



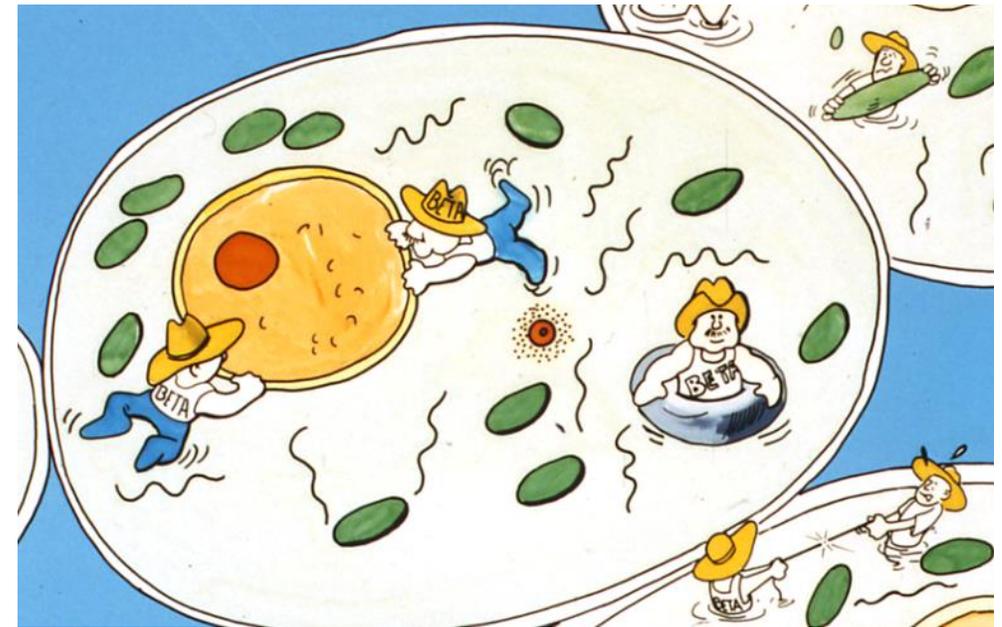
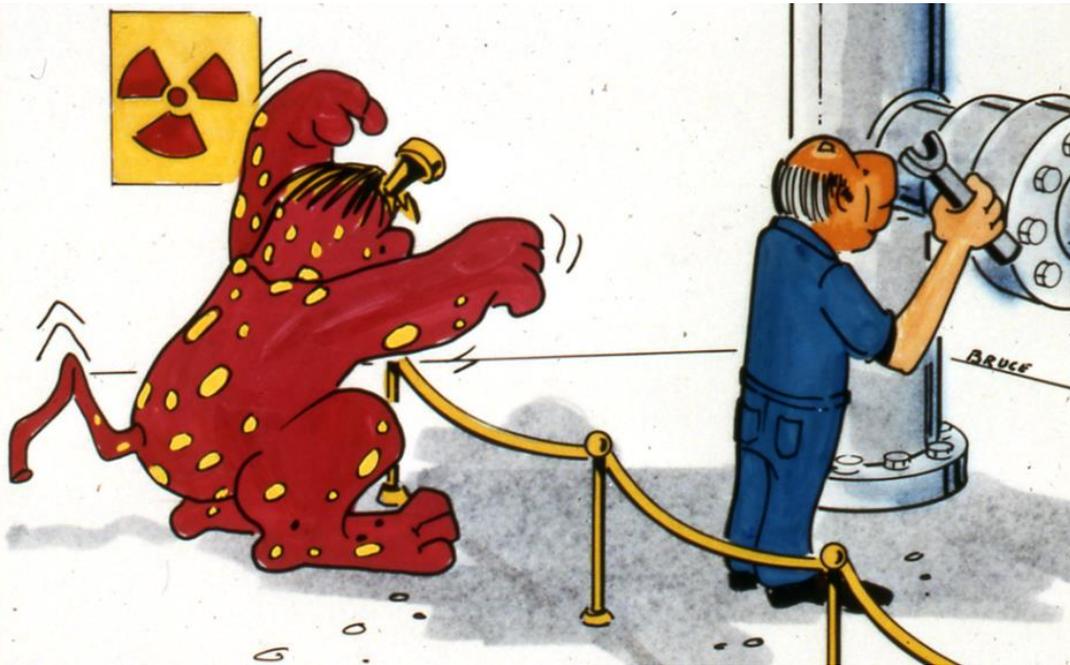
Perspective on Internal Contamination and Dose

Gene Carbaugh, Cheryl Antonio, Tim Lynch
Hanford Internal Dosimetry Program
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What is meant by contamination and dose?

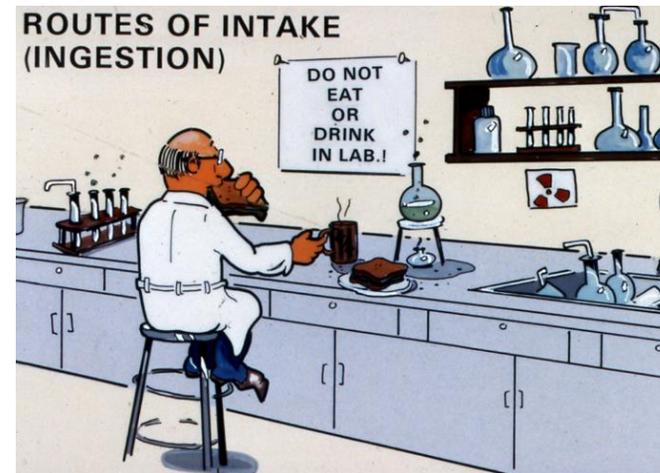
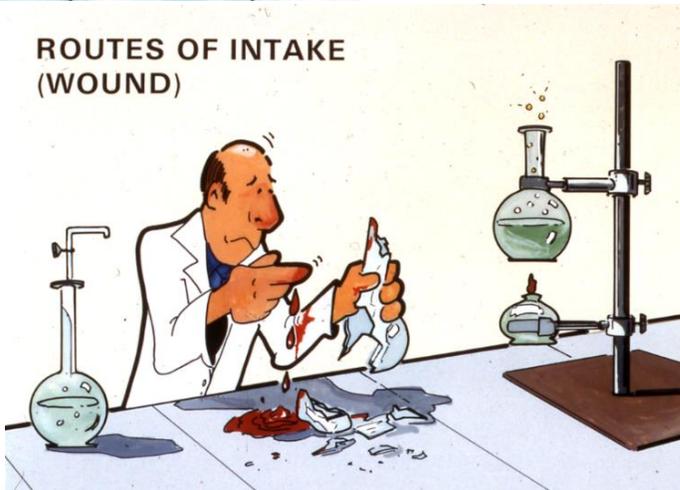
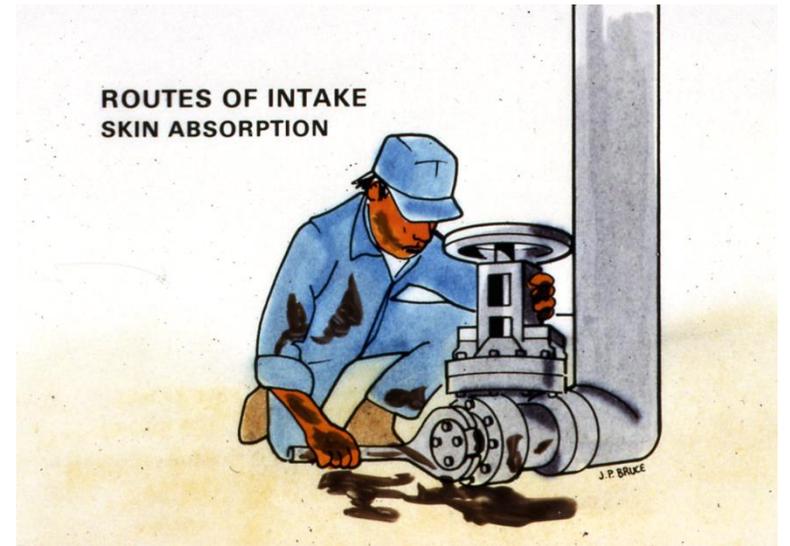
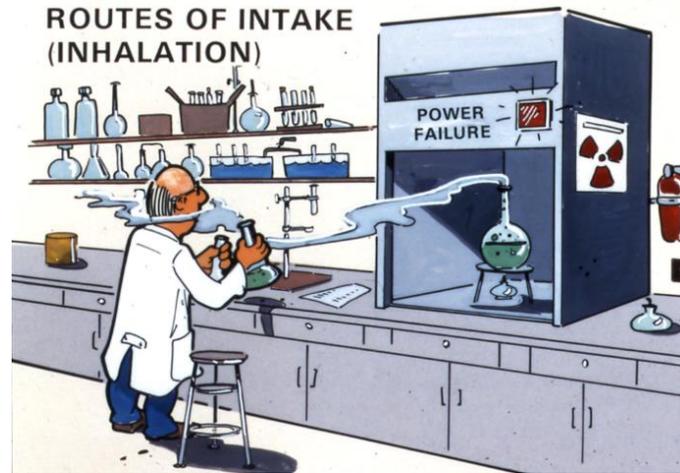
Contamination: the unwanted presence of radioactive material.

Dose: energy deposited *in the body* by the radioactive decay of contamination.



External and Internal Sources

External Exposure
– No intake



External Dose vs. Internal Dose

Dosimeters measure dose directly from external sources.

Dose from internal contamination (within the body) cannot be directly measured by dosimeters.

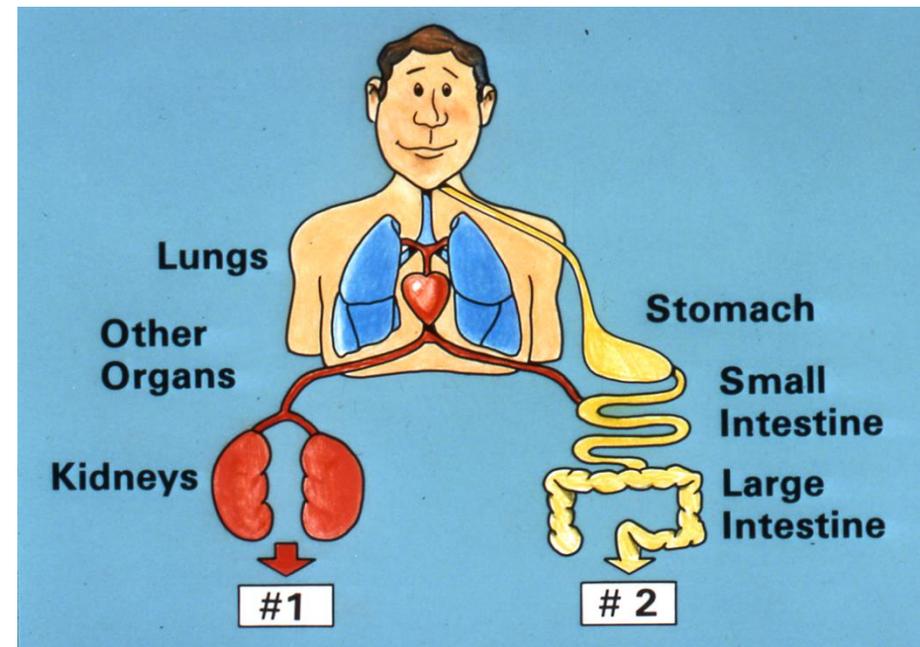
Hanford Standard Dosimeter



Hanford Combination Neutron Dosimeter



Hanford Extremity Dosimeter



External Dose vs. Internal Dose



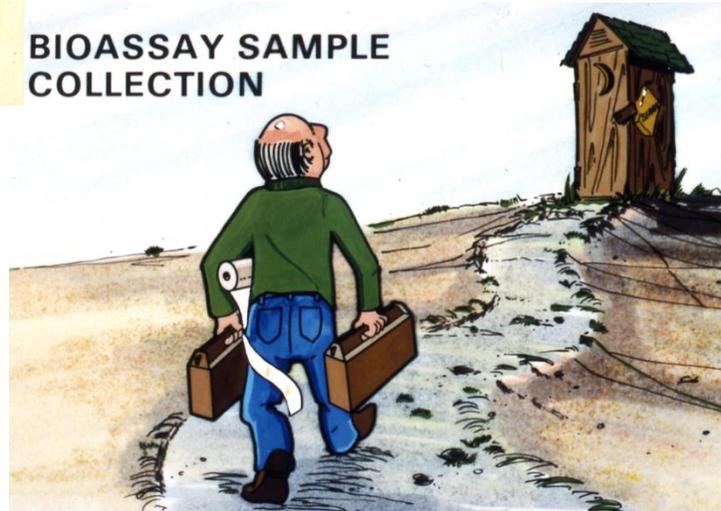
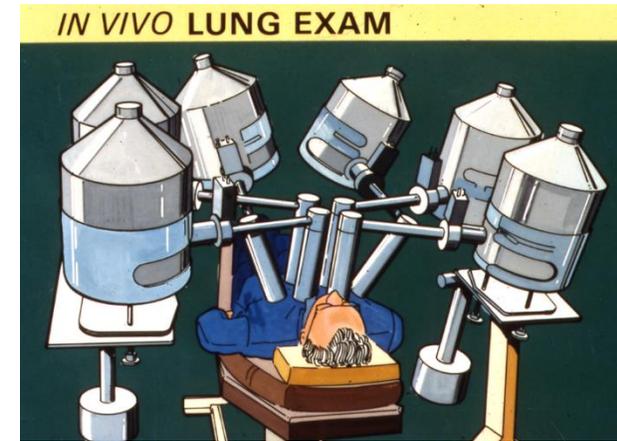
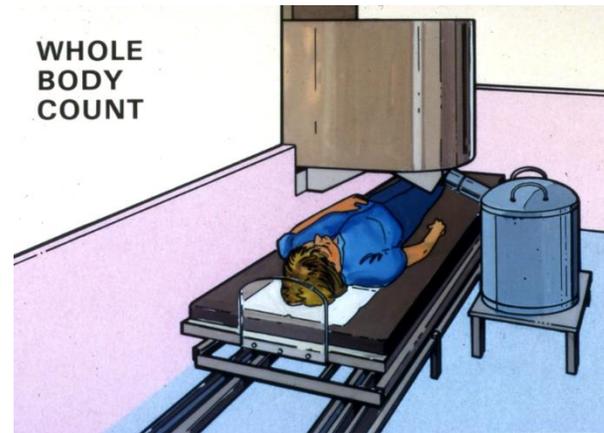
External Dose

- Generally easy to measure with a dosimeter.
- Usually reported as a “whole body” or “effective” dose.

Internal Dose

- Requires determination from bioassay measurements of material in the body or excreted from the body
- Type of bioassay depends on radioactive material.
- Optimum type of bioassay depends on radioactive material and the time since intake occurred.

Bioassay Methods



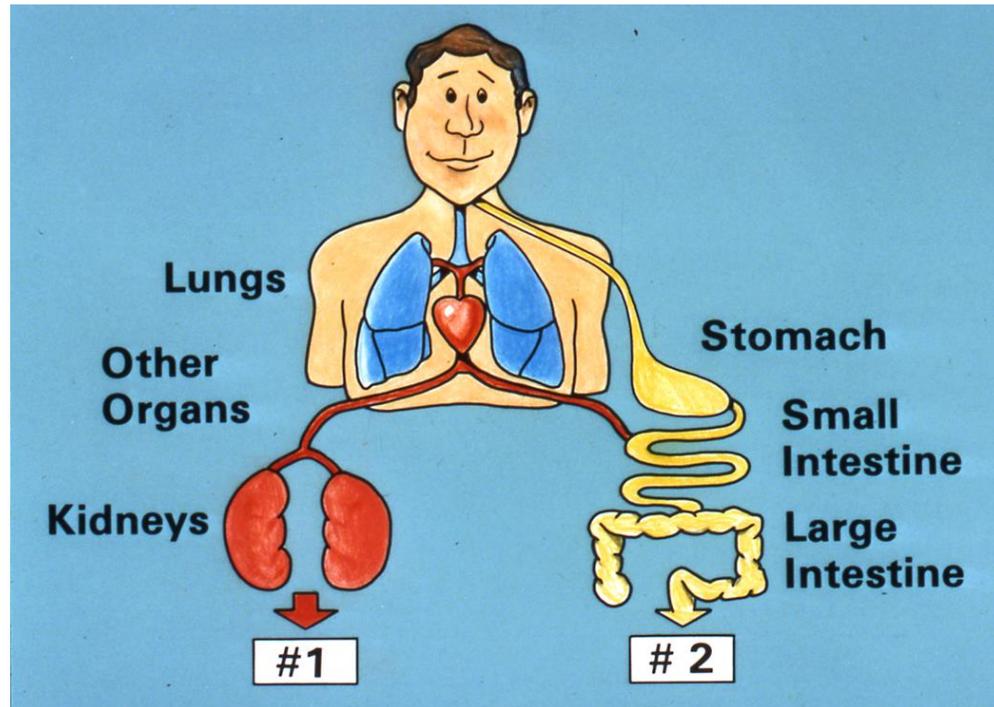
How Critical is Time to Bioassay?

- **Don't sample too soon...but don't wait too long.**
- Sampling too soon is sampling material in the bladder or bowel before the intake occurred.
- Dose detection capability varies with time after intake. Getting bioassay sooner than later provides more sensitive monitoring.

How Critical is Time to Bioassay?

- **Example: PFP = Americium-241 and Plutonium**
 - Early fecal bioassay (within a week or so of an intake) can allow determination of very low doses (1 mrem or less).
 - Bioassay at 3 or 4 months out from an intake may only allow determination of doses in excess of 100 – 500 mrem.
 - Bioassay at 1-year can still allow determination of doses well-below the occupational dose limit of 5,000 mrem.
- **Example: Tank Farms = Cesium-137, Strontium-90**
 - Bioassay at 1-day following intake can determine far below 1-mrem
 - Bioassay at 1-year following intake can easily determine 10-mrem dose

Internal Dosimetry Process



1. Obtain bioassay measurements
2. Investigate abnormal results with follow-up measurements.
3. Evaluate the measurements using computer models to address the many variables in the dose calculation process.
4. Calculate an effective dose to the whole body considering doses received by various organs and the time material remains in those organs and the whole body.

Evaluation Considerations



- Intake date
- Intake circumstances
- Particle Size for Inhalation
- Radionuclide(s)
- Chemical solubility
- Time to bioassay
- Reference Person model
- 50-year dose calculation

HNF-55719 Hanford Internal Dosimetry Program Manual

HNF-55720 Methods and Models of the Hanford Internal Dosimetry Program

Evaluation report for each individual

When Do I Hear?

- Whole body / lung counts – 1 day
- Fecal or urine sample analysis – 2 to 6 weeks
- Bioassay results reported to contractor dosimetry upon receipt
- Dose evaluation – less than 90 days from receipt of final data
- Communication to company – 1 day
- Notification to worker – 2 days

**Nominally,
One Day
To
Three Months**

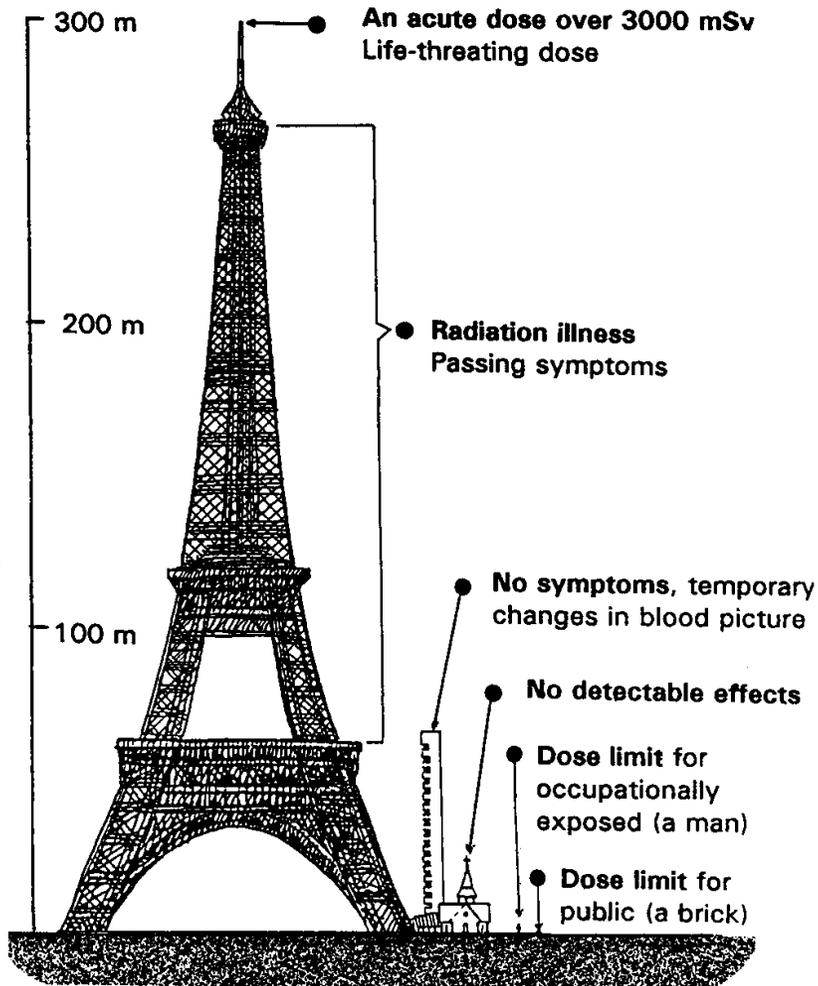
The Dose Report

- **Evaluation Report for Record**
 - The details
 - Data, interpretation and assumptions
 - Intake and dose calculation for confirmed intake
- **Summary Letter from Internal Dosimetry**
 - Why did we do the evaluation
 - What data was collected
 - What was the conclusion (confirmed intake - yes or no?)
 - **No Dose Assigned (no confirmed intake) → Sent directly to worker at MSIN**
 - Assigned dose for a confirmed intake
 - **Assignment of Internal Dose → Sent to Dosimetry Contact → Contact Worker**
- **Summary Letter and Evaluation Report permanently retained in worker's personal radiation exposure file**

Dose is Dose

- Effective dose determined from an intake (“internal dose”) is comparable to an effective dose from a source outside the body (“external dose”).
- There is a common misunderstanding that “internal dose” is worse than “external dose.” **THIS IS NOT TRUE.**
- For a cell receiving a dose (energy deposited in that cell), it doesn’t matter whether the energy came from outside the body (external), material deposited in some other organ or tissue, or from material deposited within that cell. The effect is the same.

Scale of Radiation Doses and Health Effects



- **Top of the Eiffel Tower – Life Threatening Dose:** 300,000 mrem (short-term exposure)
- **No symptoms, no detected ill health effects** (a 1-story building): 10,000 mrem (short-term exposure)
- **Occupational Dose Limit** (height of a person) 5,000 mrem/year (no health effects)
- **Avg. USA Background (height of a couple of bricks):** 600 mrem/year (no health effects)
- **Dose detectable by bioassay at 3 months following intake (a brick):** 100-500 mrem (no health effects)