



**Radiation Safety
Institute of Canada**
Institut de radioprotection du Canada



Lunch, Learn, & Dance
Wellness Webinars

March 18, 2021

Mathematics Review

Followed by Araguacu Latin Dance Company

Good Science in Plain Language®



- Audio and video
 - Will be from the presenters only
 - Use computer or telephone (call in)
 - Computer seems to give the best sound quality
- Use the “Chat” feature to enter comments
- Use the “Questions” feature to ask questions
- Posted on webinar page
 - Video, Q&A answers, copy of the slides
- Follow up email will be sent
 - Topics covered, time of attendance
- It may be possible to change your Zoom view if the controls are hiding the closed captioning.

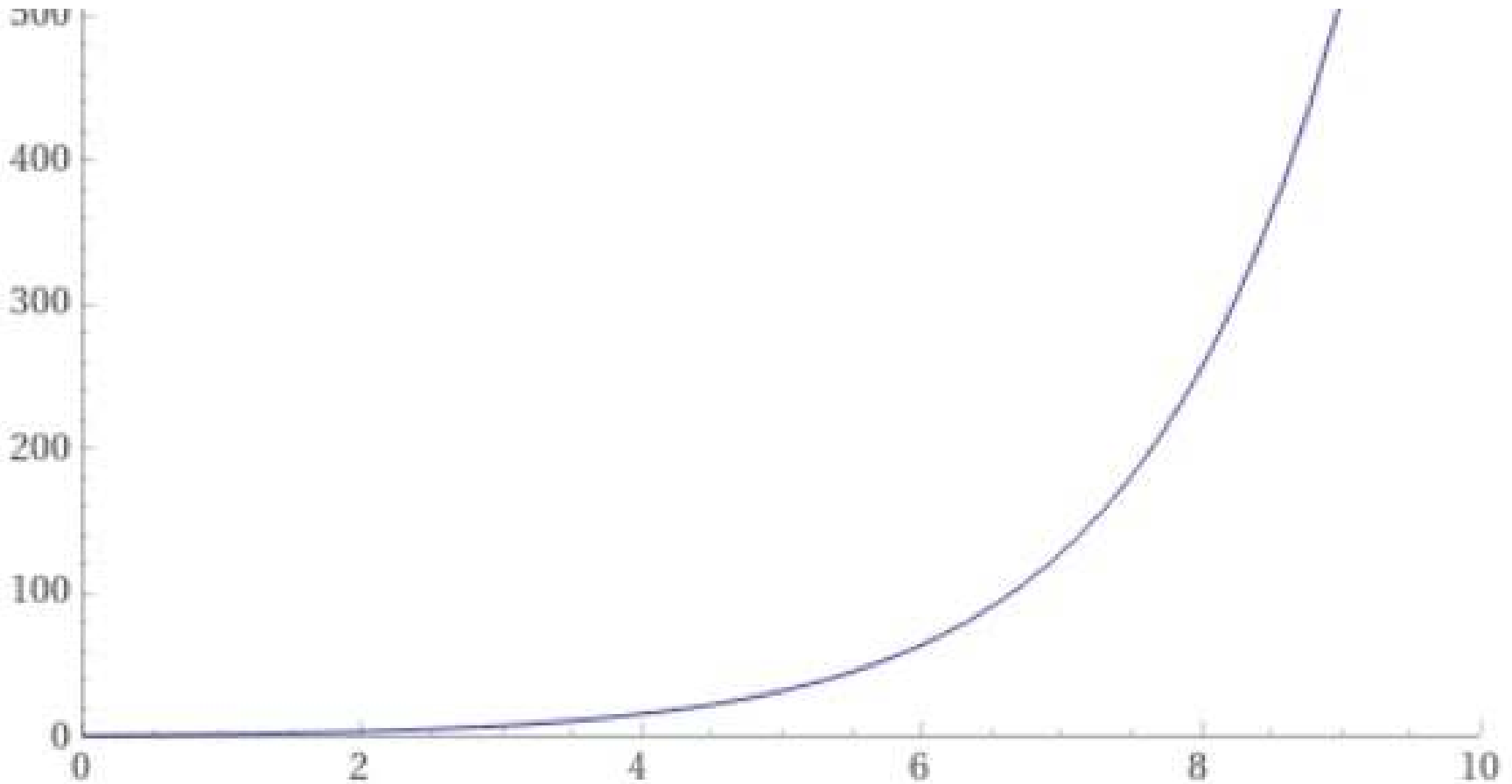


- Powers/logarithms
- Exponential functions
- Half-lives
- Gamma/X-ray Shielding Attenuation
- Half-lives are exponential
- Shielding Attenuation is exponential
- Probability misconception
- Probability and cancer risk

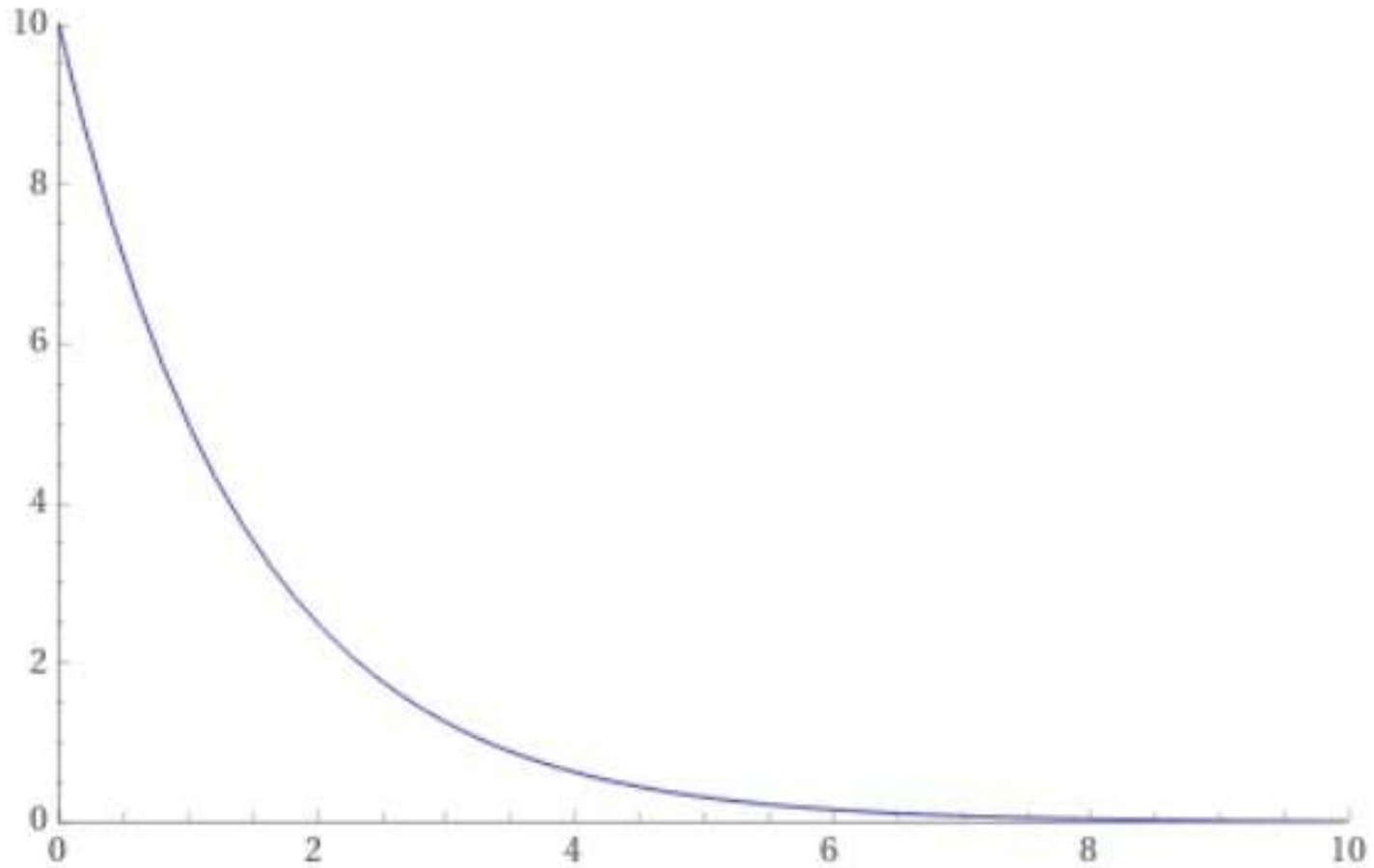




Exponential Growth



Wolfram Alpha LLC. 2021. Wolfram|Alpha. <http://www.wolframalpha.com/> (access March 17, 2021)



Wolfram Alpha LLC. 2021. Wolfram|Alpha. <http://www.wolframalpha.com/> (access March 17, 2021)

Radioactive Decay and Half Lives

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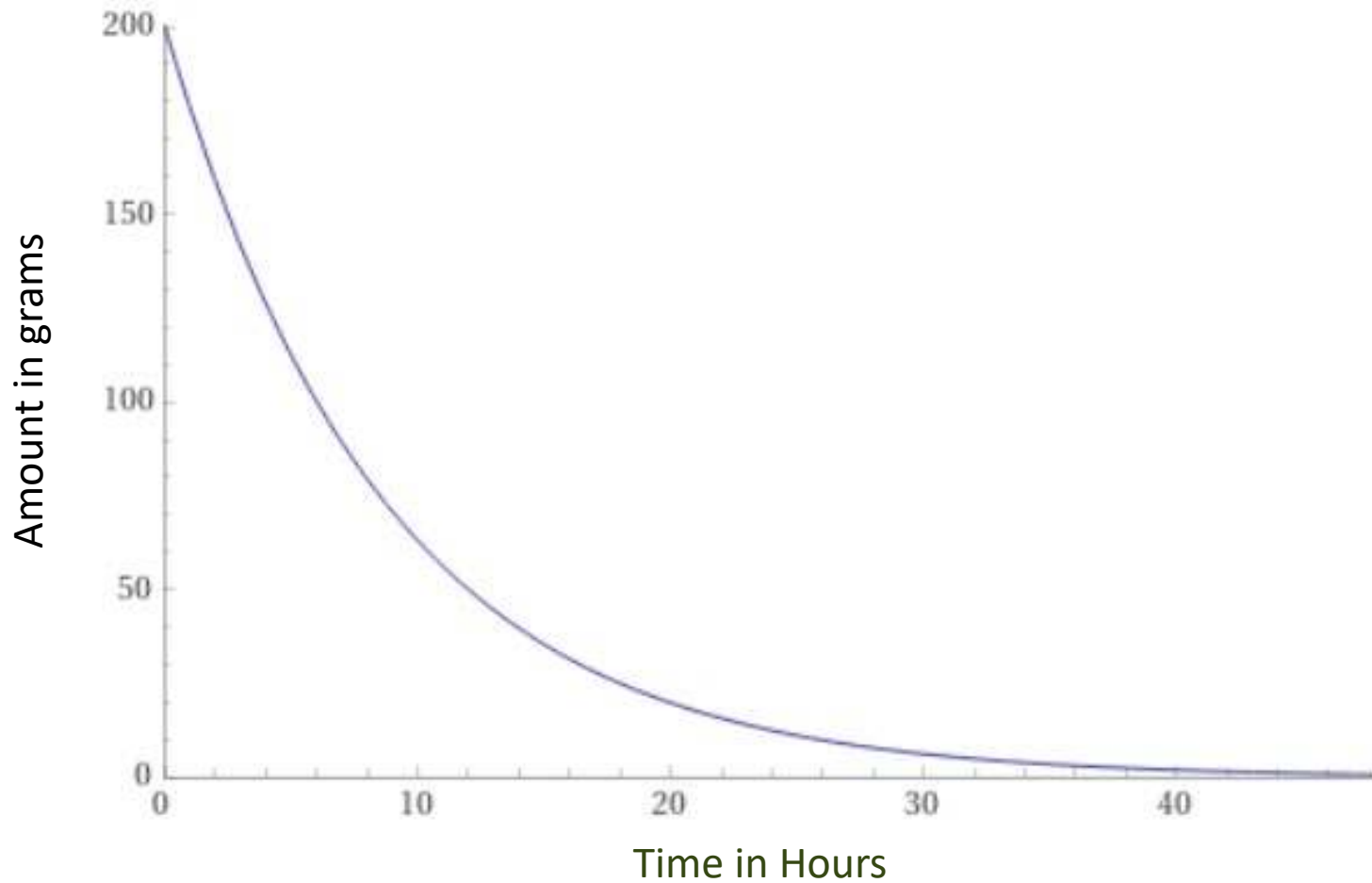
The screenshot shows the 'Alpha Decay (3.27)' simulation window. At the top, there are tabs for 'Multiple Atoms' and 'Single Atom'. Below the tabs is a control panel with a yellow background. It features a counter for ^{211}Po (set to 0) and ^{207}Pb (set to 0), a yellow circle representing an alpha particle, and a graph of Atomic Weight (211 and 207) versus Time (secs) from 0.0 to 3.0. A vertical dashed red line marks the 'Half Life' at approximately 0.5 seconds. The main simulation area contains numerous 3D models of nuclei, some of which are decaying. A 'Reset All Nuclei' button is located in the upper right of the simulation area. In the bottom right, there is a 'Bucket o' Polonium' containing many nuclei, with an 'Add 10' button below it. On the right side, a 'Legend' panel identifies Neutron (grey dot), Proton (red dot), and Alpha Particle (red and blue dots). Below the legend is the 'Choose Nucleus' section, which has radio buttons for 'Polonium-211', 'Lead-207', 'Custom', and 'Custom (Decayed)'. A 'Reset All' button is at the bottom of this panel. At the very bottom of the window, there are play and pause buttons.

Simulation created using <https://phet.colorado.edu/sims/cheerpj/nuclear-physics/latest/nuclear-physics.html?simulation=alpha-decay>



Radioactive Decay and Half Lives

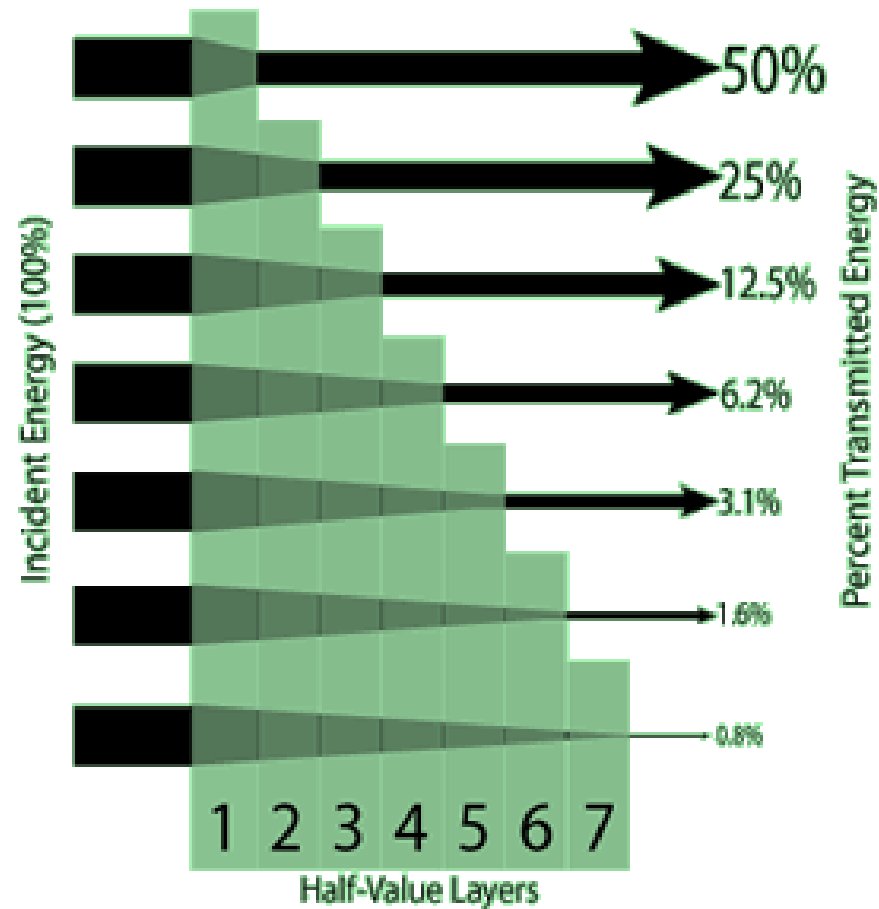




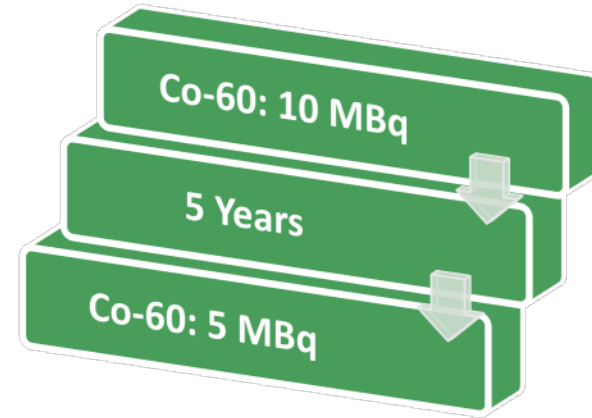
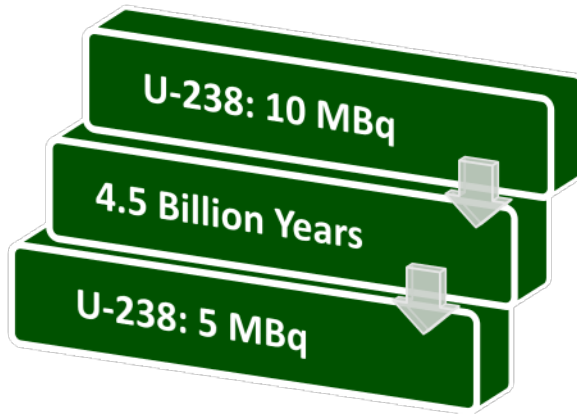
Wolfram Alpha LLC. 2021.
Wolfram | Alpha. <http://www.wolframalpha.com/> (access March 17, 2021)



Gamma X-Ray Shielding Attenuation

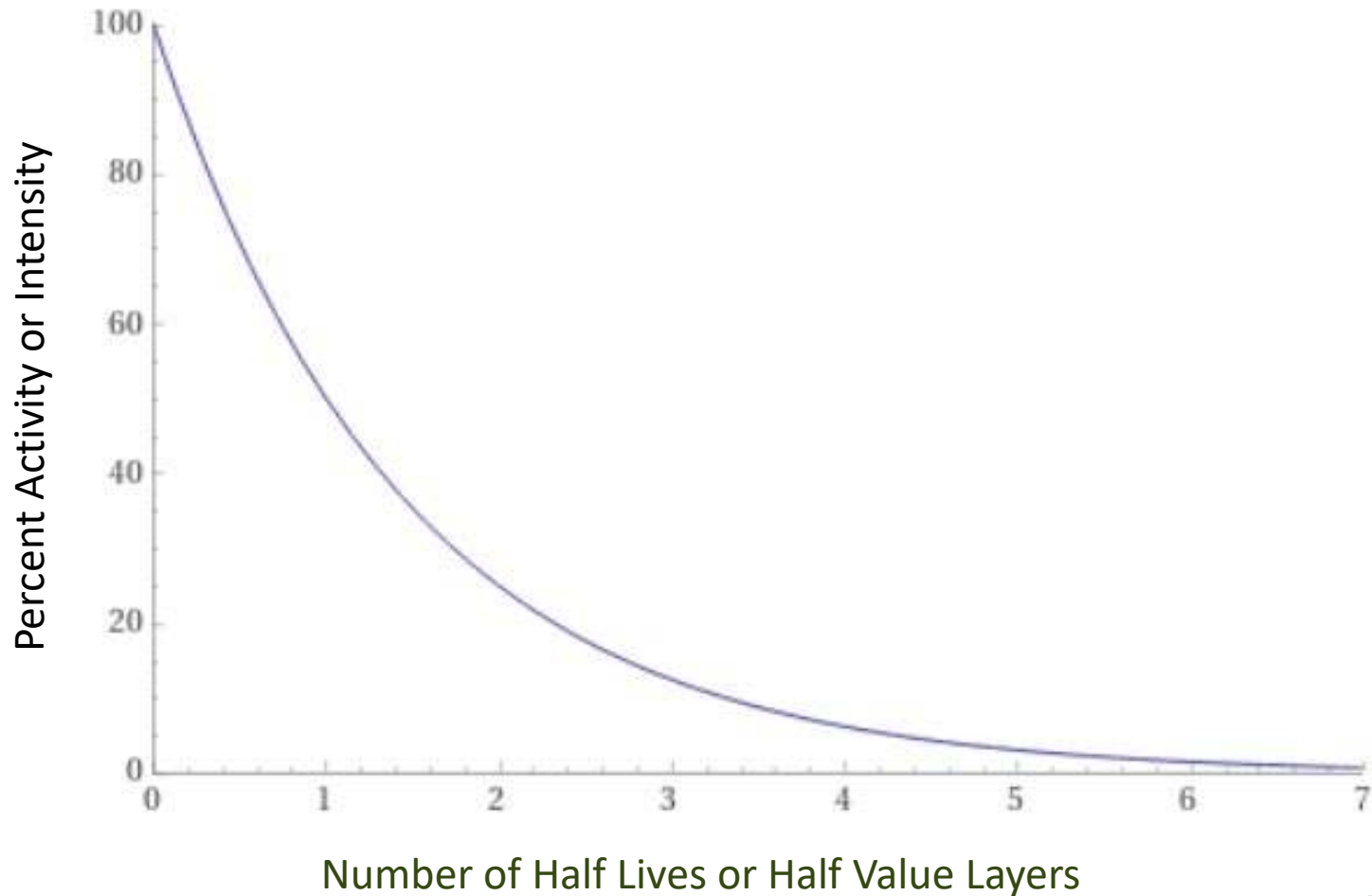


From Iowa State University Center for NDE
<https://www.nde-ed.org/Physics/X-Ray/HalfValueLayer.xhtml>



Rule of Thumb

7 half-lives leaves only 1% of the initial activity remaining.
10 half-lives leaves only 0.1% remaining.



Wolfram Alpha LLC. 2021.
Wolfram | Alpha. <http://www.wolframalpha.com/> (access March 17, 2021)



Misconception

- Lottery you can either win or lose
- You therefore have a 50-50 chance of winning with each ticket you buy

Explanation

- This does not mean you have a 50-50 chance of winning
- It matters how many possible different tickets there are, not how many different outcomes there are
- For Lotto 6/49, there will be 1 combination out of 13,983,816 possibilities
- Your chance of winning is therefore 1 in 13 983, 816
- If you buy 2 different tickets, your chance is 2 out of 13, 983, 816
- You would have to buy about 7 million tickets to get a 50-50 chance

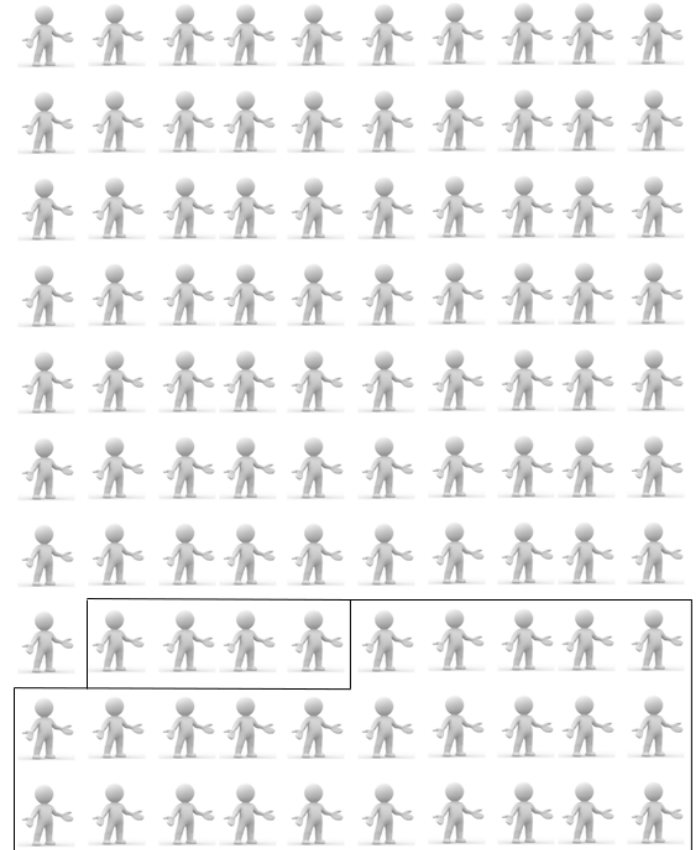


- If you are exposed to radiation, you could either get cancer or not, so you have a 50-50 chance of getting cancer if exposed to radiation



Risk of Death From Cancer

- 1 Sv (1000 mSv) corresponds to 4% increase in risk
- In Canada – 25% to 29% risk of fatal cancer





- The Radiation Safety Institute of Canada is an independent, not-for-profit organization specializing in radiation safety.
- For further information on all types of radiation contact us at:

1-800-263-5803

info@radiationsafety.ca

www.radiationsafety.ca



- <https://phet.colorado.edu/sims/cheerpi/nuclear-physics/latest/nuclear-physics.html?simulation=alpha-decay>
- <https://www.solumaths.com/en/website/free-math-apps-online-calculator-graphs-exercises-games>
- Wolfram Alpha LLC. 2021. Wolfram | Alpha.
<http://www.wolframalpha.com/> (access March 17, 2021)