

Radiation Safety for Medical Examiners

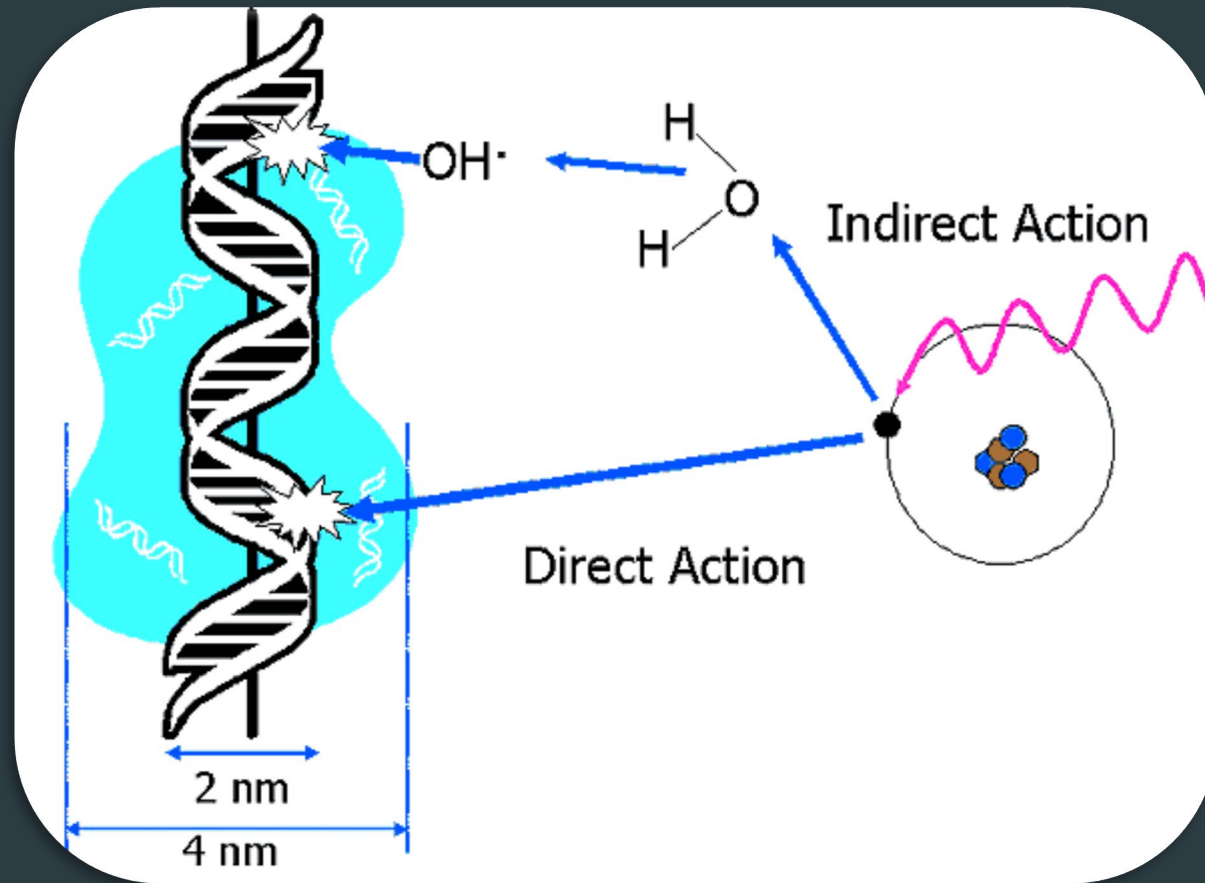
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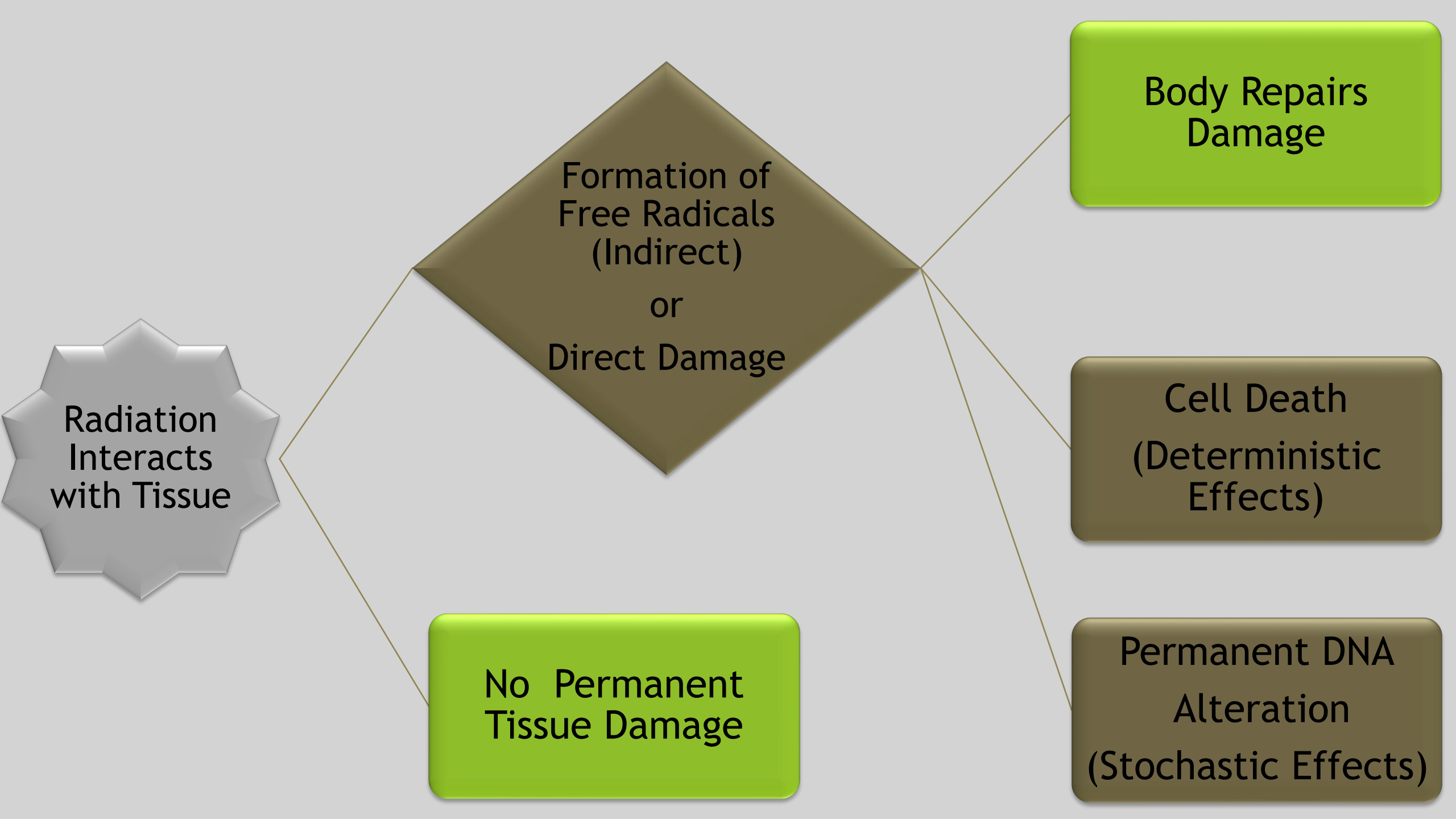
Where could Medical Examiners encounter radiation?

- ▶ Radiographic imaging during autopsy or other post-mortem evaluation
- ▶ Decedents with recent radioactive material administration
 - ▶ Nuclear medicine or therapy procedures
- ▶ Casualties from accident or incident involving radioactive materials
 - ▶ Small scale = occupational accident or exposure from lost source
 - ▶ Larger scale = radiological dispersal device
 - ▶ Largest scale = nuclear detonation

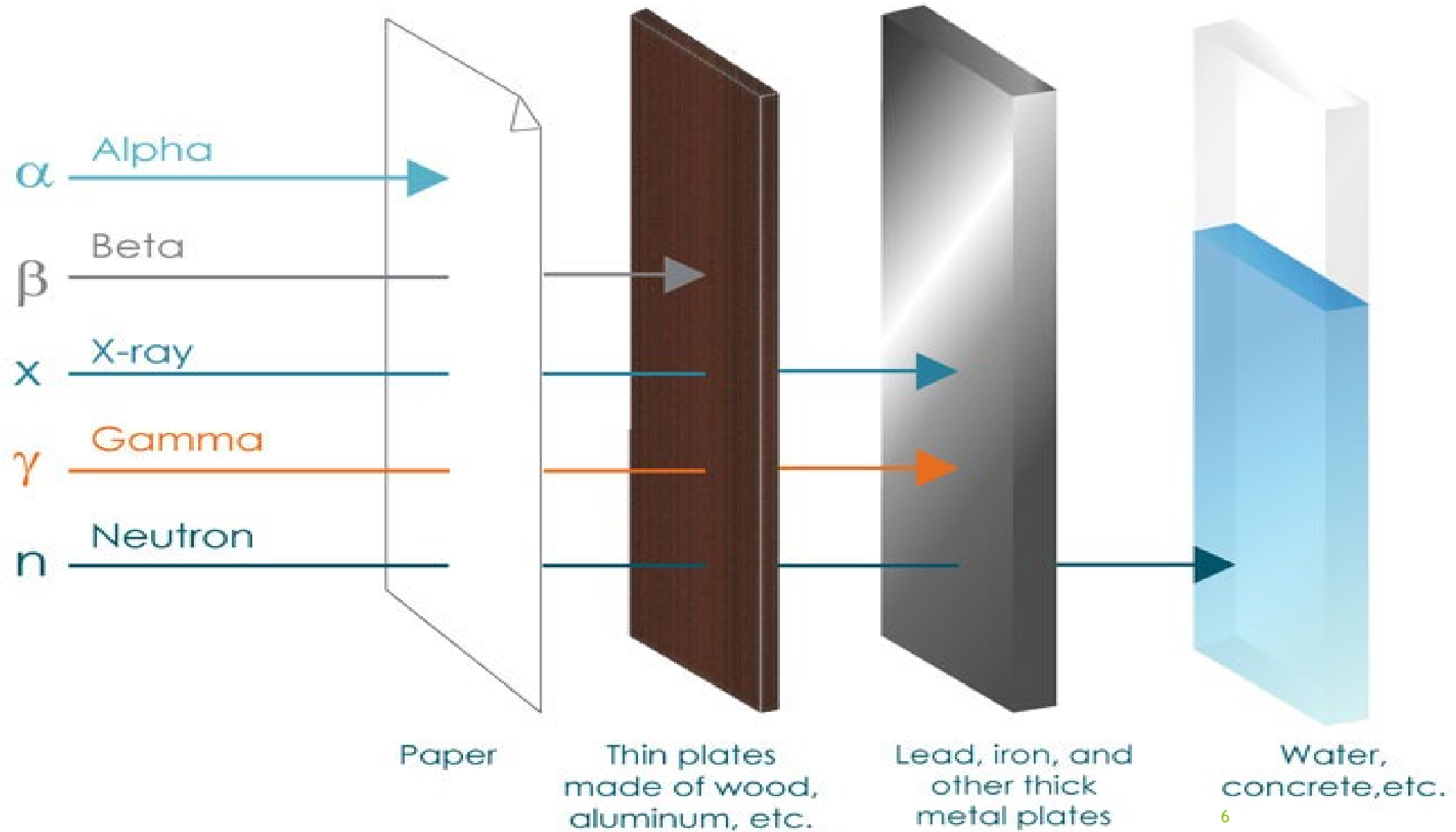
First - let's review the
basics.....



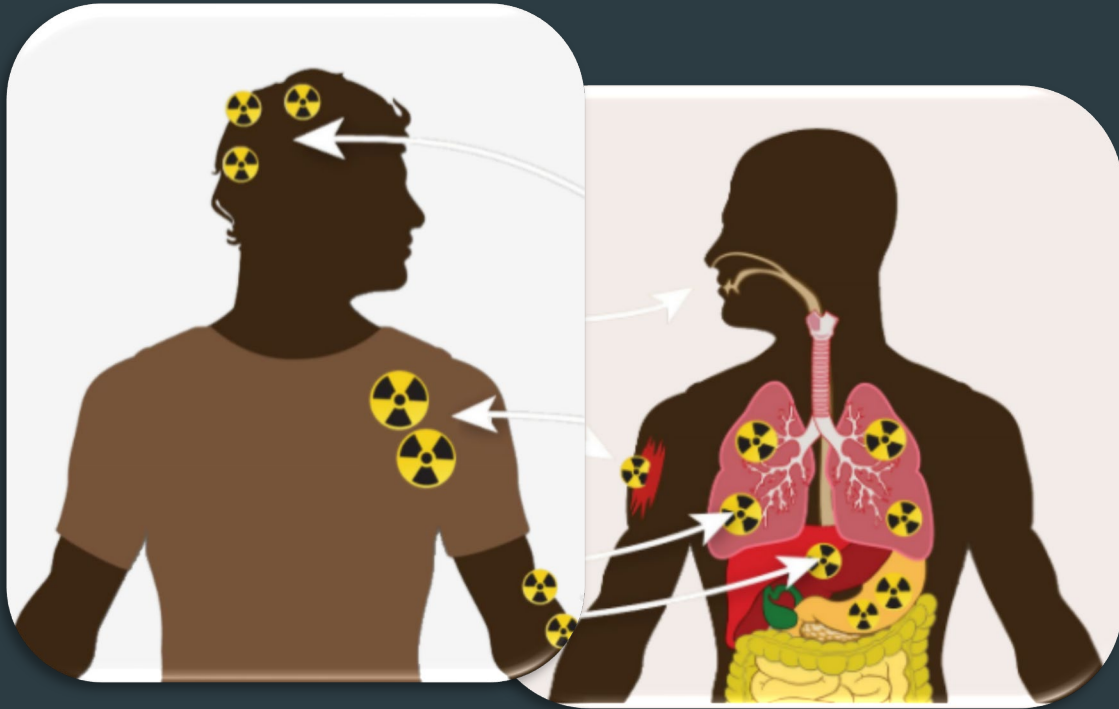
Biological
damage
caused by
radiation



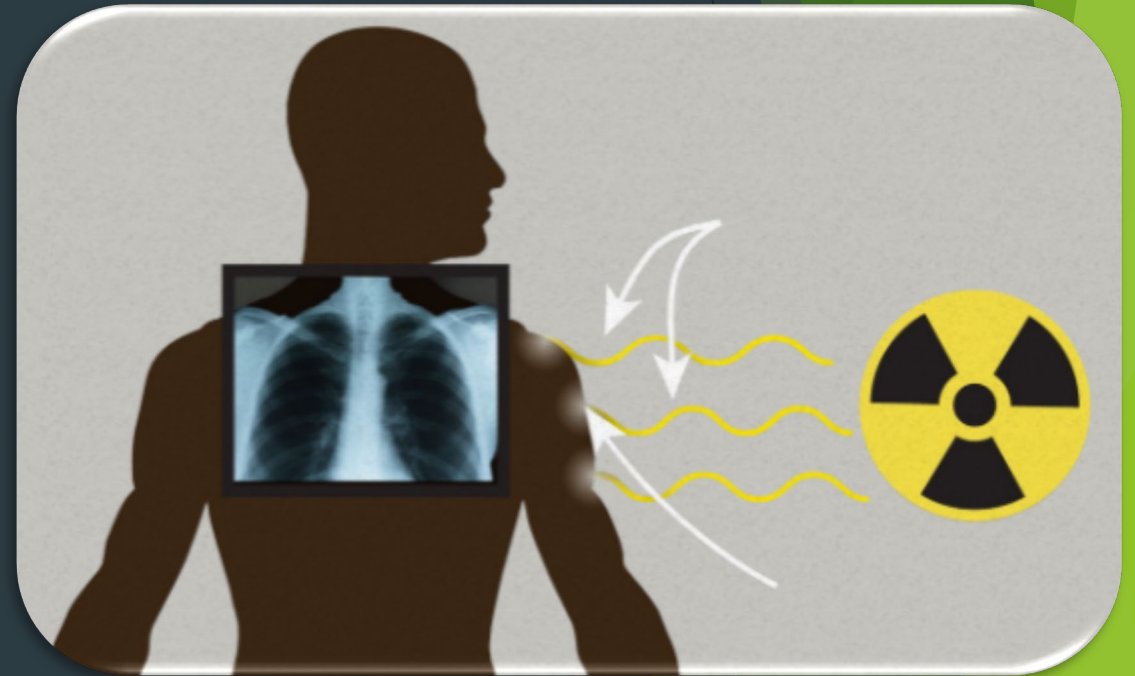
TYPES OF RADIATION AND PENETRATION



Contamination



Exposure



Radiation Dose Units

- ▶ R = Roentgen - ionizations in air



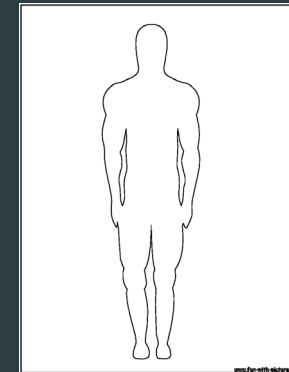
- ▶ Rad (Gray) = Absorbed Dose - energy imparted in mass



- ▶ Rem (Sievert) = Effective Dose -

Absorbed Dose x Radiation Weighting Factor

Gamma - 1 Beta - 1 Alpha - 20



Units make a big difference		
μR- micro	mR - milli	R
0.000001	0.001	1

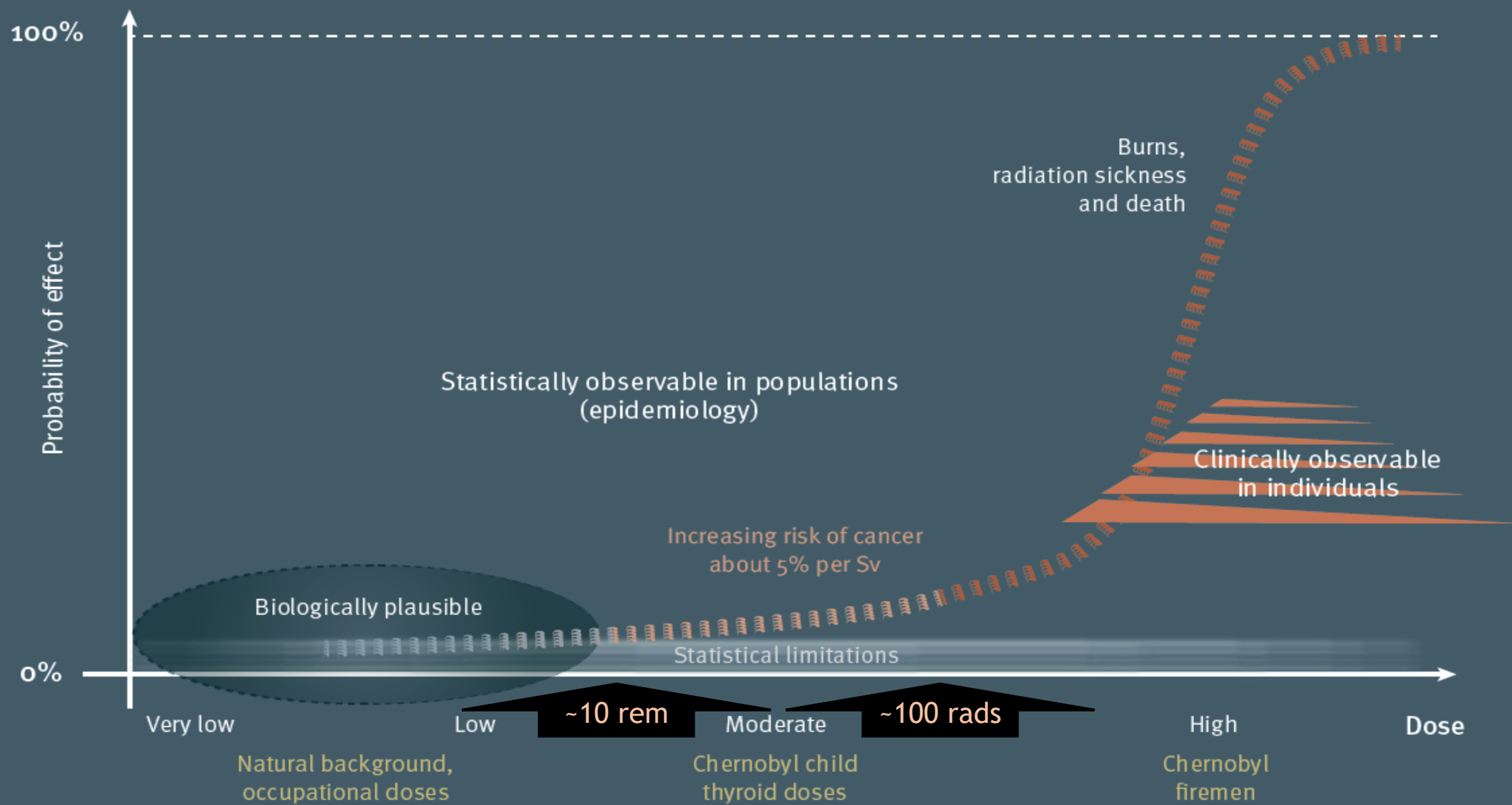


Dose Rate vs. Dose

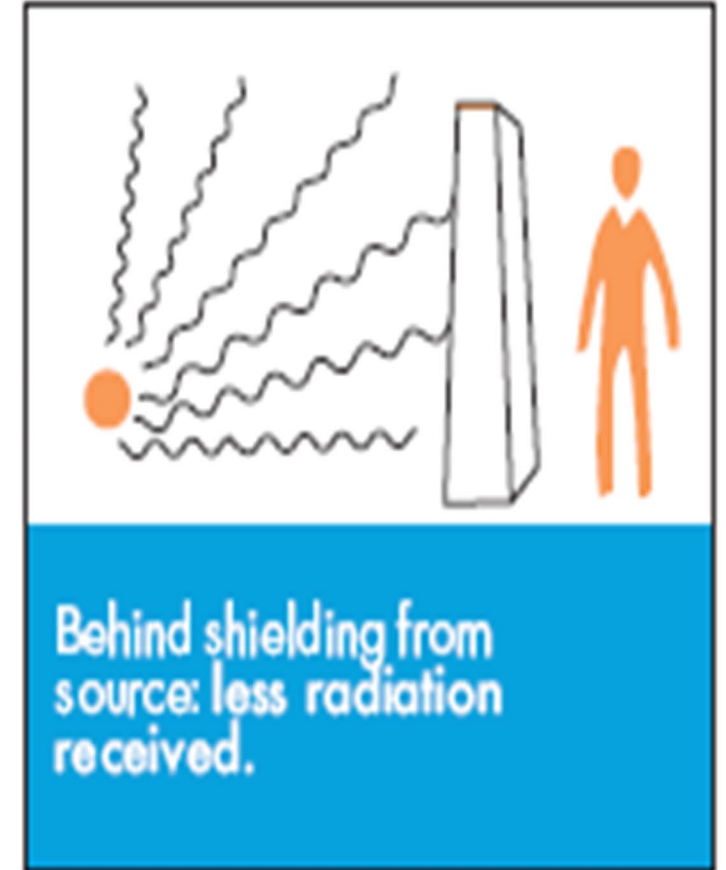
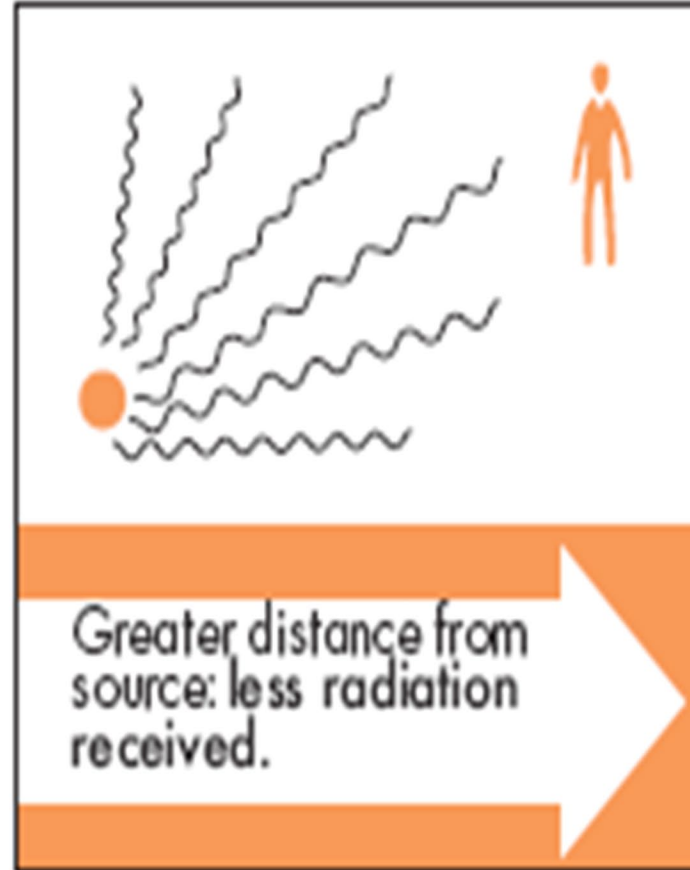
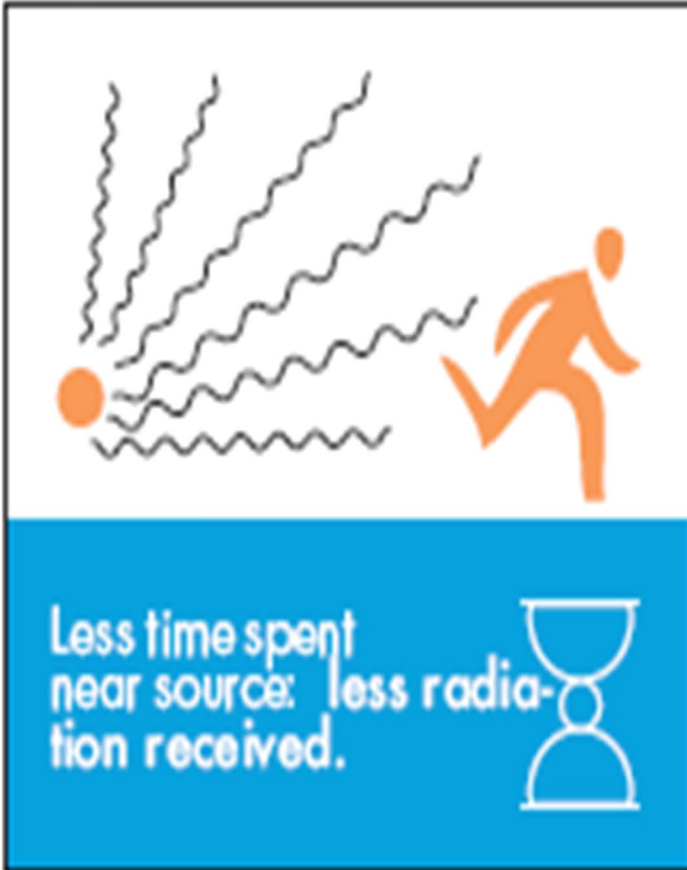
Dose Rate -
monitor environment to identify
sources and keep doses ALARA

Dose -
record what is actually received
or will contribute to health
effects

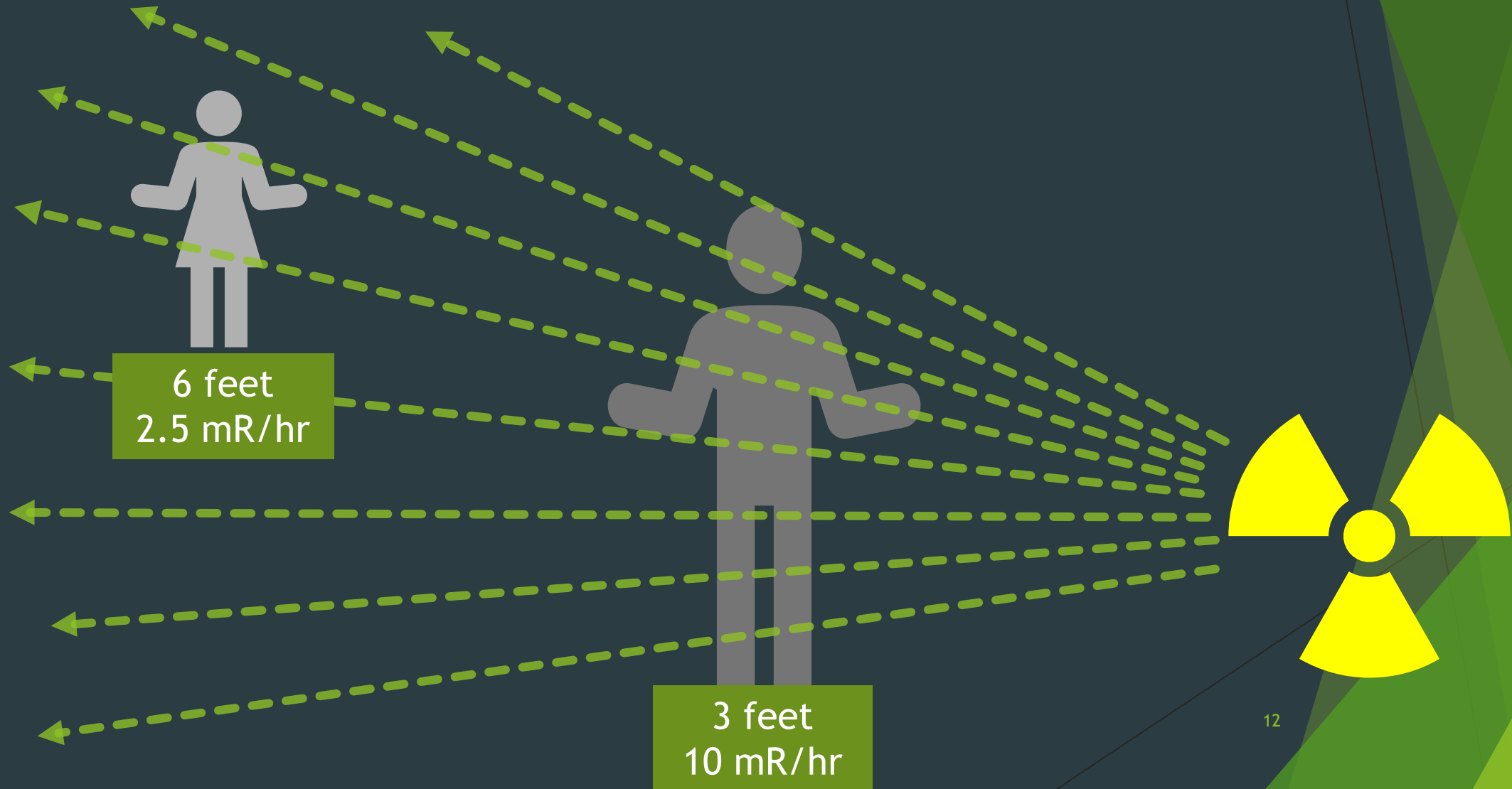
Relationship of radiation doses and health effects



TIME – DISTANCE - SHIELDING



INCREASE DISTANCE 2X = REDUCE EXPOSURE 4X





We can measure radiation to assess risk and guide actions

Now that we've reviewed the terminology, let's walk through a few scenarios.....



Post-Mortem Radiographic Imaging

- ▶ Independent unit vs. hospital/clinic unit
 - ▶ Radiation machine must be registered with IDPH
 - ▶ Radiation safety focused on exposure to operators
-
- ▶ X-ray - exposure completes in milliseconds
 - ▶ Fluoroscopy - exposure is continuous
 - ▶ Computed Tomography (CT)



Post-Mortem Radiographic Imaging

- ▶ Occupational exposures - 5 rem/year
- ▶ As Low As Reasonably Achievable (ALARA)
- ▶ Radiation Protection Program
 - ▶ Shielding
 - ▶ Lead Aprons/Gloves
 - ▶ Dosimetry



Recent radioactive material administration

- ▶ Intentional internal contamination for beneficial medical purpose
- ▶ Diagnostic vs. Therapy Administration
 - ▶ Diagnostic - short half life and low exposure potential
 - ▶ Heart Stress Test
 - ▶ Bone Scan
 - ▶ PET Scan
 - ▶ Therapy - higher doses, but still manageable and low risk
 - ▶ Thyroid ablation
 - ▶ Lutathera Dotatate
 - ▶ Y-90 Microspheres
 - ▶ Brachytherapy implants (i.e. Prostate Seeds)

Recommendations for Managing Decedents with Medical Radioactive Materials

- ▶ Normal Universal Precautions effective for protection from radioactive contamination for most cases
 - ▶ Protective Eyewear recommended
 - ▶ Longer time after administration = reduced exposure
- ▶ Therapy administration within days of death - consult with hospital RSO for guidance
 - ▶ In rare cases, may need to excise tissues with very high localized dose rates
 - ▶ Discuss proper management of implanted seeds or brachytherapy prior to autopsy or cremation

Consult Resources -

- ▶ Radiation Safety Officer (RSO) of hospital where administration performed
- ▶ Radiation Control program - IDPH Radiological Health

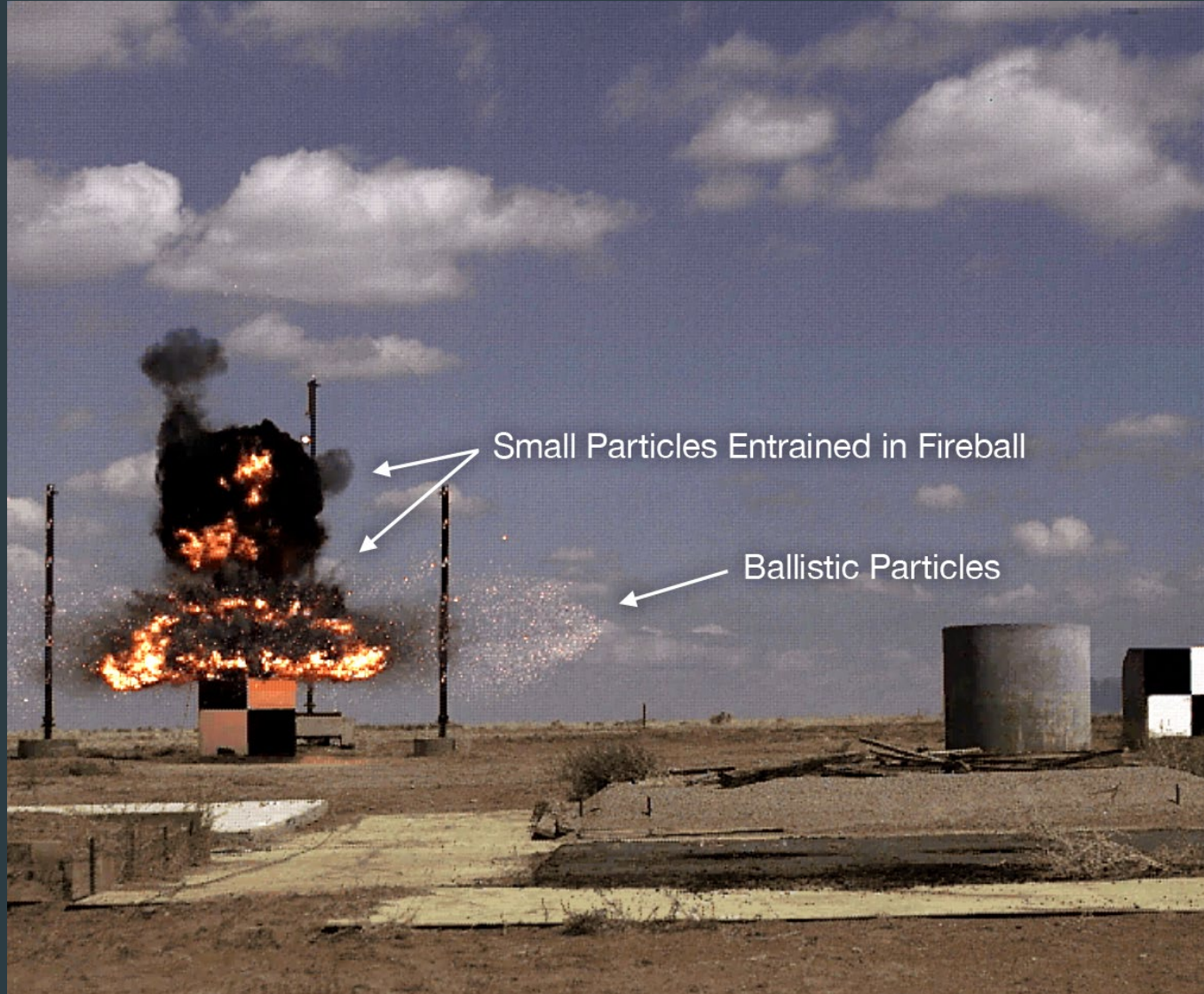
Fatalities from radiation incidents/accidents

Transportation/High Exposures

- ▶ Contamination control will need to be a consideration for your management of the body
 - ▶ Most external contamination removed with clothing removal and wipe down
 - ▶ Internal contamination from incident/accident will not be harmful to ME or staff
- ▶ Contamination surveys and protection guidance will depend on type of radiation (alpha/beta/gamma)
- ▶ Try to remove contamination and place away from work area
- ▶ Note - If exposure only - no contamination will be present on body
- ▶ Resources are available to help with assessment - same as those available for medical radioactive materials

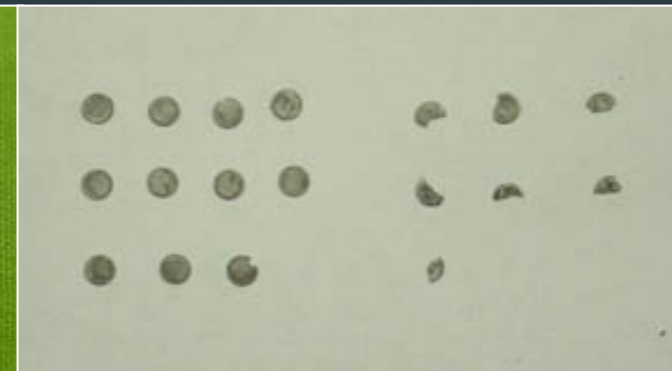
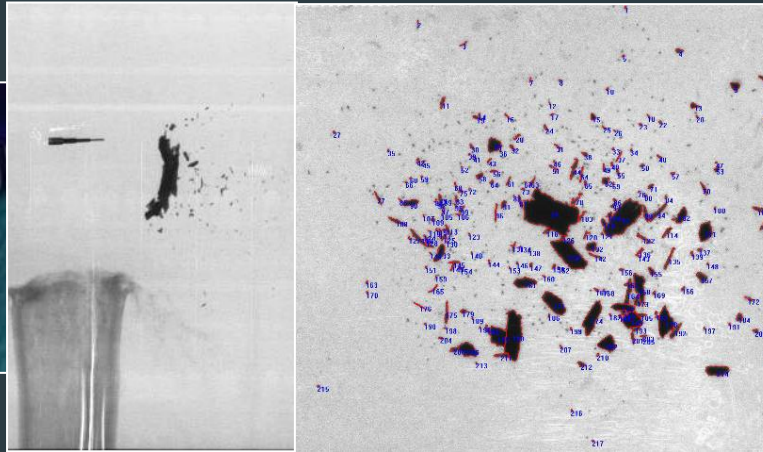


Larger scale incidents - Radiological Dispersal Device



Cobalt and Iridium:

High Bulk Modulus, High Melting Point – fragment dispersal, very little aerosol



Impact of material properties
on particle/fragment size

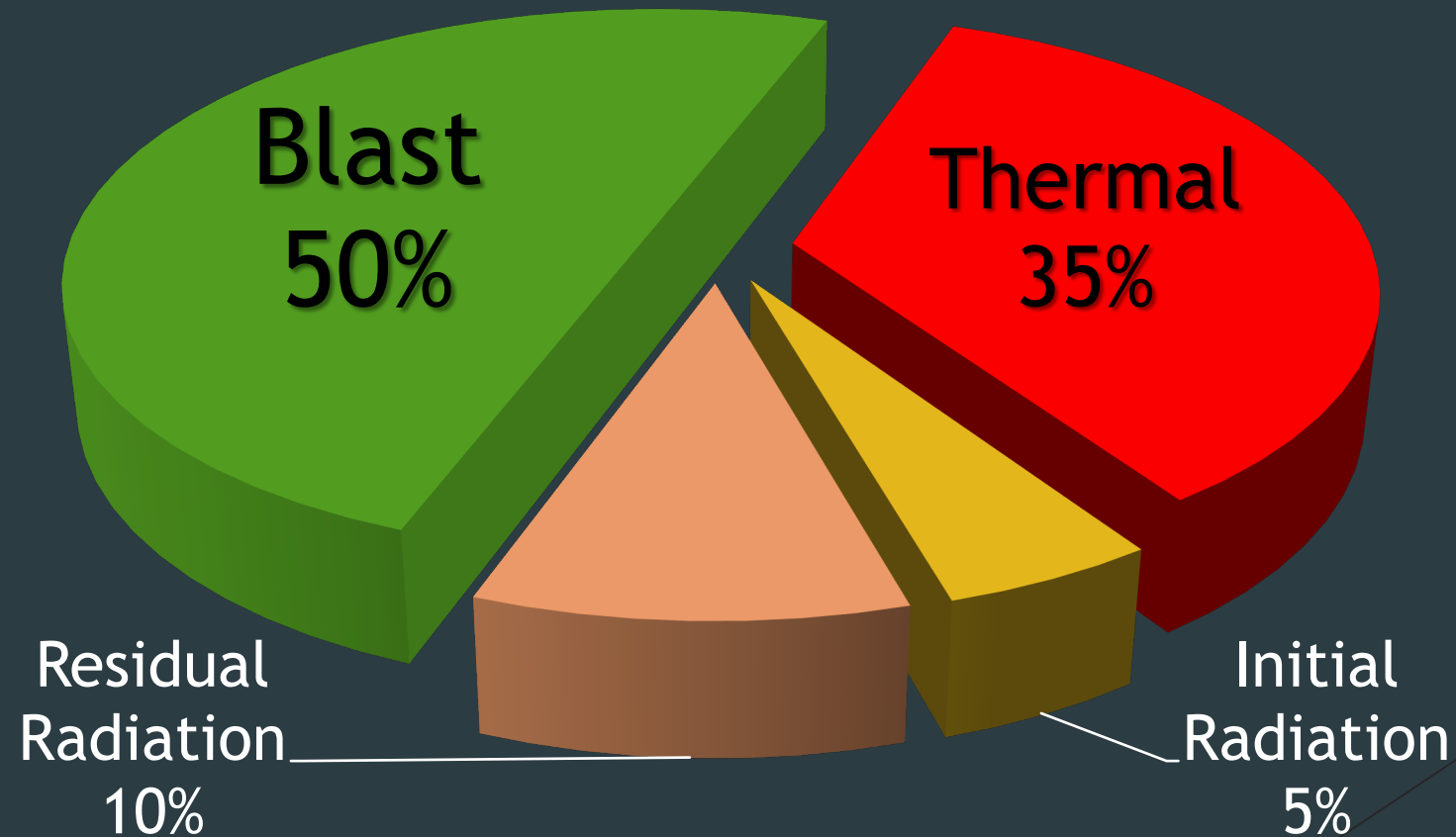
Fatality Management

Radiological Dispersal Device

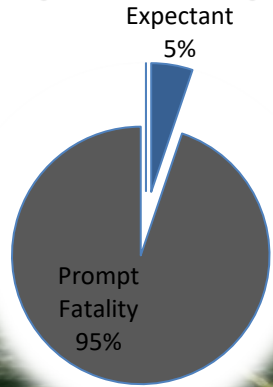
- ▶ Aerosol contamination from RDD - not significant risk to ME or staff
 - ▶ Depends on isotope present in RDD
 - ▶ More likely farther away from detonation
- ▶ Watch for embedded radioactive shrapnel - higher doses possible
 - ▶ More likely in those near detonation
- ▶ Removing clothing and wipes can remove majority of external contamination
- ▶ Internal contamination not a hazard to ME or staff
- ▶ Not all decedents will have contamination

Large scale incident - Nuclear Detonation

Distribution of Energy

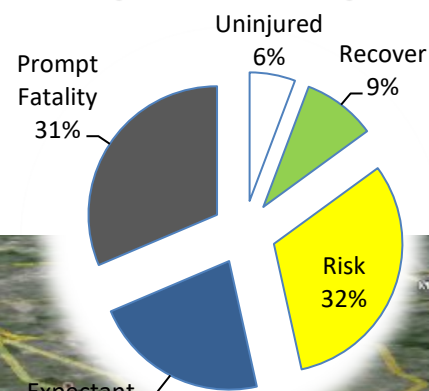


Severe Damage Zone (0-0.5 mile)



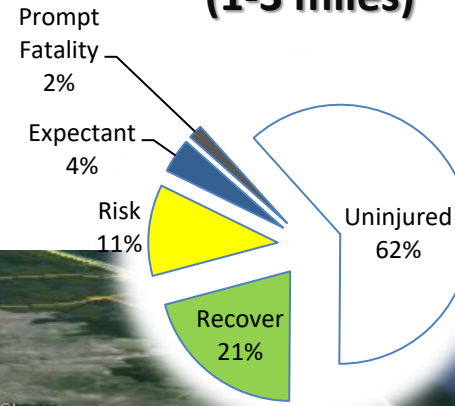
Total Population
422,000

Moderate Damage Zone (0.5 - 1 mile)



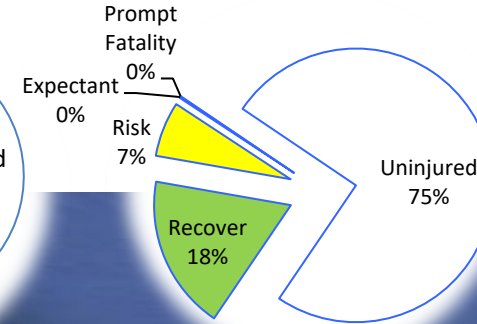
Total Population
740,000

Light Damage Zone (1-3 miles)



Total Population
1,347,000

Dangerous Fallout Zone (Outside LDZ)



Total Population
1,427,000



Accidents and Congestion Caused by Flash Blindness

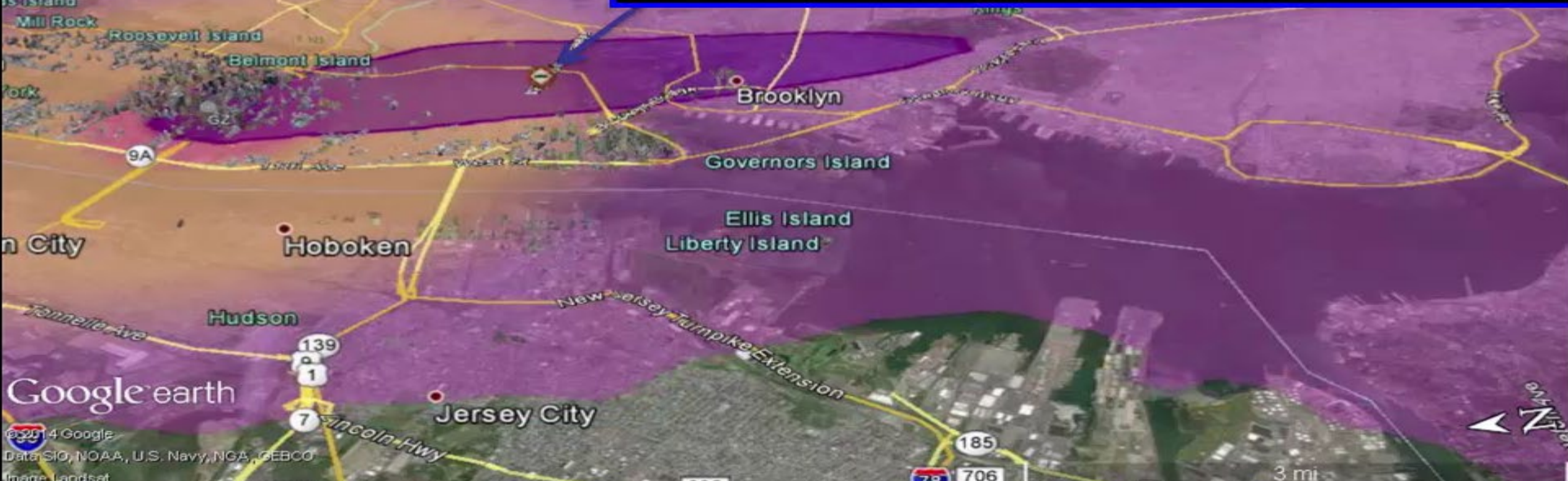
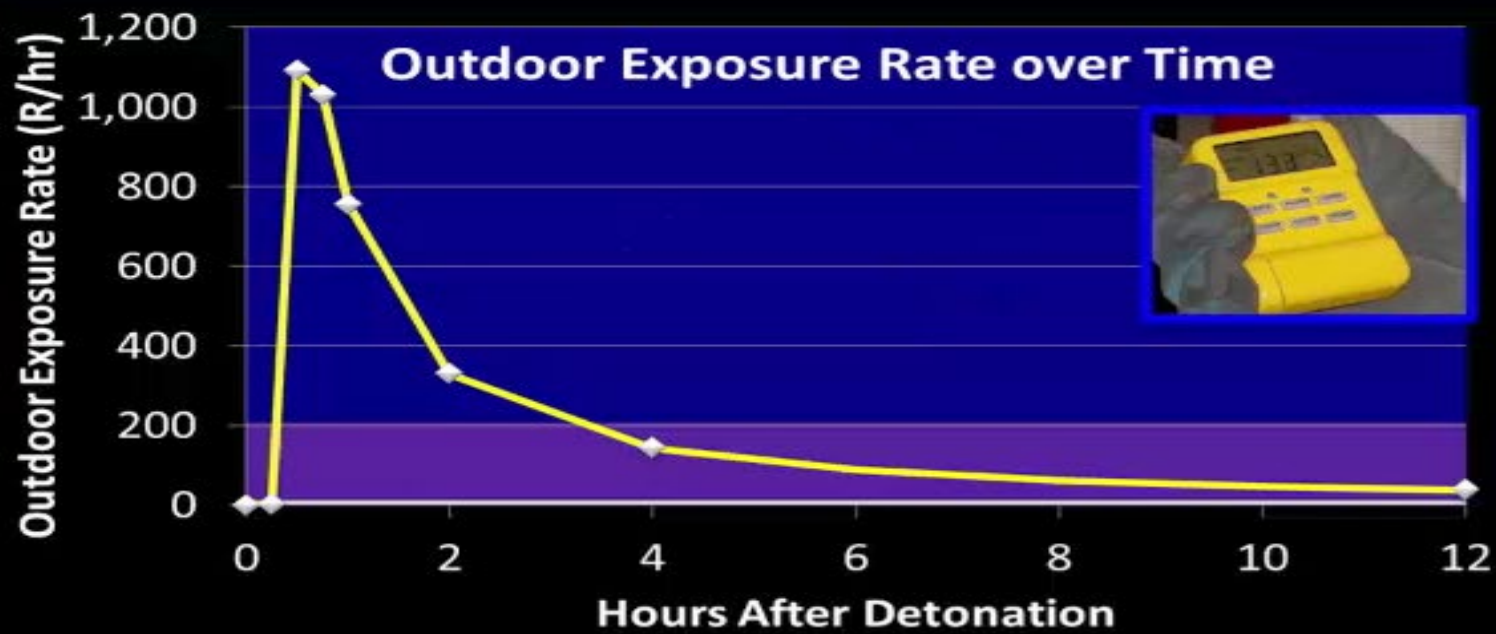


Key Fallout Considerations

- ▶ ***Fallout Decays Rapidly*** (releasing more than half of its energy in the first hour)
- ▶ Primary hazard from fallout is exposure to penetrating radiation from the particles (external exposure)
- ▶ Dangerous levels of fallout is readily visible as it falls
- ▶ Fallout is not a significant inhalation hazard
- ▶ The radiation penetrates through windows and walls, but exposure decreases with distance and intervening materials.



12 hours



Fatality Management

Nuclear Detonation

- ▶ May want to wait 24-48 hours to handle bodies from fallout areas
- ▶ In a crowded metro area, there will likely be hundreds to thousands of fatalities from ~1 to 3 mile radius
 - ▶ Where will we keep these, how to track and ID, JIT for radiation concerns as more bodies in one location
 - ▶ May be a good idea to plan for this - mass casualty with radiation concerns
- ▶ Flash blindness may cause auto accidents 10 - 20 miles away, depending on time of day - many car accident fatalities may not have fallout contamination
- ▶ Contamination from fallout will look like sandy particles
 - ▶ Very radioactive - high doses
 - ▶ Removing clothing and brushing off particles will remove most of the contamination
 - ▶ Need to isolate fallout materials and/or contaminated items away from work area before ME or staff spend significant time in the area

Recap of Radiation Considerations for the ME

- If the deceased is known or suspected to be contaminated, ME and personnel engaged in handling of the body should be issued personal protective equipment (PPE) and a personal dosimeter.
- Evaluating the deceased with appropriate radiation survey meters can confirm or rule out contamination and assess personnel risks.
 - Advice from IDPH and/or a health physicist is recommended to guide activities.
- Be aware that other, more acutely hazardous agents, may be present.
 - Non-radiological contaminant hazards (e.g., chemical agents) may pose more significant risks to health and safety of persons handling the body.
 - Non-radiological contaminant hazards (e.g., chemical agents) may necessitate use of higher levels of PPE.

Radiation Assessment in a Field Morgue for Large Scale Radiation Incidents

- Conduct radiation survey of each body coming into field morgue to determine levels of contamination
- Decedents *without measurable levels of external contamination*
 - Confirm absence of contamination
 - Transport body directly to other morgue or funeral home to manage as non-contaminated body
- Decedents with measurable levels of contamination
 - <100 millirem/hour: may be processed in field morgue
 - Remove and safely store radioactive shrapnel ASAP
 - Conduct forensic examination and victim identification
 - Decontaminate decedent prior to release of body
 - >100 millirem/hour: move to a refrigeration unit
 - Refrigerator should be at least 30 feet away from work area
 - Radiation Safety Officer or health physicist will help determine how long to store the body based on rate of decay of fission products
- Label body with dose rate, distance of probe, date & time

Autopsy

- Do not autopsy bodies with high levels of internal contamination unless absolutely necessary.
 - Remember – most internal contamination from medical procedures is not a concern
 - If you have questions about potential exposures – ask resources
- Pathologist performing the autopsy may receive significant radiation dose to the hands if handling highly contaminated organ or tissue.
- If autopsy is absolutely necessary, refrigerate decedent and defer the procedure until a health physicist can assist in planning.

Cremation

- ▶ Do not cremate decedents with high levels of long lived radioactive contamination
 - ▶ Remove tissue or implants with very high dose rates
 - ▶ Remove external contamination
- ▶ Radioactive contamination of the facility and environment is possible

Burial

- Burial of a body with internal contamination does not pose a significant health risk to humans or the environment.
- In rare cases of a highly contaminated body (*consult IDPH and/or health physicist if considering this*)
 - Metal coffin/casket preferred with a seal that releases pressure from inside the casket and retards entry of ground water
 - Metal or concrete vaults to encase the metal casket
 - Optimizing a tight seal is key to prevent environmental contamination
- ▶ For dose rates measured on vault exterior >100 counts per minute (cpm) above background
 - ▶ Bury casket and vault *in ground* and not above ground.
 - ▶ Affix discrete radiation warning label to exterior of vault indicating dose rate from buried decedent and date/time of measurement.

Resources and Help

- ▶ Radiation Control - Bureau of Radiological Health
 - ▶ Angela.leek@idph.iowa.gov
 - ▶ (515) 371-2255 or 24/7 line (515) 725-4160
- ▶ Hospital Radiation Safety Officer where decedent was administered the radioactive material

Questions?

