Cleanup at Hanford: ACTIVITIES

Total Lesson Time: 40 minutes
Total Lesson Time with Extensions: 60 minutes

Lesson Introduction: 5 minutes

Activity 1: Circle - 10 minutes

Activity 2: Tank - 20 minutes

Extension 1: Video - 15 minutes

Lesson Conclusion: 5 minutes

TIME, ACTIVITY, ACTION	SCRIPT OUTLINE *(Italics is just a suggested script)*
5 MINUTES GENERAL INTRODUCTION AND LESSON INTRODUCTION *Show Hanford Site Map picture.*	Introduce yourself and Manhattan Project National Historical Park Establish expectations of class Give the class expectations of the lesson Warm-up question or game If the B Reactor has not previously been discussed, introduce the B Reactor and some of the science involved. *Today we're going to talk about how the work that started here during the Manhattan Project affected the environment on the Hanford Reservation and methods of cleaning it up.*
10 MINUTES ACTIVITY 1 - CIRCLE *Show B Reactor picture.*	**Show picture of the B Reactor.** *What happened here?* **(Let children share what they know.)** *Neutrons from the fission (or splitting) of Uranium-235 atoms in the uranium fuel rods were absorbed into Uranium-238 atoms which then decayed to produce plutonium.* *Water was used to cool the process tubes where the fission was taking place because things get very hot during this process. The water was taken from the Columbia River, run through the reactor, then sent to a pool to cool. As it sat there and cooled down, some, but not all, radioactive elements decayed before it was sent back into the river.*

ACTIVITY 1 - CIRCLE *(continued)* *Show T Plant picture.* *Show Before Tanks were Buried, Tank Size Comparison, and Double Shell Diagram pictures.*	*There were other ways that Hanford's plutonium production affected the river. Water with low level radioactive elements and process chemicals was stored in surface ponds and cribs. Some of the harmful elements were filtered out and stored in the soil. Through this process, harmful chemicals were put into the groundwater at Hanford.* *But the largest amount of waste produced at Hanford was from the processing plants, like T plant.* **Show picture of the T Plant.** *This is where the irradiated uranium fuel rods were put through a series of chemical baths to separate the plutonium from the uranium. The liquids used here were very dangerous to humans even when they were no longer useful.* *They couldn't be put in the trash or washed down the drain, so instead huge tanks were built, and the waste liquids were put in there. In total, 177 tanks were built and buried underground to hold this liquid waste. They have enough waste to fill 88 Olympic sized swimming pools.* **Share three tank pictures: before tanks were buried, tank size comparison, and double shell tank diagram.** *An issue with these tanks is that they were not designed to store this highly corrosive liquid waste for so long. Over time, corrosion created leaks in some of the tanks and that waste has leaked out.*
35 MINUTES *(20 minutes without video)* ACTIVITY 2 - TANKS *Have the two containers ready. Have water and food coloring available.* *Have the glitter ready.* *Have the water bottles, basters, funnel, and plaster of paris ready.*	**Have two containers labeled "TANK 55,000-1,000,000 gallons" (their capacity). Have students fill each with 1 cup water and add some food coloring.** *Here we have a representative of the tanks at Hanford. Of course, the real tanks are made with metal and concrete and are buried underground, and they can hold 55,000- 1,000,000 gallons of waste.* *A variety of waste went into the tanks including 1,800 chemicals and a variety of radioactive materials.* **Get student volunteers to sprinkle glitter into the tanks.** *Now, the plan to deal with this waste is to transfer it via piping to a building where it will get mixed with glass-forming materials and heated to turn the combined mixture into a glass like substance that can be packed away and buried in a special place. It will still be radioactive for thousands of years, but due to the properties of the glass, it will stay in one place and won't leak out.* **Have volunteers come up two at a time and use baster to siphon liquid and glitter into the empty water bottles. When bottles are ¾ full, have volunteers use funnel to put in plaster of paris.**

ACTIVITY 2 - TANKS *(continued)* *Play Hanford Story Overview video (optional).*	*During this process, the waste and materials would be heated until it forms a glass like substance. Since ours is just a model, we're going to mix it up and leave it sitting here while we watch a little video.* **Watch Hanford Story Overview by the Department of Energy.**
5 MINUTES CONCLUSION *Show Vitrification Process picture.*	*This process of turning waste into glass is called vitrification.* **Share Vitrification Process picture and walk through the steps.** *You might find it interesting to know that building the Vitrification Plant started in 2002 and is still ongoing.* • *What do you think of this plan to deal with the 56,000,000 gallons of waste in the tanks at Hanford?* • *What do you want to know more about to help form your opinion?* **Mixture should dry within an hour (depending on size).** *Now that our water and glitter mixture is a solid, you don't have to worry about it leaking or getting glitter everywhere.*