PROJECT INFORMATION:

The project is meant to model the radioactive decay process from Astatine^{219} into the stable isotope of Lead^{207}(see Figure 1) and and energy resulting from this process.
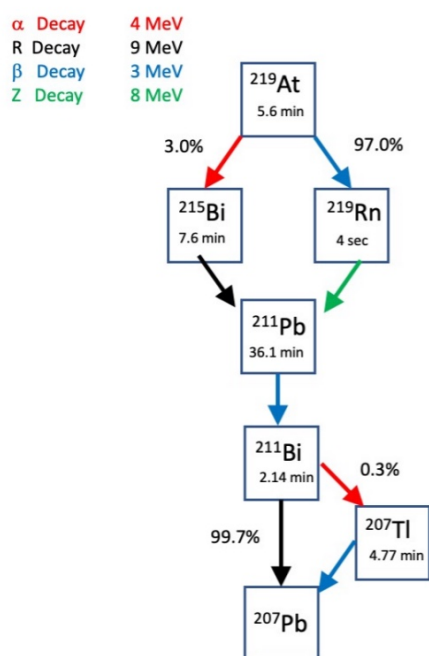

Figure 1: Decay of Astatine^{219}

PURPOSE:

The simulation will model decay of a set number of Astatine^{219} atoms over an appropriate amount of time. Following the collection of the data provided by the simulation over the decays and the energies released, the data will be used to estimate the cost of the shields necessary to protect people from the radiation excreted by the decay.

PROCEDURE:

The program, mathematically simulating the decay of the atoms, will model the decay of 25000 Astatine^{219} atoms, following the information provided by Figure 1. Within the simulation counter variables will be added in order to track the decays of each isotope. Using that information, and the energies provided in Figure 1, the total decays and energy released were provided. Using the simulation in the modeling program, the simulation will run 10 times in order to come up with an average and standard deviation for each decay type. Using these, the cost estimate for the shields required for each decay were calculated. **ANALYSIS:**

Using the code from the simulation to model, a function was made in order to run the simulation 10 times, and derive a standard deviation and average for each individual decay type. Following the collection of this data, the minimum required energy to block was calculated, equaling the 3-sigma deviation of average energy. Using the information provided to us in Figure 2, we were able to compute the minimum required thickness for each material and the cost as well.

Radiation	Material	Material blocks	Cost/cm
α	Wood	1,000 MeV per cm	$0.25
β	Water	9,000 MeV per cm	$1.25
R	Gold	5,000 MeV per cm	$75.00
Z	Lead	3,000 MeV per cm	$25.00

Figure 2: Materials by block and cost/cm

RESULTS:
ANALYSIS (and math):
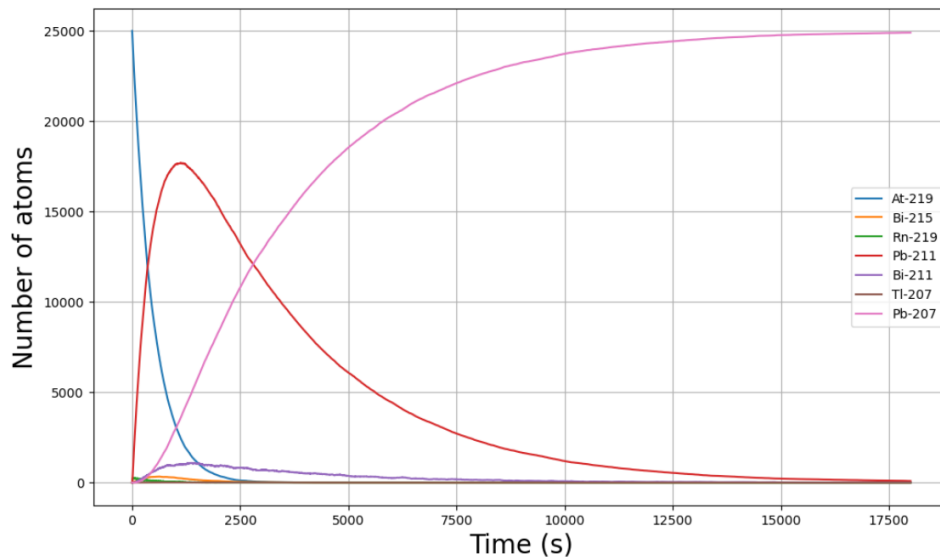The following is the graph provided from the initial simulation.

Figure 3: Graph of Simulated Decay

From the simulation, a table (below) was complied of each decay for each decay type, and the total energy released in each decay type.

	α	β	R	Z
Total Decays	791	49262	25551	24280
Energy Released (MeV)	3164	147786	229959	194240

2

After all the calculations, the determined thickness and cost of each material shield is reported in the table below.

	wood	water	gold	lead
Thickness (cm)	3.61	16.27	45.43	64.74
Total Cost (dollars)	0.9	20.34	3407.25	1618.5

CONCLUSION:

According to the Firgure 3, the relationship between the number of atoms of Astatine[219] as it decays over time is exponential, as are that of all the other Isotopes included. For the shields, it will be about .90$ for wood, 20.34$ for water, 3,407$ in gold, 1,618$ in lead.