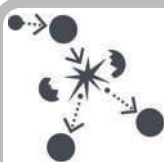
MY NAME IS ATOM U235 FISSION.

I AM NAMED AFTER ATOMS, WHICH ARE THE BASIC BUILDING BLOCKS FOR EVERYTHING! PROTONS, NEUTRONS, AND ELECTRONS MAKE UP EACH ATOM. ATOMS FIT WITH OTHER ATOMS TO CREATE MATTER.

Manhattan Project scientists studied nuclear physics to learn how to make an atomic bomb. They knew that when the nucleus of an atom splits, neutrons and lots of energy are released. Scientists worked with uranium 235 (U235) and plutonium 239 (Pu239) because these are some of the few elements whose atoms split (fission).



CONFIDENTIAL



NUCLEAR CHAIN REACTION: when the neutrons released by the splitting of an atom strike and split other atoms which, as a result, hit other atoms that then also split one after another after another much like dominoes falling.



NUCLEAR FISSION: the splitting of the nucleus of an atom into smaller atoms. This releases neutrons and lots of energy.



NUCLEAR PHYSICS: the field of physics that studies the nucleus of an atom, its parts (protons & neutrons), and how the parts of the nucleus interact.



NUCLEUS: the center of an atom. The balance of protons and neutrons in a nucleus determines whether a nucleus will be stable or unstable.



NEUTRON: a neutron has no electrical charge. Neutrons, protons, and electrons make up an atom.



PLUTONIUM: radioactive metal, rarely found in nature, that splits and releases neutrons and energy. Manhattan Project workers made plutonium at Hanford.



RADIATION: energy that moves from one place to another.



URANIUM: radioactive element found in nature.

- CLASSIFIED -

ACTIVITY: Fill in the sentences below with words from this word bank to learn about nuclear physics. *Need help?* The definitions of these words are on page 16.

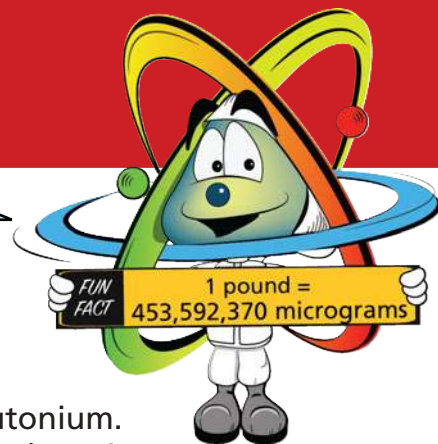
TOP-SECRET WORD BANK

Nuclear Chain Reaction Nuclear Fission Nuclear Physics
Nucleus Neutron Plutonium Radiation Uranium

1. _____ was discovered by German scientists in 1938. Manhattan Project scientists used this discovery for their research into making an atomic bomb.
2. When the _____ of an atom fissions, it releases energy and neutrons.
3. The nucleus of an atom often fissions (splits) when hit by a _____.
4. Enrico Fermi was the first person to create a sustained _____ in a nuclear reactor. This released enough energy to power a single light bulb proving that nuclear fission released energy and humans could control the reaction.
5. When an unstable nucleus changes to a stable nucleus, it emits nuclear _____ in the form of small particles and energy. Atoms that give off radiation in this way are called radioactive.
6. Scientists wanted to split _____ 235 because it is fissile, which means it can split and release neutrons and energy.
7. In 1940, Manhattan Project scientists made _____ in a lab for the first time. Pu239 fissions easily and can be made in large quantities in a nuclear reactor like the B Reactor.
8. Discoveries in _____ include nuclear power, nuclear weapons, and nuclear medicine like radiation therapy.

Plutonium factory

IN 1941, SCIENTISTS IN A LAB MADE SEVERAL MICROGRAMS OF PLUTONIUM FOR THE FIRST TIME. IN 1943, MANHATTAN PROJECT SCIENTISTS BUILT A FACTORY AT HANFORD THAT COULD MAKE POUNDS OF PLUTONIUM FOR THE WAR EFFORT.



ACTIVITY: Your job is to build a plutonium factory.

Below are descriptions of the steps and buildings involved in making plutonium.

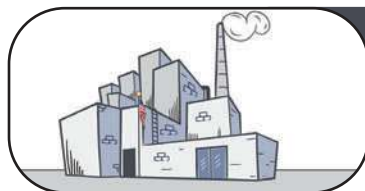
On the next page, there is a picture of each step that is needed to make plutonium.

Use the information below to correctly label each step on the next page with the correct step's number.



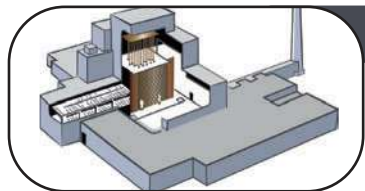
STEP 1 Uranium Processing Mills, all over the USA

At processing mills around the country, workers refined the uranium ore into uranium metal. Machines formed the metal into special shapes called billets. Workers shipped the billets to Hanford by train.



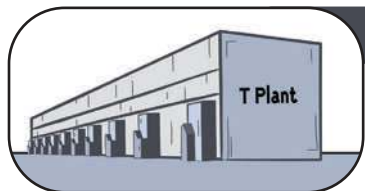
STEP 2 Fuel Fabrication Area. Hanford Site, WA

Workers placed the uranium billets into very powerful machines that shaped the billets into cylinders. These uranium cylinders are about the size of two regular Snickers bars stacked end to end. The uranium cylinders were sealed in aluminum jackets and called fuel slugs.



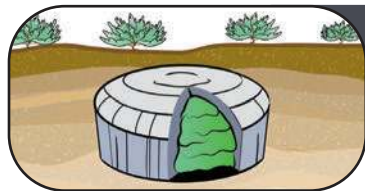
STEP 3 B Reactor, Hanford Site, WA

Workers loaded the fuel slugs into a nuclear reactor. Through a process called transmutation (see page 20 for an explanation), small amounts of plutonium were made in the reactor. The plutonium was mixed in with lots of irradiated uranium and other unneeded fission products.



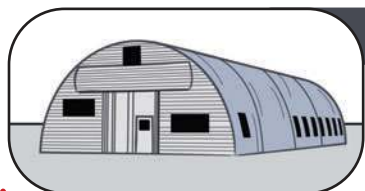
STEP 4 T Plant, Hanford Site, WA

A series of chemical baths separated the plutonium from uranium and other unwanted products. Irradiated uranium is highly radioactive. Thick concrete walls, leaded glass, and remote-controlled machines protected workers from this radiation.



STEP 5 Underground Storage Tanks, Hanford Site, WA

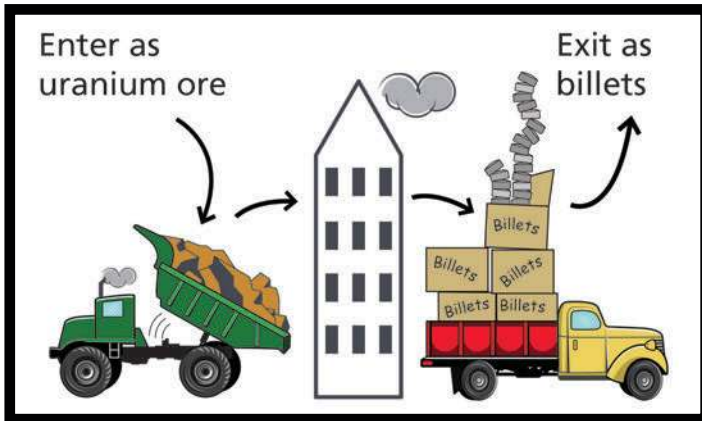
The chemical separation process created a lot of toxic waste that workers stored in underground storage tanks. Much of the work at Hanford today is figuring out how to safely dispose of this waste.



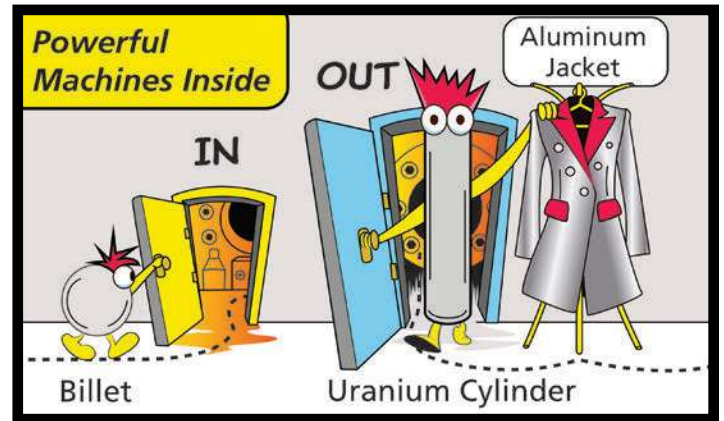
STEP 6 Shipment to Los Alamos, NM

Workers delivered Hanford's plutonium to Los Alamos, New Mexico, where scientists at this top-secret site assembled the Fat Man nuclear bomb.

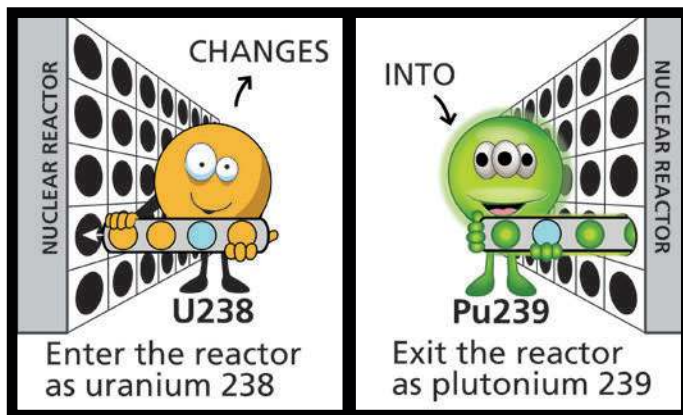
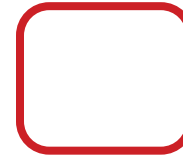
- CONFIDENTIAL -



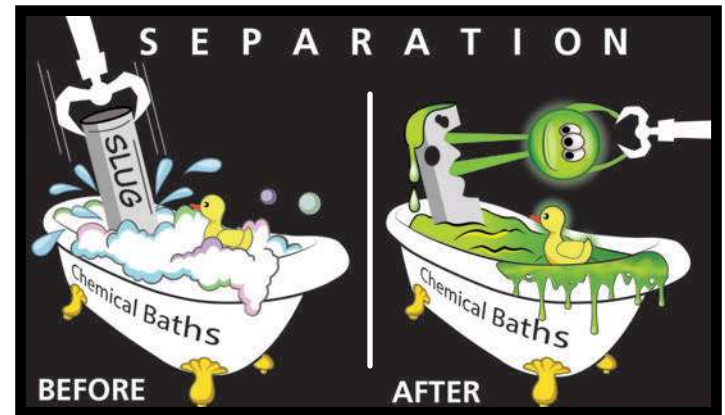
STEP



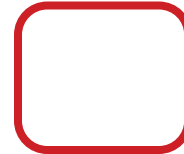
STEP



STEP



STEP



STEP



STEP



TRANSMUTE THIS!

In nature, the **URANIUM atom** has three isotopes: **U234, U235, U238**. Isotopes are like cousins—similar but different. Manhattan Project scientists were interested in U235 because it is fissile, which means it can split and release neutrons.

Scientists also wanted U238 because it can absorb neutrons released by U235 and change into a whole new element. This change is called **transmutation**.

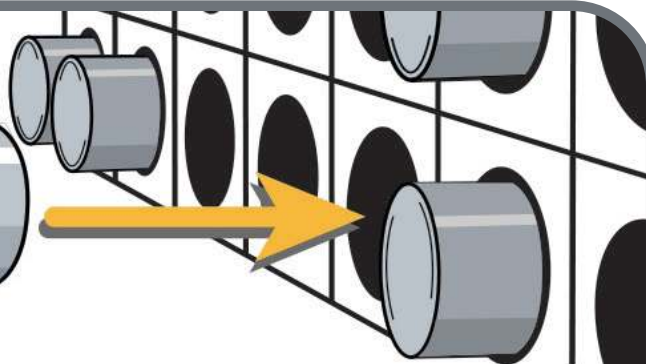
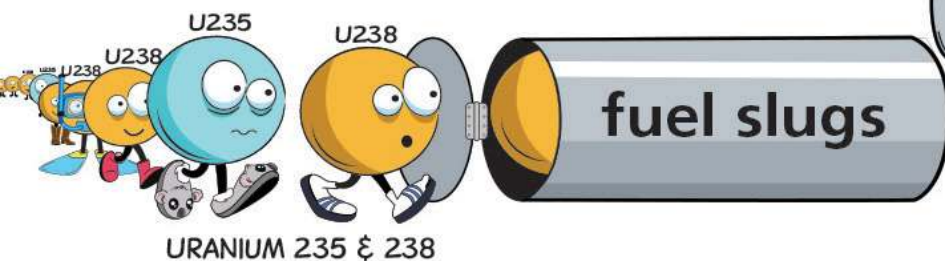


TOP-SECRET WORD BANK

U235 (uranium 235)	neutrons	transmutes (changes)
U238 (uranium 238)	fuel slugs	nuclear reactor
Np239 (neptunium 239)	fissions (splits)	nuclear chain reaction

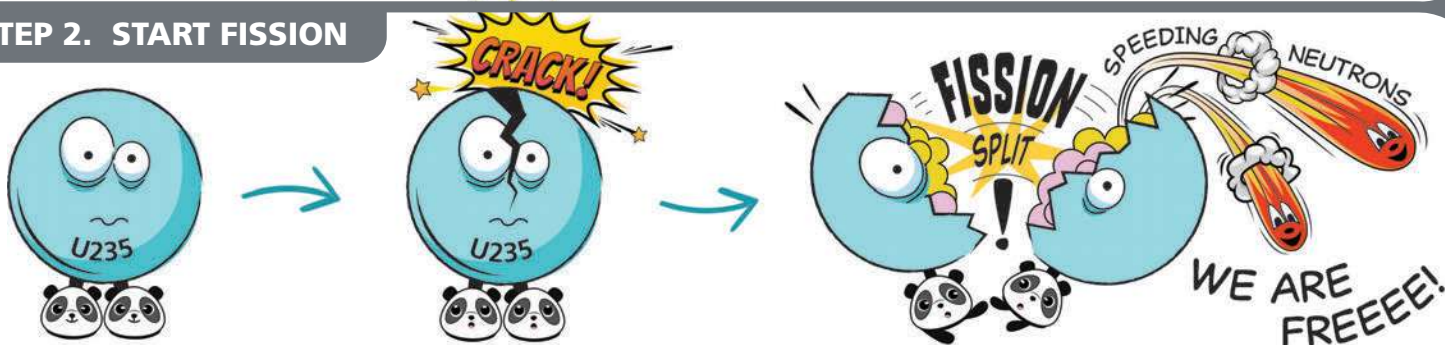
ACTIVITY: Use the words in the word bank above to fill in the blanks below.

STEP 1. MAKE & LOAD THE FUEL INTO A REACTOR



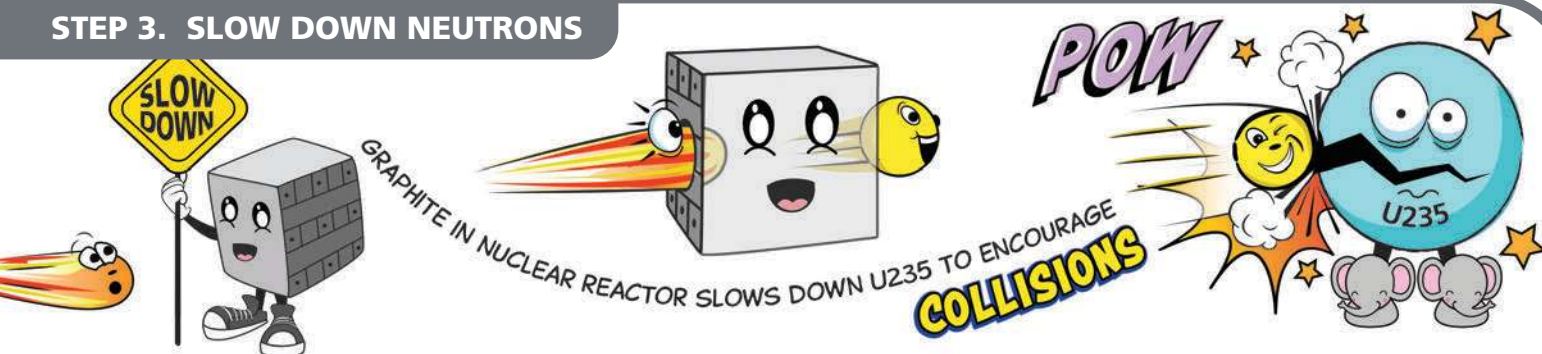
Form the uranium into _____ using uranium metal, which is mostly U238 with a tiny amount of U235. Load fuel slugs into a _____.

STEP 2. START FISSION



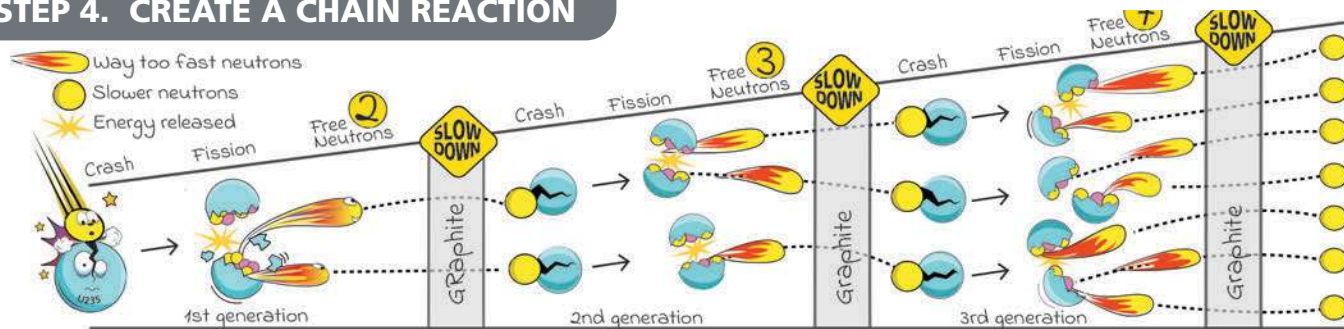
U235 atoms naturally split or fission. When U235 _____ (hint: splits), it releases on average 2.5 fast neutrons per uranium atom and lots of energy.

STEP 3. SLOW DOWN NEUTRONS



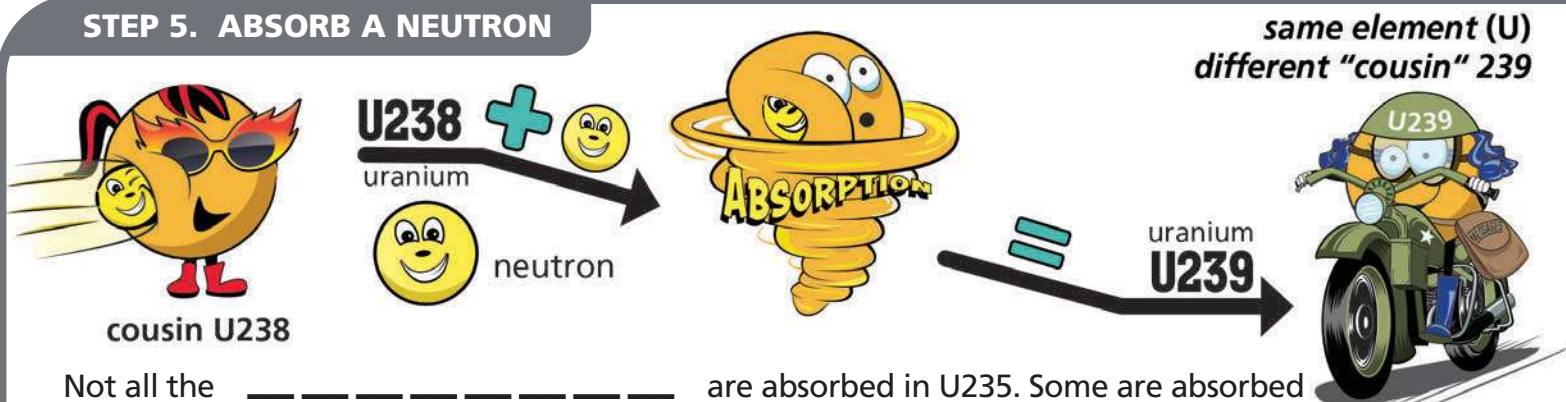
The fast neutrons must be slowed down so they can hit more _____ atoms and cause more U235 atoms to fission. Graphite is used to slow down fast neutrons.

STEP 4. CREATE A CHAIN REACTION



The fission process generates neutrons that initiate fission in other U235 atoms in a continual process of splitting U235 atoms and releasing more neutrons. Soon, there are enough slowed neutrons to create a _____ . (hint: )

STEP 5. ABSORB A NEUTRON



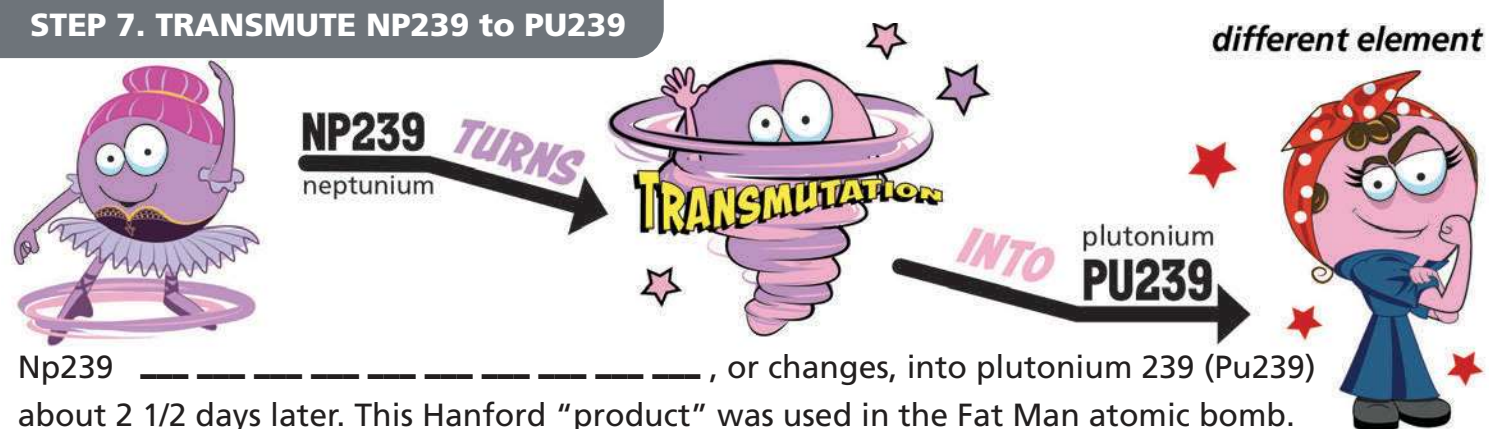
Not all the _____ are absorbed in U235. Some are absorbed by U238. When a _____ (hint: $U239 - 1$) atom absorbs one neutron, it becomes U239.

STEP 6. TRANSMUTE U239 to NP239



The change does not stop there. U239 then transmutes, or changes, to _____. It takes an average of 23 minutes for half of the U239 to transmute into Np239 (hint: Neptune).

STEP 7. TRANSMUTE NP239 to PU239



Hardship & friendship



Sadako Sasaki and her friend in a relay race. Scan this code to learn more about Sadako and her legacy of the origami peace crane.



For the Manhattan Project, people from across the country came together to build the world's first atomic bombs and forever changed the world. This achievement is directly connected to two very sad events: the dropping of atomic bombs on the Japanese cities of Hiroshima and Nagasaki in August 1945.

The United States and Imperial Japan fought each other during World War II. Both were fighting for what they believed was right, and many lives were lost in this fight. In the years since the end of World War II, Japan and the United States have become friends through a lot of hard work.

Friendship is a precious gift in the lives of all people. Think about what you say or do to show your friends what they mean to you. With this in mind, complete the activity below.

ACTIVITY: List words and actions that you use to show your friends that you care about them.

Words of Friendship

Actions of Friendship



Legacies



THE MANHATTAN PROJECT LAUNCHED THE NUCLEAR AGE AND FOREVER CHANGED THE WORLD WE LIVE IN.

Legacies of the Manhattan Project include, but are not limited to:

1. Very powerful nuclear weapons.
2. The technology to build nuclear reactors to power cities.
3. Nuclear medicine like radiation therapy used to treat cancers.
4. Environmental legacy including millions of gallons of toxic waste stored on the Hanford site from plutonium production.
5. The nuclear technology that allows aircraft carriers and submarines to stay out at sea for months at a time.

ACTIVITY: Pick one of the legacies listed above, or one you are familiar with, and identify the positive and negative impacts of that legacy.

I choose legacy number

Positive

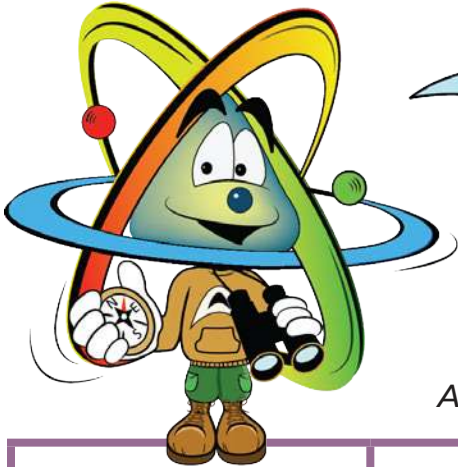
Example: *Very powerful weapons.*

Positive: *Helped end World War II*

Negative: *Long lasting side effects*

Negative

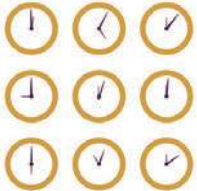
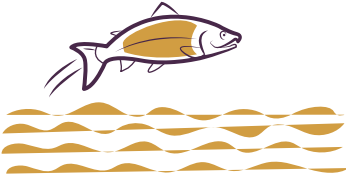
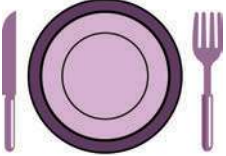
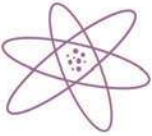
Scavenger Hunt



LET'S EXPLORE AND LEARN MORE ABOUT THE PEOPLE, PLACES, AND STORIES OF THE MANHATTAN PROJECT.

ACTIVITY: Visit one or all of the places below and do the activities listed below each place. Once you've done that activity, check it off the list. To complete this activity, four or more of the activities must be completed.

Ask a ranger or a park docent for directions to the places in Richland.

B REACTOR TOUR	RICHLAND	PRE-WAR TOUR	VISITOR CENTER
Find "Poppy" to help Atom U. Fission detect radiation 	Visit a street named after a famous engineer 	Find a sagebrush 	Watch "Hanford Made" Video 
Write a haiku 5 syllables 7 syllables 5 syllables 	Find an alphabet home 	Spot a deer or elk 	Visit the park's digital app (QR code on page 2) 
Visit the control room 	Watch the Nčł Wána (Columbia River) 	Visit Hanford High School 	Test the radioactivity of a Fiestaware plate 
Hold a replica fuel slug 	Find a business with "Atomic" in its name 	Observe a hawk or a raven 	Stamp the certificate on page 26 with the passport stamp 

Reflection

YOU'VE COME A LONG WAY ON YOUR JOURNEY.
LET'S REFLECT.

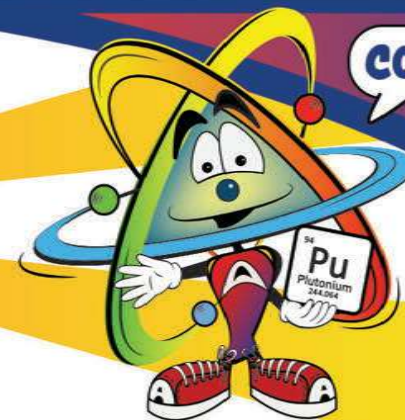
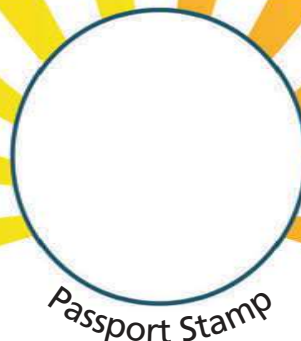
ACTIVITY: Use this space to reflect upon your experience at the park today. Choose one of the activities below.

- 1. POSTER:** The Manhattan Project was a really big challenge that required people from across the country to come together and work towards a common goal. Pick one challenge we face in the world today. Create a poster to persuade people to work together to solve the problem.
- 2. WRITING:** Do you think it is important for people to learn about the Manhattan Project? Yes or no? Explain why.
- 3. DRAW:** (for ages 8 and under) You are making history right now! Draw a favorite memory from today so that you can remember it for years to come.

I choose activity number _____



THIS CERTIFICATE IS PROUDLY PRESENTED TO



for completing the

Manhattan Project National Historical Park Hanford, WA

Junior Ranger Activity Booklet

Atom U. Fission

Atom U. Fission

Park Ranger



Check out our app:

