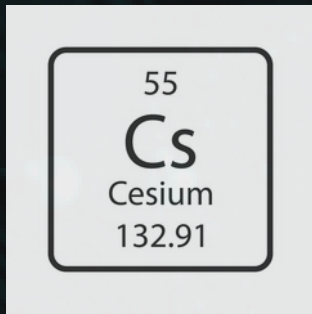# MATHEMATICAL MODEL THAT PREDICTS THE AMOUNT LEFT OF A RADIOACTIVE SUBSTANCE ASSUMING AN INITIAL AMOUNT AND TIME IN YEAR

Cesium-137

Half Life: 30 years

Initial amount: 760 grams

• **Uses:**

- Cesium-137 (Cs-137) is used in industrial radiography to test the integrity of welds and detect structural flaws in materials.

- It is used in certain medical treatments for cancer, specifically in brachytherapy.

- Cs-137 is used in gamma irradiators to sterilize medical equipment and preserve food.

•**Effects:**

- Cs-137 is a strong gamma emitter, and exposure to high doses of gamma radiation can cause radiation sickness, tissue damage, and increased cancer risk.

- If Cs-137 is released into the environment, it can contaminate soil and water, posing long-term radiation hazards.

Table of values:

x(years)	0	30	60	90	120
y(amount of substance)	760	380	190	95	47.5

• **Exponential Decay Model:**

$y = 760 (½)^{x/30}$
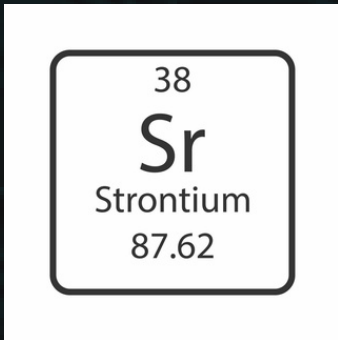
Given Cesium-137 with initial amount of 760 grams and half life of 30 years. What is the remaining amount in 120 years?

$y = 760 (½)^{120/30}$

$y = 760 (½)^4$

$y = 760 (^1/_{16})$

$y = 47.5$

Table of values:

x(years)	0	30	60	90	120
y(amount of substance)	760	380	190	95	47.5

Therefore, the remaining amount of Cesium-137 in 120 years is 47.5 grams.

Strontium-90

Half Life: 29 years
Initial amount: 1500 grams

• Uses:

- Strontium-90 (Sr-90) has been used in radioisotope thermoelectric generators (RTGs) to power space probes and satellites.
- It was historically used in paint for luminescent watch dials and instrument panels.

•Effects:

- Sr-90 is a beta emitter, and exposure to high doses of beta radiation can damage living tissues and increase the risk of cancer.
- If Sr-90 contaminates soil or enters the food chain, it can accumulate in bones, potentially leading to bone cancer and other health issues.

Table of values:

x(years)	0	29	58	87	116
y(amount of substance)	1500	750	375	187.5	93.75

• Exponential Decay Model:

$y = 1500 (½)^{x/29}$

Given Strontium-90 with initial amount of 1500 grams and half life of 29 years. What is the remaining amount in 58 years?
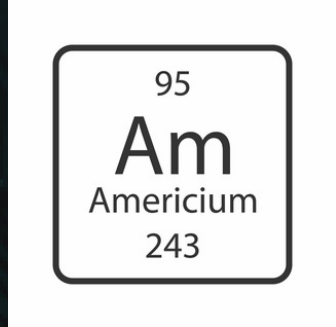
$y = 1,500 (½)^{58/29}$
$y = 1,500 (½)^2$
$y = 1,500 (¼)$
$y = 375$

Table of values:

x(years)	0	29	58	87	116
y(amount of substance)	1500	750	375	187.5	93.75

Therefore, the remaining amount of Strontium in 58 years is 375 grams.

Americium-241

Americium-241

95
Am
Americium
243

Half Life: 432 years
Initial amount: 2000 grams

• **Uses:**

- Americium-241 (Am-241) is used in some household smoke detectors. Its alpha radiation ionizes air, making the detector sensitive to smoke particles.

- It has been used in well logging, a technique to measure the properties of underground rock formations in the oil industry.

•**Effects:**

- Americium-241 primarily emits alpha particles, which are not very penetrating. However, if Am-241 is ingested or inhaled, it can pose a radiation hazard, potentially leading to internal tissue damage and cancer.

- Proper disposal and handling of devices containing Am-241, like smoke detectors, are essential to minimize risks.

Table of values:

x(years)	0	432	864	1296	1728
y(amount of substance)	2000	1000	500	250	125

• **Exponential Decay Model:**

y = 2000 (½)^x/432

Given Americium-241 with initial amount of 2000 grams and half life of 432 years. What is the remaining amount in 864 years?

$y = 2{,}000$
$(½)^{864/432}$
$y = 1{,}500 \ (½)^2$
$y = 2{,}000 \ (¼)$
$y = 500$

Table of values:

x(years)	0	432	864	1296	1728
y(amount of substance)	2000	1000	500	250	125

Therefore, the remaining amount of Americium in 864 years is 500 grams.