

TENORM Waste/Radiation Safety

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Radiation Safety

- TENORM radioactive materials of concern:
 - Radium-226 (Ra-226)
 - Radium-228 (Ra-228)

Radiation Safety

- Why are they a concern?
- These materials emit radiation:
 - Alpha radiation:
 - Internal hazard (e.g., swallowed, inhaled, absorbed through wounds)
 - Not an external hazard
 - Beta radiation:
 - Short range particle
 - Gamma radiation:
 - Penetrating, external hazard

Radiation Safety

- Ra-226 emits alpha and gamma radiation (186 keV gamma)
 - Not much of an external exposure concern
 - Concern with inhalation (breathing in), ingestion (eating), and absorption (open wounds, etc.)

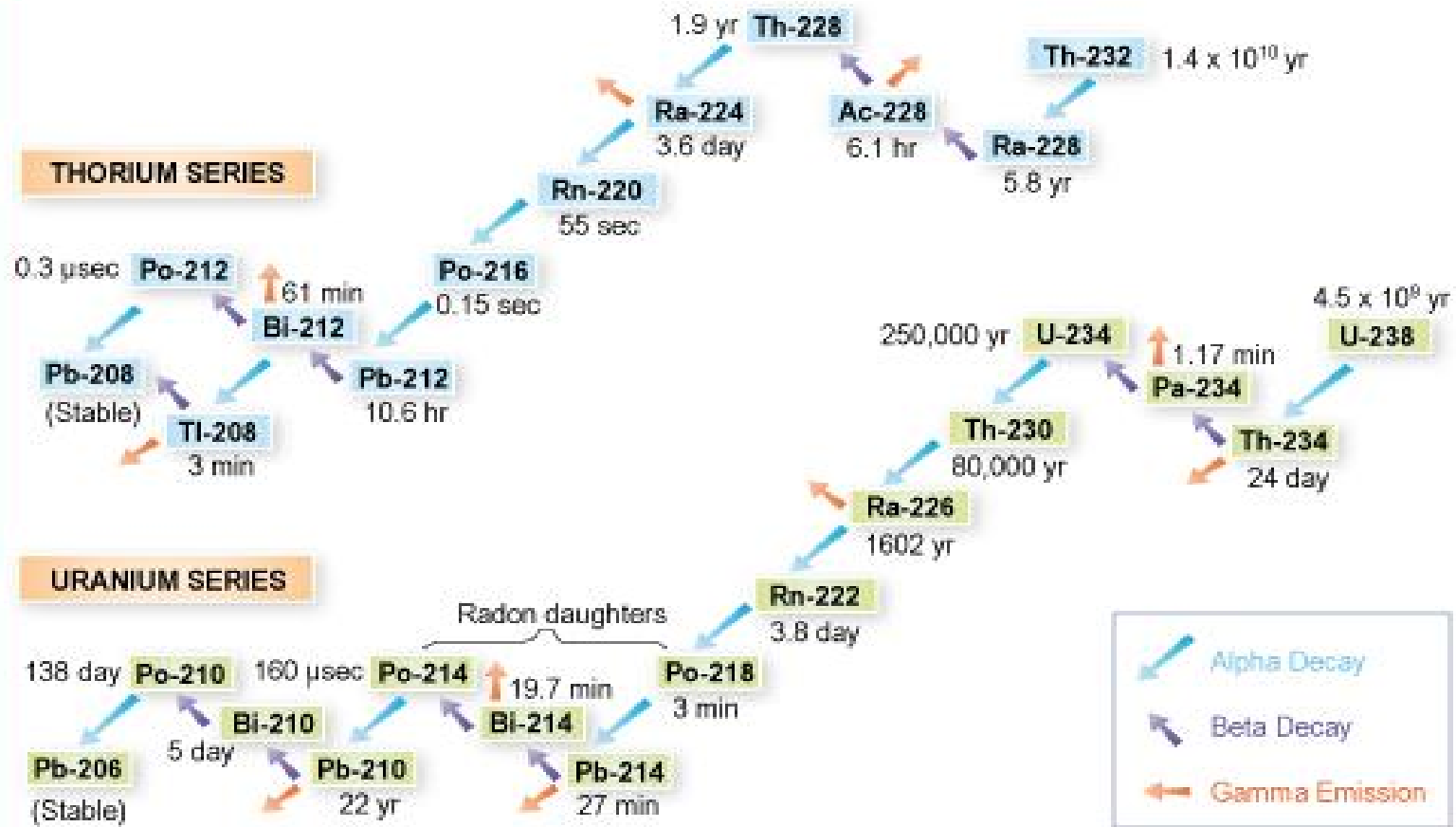
Radiation Safety

- Ra-228 emits beta radiation
 - Not much of an external exposure concern
 - Moderate internal exposure concern

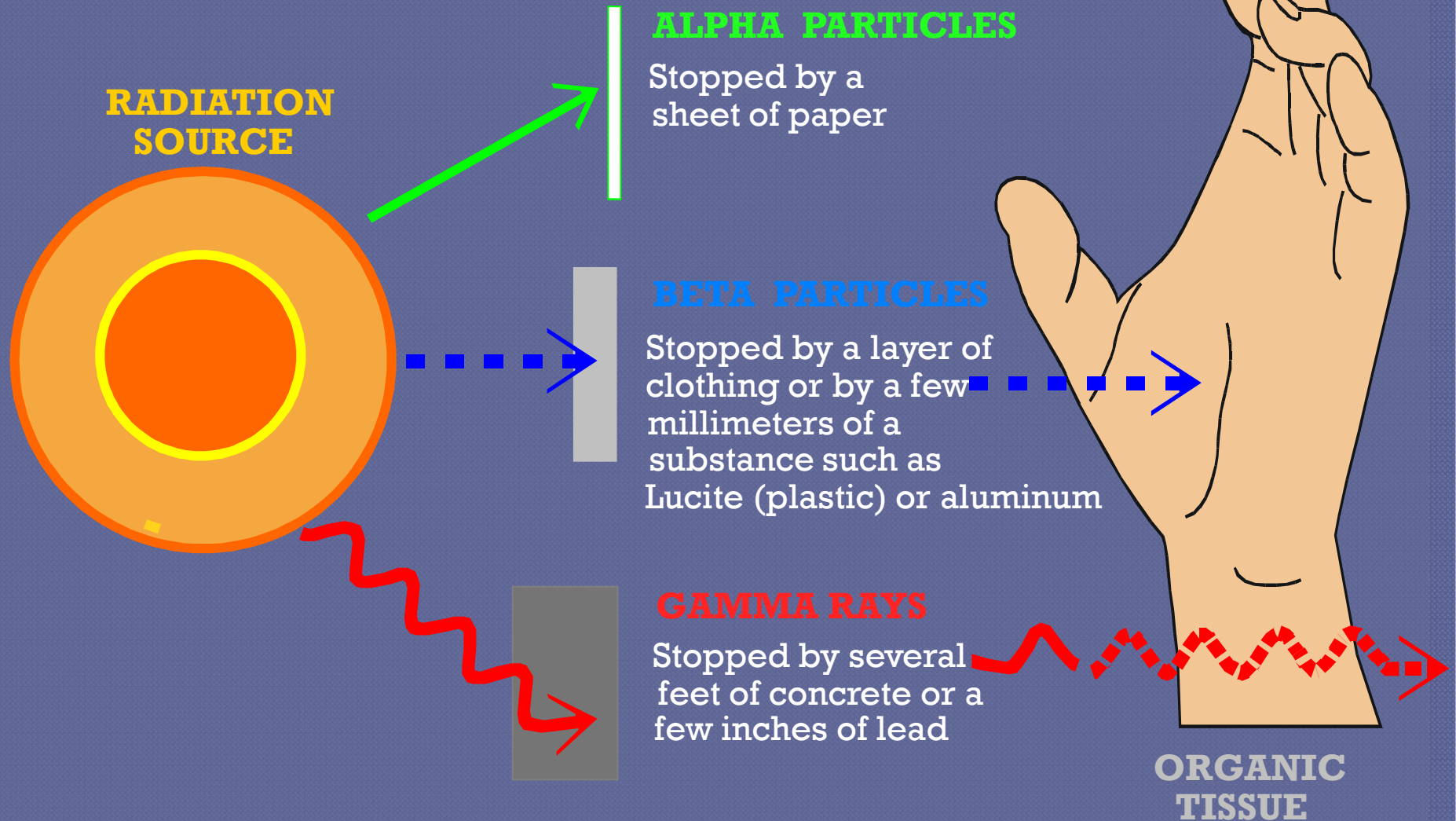
Radiation Safety

WORLD NUCLEAR ASSOCIATION

Radioactive Decay in Thorium and Uranium Series



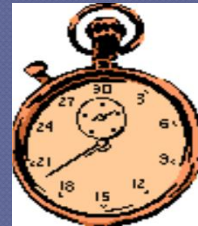
THE PENETRATING POWER OF ALPHA AND BETA PARTICLES, AND GAMMA RAYS



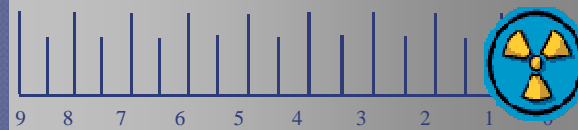
Radiation Safety

- External exposure protection factors

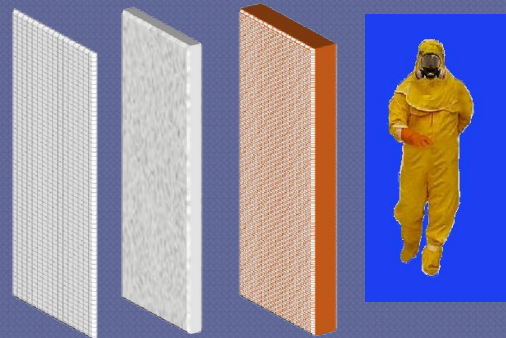
- Time



- Distance

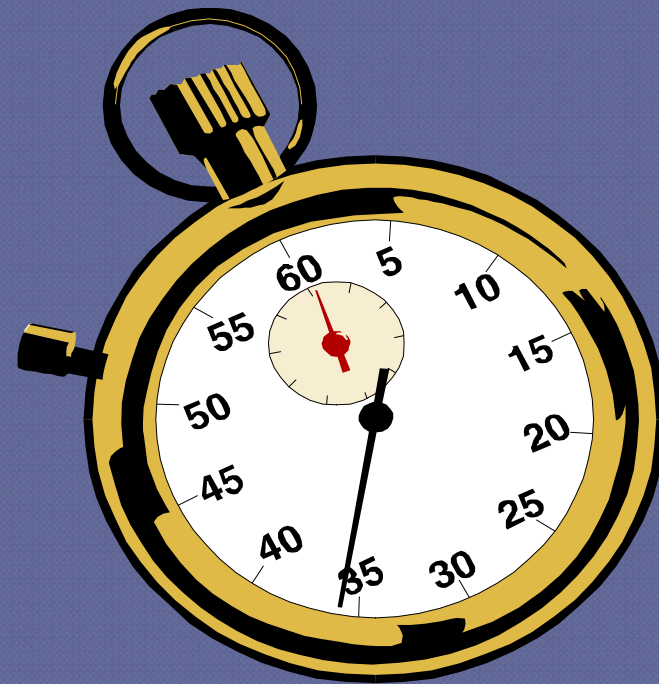


- Shielding

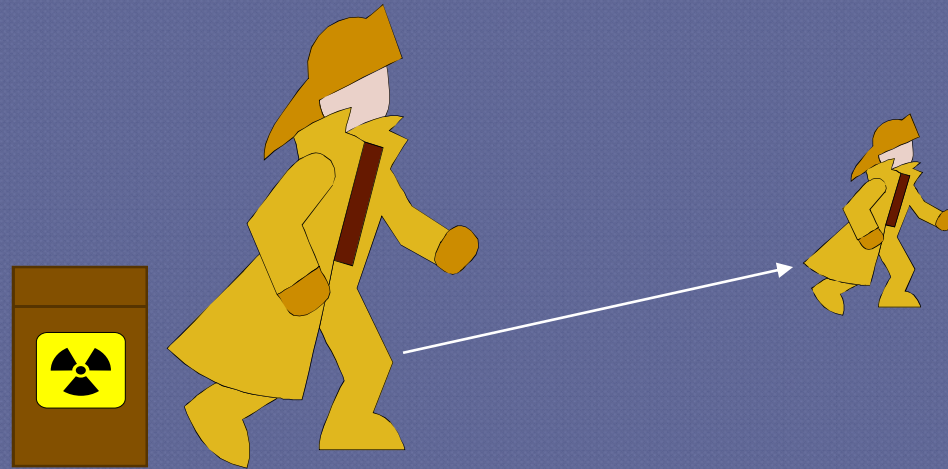


Minimizing Exposure - Time

- Minimize the amount of time spent near sources of radiation



Minimizing Exposure - Distance



- As the distance from a radioactive source doubles, the exposure rate decreases by a factor of four
- Moving back just a couple of feet makes a big difference

Minimize Exposure - Shielding

- Use of proper personnel protection equipment (PPE)
 - Protective clothing (i.e., coveralls, Tyvek suits)
 - Gloves
 - Masks
 - Respirators

Minimize Exposure - Shielding

- Practicing good personnel hygiene
 - Do not take dirty clothing, etc. home
 - Wash hands thoroughly
 - Survey hands and feet prior to leaving restricted areas

Minimize Exposure - Other

- Use of Survey Meters (detection)
 - Essential for detection and measurement of radiation in the workplace
 - Calibrated at least annually
 - Users must be trained

Minimize Exposure - Other

○ Labels, Signs & Warnings

- Warning signs should be used on:
 - TENORM storage/transport containers
 - TENORM storage areas
 - TENORM use areas



○ “Notice to Employees”

- Posting of location of ND Radiological Health Rules, operating and emergency manual, radioactive material license, etc.

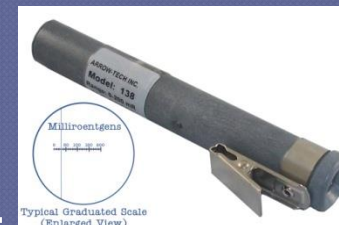
Minimize Exposure - Other

- TENORM Storage & Security
 - Limit access
 - Use properly lined storage containers
 - Perform regular area surveys
- TENORM Waste Management
 - Use proper waste transport containers
 - Proper labeling of waste containers
 - Manifests

Personnel Monitoring

○ How do we determine external exposure?

- Ring and/or whole-body badges
- Monitoring devices include:
 - Film badges
 - TLDs (thermoluminescent dosimeters)
 - Luxel+[®] OSL (optically stimulated luminescence) dosimeters
 - Pocket-type dosimeters
- Exchanged monthly or quarterly



Typical Graduated Scale (Enlarged View)

Personnel Monitoring

- What are the permissible limits for external exposure?
 - Public dose limit = 100 mrem/year
 - Occupational dose limit = 5000 mrem/year

Personnel Monitoring

- What is occupation dose?
 - The dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to radiation or to radioactive material.

Personnel Monitoring

- What is public dose?
 - The dose received by everyone else.

Personnel Monitoring

- How do the dose limits compare?
 - Average individual dose from normal background radiation (not including medical) = 360 mrem/year
 - “ Average individual dose from background radiation including medical = 620 mrem/year

Take Backs

- The three cardinal rules for radiation protection are time, distance and shielding
- Use common sense

Questions?

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