

Safety and Medical Context in an Ionizing Radiation Lab Curriculum



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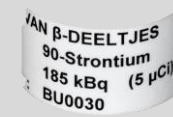


SAFETY CONTEXT

Student Safety Instructions

As Low As Reasonably Achievable principal:

- minimized activity of the radiation source (kBq)
- maximized shielding of the radiation source (plexiglass or lead)
- maximized distance in respect to the radiation source with a minimum of 30 cm
- minimized time of exposure (only during collecting data)



Visual Conformations

- lead sealed strong gamma ray sources
- plexiglass sealed beta ray sources
- various sealed multiple ray sources
- a double secured and sealed isotope generator
- lead (glass) sealed X-ray devices
- position of a source when measuring the background radiation





SAFETY CONTEXT

Safe Handling

- i. implementing short exposure times
- ii. safe positioning may be checked by:
 - various source vs GM counter positions
 - a gamma ray exposure rate device



Possible Student Findings

- effect on exposure when using forceps vs fingers while handling a source
- minimum size of a cardboard box needed to reduce the intensity by 25000 times
- minimum layer of lead needed to reduce the equivalent dose by 8 times
- use of an X-ray apron with X-rays vs high energy gamma rays
- half-value thickness of water compared to lead
- number of half-value layers needed for a reduction in equivalent dose by 10 times
- proper disposal of an old smoke detection device containing Am-241
- different kinds of shielding and their layers required for different sources
- danger involved with external and internal alpha particles caused by Rn-220
- use of charged electrosopes for checking the proper sealing of an X-ray device

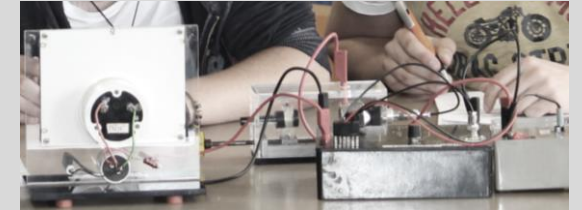


MEDICAL CONTEXT

Range of Alpha Particles in Air

- preferred use of protons above alpha particles in nuclear medicine

Exp 1



Universal Range of a Beta Particle

- maximum range of a specified beta particle in the human body
- significance of this particular beta particle in nuclear medicine

Exp 5



Ionization of Air by X-rays

- dose rate caused by X-rays by measuring a saturation current
- exposure time allowed for a maximum dose
- lethal doses as received during the Chernobyl disaster

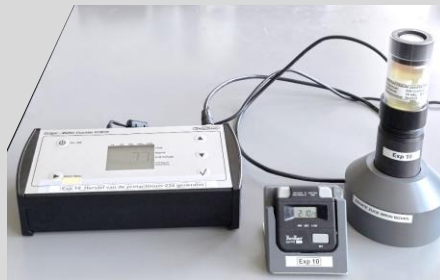
Exp 15



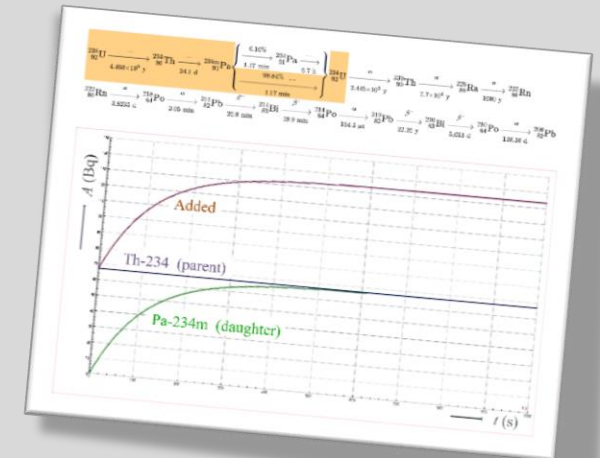
MEDICAL CONTEXT

Recovery of Pa-234m

- working of an isotope generator
- estimation and calculation of the recovery time of a Pa-234m generator
- ultimate recovery time of a Tc-99m generator as used in nuclear medicine



Exp 10



Radioactive Decay of Pa-234m

- working of an isotope generator
- importance of using short half-life isotopes in nuclear medicine
- significance of using isotope generators for short half-life isotopes

Exp 20

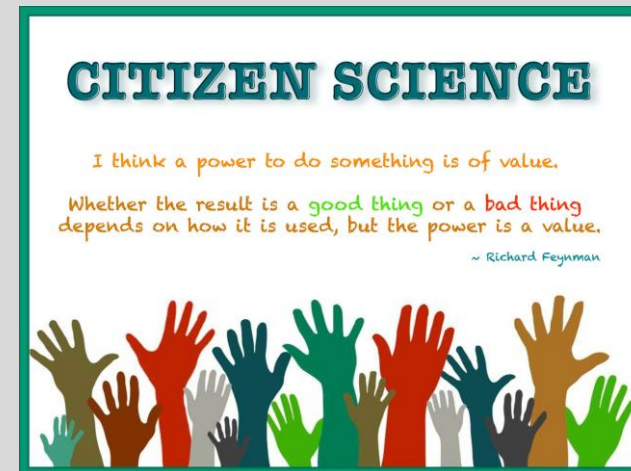
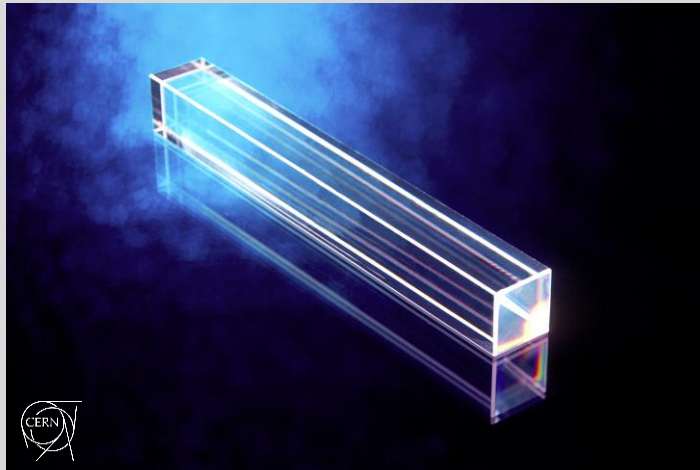
Current Status

- I. With a stable number of 300+ schools the ISP reaches out to a majority of high school science track students in the Netherlands.
- II. With safety context in all 22 and medical context in some, the ISP offers a wide range of contextual ionizing radiation experiments.
- III. Minimized source activities do not always deliver desired results, but can be well used for clarifying discussion.
- IV. 'The Radiant Week': a daily, week-long program on-site with a guided tour and an ISP lab for groups of high school science track students and teachers at four nuclear facilities, sponsored by Nucleair Nederland, an association of the six major nuclear companies and organizations in the Netherlands.



Future Development

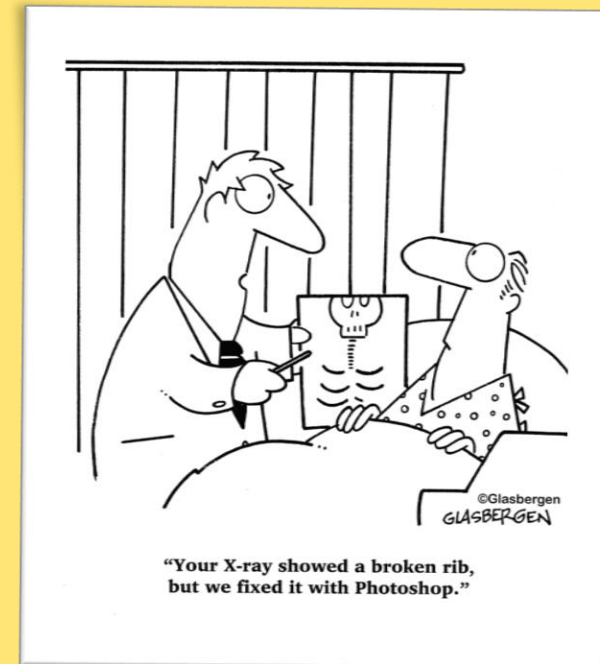
- I. Medical context: further expansion of medical content by various masters students of science attending the Technical University Eindhoven (NL).
- II. Student PET scanner: development of a simple device based on a CERN (CH) prototype.
- III. Citizen science: plans for a collaboration with interested schools and the National Institute for Public Health and the Environment (RIVM-NL) to monitor ionizing radiation in the Netherlands, are under construction.



Thank You ...

... for your interest.

- Feel free to ask questions.



<https://stralenpracticum.nl/english-information/>