

PROTONS	95
NEUTRONS	146
HALF LIFE	430 YEARS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

²⁴¹Am

GAME 1



AMERICIUM-241

²⁴¹Am

Used in fire prevention; nearly all smoke detectors sold in the UK in the last 50+ years contain very small amounts of americium-241, including ones in your home!

GAME 2

²⁴¹Am

EMISSION TYPE	ALPHA, GAMMA
OCCURRENCE	MAN-MADE, SOLID
USES	HOUSEHOLD
ENVIRONMENTAL IMPACT	🌲🌲🌲🌲

PROTONS	55
NEUTRONS	82
HALF LIFE	30 YEARS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

¹³⁷Cs

GAME 1



CAESIUM-137

¹³⁷Cs

One of the biggest sources of unwanted radioactivity in the environment (water and soil around sites of large nuclear accidents is contaminated with caesium-137). Also used to treat cancers.

GAME 2

¹³⁷Cs

EMISSION TYPE	BETA, GAMMA
OCCURRENCE	MAN-MADE, SOLID
USES	MEDICINE
ENVIRONMENTAL IMPACT	🌲🌲🌲🌲

PROTONS	20
NEUTRONS	27
HALF LIFE	4.5 DAYS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

⁴⁷Ca

GAME 1



CALCIUM-47

⁴⁷Ca

Used in medical research to study how bones form in animals (bones are made of calcium phosphate).

GAME 2

⁴⁷Ca

EMISSION TYPE	BETA, GAMMA
OCCURRENCE	MAN-MADE, SOLID
USES	MEDICINE
ENVIRONMENTAL IMPACT	🌲🌲🌲🌲

PROTONS	98
NEUTRONS	154
HALF LIFE	2.6 YEARS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

²⁵²Cf

GAME 1



CALIFORNIUM-252

²⁵²Cf

The heaviest element in the periodic table used widely in everyday life, californium-252 is a substance used to detect for explosives detectors at airports. It is also used on building sites to see how wet things are (things that are too wet don't set very well so californium-252 is sometimes used by specialists to see if cements are ready to be poured and set for building work).

GAME 2

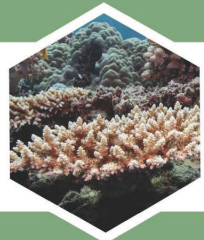
²⁵²Cf

EMISSION TYPE	ALPHA
OCCURRENCE	MAN-MADE, SOLID
USES	SCIENTIFIC
ENVIRONMENTAL IMPACT	🌲🌲🌲🌲

PROTONS	6
NEUTRONS	8
HALF LIFE	5700 YEARS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

¹⁴C

GAME 1



CARBON-14

¹⁴C

Useful for determining ages of old artefacts (radiocarbon dating uses carbon-14).

GAME 2

¹⁴C

EMISSION TYPE	BETA, GAMMA
OCCURRENCE	NATURAL, SOLID
USES	SCIENTIFIC
ENVIRONMENTAL IMPACT	🌲🌲🌲🌲

PROTONS	27
NEUTRONS	33
HALF LIFE	5 YEARS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

⁶⁰Co

GAME 1



COBALT-60

⁶⁰Co

Widely used from medical imaging, cancer treatment and food sterilisation (the gamma emission kills bacteria, making food last longer).

GAME 2

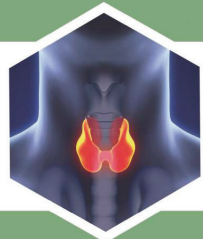
⁶⁰Co

EMISSION TYPE	BETA, GAMMA
OCCURRENCE	MAN-MADE, SOLID
USES	MEDICINE
ENVIRONMENTAL IMPACT	🌲🌲🌲🌲

PROTONS	53
NEUTRONS	70
HALF LIFE	13 HOURS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

¹²³I

GAME 1



IODINE-123

¹²³I

Used in treating thyroid conditions (the thyroid helps control metabolism – digestion, hunger, etc.).

GAME 2

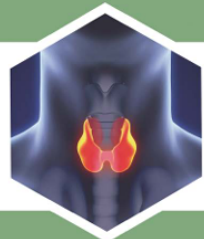
¹²³I

EMISSION TYPE	BETA
OCCURRENCE	MAN-MADE, SOLID
USES	MEDICINE
ENVIRONMENTAL IMPACT	🌲🌲🌲🌲

PROTONS	53
NEUTRONS	78
HALF LIFE	8 DAYS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

¹³¹I

GAME 1



IODINE-131

¹³¹I

Used in medicine to treat cancerous and non-cancerous (benign) conditions of the thyroid gland. It is also used as a tracer to detect leaks in pipes in the oil industry.

GAME 2

¹³¹I

EMISSION TYPE	BETA, GAMMA
OCCURRENCE	MAN-MADE, SOLID
USES	MEDICINE
ENVIRONMENTAL IMPACT	🌲🌲🌲🌲

PROTONS	77
NEUTRONS	115
HALF LIFE	74 DAYS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

¹⁹²Ir

GAME 1



IRIDIUM-192

¹⁹²Ir

Used in aeroplane engineering to test how well a plane is welded together.

GAME 2

¹⁹²Ir

EMISSION TYPE	BETA, GAMMA
OCCURRENCE	MAN-MADE, SOLID
USES	SCIENTIFIC
ENVIRONMENTAL IMPACT	🌲🌲🌲🌲

PROTONS	26
NEUTRONS	29
HALF LIFE	3 YEARS
PRICE	👤👤👤👤
DANGER RATING	👤👤👤👤

⁵⁵ Fe
GAME 1



IRON-55
⁵⁵ Fe

Used to study metals, specifically steel, and their corrosion over time and in construction analysis.

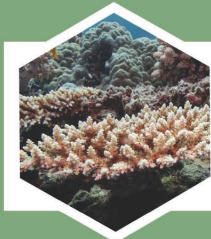
GAME 2

EMISSION TYPE	BETA
OCCURRENCE	MAN-MADE, SOLID
USES	SCIENTIFIC
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

⁵⁵ Fe

PROTONS	82
NEUTRONS	128
HALF LIFE	22 YEARS
PRICE	👤👤👤👤
DANGER RATING	👤👤👤👤

²¹⁰ Pb
GAME 1



LEAD-210
²¹⁰ Pb

Used to determine how old soils, rocks and other environmental things are, particularly from lakes and the sea floor (useful in determining how long ago ice ages were).

GAME 2

EMISSION TYPE	BETA, GAMMA
OCCURRENCE	NATURAL, SOLID
USES	SCIENTIFIC
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

²¹⁰ Pb

PROTONS	28
NEUTRONS	35
HALF LIFE	100 YEARS
PRICE	👤👤👤👤
DANGER RATING	👤👤👤👤

⁶³ Ni
GAME 1



NICKEL-63
⁶³ Ni

Used in airport scanners to detect likely explosives, and in scientific analysis.

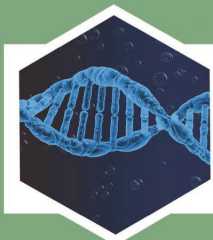
GAME 2

EMISSION TYPE	BETA
OCCURRENCE	MAN-MADE, SOLID
USES	SCIENTIFIC
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

⁶³ Ni

PROTONS	15
NEUTRONS	17
HALF LIFE	14 DAYS
PRICE	👤👤👤👤
DANGER RATING	👤👤👤👤

³² P
GAME 1



PHOSPHORUS-32
³² P

Used in medicine, biology, etc. to track DNA in the body (DNA contains phosphorus).

GAME 2

EMISSION TYPE	BETA
OCCURRENCE	NATURAL, SOLID
USES	MEDICINE
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

³² P

PROTONS	94
NEUTRONS	144
HALF LIFE	88 YEARS
PRICE	👤👤👤👤
DANGER RATING	👤👤👤👤

²³⁸ Pu
GAME 1



PLUTONIUM-238
²³⁸ Pu

Probably the most dangerous element in the periodic table. Extremely radioactive, toxic, but also very useful; it can power spacecraft engines (radioisotope thermoelectric generators), and can be used in nuclear weapons and power.

GAME 2

EMISSION TYPE	ALPHA
OCCURRENCE	MAN-MADE, SOLID
USES	NUCLEAR POWER
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

²³⁸ Pu

PROTONS	84
NEUTRONS	126
HALF LIFE	140 DAYS
PRICE	👤👤👤👤
DANGER RATING	👤👤👤👤

²¹⁰ Po
GAME 1



POLONIUM-210
²¹⁰ Po

Used in photocopyers to improve image quality (in much higher doses it was also used by Russian security to kill one of their double agents, Alexander Litvinenko, in 2006).

GAME 2

EMISSION TYPE	ALPHA
OCCURRENCE	MAN-MADE, SOLID
USES	HOUSEHOLD (IN THE PAST)
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

²¹⁰ Po

PROTONS	19
NEUTRONS	21
HALF LIFE	1.3 BILLION YEARS
PRICE	👤👤👤👤
DANGER RATING	👤👤👤👤

⁴⁰ K
GAME 1



POTASSIUM-40
⁴⁰ K

Most of the radioactivity in humans comes from potassium-40. Also present in bananas (but you'd need to eat about 10 million bananas in one go to die from radiation).

GAME 2

EMISSION TYPE	BETA, GAMMA
OCCURRENCE	NATURAL, SOLID
USES	SCIENTIFIC
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

⁴⁰ K

PROTONS	61
NEUTRONS	86
HALF LIFE	2.6 YEARS
PRICE	👤👤👤👤
DANGER RATING	👤👤👤👤

¹⁴⁷ Pm
GAME 1



PROMETHIUM-147
¹⁴⁷ Pm

Historically used to ensure electric blankets stay at the correct temperature. It glows thanks to its radioactivity and is sometimes used in night-vision sniper scopes.

GAME 2

EMISSION TYPE	BETA
OCCURRENCE	NATURAL, SOLID
USES	HOUSEHOLD
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

¹⁴⁷ Pm

PROTONS	88
NEUTRONS	138
HALF LIFE	1600 YEARS
PRICE	👤👤👤👤
DANGER RATING	👤👤👤👤

²²⁶ Ra
GAME 1



RADIUM-226
²²⁶ Ra

Used in the past to make glow-in-the-dark watches. Marie and Pierre Curie first helped to study the radioactivity of radium around the 1900s.

GAME 2

EMISSION TYPE	ALPHA, GAMMA
OCCURRENCE	NATURAL, SOLID
USES	HOUSEHOLD (IN THE PAST)
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

²²⁶ Ra

PROTONS	86
NEUTRONS	136
HALF LIFE	4 DAYS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

²²²Rn

GAME 1



RADON-222
²²²Rn

A naturally-occurring radioactive gas, radon can sometimes be a problem in areas with a lot of granite (which gives off radon). Some homes are fitted with radon sensors to detect if the levels of radioactivity are getting too high.

GAME 2

EMISSION TYPE	ALPHA
OCCURRENCE	NATURAL, GAS
USES	NOT USED
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

²²²Rn

PROTONS	62
NEUTRONS	91
HALF LIFE	46 HOURS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

¹⁵³Sm

GAME 1



SAMARIUM-153
¹⁵³Sm

Used to help treat pain for cancer patients (particularly bone cancer) that are having aggressive radiotherapy.

GAME 2

EMISSION TYPE	BETA, GAMMA
OCCURRENCE	MAN-MADE, SOLID
USES	MEDICINE
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

¹⁵³Sm

PROTONS	38
NEUTRONS	52
HALF LIFE	28 YEARS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

⁹⁰Sr

GAME 1



STRONTIUM-90
⁹⁰Sr

Used to detect nuclear weapons testing (one of the ways we know how North Korea tests nuclear weapons is to look for atmospheric strontium-90 concentrations).

GAME 2

EMISSION TYPE	BETA
OCCURRENCE	MAN-MADE, SOLID
USES	SCIENTIFIC
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

⁹⁰Sr

PROTONS	43
NEUTRONS	56
HALF LIFE	200,000 YEARS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

⁹⁹Tc

GAME 1



TECHNETIUM-99
⁹⁹Tc

A big problem in nuclear waste. If it gets into water it can move great distances and causes contamination over a large area.

GAME 2

EMISSION TYPE	BETA
OCCURRENCE	MAN-MADE, SOLID
USES	NOT USED
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

⁹⁹Tc

PROTONS	43
NEUTRONS	56
HALF LIFE	6 HOURS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

^{99m}Tc

GAME 1



TECHNETIUM-99M
^{99m}Tc

The most widely used radioisotope in radiation-based medical treatments. Used in brain, bone, liver, kidneys, and lots else.

GAME 2

EMISSION TYPE	GAMMA
OCCURRENCE	MAN-MADE, SOLID
USES	MEDICINE
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

^{99m}Tc

PROTONS	81
NEUTRONS	120
HALF LIFE	73 HOURS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

²⁰¹Tl

GAME 1



THALLIUM-201
²⁰¹Tl

Used as a radiotracer to see how much blood is reaching the different parts of your heart.

GAME 2

EMISSION TYPE	BETA
OCCURRENCE	MAN-MADE, SOLID
USES	MEDICINE
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

²⁰¹Tl

PROTONS	90
NEUTRONS	142
HALF LIFE	14 BILLION YEARS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

²³²Th

GAME 1



THORIUM-232
²³²Th

Used as an alternative to uranium in some nuclear power stations.

GAME 2

EMISSION TYPE	ALPHA
OCCURRENCE	NATURAL, SOLID
USES	NUCLEAR POWER
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

²³²Th

PROTONS	1
NEUTRONS	2
HALF LIFE	12 YEARS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

³H

GAME 1



TRITIUM
(HYDROGEN-3)
³H

Used in everything from glow-in-the-dark watches to nuclear weapons research. Among the most common radioisotopes used in day to day life.

GAME 2

EMISSION TYPE	BETA
OCCURRENCE	NATURAL, GAS
USES	HOUSEHOLD
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

³H

PROTONS	92
NEUTRONS	143
HALF LIFE	700 MILLION YEARS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

²³⁵U

GAME 1



URANIUM-235
²³⁵U

Although only about 1% of uranium in the world, uranium-235 is used as the main fuel source for nuclear power stations. It needs to be separated from uranium-238 before use, through uranium enrichment. Most uranium (uranium-238) remains unused, but is occasionally made into armour-piercing weapons for the military.

GAME 2

EMISSION TYPE	BETA, GAMMA
OCCURRENCE	NATURAL, SOLID
USES	NUCLEAR POWER
ENVIRONMENTAL IMPACT	🌳🌳🌳🌳

²³⁵U

PROTONS	92
NEUTRONS	146
HALF LIFE	4.5 BILLION YEARS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

²³⁸
U
GAME 1



URIANIUM-238

²³⁸
U
Although only about 1% of uranium in the world, uranium-235 is used as the main fuel source for nuclear power stations. It needs to be separated from uranium-238 before use, through uranium enrichment. Most uranium (uranium-238) remains unused, but is occasionally made into armour-piercing weapons for the military.

GAME 2

EMISSION TYPE	ALPHA, GAMMA
OCCURRENCE	NATURAL
USES	NUCLEAR POWER
ENVIRONMENTAL IMPACT	🌲🌲🌲🌲🌲

²³⁸
U

PROTONS	54
NEUTRONS	79
HALF LIFE	5 DAYS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

¹³³
Xe
GAME 1



XENON-133

¹³³
Xe
Xenon-133 is a gas that can be inhaled and used to image the lungs to see how well they are working.

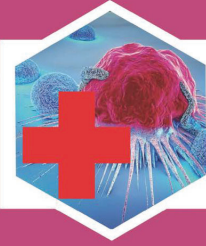
GAME 2

EMISSION TYPE	BETA, GAMMA
OCCURRENCE	MAN-MADE, GAS
USES	MEDICINE
ENVIRONMENTAL IMPACT	🌲🌲🌲🌲🌲

¹³³
Xe

PROTONS	39
NEUTRONS	51
HALF LIFE	64 HOURS
PRICE	£££££
DANGER RATING	☠☠☠☠☠

⁹⁰
Y
GAME 1



YTTRIUM-90

⁹⁰
Y
Widely used in cancer treatment, particularly leukaemia or lymphoma.

GAME 2

EMISSION TYPE	BETA
OCCURRENCE	MAN-MADE, SOLID
USES	MEDICINE
ENVIRONMENTAL IMPACT	🌲🌲🌲🌲🌲

⁹⁰
Y