LSU Health
NEW ORLEANS

Radiation Safety Training

July 25, 2018

LSU Health NEW ORLEANS

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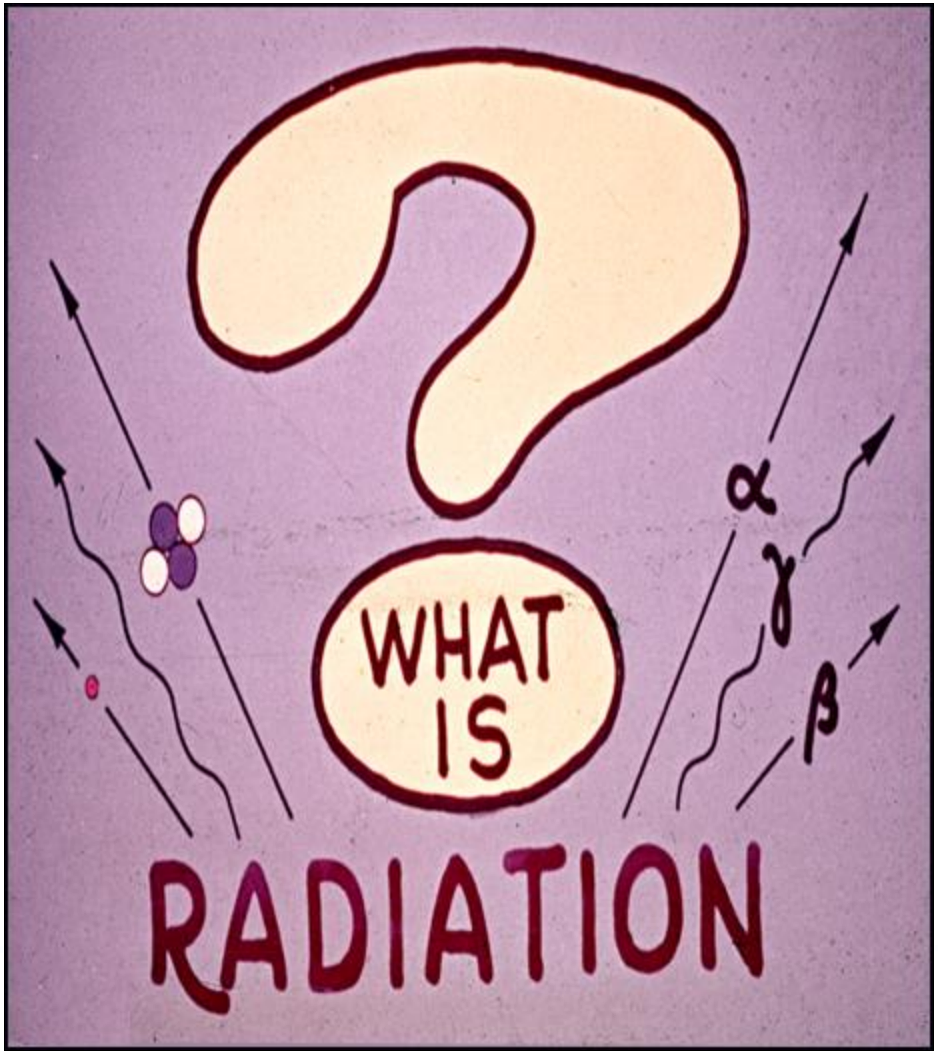
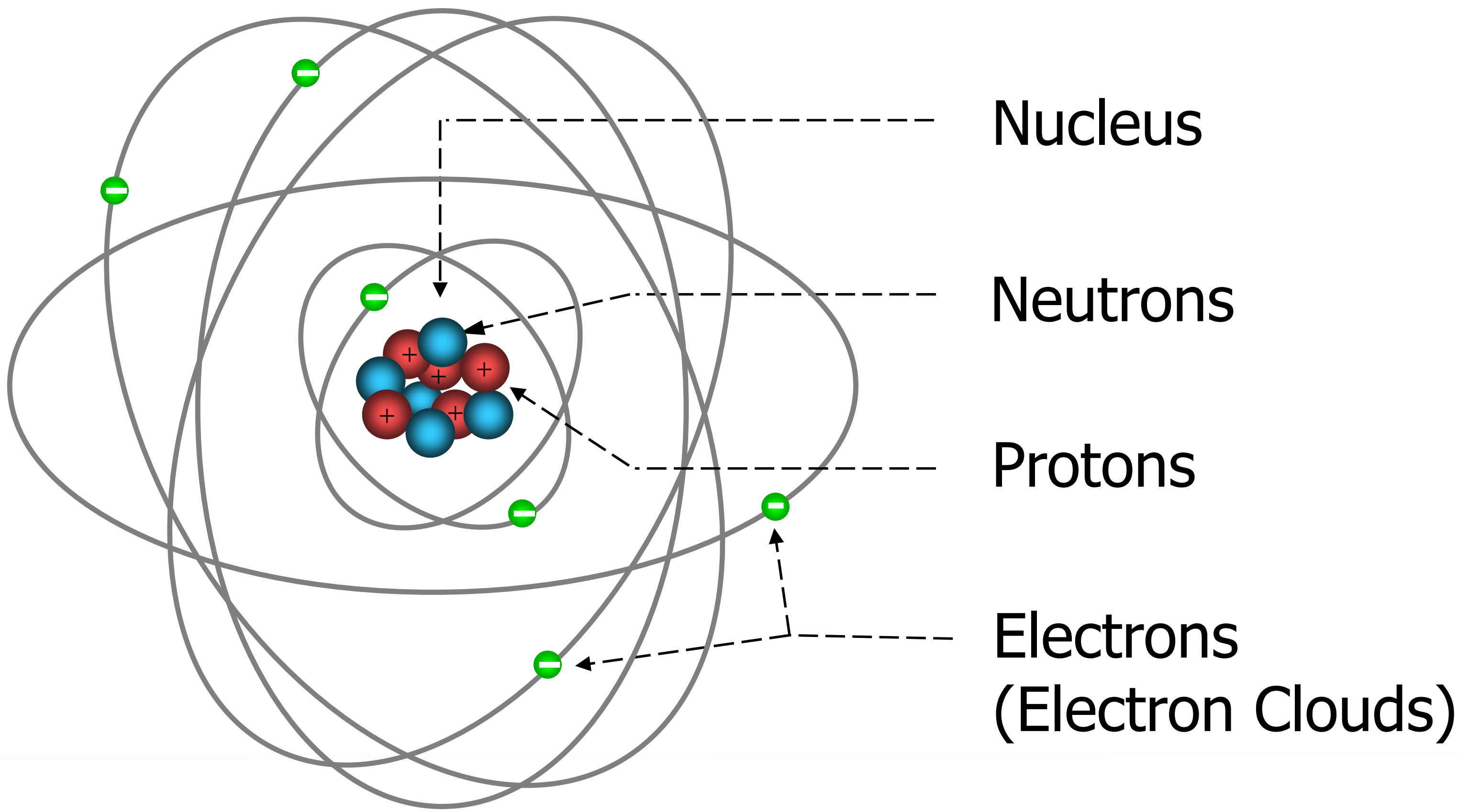


Any spontaneous change in the state of the nucleus accompanied by the release of energy.

Structure of the Atom



Radiation Basics

Periodic Table of Elements

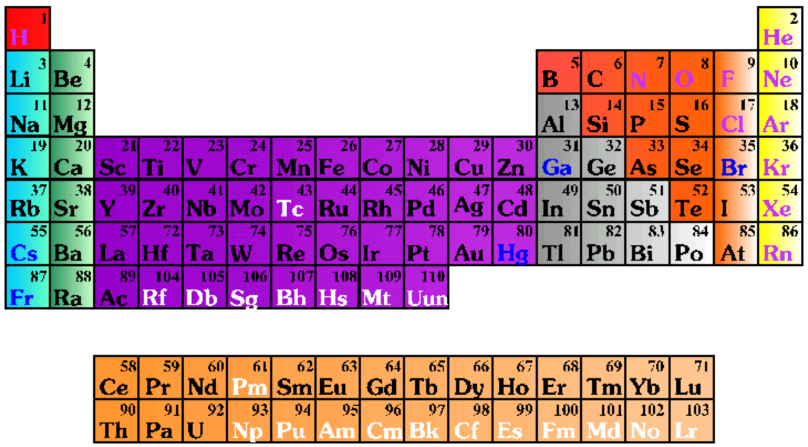
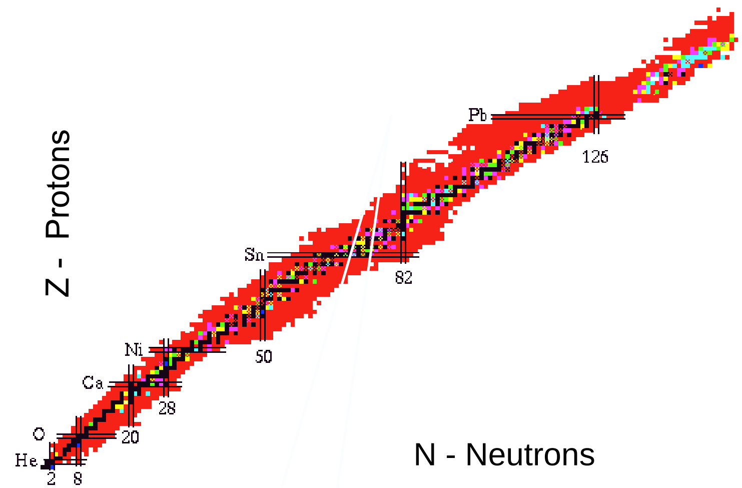


Chart of the Nuclides



				Tc	Tc90	Tc91	Tc92	Tc93	Tc94	Tc95	Tc96	Tc97	Tc98	Tc99	Tc100	Tc101
		Mo	Mo87	Mo88	Mo89	Mo90	Mo91	Mo92	Mo93	Mo94	Mo95	Mo96	Mo97	Mo98	Mo99	Mo100
Nb	Nb84		Nb86	Nb87	Nb88	Nb89	Nb90	Nb91	Nb92	Nb93	Nb94	Nb95	Nb96	Nb97	Nb98	Nb99
Zr82	Zr83	Zr84	Zr85	Zr86	Zr87	Zr88	Zr89	Zr90	Zr91	Zr92	Zr93	Zr94	Zr95	Zr96	Zr97	Zr98
Y81	Y82	Y83	Y84	Y85	Y86	Y87	Y88	Y89	Y90	Y91	Y92	Y93	Y94	Y95	Y96	Y97
Sr80	Sr81	Sr82	Sr83	Sr84	Sr85	Sr86	Sr87	Sr88	Sr89	Sr90	Sr91	Sr92	Sr93	Sr94	Sr95	Sr96
Rb79	Rb80	Rb81	Rb82	Rb83	Rb84	Rb85	Rb86	Rb87	Rb88	Rb89	Rb90	Rb91	Rb92	Rb93	Rb94	Rb95
Kr78	Kr79	Kr80	Kr81	Kr82	Kr83	Kr84	Kr85	Kr86	Kr87	Kr88	Kr89	Kr90	Kr91	Kr92	Kr93	Kr94
Br77	Br78	Br79	Br80	Br81	Br82	Br83	Br84	Br85	Br86	Br87	Br88	Br89	Br90	Br91	Br92	58
42		44		46		48		50			Stable			Natural Radioactive		

Half-Life

1 – 10 days

10-100 days

The Chart of the Nuclides

				7	N			N-12	N-13	N-14	N-15
			6	C	C-8	C-9	C-10	C-11	C-12	C-13	C-14
		5	B		B-7	B-8	B-9	B-10	B-11	B-12	B-13
		4	Be		Be-6	Be-7	Be-8	Be-9	Be-10	Be-11	Be-12
3	Li				Li-5	Li-6	Li-7	Li-8	Li-9	Li-10	Li-11
2	He			He-3	He-4	He-5	He-6	He-7	He-8	He-9	He-9
1	H		H-1	H-2	H-3						
						3	4	5	6	7	8
			0	1	2						

Dark Blue – Naturally occurring Non-radioactive
Light Blue – Naturally occurring radioactive
White – Manmade radioactive

Major Emissions

α - Alpha particle emission (decay)

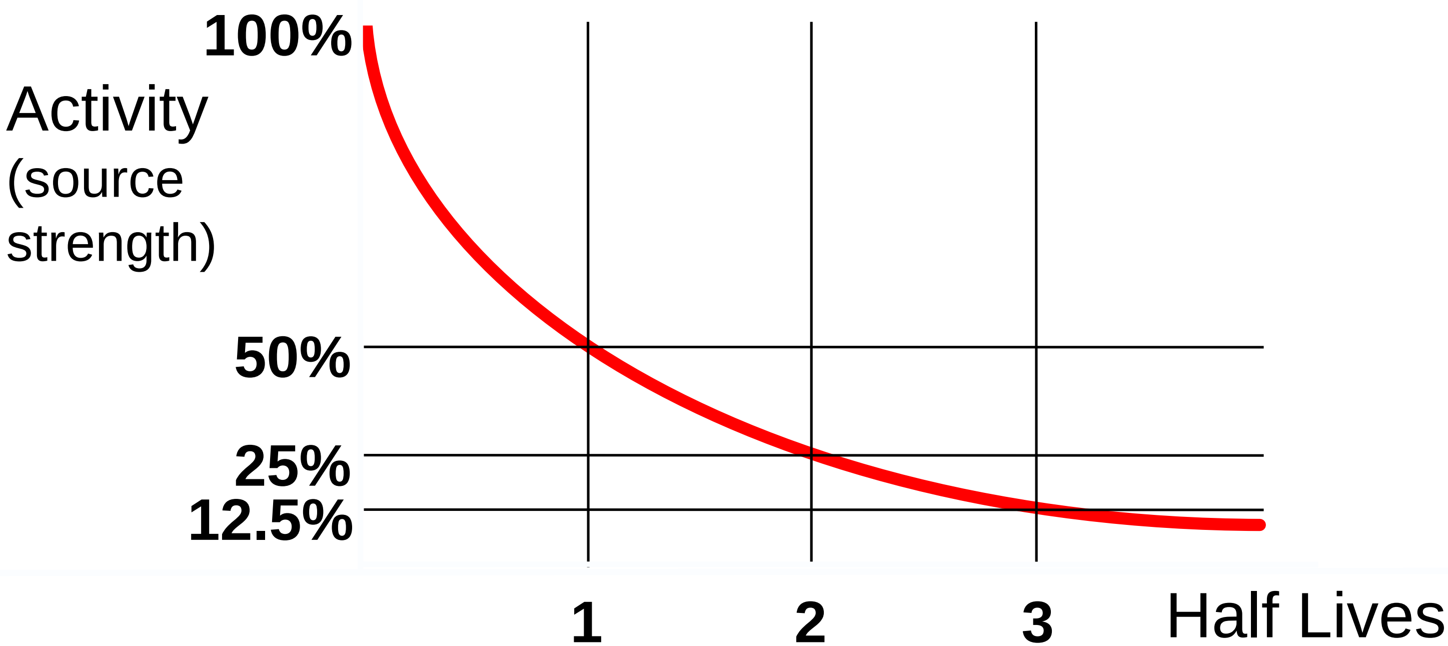
β^- - Beta particle emission (β^- decay)

β^+ - Beta positron emission (β^+ decay)

γ - Gamma emission

Half-Live

- Time required for a radioactive substance to lose 50% of its activity by decay
- Each Nuclide has a characteristic Half Life



Types of Radiation

Ionizing Radiation: Radiation is energy transmitted as particles or waves. Ionizing radiation has sufficient energy to dislodge orbital electrons, thereby producing ions.

- Examples: ***Alpha, Beta, Gamma, Neutron, and X-rays***

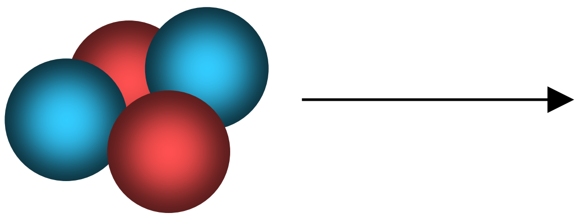
Non-Ionizing Radiation: Radiation that does not have sufficient energy to dislodge orbital electrons.

- Examples: ***Visible light, Infra-red , Micro & Radio waves, and Radar***

Types of Radiation

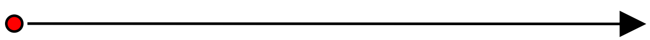
<u>Major Types of Ionizing Radiation</u>
Alpha, Beta, Gamma

Alpha Particle



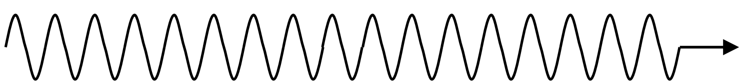
Large Mass – Helium Nucleus with a +2 charge

Beta Particle



Small Mass - Electron (subatomic particle)

Gamma Photon and X-Rays



No Mass (Electromagnetic Radiation)

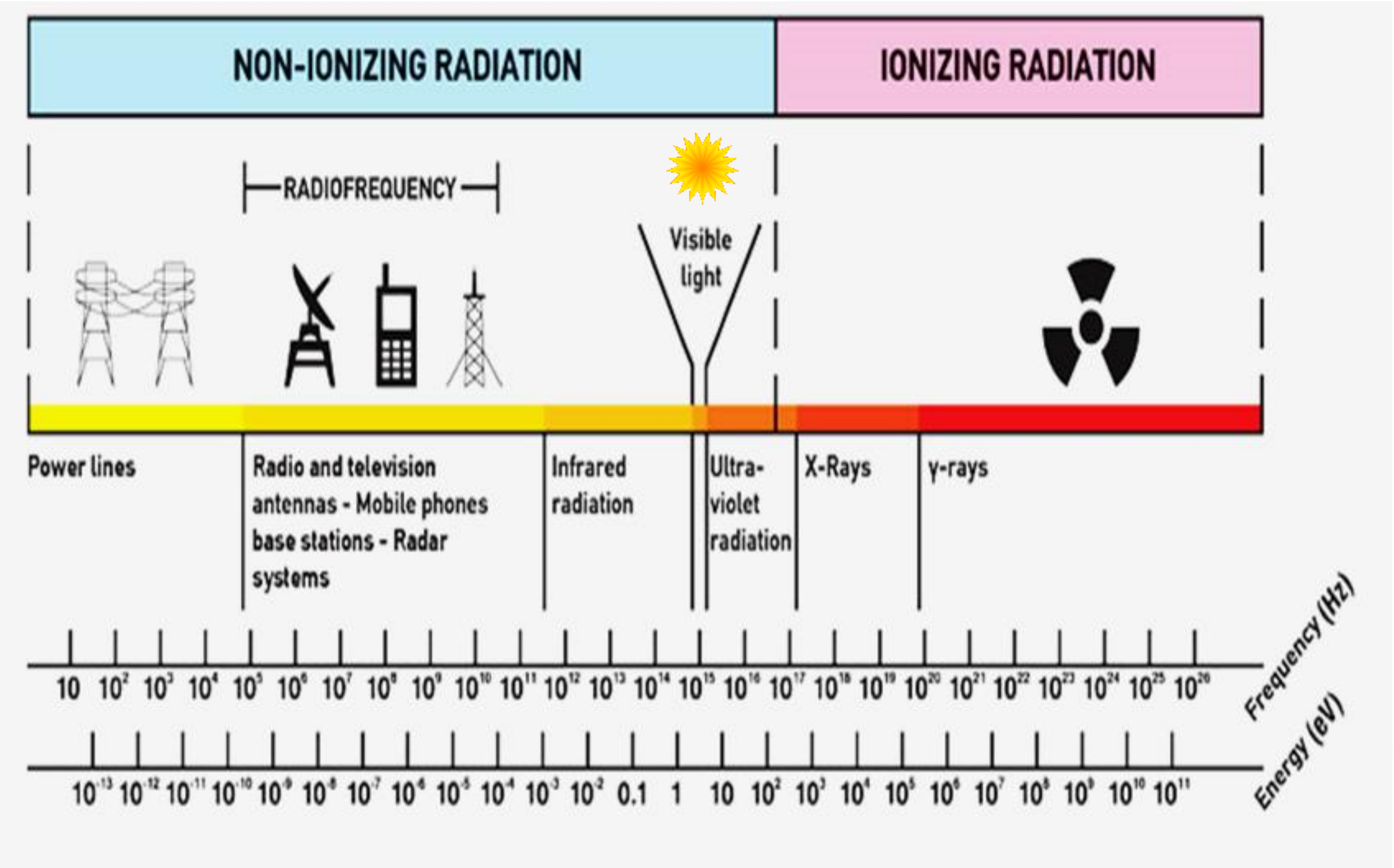
Types of Radiation

Non - Ionizing Radiation

Definition – All other types of radiation that does not have sufficient energy to dislodge orbital electrons.

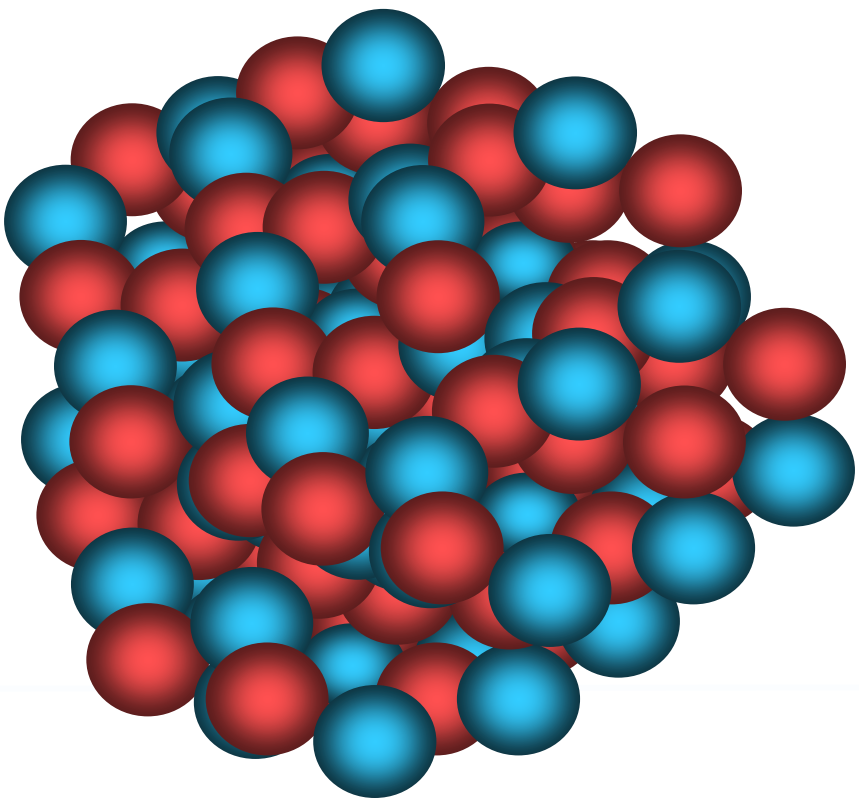
Types of Radiation

Frequency and Energy Spectrum

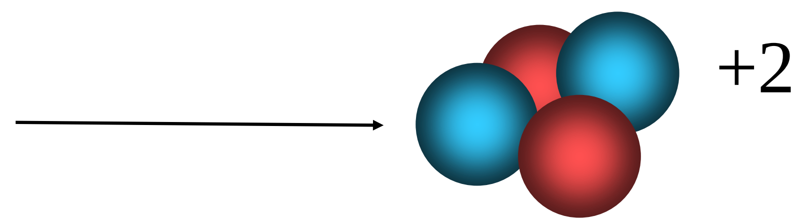


α Decay

α has a discrete energy that can be measured and related to its parent. The neutron-to-proton ratio is too low !



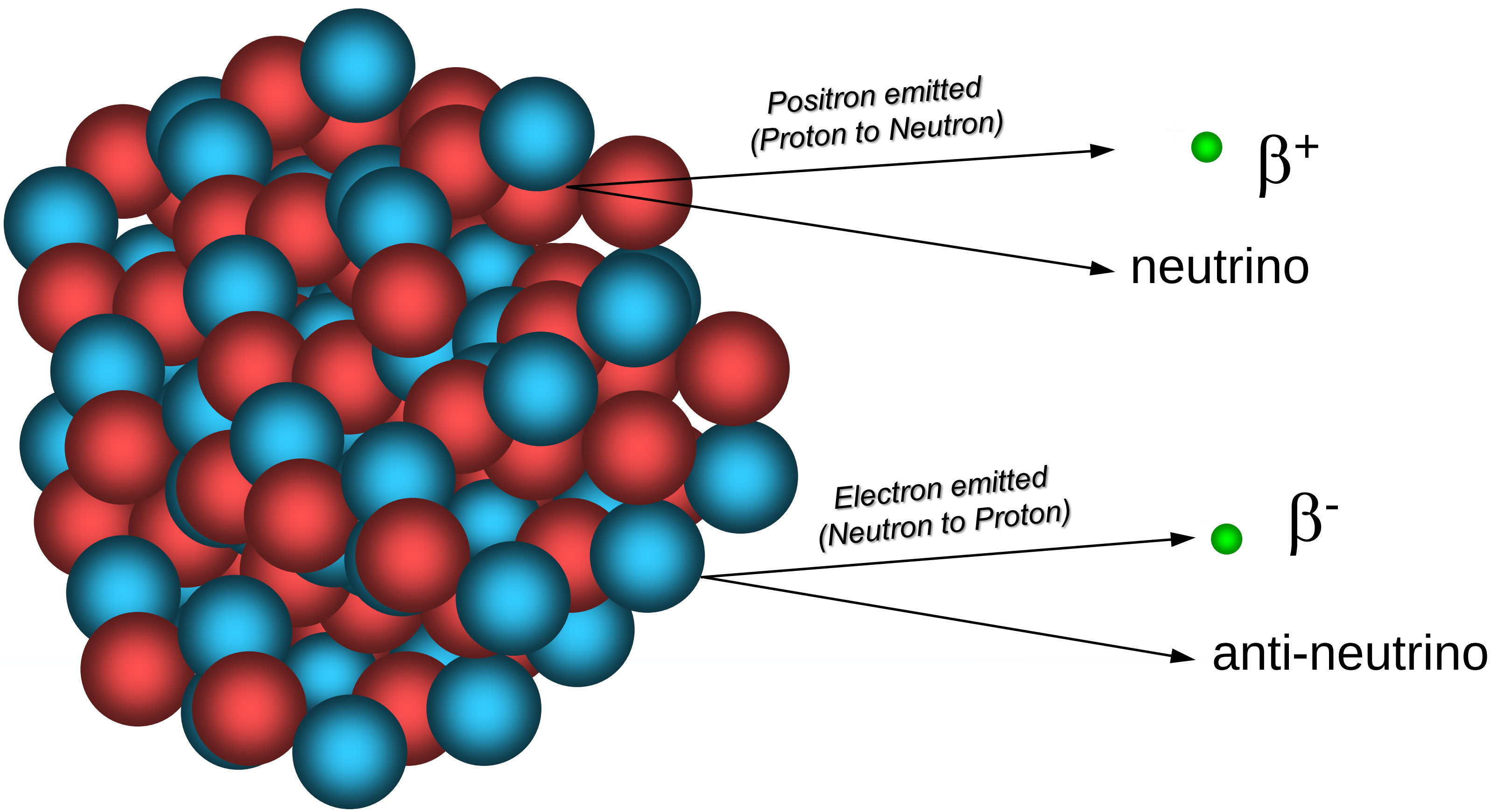
^{4}He Nucleus
Ejected from Nucleus



Most of the energy associated with α lost during ejection

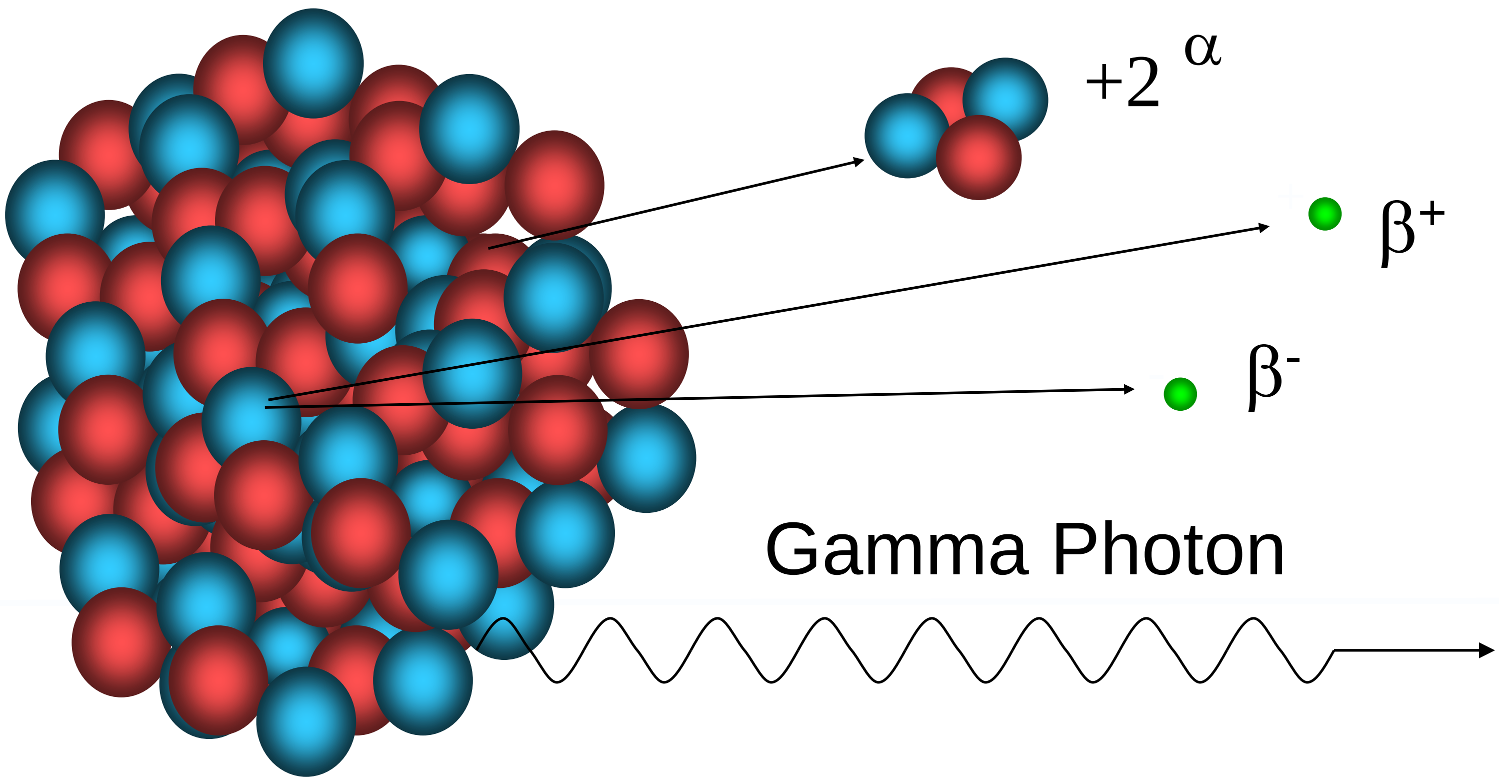
β^+ Decay or β^- Decay

Beta decay is a radioactive decay in which a Beta particle (Positron or Electron) is emitted.



γ Decay

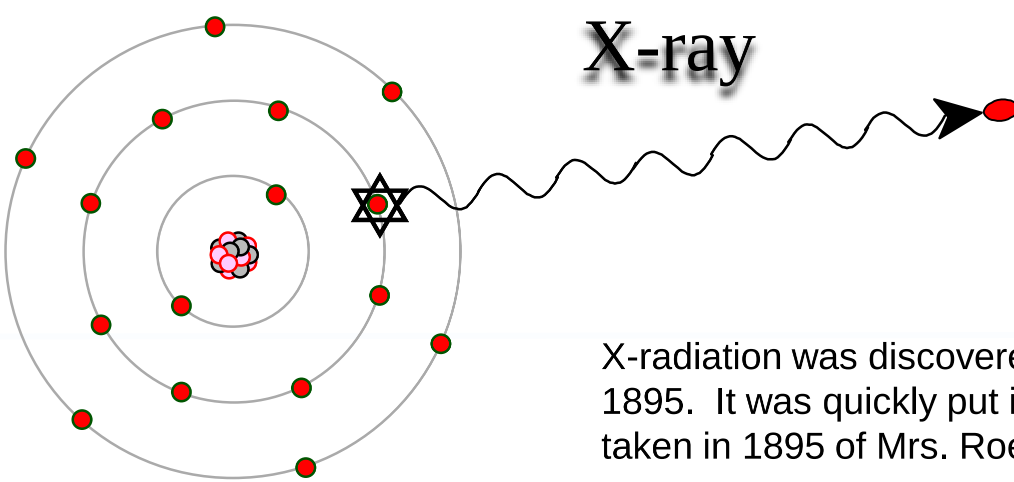
- Following the emission of an Alpha or Beta particle, the nucleus is frequently left in an excited state. A photon from the nucleus, no weight, mass or charge usually occurs after α or β emission when nucleus has extra energy to get rid of it
- Given off with discrete energies, are highly penetrating
- Can identify isotope by measuring photon energy



Types of Radiation

X-rays

- Very Short Wavelength Electromagnetic Radiation emitted when
  - Displaced Electrons replaced by another from an outer orbit (Characteristic X-ray)
  - Rapid Deceleration of Beta Particle or electron (Bremstrahlung)
- Travel at the Speed of Light
- No Weight, Mass or Charge
- Highly Penetrating



X-radiation was discovered by W.C. Roentgen, 1895. It was quickly put into clinical use. Photo taken in 1895 of Mrs. Roentgen hand. (*nice ring*)

Units of Measurements

Energy

- electron volts (eV)
  - 1 eV = 1.601 x 10^{-19} Joule
  - 1,000 eV = 1 keV
  - 1,000,000 = 1 MeV
- Generally, for the same types of radiation, the radiation with the higher energy will also be more penetrating and travel farther in air or tissue.

		Range in Air	In Tissue
$^{4}_{2}\alpha^{++}$	Alpha	5 cm	0.037 mm
$^{0}_{-1}\beta^{-}$	Low-energy Beta (S-35)	25 cm	0.29 mm
$^{0}_{-1}\beta^{-}$	High-energy Beta (P-32)	6 m	8.0 mm
$^{0}_{0}\gamma$	Gamma I-125 (35 keV)	34 m	
$^{0}_{0}\gamma$	Gamma Cr-51 (320 keV)	310 m	

Units of Measurements

Activity

- Decay is a statistical process.
  - Cannot predict when a particular atom will decay.
  - Can predict when certain amount will have decayed.
- Unit of activity is the Curie (Ci)
  - 1 Ci = 37,000,000,000 dps (3.7×10^{10} dps) or
    1 Ci = 2.22×10^{12} dpm
  - 1 mCi = 0.001 Ci = 37,000,000 dps
  - 1 μCi = 0.000 001 Ci = 37,000 dps
  - 1 nCi = 0.000 000 001 Ci = 37 dps
- New activity unit the Becquerel (Bq)
  - 1 Bq = 1 dps
  - 1 Ci = 37,000,000,000 Bq = 37 GBq (Giga Becquerel)

Units of Measurements

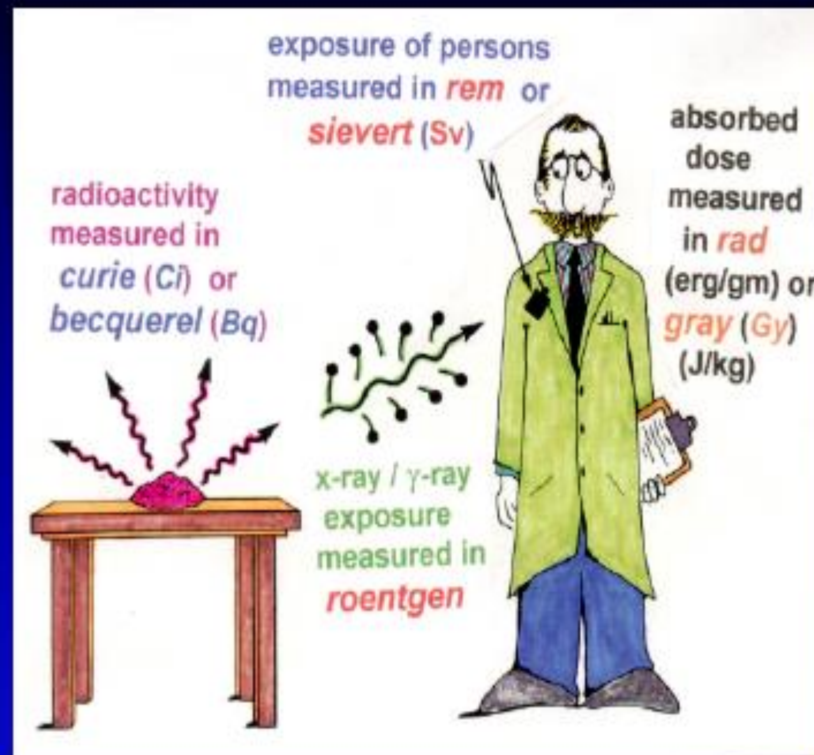
Quantities and Units

Beta and gamma radiation cause the same amount of biological change.

1 R ≈ 1 rad ≈ 1 rem

Alpha particles interacting Inside the body cause 20 times more biological changes than beta or gamma.

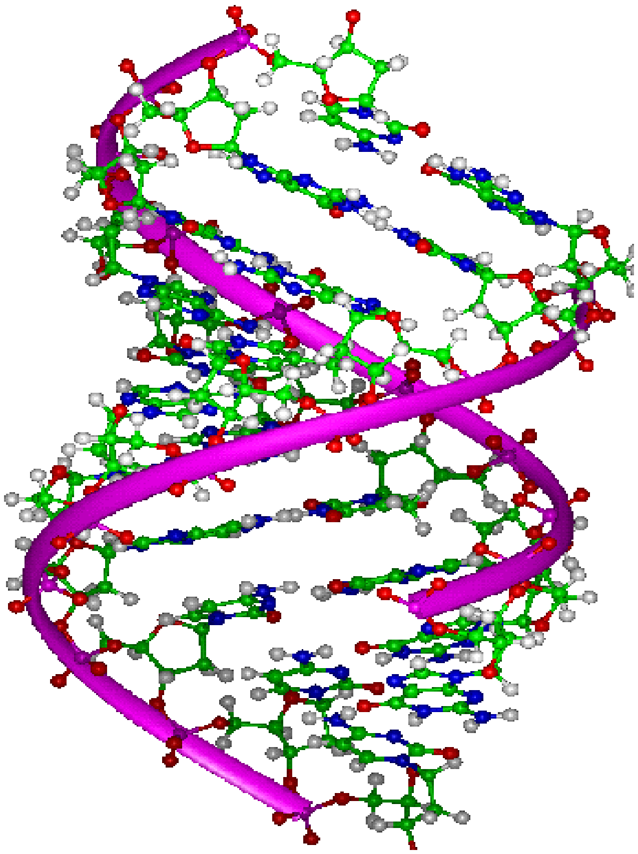
1 rad alpha = 20 rem



Potential Health Effects

Large Acute Radiation Dose

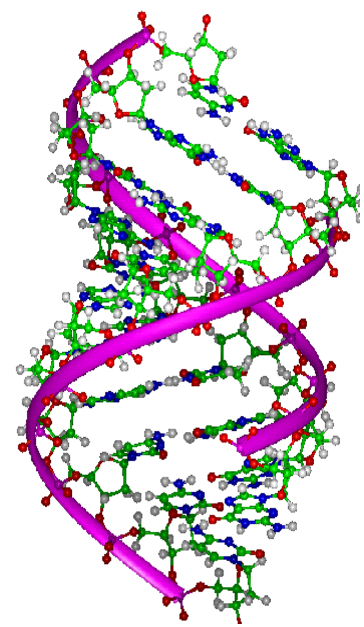
- >100 rem and higher penetrating radiation to the whole body:
  - Biochemical effects occur in SECONDS
  - Cell division effects are seen in HOURS
  - Gastrointestinal and Central Nervous System effects may be seen in a matter of HOURS
  - Greater risk of CANCER in 15+ YEARS
  - Greater risk of Genetic Effects in OFFSPRING



Potential Health Effects

Small chronic radiation doses

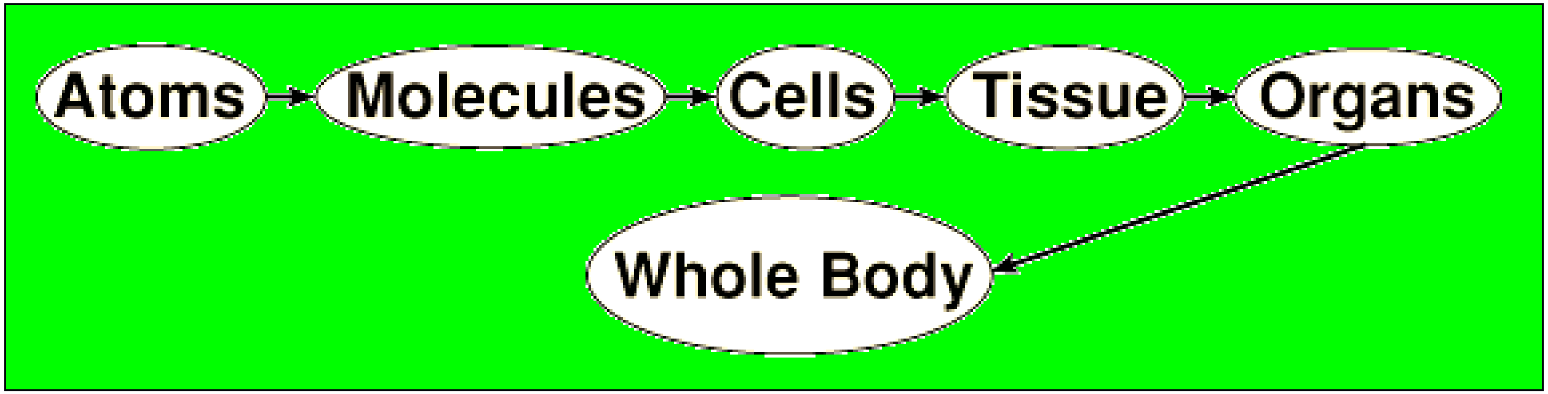
- Small doses delivered at low dose rates within the regulatory limits:
  - Biochemical effects similar to those for background doses
  - Tiny calculated increase in long-term cancer risk (additional 3 in 10,000 for each 1,000 mrem)
  - Miniscule calculated increased risk of Genetic Effects
  - These are not “SEEN” among radiation workers



Potential Health Effects

I don't think so !!!!!!

Potential Health Effects



Radiation causes ionizations of atoms which will may affect molecules which may affect cells which may affect tissues which may affect organs which may affect the whole body.

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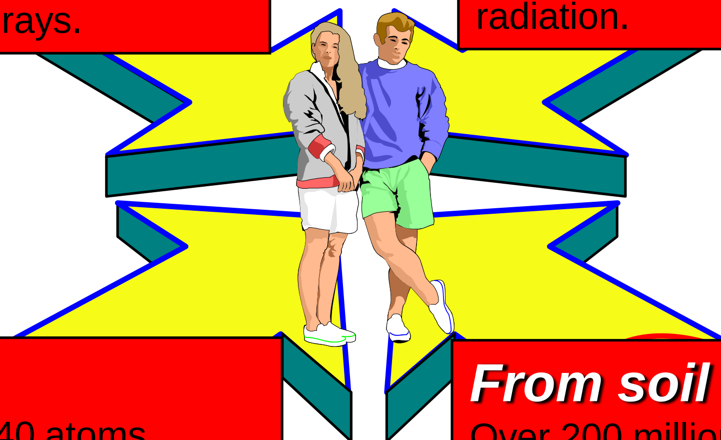
Background Radiation Sources

From the air we breathe

About 30,000 atoms (radon, polonium, bismuth and lead) disintegrate each hour in the lung and give off alpha, beta particles and gamma rays.

From the sky

About 500,000 cosmic rays penetrate the average individual every hour. These rays are subatomic particles created in the upper atmosphere by extraterrestrial radiation.



From Food

About 15 million potassium-40 atoms per hour disintegrate inside each of us, giving off high energy beta particles and gamma rays. Also, about 7,000 Uranium atoms disintegrate inside us each hour, giving off alpha particles

From soil and buildings

Over 200 million gamma rays pass through the average individual each hour. These gamma rays come from the radioactive material in the soil and buildings.

All individuals living on the Earth are exposed to radiation from a variety of sources, both natural and man-made.

Background Radiation Sources

Common Radioactive Items!

Item	Radioactivity
1 Adult Human	3000 Bq (80 nCi)
1 kg Coffee	1000 Bq (27 nCi)
1 kg Superphosphate fertilizer	5000 Bq (135 nCi)
Air in a 100 m^2 house	3000 Bq (80 nCi)
Household Smoke Detector	37 kBq (1 μCi)
1 kg Uranium	10 MBq (270 mCi)
1 kg Coal Ash	2000 Bq (54 nCi)
1 kg Granite	1000 Bq (270 nCi)

Background Radiation Sources

Cosmic Rays

	Equator	50° Latitude
Sea Level	0.35 mSv (35 mrem)	0.5 mSv (50 mrem)
1000 m	0.6 mSv (60 mrem)	0.9 mSv (90 mrem)
5000 m	4.0 mSv (400 mrem)	8.0 mSv (800 mrem)
10,000 m	14.0 mSv (1.4 rem)	45.0 mSv (4.5 rem)
20,000 m	35.0 mSv (3.5 rem)	140.0 mSv (14 rem)

- Paris - Houston flight: 50 mSv (5 mrem)
- Concord flight: 4 to 17 mSv/hr (0.4 to 1.7 mrem/hr)
- During solar storm: as high as 0.5 mSv/hr (50 mrem/hr)
- U.S. Space Shuttle (360 km) : ~ 80 to 90 mSv/hr(8-9 mrem/hr)
- during solar storm: as high as 3 mSv/hr (300 mrem/hr)
- **Average cosmic dose is 400 mSv (40mrems) per year**

Background Radiation Sources

Radiation from the Earth

- Three radioactive “Families” exist in nature:
  - The Uranium series, starting with 238U, half life 4.47 x 10^9 years
  - The Actinium series, starting with 235U, half life 7.04 x 10^8 years
  - The Thorium series, starting with 232Th, half life 1.41 x 10^{10} years
- Other abundant radioactive isotopes:
  - ^{40}K, the radioactive isotope of Potassium (only 0.012% of potassium)
  - ^{14}C, created by the nuclear transformation of ^{14}N, principally by cosmic ray bombardment
- **Natural radioactivity exposure is from gamma rays: from 300 to 400 mSv (30 to 40 mrems) per year**

Background Radiation Sources

Internal Radioactive Material

- Natural radioactive material such as Uranium and Thorium daughters (especially ^{210}Pb and ^{210}Po) are dissolved in groundwater, taken up by plants and enter the food chain, ending up in our bodies
- Fallout from weapons testing and reactor accidents, such as ^{131}I, ^{134}Cs, ^{137}Cs and ^{90}Sr also pass to humans through dairy products and meat of animals which have grazed on contaminated vegetation
- **Internal radiation averages 370 mSv (37 mrem) per year**

Background Radiation Sources

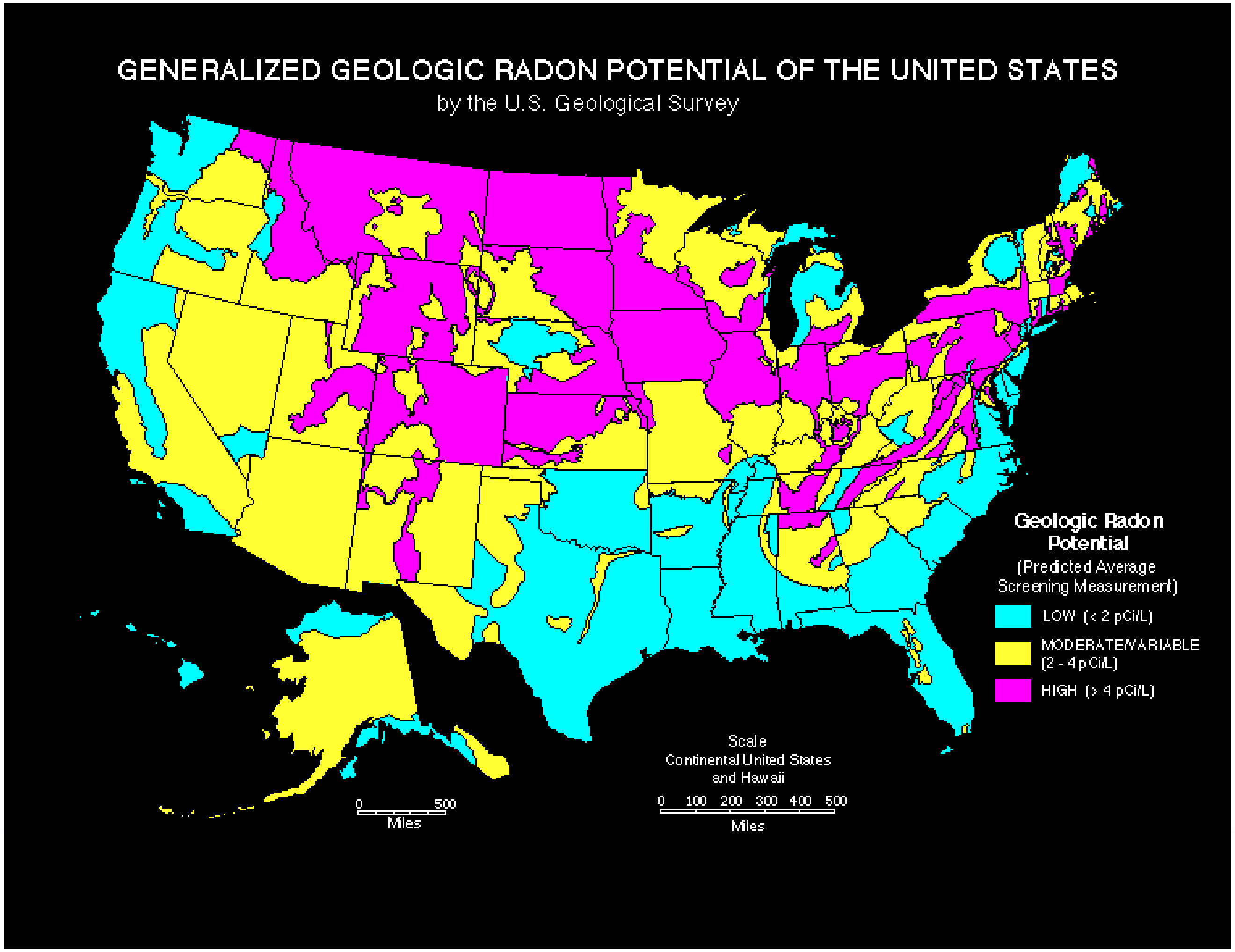
Radon Gas

- Radon-222 and Thoron (Radon-220) are radioactive gases created in the decay of Uranium and Thorium, which seep from the ground
- Each gas has a short half life, but their daughters are particles and will remain suspended in air.
- We breathe these in!

- **Radon/Thoron are generally the highest contributor to radioactive dose: 1.4-1.8 mSv (140-180 mrem) per year.**

Background Radiation Sources

Radon Gas



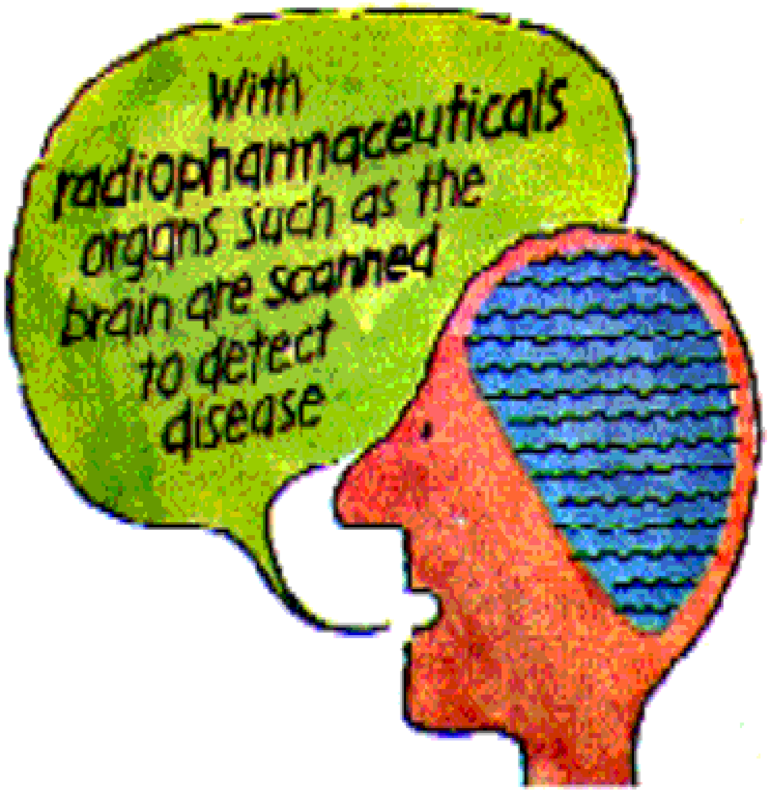
Other Radiation Sources

Diagnostic X-rays

- External application of X-rays
- Contrast agents (e.g., Barium) sometimes introduced in body
- Recorded on film or with scanner
- Dose equivalent from 20mSv **(2 mrem)** to >9 mSv **(900mrem)**
- Average dose equivalent is 0.5mSv **(50 mrem)** per examination

Other Radiation Sources

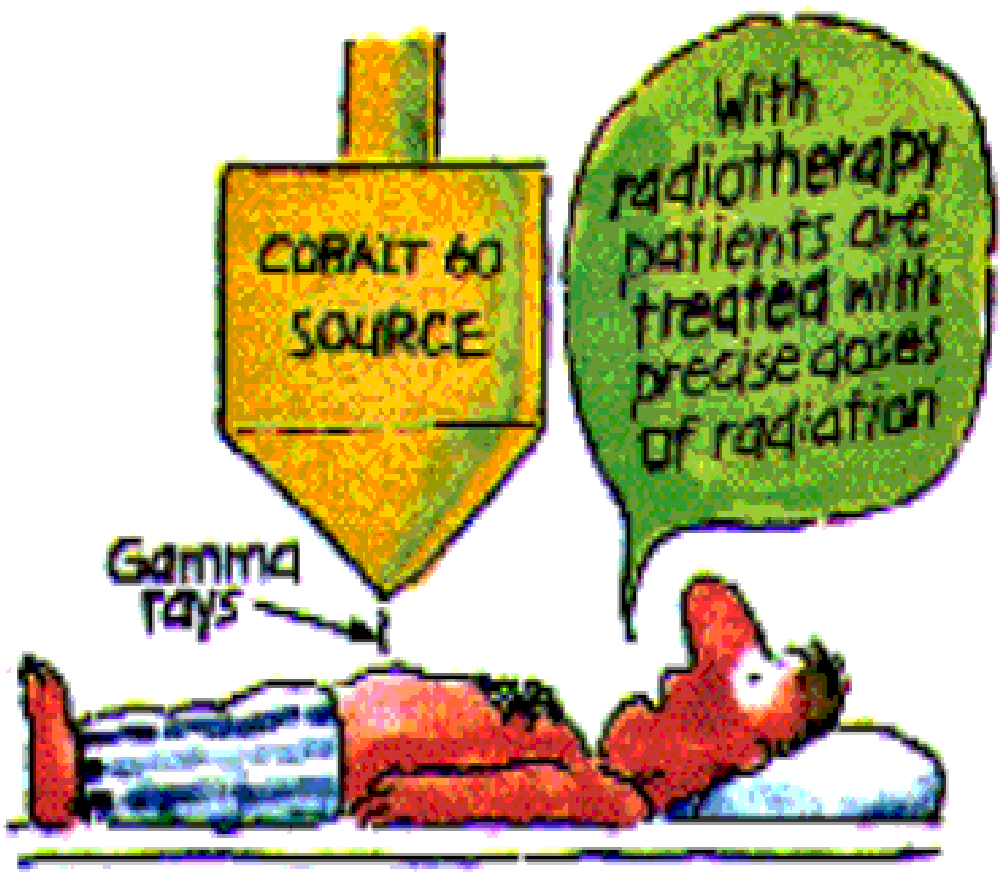
Nuclear Medicine



- Gamma ray emitter introduced into organ
- Image of organ taken with Scanner
- Dose equivalent from 250 mSv **(25 mrem)** to 30 mSv **(3 rem)**
- Average dose is 4.3 mSv **(430 mrem)** per examination

Other Radiation Sources

Radiotherapy



- Direct irradiation of portion of body with high energy radiation
- Purpose is destruction of malignant tumors
- Dose equivalent can be up to 10’s of Sv **(1000’s of rem)** localized dose

Other Radiation Sources

Consumer Products

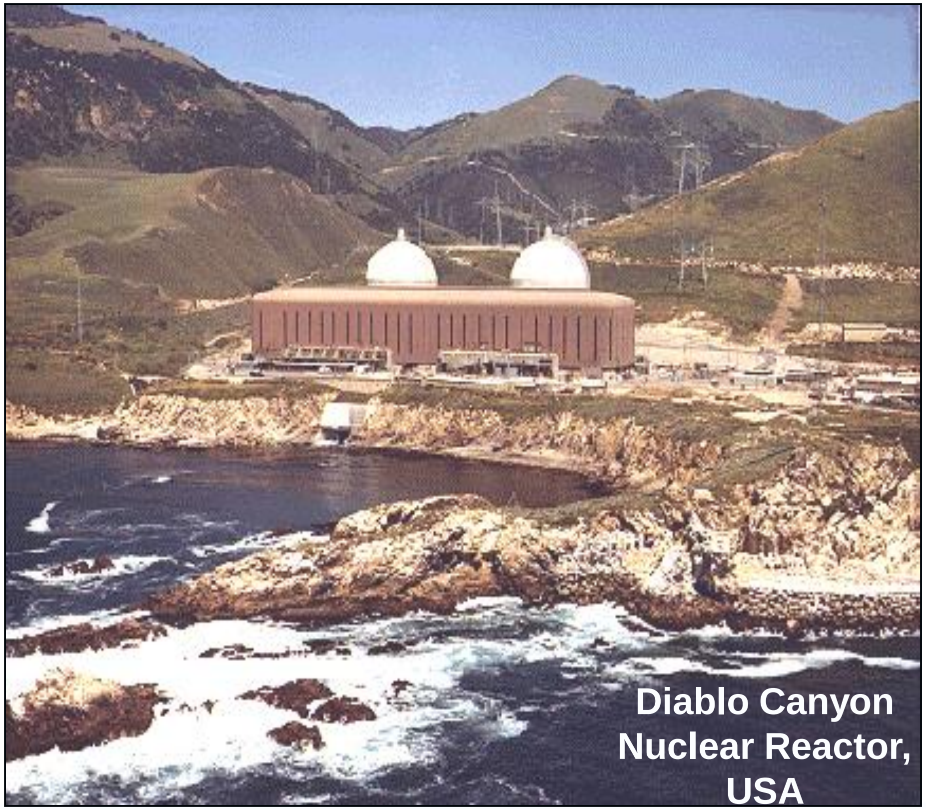
- Airport X-rays
- Televisions
  - X-rays from H.E. electrons
- Smoke detectors
  - Americium-241
- Watch and Meter Dials
  - Tritium

Other Radiation Sources

Nuclear Power Emissions

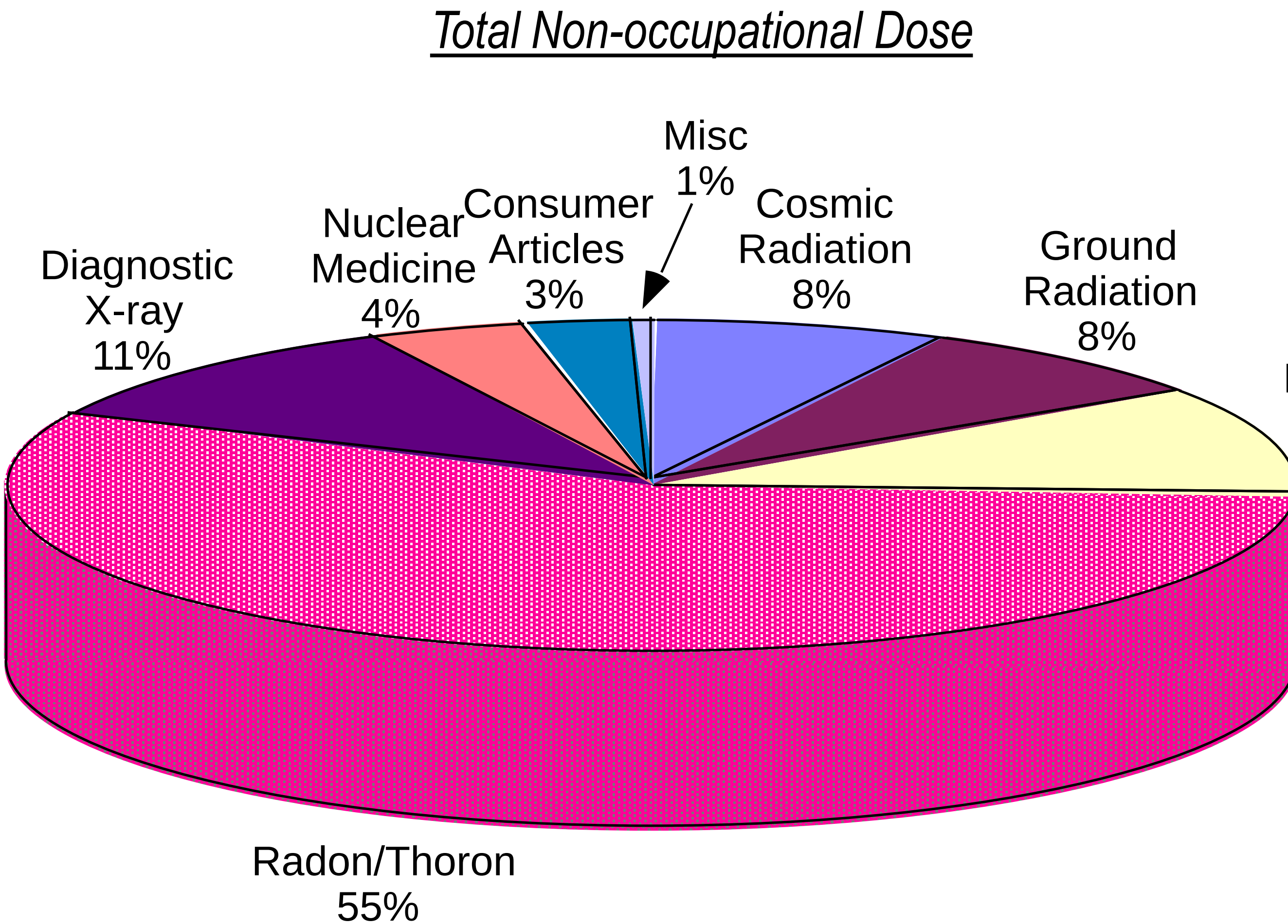
Emissions from the Nuclear power industry amount to an average dose of about 1.5 mSv **(0.15 mrem)** per year

Chernobyl increased this to ~25mSv (2.5mrem) per year temporarily in Europe, but quickly returned to normal level



Diablo Canyon Nuclear Reactor, USA

Other Radiation Sources



Total Annual Dose Equivalent = 3.6 mSv (360 mrem)

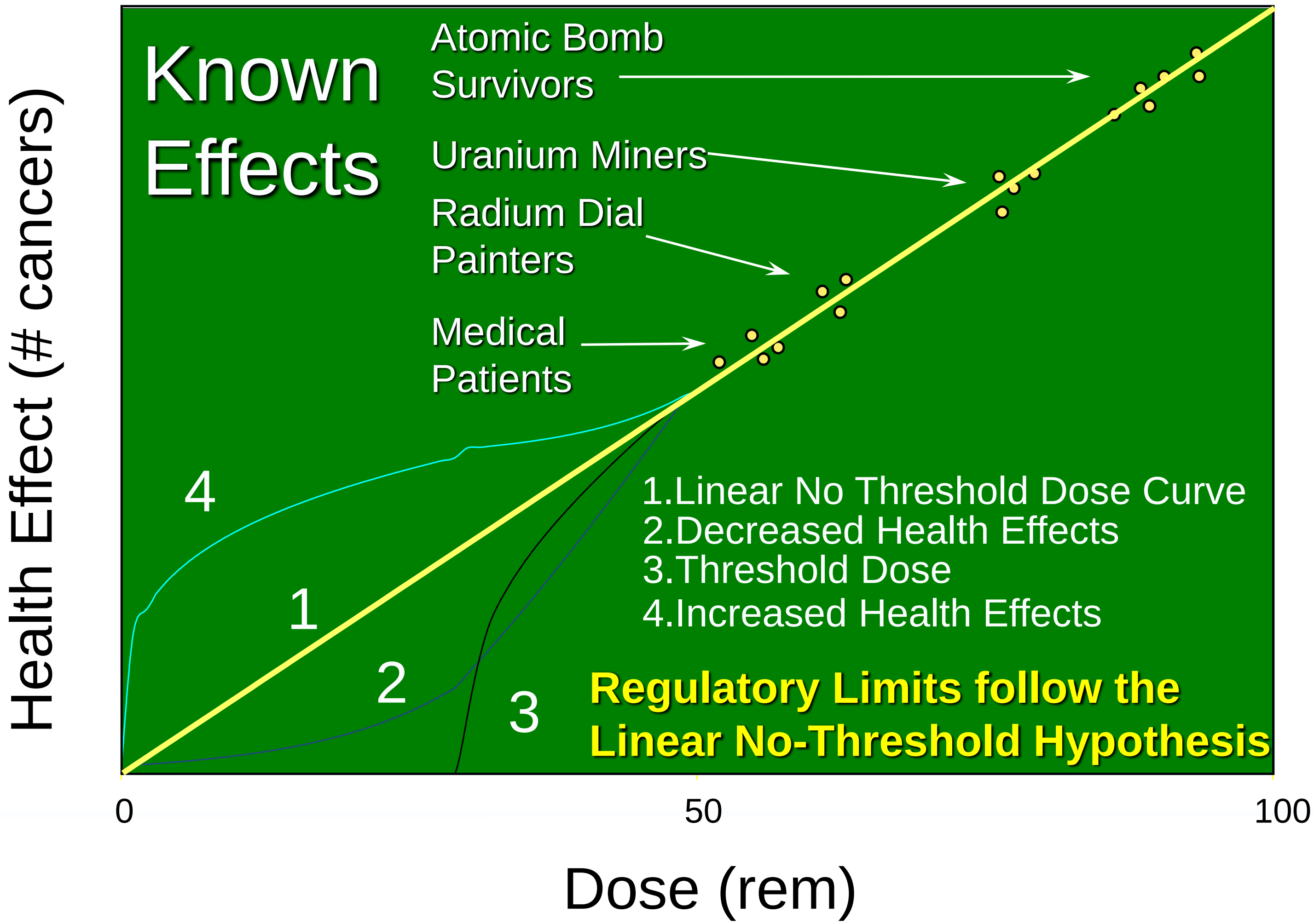
Occupational Dose Limits

What if we work with radionuclides?

Liquid Radioisotopes used for Biological and Environmental Research are the Most Common Forms of Radioactive Materials at LSUHSC

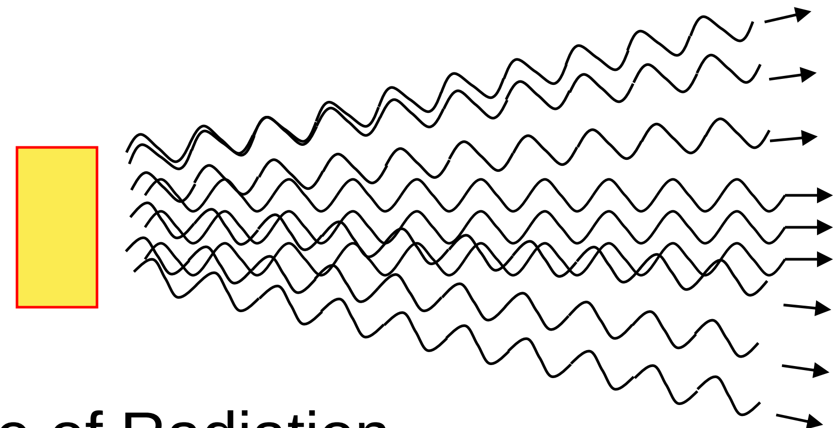
Occupational Dose Limits

Dose-Response Hypotheses



Occupational Dose Limits

Whole Body Dose



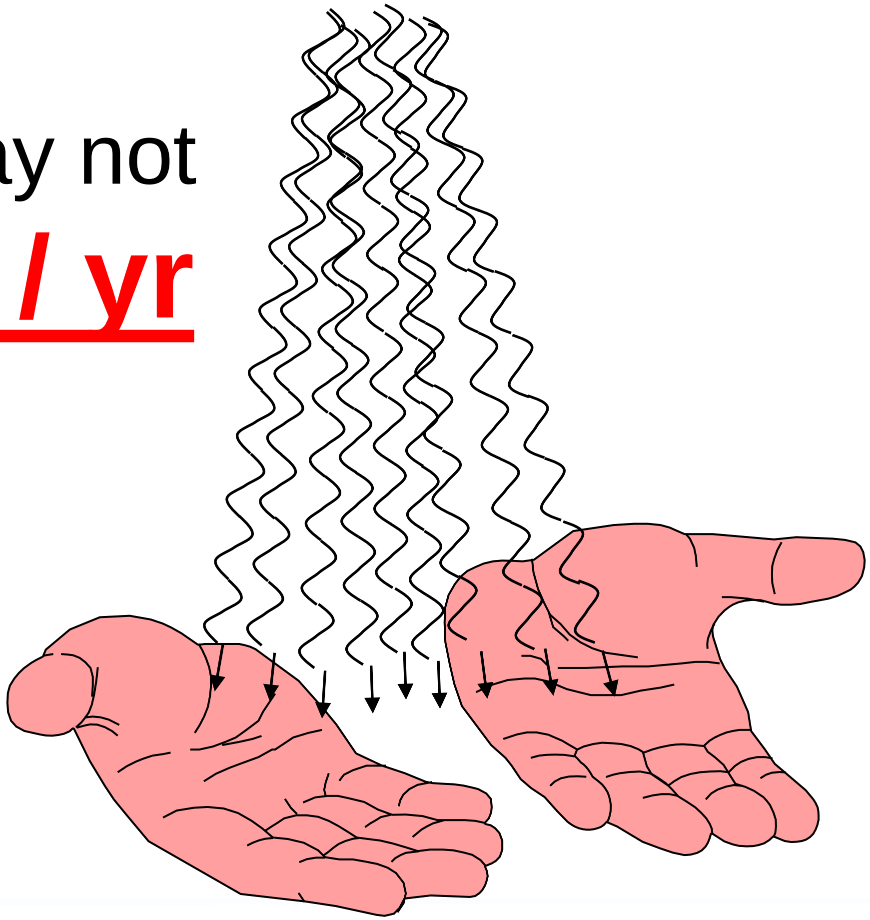
Source of Radiation

Not to exceed **5 rem/ yr**

Occupational Dose Limits

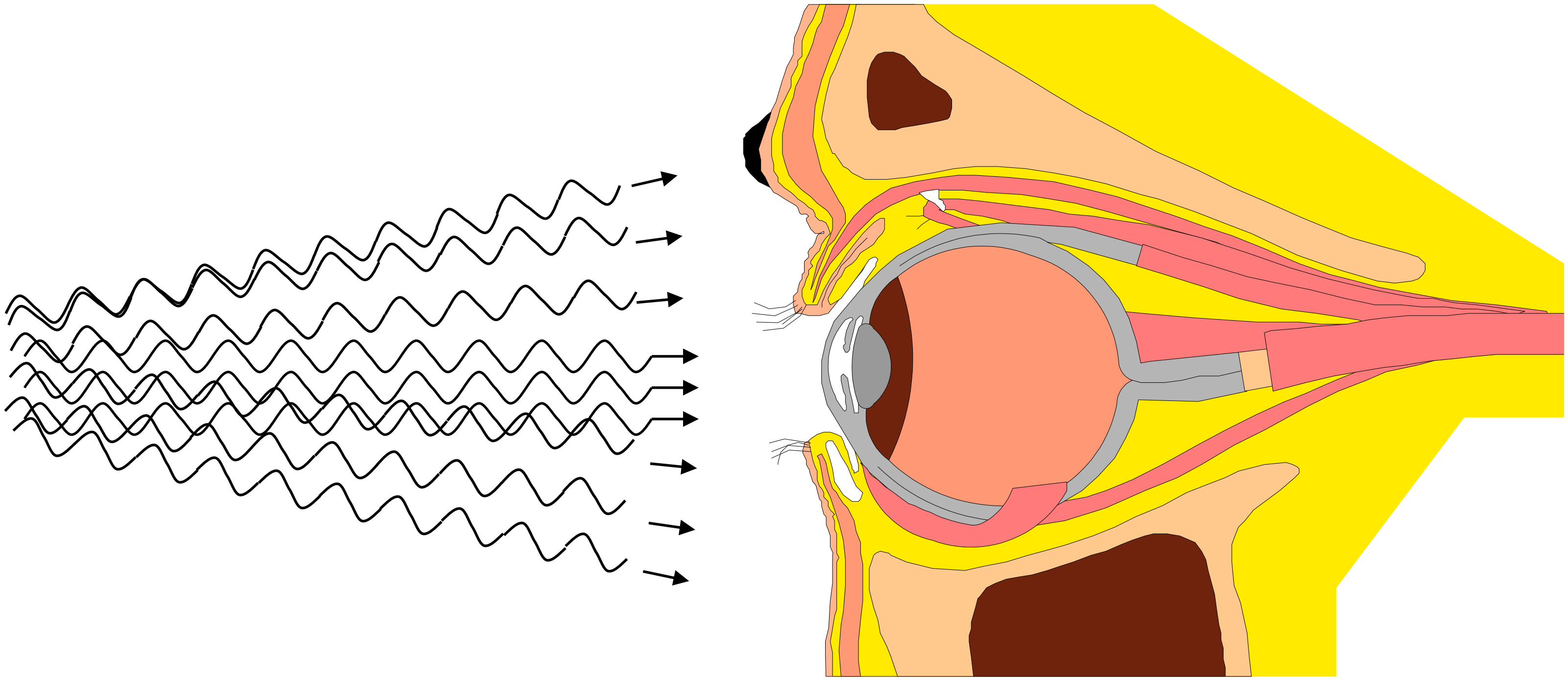
Extremities

The Dose Limit may not exceed **50 rem / yr**



Occupational Dose Limits

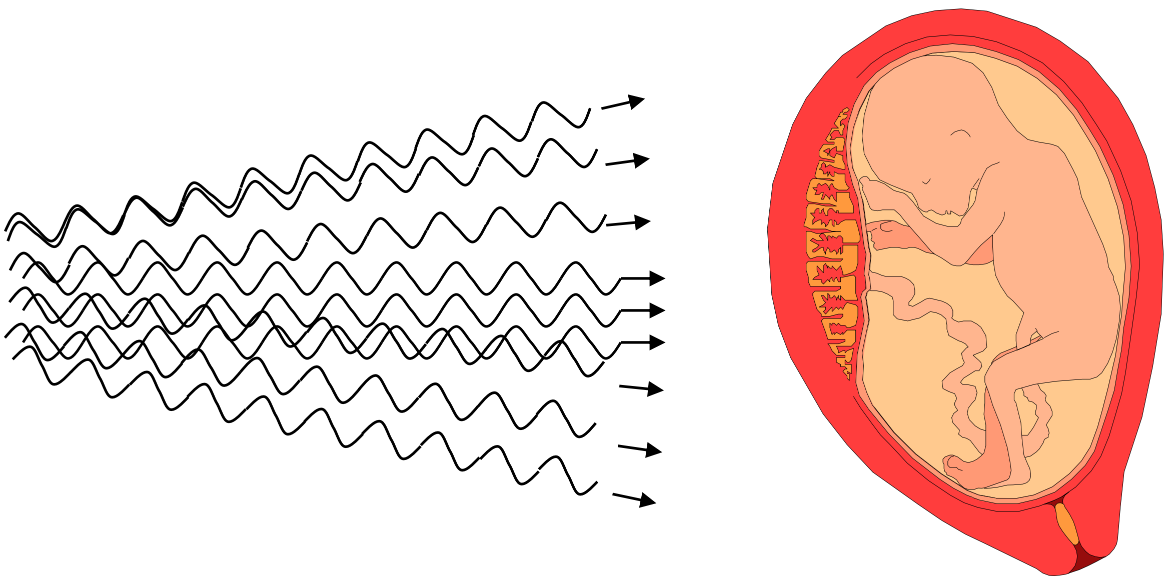
Lens of Eyes



Dose must not exceed **15 rem/ yr**

Occupational Dose Limits

Declared Pregnant Mothers and Occupational Minors



Dose must not exceed **0.5 rem or 500 mrem** during the gestation period for declared pregnant mothers. Occupational minors must not exceed this dose in a year long period

- Rapidly dividing and non-specialized cells are more sensitive to radiation
- Birth defects have been observed

Occupational Dose Limits

Written Declaration for Pregnancy for Pregnant Workers

- The only way to protect the embryo/fetus from excess radiation is to protect the mother
  - "Belly" badge for the baby is issued
  - Bioassay for radioactive material intake is initiated and repeated **monthly**
- Dose to baby is measured/ estimated and reported
- To protect her baby, a mother must **voluntarily**, in writing, declare herself pregnant
  - Present to *Principal User/Supervisor* and to *the Radiation Safety Office*
- Additional information is available through the Radiation Safety Office
- Confidential discussions with RSO about radiation risks to embryo/fetus
  - Even if just planning to get pregnant
  - Arrangements may be made to discuss with female radiation health professional

To download the Pregnancy Declaration form go to:
http://www.lsuhsc.edu/admin/pfm/ehs/docs/dop.pdf

Carbon-14

Radioactive half-life $T_{1/2}$	5730 years
Principal emission	0.157 MeV beta (maximum)
Monitoring for contamination	Thin end-window beta detector
Biological monitoring	Urine samples or breath measurements $^{14}CO_2$
20 mSv annual limit on intake by inhalation	3.4×10^7 Bq (~ 0.92 mCi)
Shielding required	1-cm perspex/plexiglas. Although thinner shielding is adequate to reduce dose, it does not have good mechanical properties.

Special considerations

- Some organic compounds may be absorbed through surgical gloves.
- Avoid the generation of $^{14}CO_2$, which could be inhaled.

Tritium - H_3

Radioactive half-life $T_{1/2}$	12.3 years
Principal emission	19 keV beta (maximum)
Monitoring for contamination	Swabs counted by liquid scintillation
Biological monitoring	Urine samples
20 mSv annual limit on intake by inhalation	4.9×10^8 Bq (~ 13 mCi)
Shielding required	Consistent with avoiding direct contact

Special considerations

- Due to its low beta-energy, tritium is difficult to monitor directly, and therefore regular swabbing and counting of the work area is advisable.
- Tritium compounds can be absorbed readily through the skin.

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Radioactive Isotopes

Phosphorus-32

Radioactive half-life $T_{1/2}$	14.3 days
Principal emission	1.71 MeV beta (maximum)
Monitoring for contamination	Beta detector
Biological monitoring	Urine samples
20 mSv annual limit on intake by inhalation	6.3×10^6 Bq (~ 0.17 mCi)
Dose rate from a 1 MBq at 30 cm	0.118 mSv/hr skin dose
Shielding required	1-cm perspex/plexiglas stops betas and minimizes production of bremsstrahlung (perspex nearest the source).

Special considerations

- Lead shielding can be used to reduce the dose from bremsstrahlung.

Iodine-125

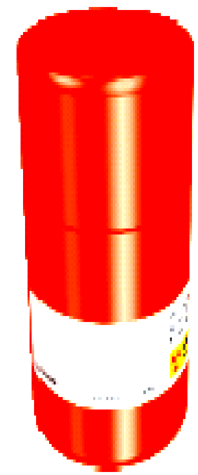
Radioactive half-life $T_{1/2}$	59.9 days
Principal emission	27 keV X-ray (114%, 31 keV X-ray (26%) 36 keV Gamma ray (7%)
Monitoring for contamination	X-ray detector
Biological monitoring	Thyroid scans
20 mSv annual limit on intake by inhalation	2.7×10^6 Bq (~ 73 μCi)
Dose rate from a 1 MBq point source at 30 cm	3.9×10^{-4} mSv/hr deep tissue dose
Shielding, first half value layer	< 1-mm lead, < 1-mm steel

Special considerations

- Freezing or acidification of solutions containing iodide ions can lead to formation of volatile elemental iodine.
- Active aerosols can be produced by opening a vial of high radioactive concentration of iodine-125.
- Some iodo-compounds can penetrate surgical gloves, two pairs or polythene alternatives are recommended.
- In the event of a suspected intake, the thyroid may be blocked by the administration of potassium iodate or potassium iodide under appropriate supervision.
- Spills of iodine-125 should be stabilized with alkaline sodium thiosulfate solution before commencing decontamination.
- Vials should be opened and used in ventilated enclosures.

Radioactive Isotopes

Sulfur-35



Radioactive half-life $T_{1/2}$	87.5 days
Principal emission	0.168 MeV beta (maximum)
Monitoring for contamination	Thin end-window beta detector
Biological monitoring	Urine samples
20 mSv annual limit on intake by inhalation	1.5×10^7 Bq (~ 0.4 mCi)
Shielding required	1-cm perspex/plexiglas. Although thinner shielding is adequate to reduce dose, it does not have good mechanical properties.

Special considerations

- Vials should be opened and used in ventilated enclosures.
- Avoid generation of sulfur dioxide or hydrogen sulfide, which could be inhaled.
- Radiolysis of ^{35}S-labelled amino acids may lead to the production of labelled volatiles that could contaminate internal surfaces and reaction vessels.

ALARA

- Low dose risks based on total exposure, Lower the dose, lower the risk
- Prudent practice is to keep radiation exposure ALARA - As Low As Reasonably Achievable
- ALARA considers:
  - Control use of radioactive materials
  - Prevent spread of contamination at and from worksite
- Benefits
  - Reduce cancer risk among working population
  - Reduce hereditary effects in population

In Perspective

Loss of life expectancy (in days due to various causes) :

Rate these from most to less.

- Construction worker
- Driving a small car
- Being an unmarried female
- 25 % overweight
- Coffee
- Smoking one pack a day
- Being an unmarried male
- All industry
- Radiation (100 mrem/yr for 70 yrs)
- Alcohol (U.S. average)

In Perspective

Loss of life expectancy (in days due to various causes) :

• Being an unmarried male	3500	(10 years)
• Smoking one pack a day	2250	(7 years)
• Being an unmarried female	1600	(5 years)
• 25 % overweight	777	(2 years)
• Alcohol (U.S. average)	365	(1 year)
• Driving a small car	290	
• Construction worker	227	
• All industry	60	
• Radiation (100 mrem/yr for 70 yrs)	10	
• Coffee	6	

General Safety Measures

Time – Distance – Shielding - Housekeeping

- Caution - Radioactive Materials signs / labels on containers

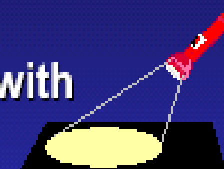
- Information to determine exposure
  - Isotope Characteristics
    - Half-Life
    - Type of radiation
    - Energy (for beta list maximum energy)
  - Quantity - how much (mCi, µCi, nCi)

- **TIME**

  Exposure increases with time

- **DISTANCE**

  Exposure decreases with distance



- **SHIELDING**

  Plastic for beta

  Lead for gamma

- **HOUSEKEEPING**

  Cleanliness reduces risk of ingestion & skin contamination

LSU Health NEW ORLEANS

General Safety Measures

Time vs Exposure

- Radiation at a fixed exposure rate results in increased exposure over time

- Practice new procedures with non- radioactive sources (e.g., dry runs) increases proficiency & reduces exposure time

General Safety Measures

Distance vs Exposure

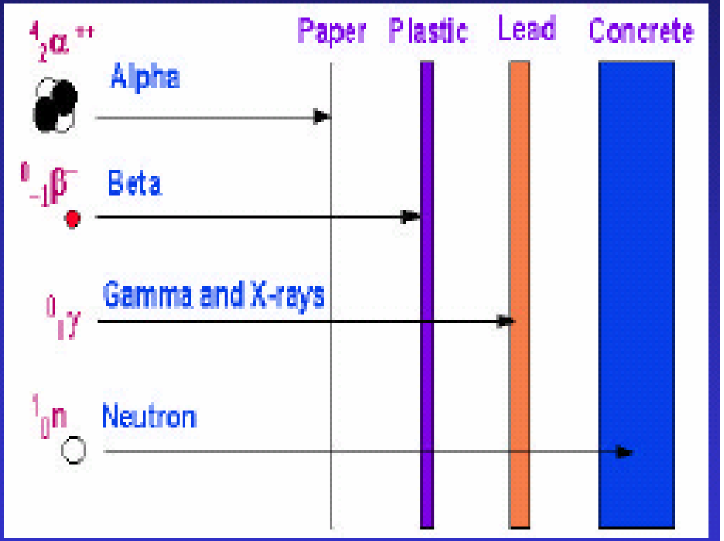
- Inverse Square Law $I_1 d_1^2 = I_2 d_2^2$
- If you double the distance, you reduce the exposure rate by Factor of 4
- Exposure rate at 6 ft is only 2.7% the exposure at 1 ft
- If exposure @ 1 cm from P-32 is 200 mrad/hr, @ 10 cm is 2 mrad/hr

General Safety Measures

Exposure & Shielding

- The thicker the shield, the smaller the exposure
- Type of shield used governed by type of radiation emitted
  - Thick, dense shield (i.e., lead) for gamma / x-rays
  - Plastic (1/3") for P-32 beta
  - Graded (plastic+lead) or pure lead for positrons or beta-gamma (Rb-86) emitters
  - Hydrogeneous (or boron + cadmium) for neutrons

No shielding needed for alpha or low-energy (S-35, Ca-45) beta



Shielding for α, β and x/γ

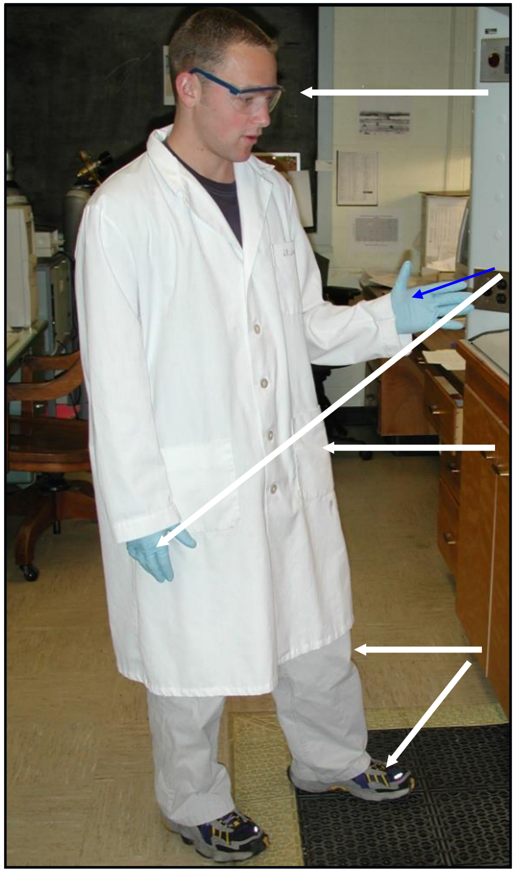




- α radiation: no shield required for external exposures; clothing, dead skin layer stops α's,
- β radiation: ranges of meters in air; some can penetrate dead skin layer; thin plexiglass shields adequate, bunker gear effective for low energy
- *x* and γ radiation: highly penetrating, best shields are dense materials (lead), vehicles can be used as shields

General Safety Measures

Shielding - Dress for Success



Eye Protection

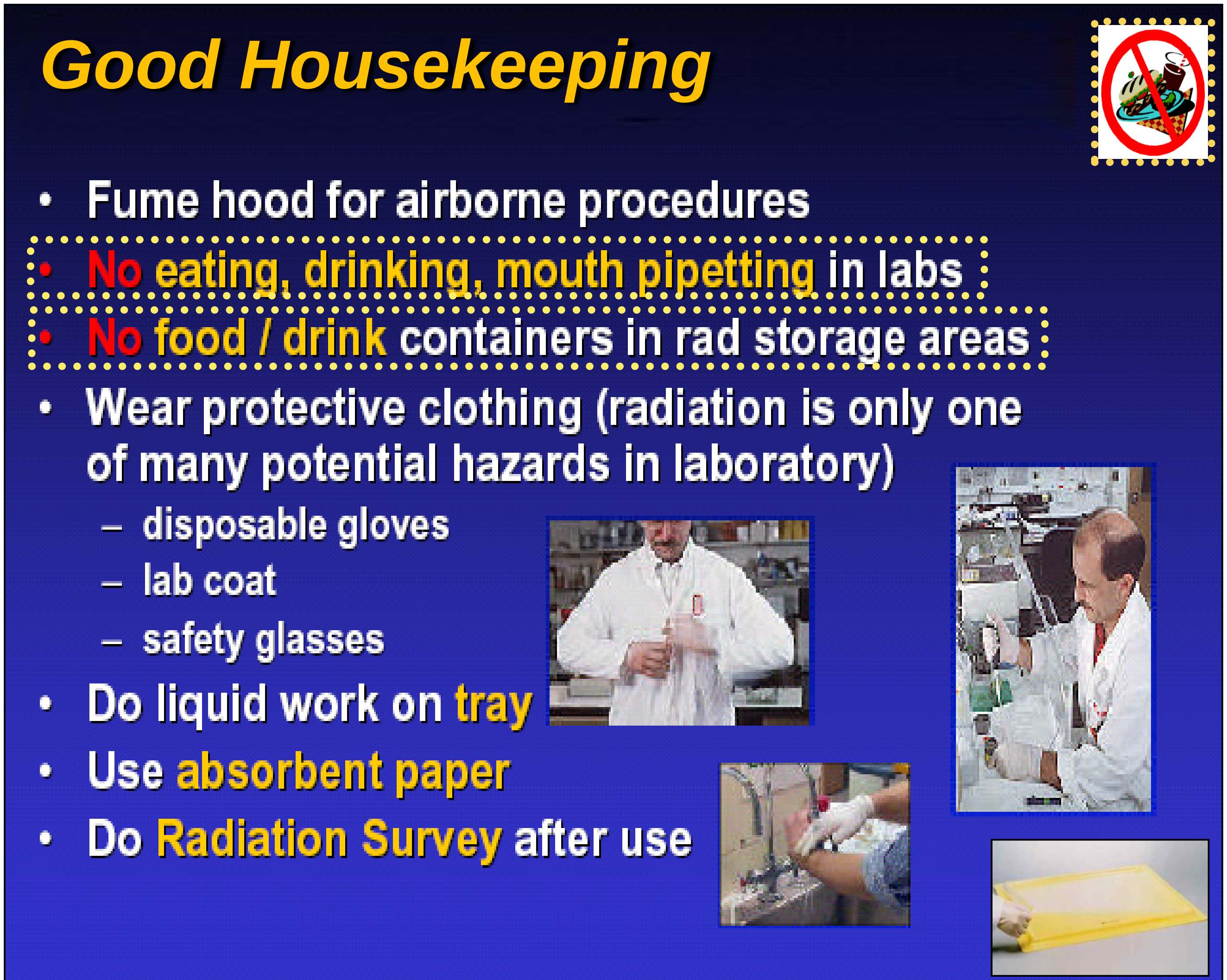
Latex Gloves (2 pair better than one)

Lab Coat

Complete Coverage Feet and Legs

- **No Open-Toed Shoes**
- **No Shorts**

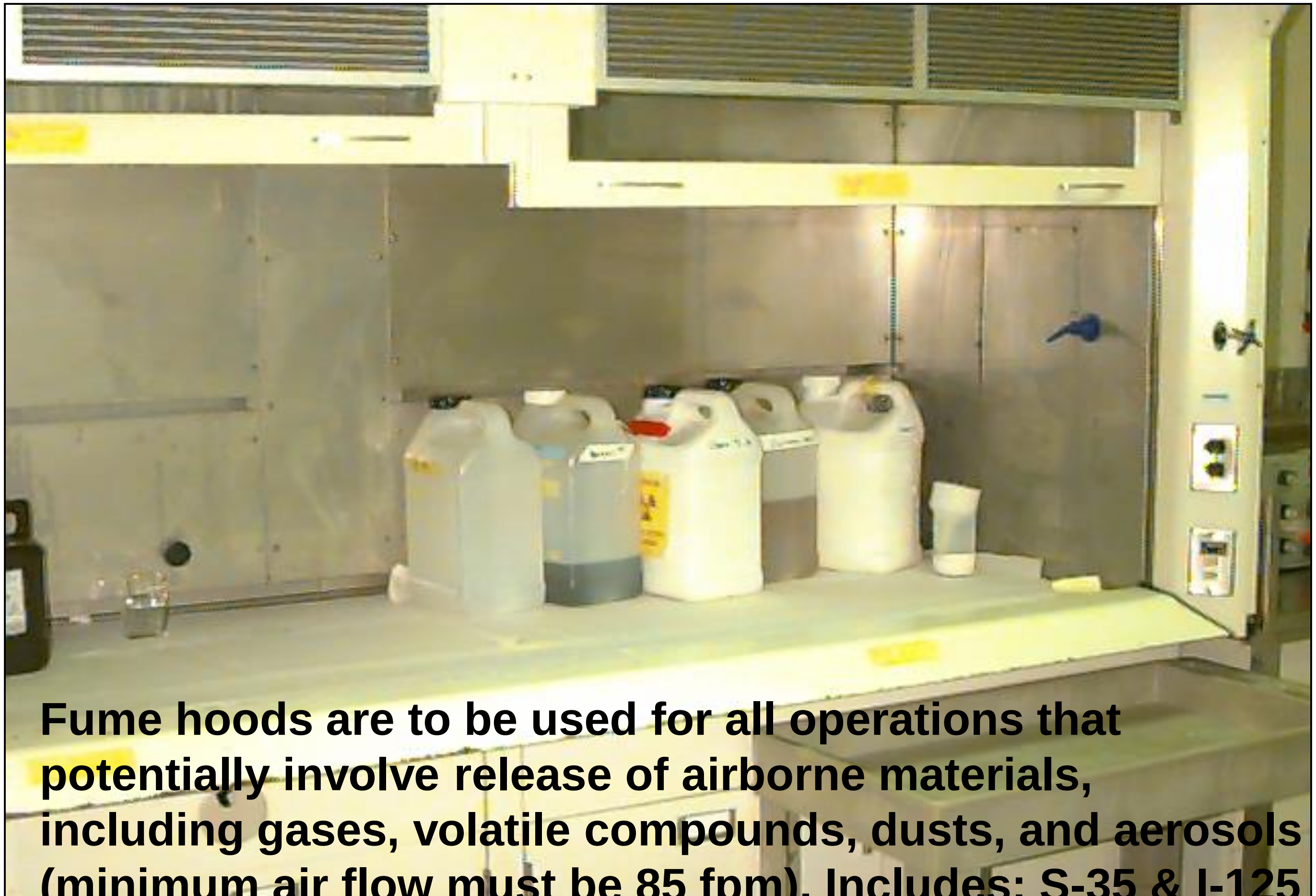
General Safety Measures



General Safety Measures

Good Housekeeping

Good Housekeeping



Fume hoods are to be used for all operations that potentially involve release of airborne materials, including gases, volatile compounds, dusts, and aerosols (minimum air flow must be 85 fpm). Includes: S-35 & I-125

Radiation Spills

Minor Radiation Spill (≤ 100 uCi (microcuries) of any radionuclide)

- Confine the spill immediately.
- Alert people in immediate area of spill and keep non-essential personnel out of the area.
- Wear protective equipment, including safety goggles, disposable gloves, shoe covers, and long-sleeve lab coat.
- Place absorbent paper towels over liquid spill. Place towels dampened with water over spills of solid materials.
- Using forceps, place towels in plastic bag. Dispose in radiation waste container.
- Monitor area, hands, and shoes for contamination with an appropriate survey meter or method. Repeat cleanup until contamination is no longer detected.
- If assistance needed, call the Radiation Safety Officer at 314-5989

Major Radiation Spill (> 100 uCi (microcuries) of any radionuclide)

- Attend to injured or contaminated persons and remove them from exposure.
- Alert people in the laboratory to leave the immediate area.
- Have potentially contaminated personnel stay in one area until they have been monitored and shown to be free of contamination.
- Call the Campus police at 568-8999, who will notify EH&S.
- Close doors and prevent entrance into affected area.
- Have person knowledgeable of incident and laboratory assist emergency personnel

The Radiation Spill Response Procedure is online at:

EHS100.04-Radiation Spill Response Procedure

Personnel Monitoring

Radiation Dosimeter Badges

- If worker may get 100 mrem in 1 year, monitoring is provided
- Monitoring devices / methods
  - whole body dosimeters
  - collar or Ring TLD
  - bioassay -- thyroid (> 1 mCi iodine), urinalysis (> 10 mCi tritium)
- requirements -- worker must handle / order stock vials
  - external hazard (high-energy beta, any gamma)
  - > 1 mCi per stock vial
  - not for H-3, C-14, or S-35

Personnel Monitoring

External Radiation Dosimetry

Radiation dosimeter badge use conditions:

- Individuals handling C-14/Tritium (H-3) **are not required to wear a badge**
- Anyone handling Beta emitters; P-32, P-33, or S-35 are required to wear a badge
- Anyone handling Gamma emitters; I-125, or Rb-86 are required to wear a badge
- All X-Ray device or approved Gamma Irradiator users are required to wear a badge

Multiple Badge Use Notice:

If you are issued a dosimeter badge due to potential exposure at a non-LSUHSC facility, notify the LSUHSC Radiation Safety Officer. The LSUHSC Radiation Safety Officer will contact the Radiation Safety Officer at the non-LSUHSC facility. The Radiation Safety Officer at the non-LSUHSC facility will then notify the LSUHSC Radiation Safety Officer if the LSUHSC employee exceeds 20% of the applicable regulatory exposure limit. The LSUHSC Radiation Safety Officer will then notify the LSUHSC employee of their total exposure.

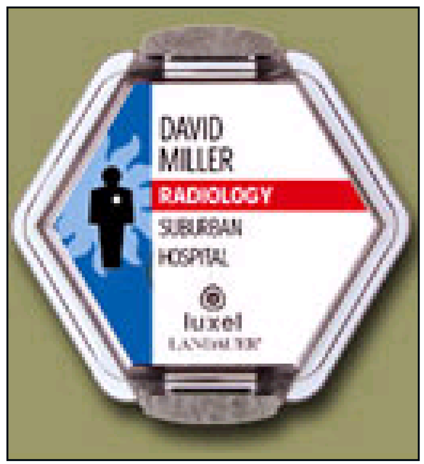
Personnel Monitoring

External Radiation Dosimetry

- Primary LSUHSC dosimeter is the OSL Badge
  - Optically Stimulated Luminescence Dosimeter
- Sensitive to x-ray, gamma and beta radiations
- Provides RSO dose information on a quarterly basis

Badge issue

Order a badge on-line or call EHS at 568-4952



Responsibility

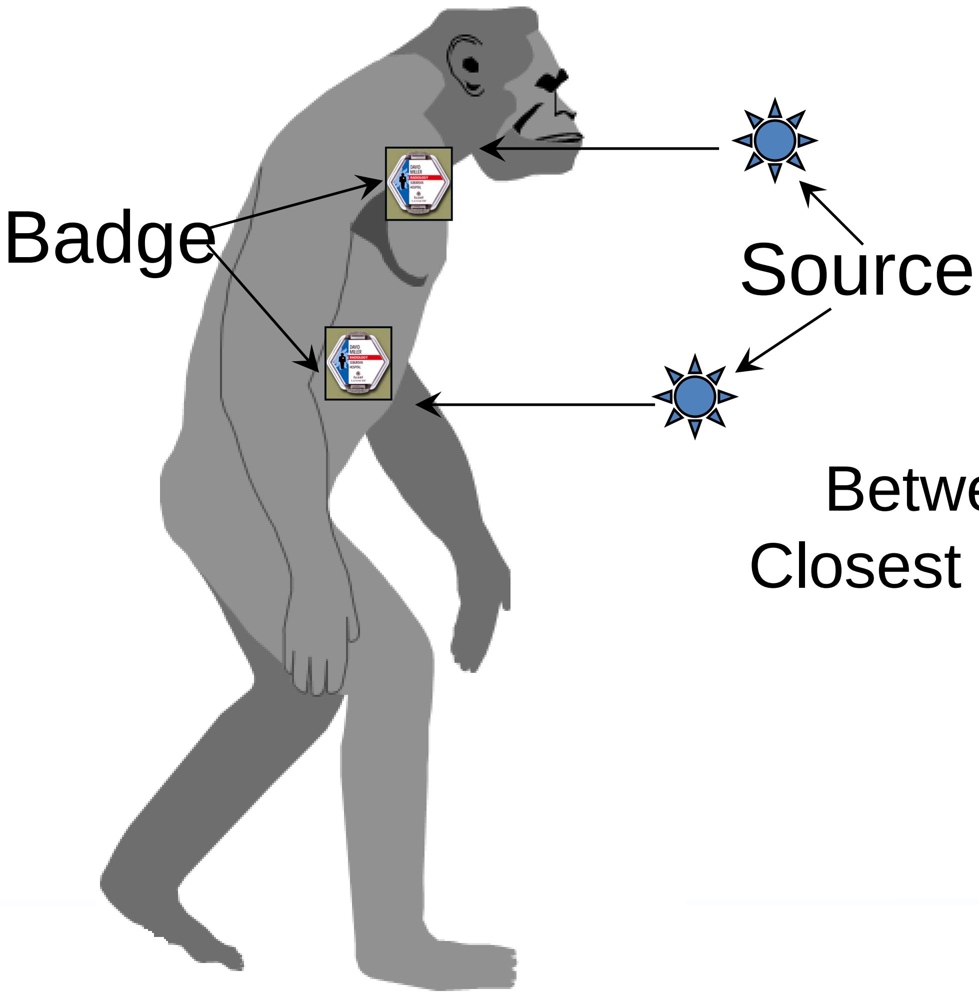
Your responsibility to exchange your badge

Badge Exchange

"Change-out" procedure with departmental badge coordinator

Personnel Monitoring

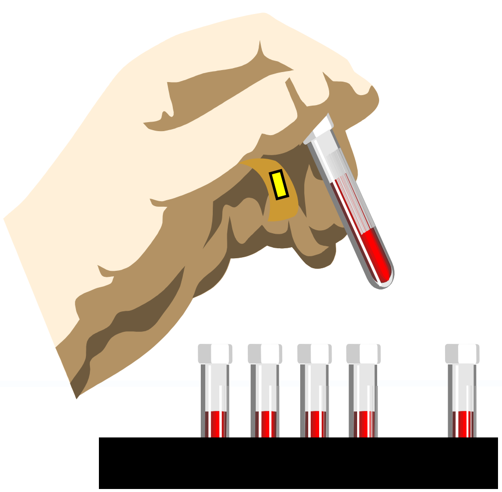
Body Badge Location



Between Neck and Waist
Closest to Source of Radiation

Ring Badge Location

A ring badge is recommended when using activity of 1 *m*Ci or more of P-32. Your Ring Badge will come with your name on it. Wear the badge with the name plate facing the source of radiation.



Exchanging your Dosimetry Badge

WHERE? Usually at your department's main office or designated laboratory.

WHO? A designated person who handles all the badges for your department, typically someone in your departments main office.

WHEN? Quarterly badges are exchanged at the end of every calendar quarter; March 31, June 30, September 30 and December 31.

Survey Instruments

- Portable and hand-held
- Direct, real time and immediate measurements

Measure:
exposure rate in *m*R/hr or
CPS or CPM

Selection

- What type of radiation does the instrument detect?
- Some instruments detect more than one type of radiation.
- It is critical to use an instrument appropriate for the radiation of concern.
- G-M: can respond to α, β and γ: β and γ; or γ only depending on the tube/window wall thickness.
- Thin windowed probes required to pick up weak Betas like C-14.

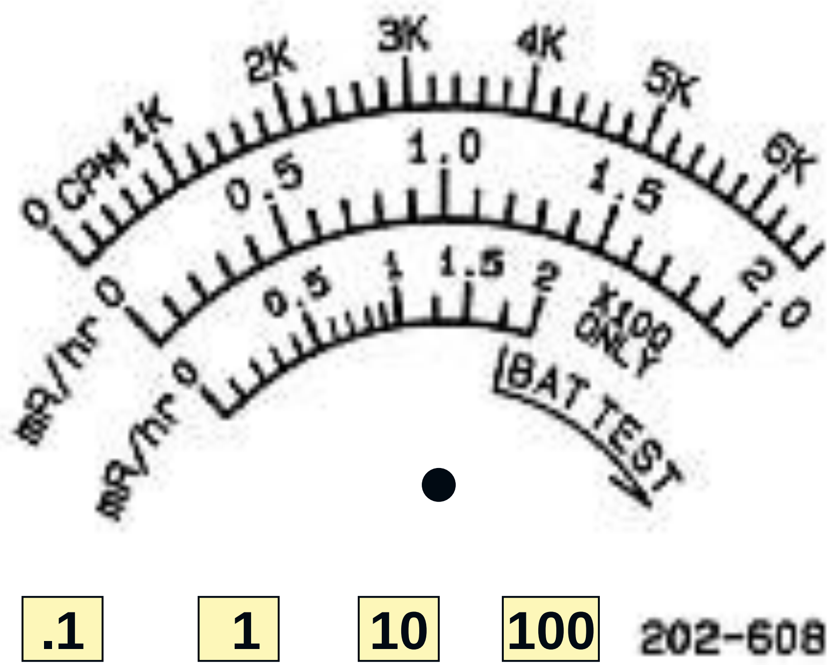
Additional information may be found online at:

EHS100.02 - Radiation Survey Meter Policy and Operation

Survey Instruments

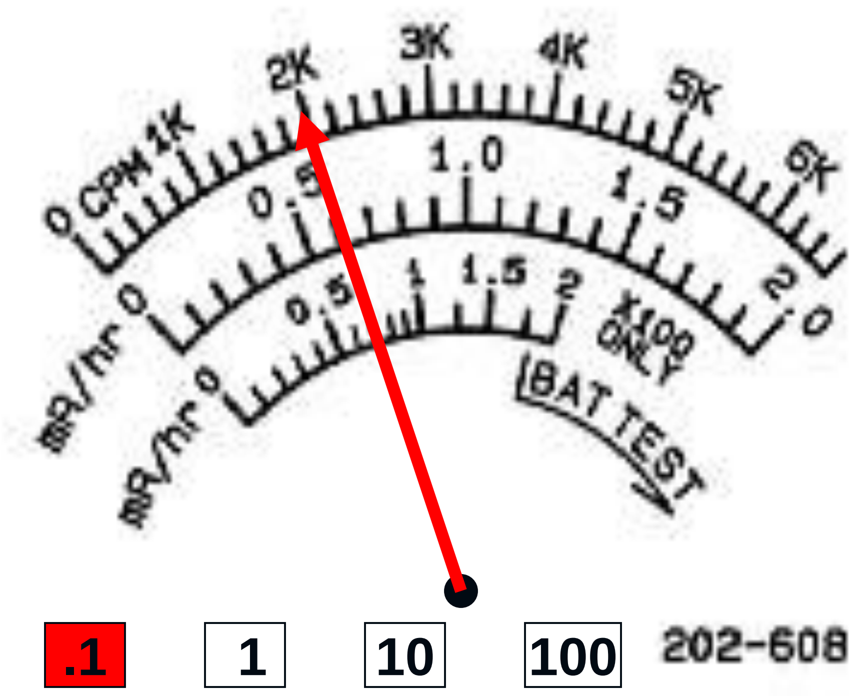
Recommended

Ludlum model 3 instrument (Part No. 48-1605) with a 202-608 meter dial and extra cable



4 scales

How to Read



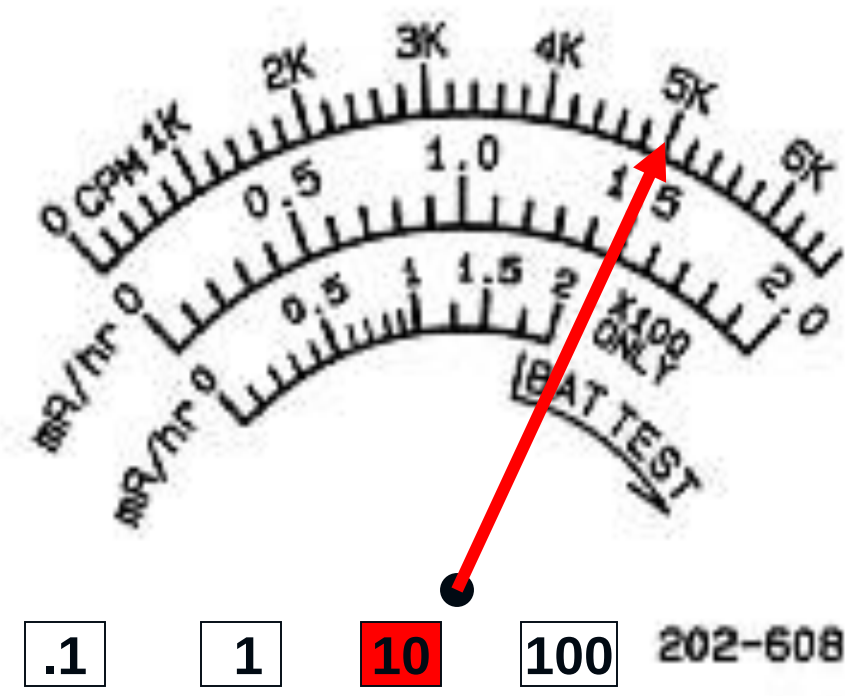
What are the readings?

CPM = **200 CPM**

mR/hr = **.06 mR/hr**

The meter is on the .1 Scale

How to Read



What are the readings?

CPM = **50000 CPM**

mR/hr = **15 mR/hr**

The meter is on the 10 Scale

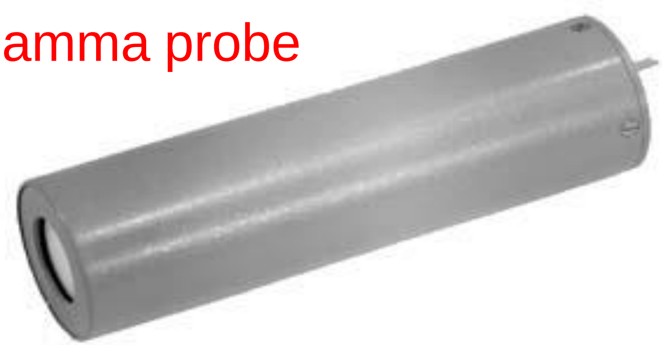
Probe Types

General Purpose

Ludlum model 44-9
(Part No. 47-1539)
Beta or Beta-Gamma
pancake probe

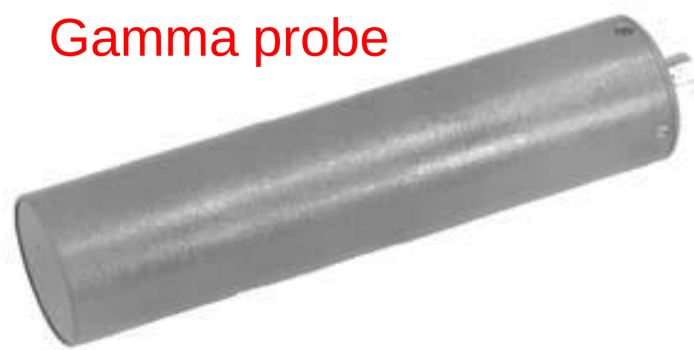
Low Energy Gamma
(10-60 keV, Iodine)

Ludlum model 44-3
Gamma probe



High Energy Gamma

Ludlum model 44-2
Gamma probe



Time Constant and Survey Speed

Time Constant

Slow setting (s) reduced meter fluctuations, but requires more time to stabilize

Fast setting (f) increases meter fluctuations, but requires less time to stabilize and gives faster readings

Does not change the audible signal

Survey Speed

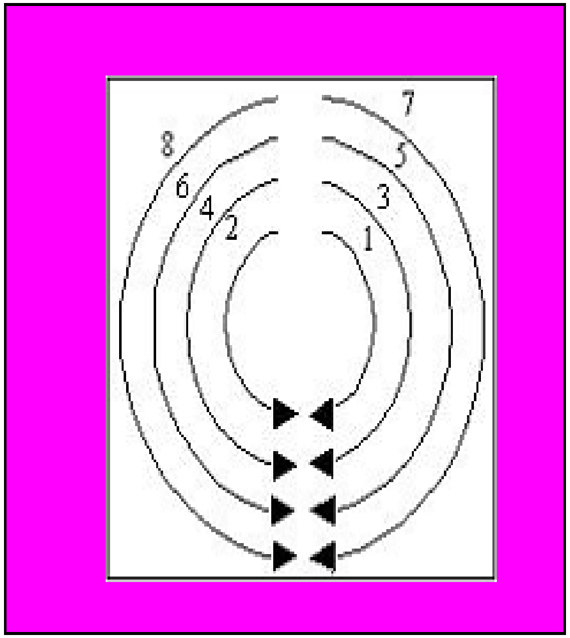
Basic speed is 1 detector width per second @ ½" distance away without touching the source

Labels


LSU Health Sciences Center
NEW ORLEANS
Environmental Health & Safety
Meter Calibration
PI
Cal Date
Serial #
Cal Due
Calibrated by
.1x
1x
10x
100x

Wipe Testing

1. Wipe tests of bench and sink areas to be over an area of 100 cm^2 (i.e., wipe an area of bench or sides measuring 10cm x 10cm (or 4” x 4”). It will not be possible to wipe an area of $100cm^2$ when wipe testing uneven surfaces such as telephones, centrifuge knobs or heat sealers.
2. Use an alcohol swab, moistened glass fiber filter disk or similar material.
3. Wiping of bench and sink areas is done in a series of semi-circles, wiping from the outside to the inside. (Start 8,7,6,5,4,3,2 and end at 1)
4. When wiping uneven surfaces, ensure that the surface is wiped once and not several times over.



Additional information may be found online at:

[EHS100.07 - Radiation Survey Wipe Test Policy and Procedures]

Radiation Signage

Radiation Signage

Lab Door Entrance

NAME
OFFICE
PHONE
HOME PHONE

Radiation Signage

CAUTION

RADIOACTIVE MATERIAL
NO FOOD
OR BEVERAGE
MAY BE STORED
IN THIS UNIT

Refrigerator doors

Radioactive Waste

- Use appropriate containers
- Separate waste types
- Don’t overfill containers
- Label properly
- Keep secure
- Don’t forget green forms.
- Every Tuesday pickup

Call Medical Center Stores – give them all information

Radioactive Material Order Form

Auxiliary Enterprises

Medical Center Stores

Radioactive Material Order Form

Date: July 31, 2010
Company: Perkin Elmer
Catalog: BLU013H250UC   Amount: 1 mCi   Cost: ________
Isotope: P-32 DCTP   Do you need a special lot# or specific activity? ____

Permit holder: Doctor Glow   Ordered by: Your Name   Phone: Your phone
Acct. Name: Doctor Glow   Acct. #: ________   Dept: Dept.   Bldg: Bldg

Day/Date Needed: 08/03/10   Date Ordered: 07/31/10   Arrival Date: ________

RSO Approval James J. Davis III

All Information Must be filled in at the time the order is taken

Example

Documentation

After Arrival

Example

- The RSO will check in all nuclides, contact appropriate personnel to pick up Package on the ground floor MEB Building – Rad Lab – Next to deliveries

- Pick up and sign **PACKAGE RECEIPT LOG**, (hangs on Refrigerator door)

PACKAGE RECEIPT LOG

RECEIPT DATE	PERMIT HOLDER	**SIGNATURE**	SOURCE NUMBER	PERSON CALLED
08/03/2010	Doctor Glow	***Your signature here***	2010047	contact

Once in the Lab

- There is a **RADIOACTIVE INVENTORY FORM** included in nuclide package.
(Fill out and save until waste pickup)

LSUHSC-NO RADIONUCLIDE INVENTORY FORM

Vial No. 2010047 **Date Rec'd 08/03/2010** **Storage location ________**
Radionuclide/Activity 1 mCi P-32
Permit Holder Doctor Glow **Dept. Genetics** **Reference Date 08/10/2010**

FOR COMPLETION BY LAB PERSONNEL

Amount used (*u, mCi* or ml)	Balance	Date Used	User's Name	Amount Disp.	Disp. Form L/D/V/C
.5 mCi	.5 mCi	08/03/10	*Your Name*		L
.5 mCi	0	08/06/10	*Your Name*		L

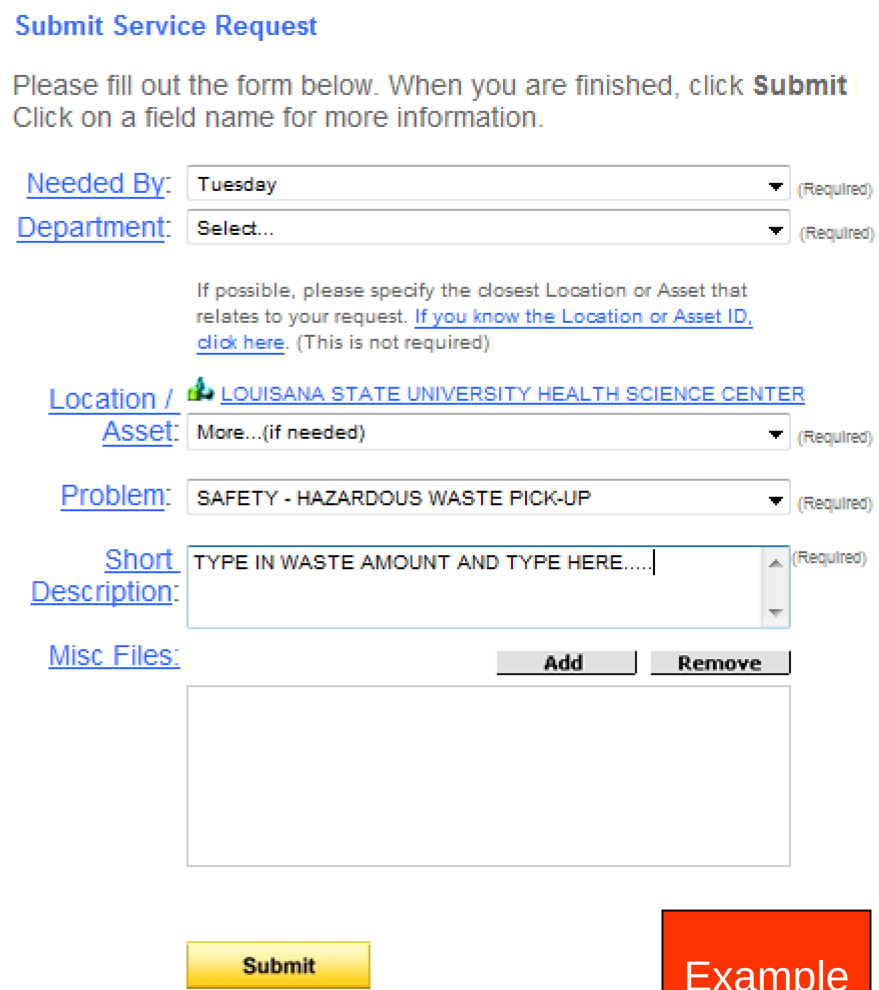
Example

Documentation

Radioactive Waste Pick Up Every Tuesday

A service work order request must be created for radiation waste pickup.

- Go online to **bob.lsuhsc.edu** and select Service Requester.



Example

RADIOACTIVE MATERIAL WASTE RECORD

____

Permit Holder

____

Room No. / Bldg/Tel. No.

____

Radionuclide/Activity/Date:

____

____

Waste Type: (Circle One)

DRY SOLIDS
LSC in VIALS

____
Name of Cocktail

BULK LIQUID

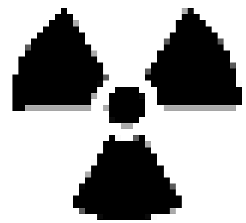
ANIMAL CARCASSES

If Bulk Liquid: Aqueous or Organic? (circle one)

If Organic, list contents:

____

CAUTION



RADIOACTIVE MATERIAL

EH&S DEPT USE ONLY:

____

Date removed from LAB

____

Date removed from LSUHSC-NO

____

Method of removal

RAD-Material Waste Record form must be filled out and provided with the waste containers.
(**We can provided blank ones**)

Radiation Safety Web Page

http://www.lsuhsc.edu/admin/pfm/ehs/rad.aspx

Careers | Contact | Donate | Quicklinks ▼

Patient Care | Search

Allied Health Professions | Dentistry | Graduate Studies | Medicine | Nursing | Public Health

Wednesday, August 02, 2017 7:51 AM | 82°F

- Radiation Safety
- Radiation Spill Response
- Laser Safety
- Nuclide Safety Data Sheets
- Policies and Procedures
- Radiation Dosimeter Badges
- Radiation Safety Committee
- Radiation Safety Manual
- Radiation Use - Application
- Radiation Waste

ENVIRONMENTAL HEALTH AND SAFETY

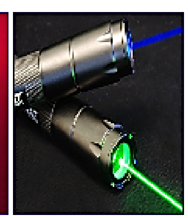
Radiation Safety

The Radiation Safety Officer (RSO) provides oversight and consultation for all activities that involve ionizing and non-ionizing radiation to protect personnel and comply with all state and federal regulations. RSO support includes regulatory licensing and registration, radiation monitoring, personnel dose assessments, radiation safety training, and confirmatory laboratory surveys.

If you have a question or require support, contact Jim Davis, Radiation Safety Officer, at *jdavis3@lsuhsc.edu* or 504-568-4952.

Useful Links

- *Nuclide Safety Data Sheets*
- *(PM-30) LSU System Radiation Protection Program*
- *Safety Procedures for Non-Ionizing Radiation*



Sign In

Disclaimer

Privacy Policy

LSU Health NEW ORLEANS

In Conclusion

<u>THE MORE YOU KNOW !!!</u>

In Conclusion

THE LESS YOU'LL GLOW !!!

Miscellaneous

- Nuclide Safety Data Sheets
- Irradiators
- C-Arm and Dentistry X-Ray machines
- Radiation Lab Survey and Wipe Test Form
  (perform weekly in lab and keep records, LSUHSC policy while radionuclides in use)
- Louisiana State Regulation Notice
  (place one in your lab)

^{14}C	Nuclide Safety Data Sheet Carbon-14 www.nchps.org	^{14}C

I. PHYSICAL DATA

Radiation:	Beta (100% abundance)	
Energy:	Max.: 156 keV; Average: 49 keV	
Half-Life [$T_{½}$] :	Physical $T_{½}$:	5730 years
	Biological $T_{½}$:	12 days
	Effective $T_{½}$:	Bound - 12 days; unbound - 40 days
Specific Activity:	4.46 Ci/g [0.165 TBq/g] max.	
Beta Range:	Air:	24 cm [10 inches]
	Water/Tissue:	0.28 mm [0.012 inches]
	[~1% of ^{14}C betas transmitted through dead skin layer, i.e. 0.007 cm depth]	
	Plastic:	0.25 mm [0.010 inches]

II. RADIOLOGICAL DATA

Radiotoxicity[1]:	6.36E-12 Sv/Bq [0.023 mrem/uCi] of $^{14}CO_2$ inhaled; 5.64E-10 Sv/Bq [2.09 mrem/uCi] organic compounds inhaled/ingested
Critical Organ:	Fat tissue [most labeled compounds]; bone [some labeled carbonates]
Exposure Routes:	Ingestion, inhalation, puncture, wound, skin contamination absorption
Radiological Hazard:	External Exposure - None from weak ^{14}C beta Internal Exposure & Contamination - Primary concern

III. SHIELDING

None required - mCi quantities not an external radiation hazard

IV. DOSIMETRY MONITORING

Urine bioassay is the most readily available method to assess intake [for ^{14}C, no intake = no dose]
Provide a urine sample to Radiation Safety whenever your monthly ^{14}C use exceeds 5 mCi, or after any accident/incident in which an intake is suspected

V. DETECTION & MEASUREMENT

Portable Survey Meters: Geiger-Mueller [e.g. Bicron PGM, ~10% efficiency];
Beta Scintillator [e.g. Ludlum 44-21, ~5% efficiency]

Wipe Test: Liquid Scintillation Counting is the best readily available method for counting ^{14}C wipe tests

VI. SPECIAL PRECAUTIONS

- Avoid skin contamination [absorption], ingestion, inhalation, & injection [all routes of intake]
- Many ^{14}C compounds readily penetrate gloves and skin; handle such compounds remotely and wear double gloves, changing the outer pair at least every 20 minutes.

[1] Federal Guidance Report No. 11 [Oak Ridge, TN; Oak Ridge National Laboratory, 1988], p. 122, 156

^{3}H	Nuclide Safety Data Sheet Hydrogen-3 [Tritium] **www.nchps.org**	^{3}H

I. PHYSICAL DATA

Radiation:	Beta (100% abundance)	
Energy:	Max.: 18.6 keV; Average: 5.7 keV	
Half-Life [$T_{½}$] :	Physical $T_{½}$:	12.3 years
	Biological $T_{½}$:	10 - 12 days
	Effective $T_{½}$:	10 - 12 days*

* Large liquid intake (3-4 liters/day) reduces effective $T_{½}$ by a factor of 2+; ^{3}H is easily flushed from the body

Specific Activity:	9650 Ci/g [357 TBq/g] max.	
Beta Range:	Air:	6 mm [0.6 cm; 0.25 inches]
	Water:	0.006 mm [0.0006 cm; 3/10,000 inches]
	Solids/Tissue:	insignificant [No ^{3}H betas pass through the dead layer of skin]

II. RADIOLOGICAL DATA

Radiotoxicity[1]: Least radiotoxic of all nuclides; CEDE, ingestion or inhalation:

- Tritiated water: 1.73E-11 Sv/Bq (0.064 mrem/uCi) of ^{3}H intake
- Organic Compounds: 4.2E-11 Sv/Bq (0.16 mrem/uCi) of ^{3}H intake

Critical Organ: Body water or tissue

Exposure Routes: ingestion, inhalation, puncture, wound, skin contamination absorption

Radiological Hazard: External Exposure - None from weak ^{3}H beta
Internal Exposure & Contamination - Primary concern

III. SHIELDING

None required - not an external radiation hazard

IV. DOSIMETRY MONITORING

Urine bioassay is the only readily available method to assess intake [for tritium, no intake = no dose]
Be sure to provide a urine sample to Radiation Safety whenever your monthly ^{3}H use exceeds 100 mCi, or after any accident/incident in which an intake is suspected

V. DETECTION & MEASUREMENT

Liquid Scintillation Counting is the only readily available method for detecting ^{3}H
NOTE: PORTABLE SURVEY METERS WILL NOT DETECT LABORATORY QUANTITIES OF ^{3}H

VI. SPECIAL PRECAUTIONS

- Avoid skin contamination [absorption], ingestion, inhalation, & injection [all routes of intake]
- Many tritium compounds readily penetrate gloves and skin; handle such compounds remotely and wear double gloves, changing the outer pair at least every 20 minutes.
- While tritiated DNA precursors are considered more toxic that $^{3}H_2O$, they are generally less volatile and hence do not normally present a greater hazard
- The inability of direct-reading instruments to detect tritium and the slight permeability of most material to [tritiated] water & hydrogen [tritium] facilitates undetected spread of contamination. Use extreme care in handling and storage [e.g. sealed double or multiple containment] to avoid contamination, especially with high specific activity compounds.

[1] Federal Guidance Report No. 11 [Oak Ridge, TN; Oak Ridge National Laboratory, 1988], p. 122, 156; Radionuclide and Radiation Protection Data Handbook [Delacroix, et al; Radiation Protection Dosimetry, Kent, England: Nuclear Technology Publishing 1998], p. 19.

^{125}I	Nuclide Safety Data Sheet Iodine-125 www.nchps.org	^{125}I

I. PHYSICAL DATA

Radiation:	Gamma - 35.5 keV (7% abundance)	
	X-ray - 27 keV (113% abundance)	
Gamma Constant:	0.27 mR/hr per mCi @ 1.0 meter [7.432E-5 mSv/hr per MBq @ 1.0 meter][1]	
Half-Life [$T_{½}$] :	Physical $T_{½}$:	60.14 days
	Biological $T_{½}$:	120-138 days (unbound iodine)
	Effective $T_{½}$:	42 days (unbound iodine)
Specific Activity:	1.73E4 Ci/g [642 TBq/g] max.	

II. RADIOLOGICAL DATA

Radiotoxicity[2]:	3.44E-7 Sv/Bq (1273 mrem/uCi) of ^{125}I ingested [Thyroid]
	2.16 E-7 Sv/Bq (799 mrem/uCi) of ^{125}I inhaled [Thyroid]
Critical Organ:	Thyroid Gland
Intake Routes:	Ingestion, inhalation, puncture, wound, skin contamination (absorption);
Radiological Hazard:	External & Internal Exposure; Contamination

III. SHIELDING

	Half Value Layer [HVL]	Tenth Value Layer [TVL]
Lead [Pb]	0.02 mm (0.0008 inches)	0.07 mm (0.003 inches)

- The accessible dose rate should be background but must be < 2 mR/hr

IV. DOSIMETRY MONITORING

- Always wear radiation dosimetry monitoring badges [body & ring] whenever handling ^{125}I
- Conduct a baseline thyroid scan prior to first use of radioactive iodine
- Conduct thyroid bioassay measurement [at neck just above collar bone] no earlier than 6 hours but within 72 hours of handling 1 mCi or more of ^{125}I or after any suspected intake

V. DETECTION & MEASUREMENT

Portable Survey Meters:

Geiger-Mueller [e.g. Bicron PGM,] to assess shielding effectiveness

Low Energy Gamma Detector [e.g. Ludlum 44-21, ~19% eff. for ^{125}I] for contamination surveys

Wipe Test: Liquid Scintillation Counter

VI. SPECIAL PRECAUTIONS

- Avoid skin contamination [absorption], ingestion, inhalation, & injection [all routes of intake]
- Use shielding [lead or leaded Plexiglas] to minimize exposure while handling mCi quantities of ^{125}I
- Avoid making low pH [acidic] solutions containing ^{125}I to avoid volatilization
- For Iodinations:
    - Use a cannula adapter needle to vent stock vials of ^{125}I used; this prevents puff releases
    - Cover test tubes used to count or separate fractions from iodinations with parafilm or other tight caps to prevent release while counting or moving outside the fume hood.

VII. GENERAL PRECAUTIONS

[1] Health Physics & Radiological Health Handbook, 3rd Ed. [Baltimore, MD; Williams & Wilkins, 1998], p. 6-11
[2] Federal Guidance Report No. 11 [Oak Ridge, TN; Oak Ridge National Laboratory, 1988], p. 136, 166

^{32}P	Nuclide Safety Data Sheet Phosphorous-32 **www.nchps.org**	^{32}P

I. PHYSICAL DATA

Radiation:	Beta (100% abundance)	
Energy:	Maximum: 1,710 keV; Average: 695 keV	
Half-Life [$T_{½}$] :	Physical $T_{½}$:	14.29 days
	Biological $T_{½}$:	Bone ~ 1155 days; Whole Body ~ 257 days[1]
	Effective $T_{½}$:	14.29 days
Specific Activity:	286,500 Ci/g [10,600 TBq/g] max.	
Beta Range:	Air:	610 cm [240 inches; 20 feet]
	Water/Tissue:	0.76 cm [0.33 inches]
	Plastic:	0.61 mm [3/8 inches]

II. RADIOLOGICAL DATA

Radiotoxicity[2]: Inhaled: 2.6E-8 Sv/Bq [95 mrem/uCi] Lung; 4.2E-9 Sv/Bq [16 mrem/uCi] CEDE
Ingested: 8.1E-9 Sv/Bq [30 mrem/uCi] Marrow; 2.4E-9 Sv/Bq [8.8 mrem/uCi] CEDE

Critical Organ: Bone [soluble ^{32}P]; Lung [Inhalation]; GI Tract [Ingestion - insoluble compounds]

Exposure Routes: Ingestion, inhalation, puncture, wound, skin contamination absorption

Radiological Hazard: External Exposure [unshielded dose rate at 1 mCi ^{32}P vial mouth[3]: approx. 26 rem/hr], Internal Exposure & Contamination

III. SHIELDING

Shield ^{32}P with 3/8 inch Plexiglas and monitor for Bremstrahlung; If Bremstrahlung X-rays detected outside Plexiglas, apply 1/8 to 1/4 inch lead [Pb] shielding outside Plexiglas
The accessible dose rate should be background but must be < 2 mR/hr

IV. DOSIMETRY MONITORING

Always wear radiation dosimetry monitoring badges [body & ring] whenever handling ^{32}P

V. DETECTION & MEASUREMENT

Portable Survey Meters: Geiger-Mueller [e.g. Bicron PGM];
Beta Scintillator [e.g. Ludlum 44-21]

Wipe Test: Liquid Scintillation Counting is an acceptable method for counting ^{32}P wipe tests

VI. SPECIAL PRECAUTIONS

- Avoid skin contamination [absorption], ingestion, inhalation, & injection [all routes of intake].
- Store ^{32}P (including waste) behind Plexiglas shielding [3/8 inch thick]; survey (with GM meter) to check adequacy of shielding (accessible dose rate < 2 mR/hr; should be background); apply lead [Pb] shielding outside Plexiglas if needed.
- Use 3/8 inch Plexiglas shielding to minimize exposure while handling ^{32}P.
- Use tools [e.g. Beta Blocks] to handle ^{32}P sources and contaminated objects; avoid direct hand contact.
- Always have a portable survey meter present and turned on when handling ^{32}P.
- ^{32}P is not volatile, even when heated, and can be ignored as an airborne contaminant[4] unless aerosolized.
- White vinegar can be an effective decontamination solvent for this nuclide in most forms.

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[1] NCRP Report No. 65, p.88
[2] Federal Guidance Report No. 11 [Oak Ridge, TN; Oak Ridge National Laboratory, 1988], p. 122, 156
[3] Dupont/NEN, Phosphorous-32 Handling Precautions [Boston, MA; NEN Products, 1985]
[4] Bevelacqua, J. Contemporary Health Physics [New York; John Wiley & Sons, 1995], p. 282

^{35}S	Nuclide Safety Data Sheet Sulfur-35 **www.nchps.org**	^{35}S

I. PHYSICAL DATA

Radiation:	Beta (100% abundance)	
Energy:	Maximum: 167.47 keV; Average: 48.8 keV	
Half-Life [$T_{½}$] :	Physical $T_{½}$:	87.44 days
	Biological $T_{½}$:	623 days [unbound ^{35}S]; 90 days [bound ^{35}S]
	Effective $T_{½}$:	44 - 76 days [unbound ^{35}S]
Specific Activity:	42,707 Ci/g [1,580 TBq/g] max.	
Beta Range:	Air:	26 cm [10.2 inches]
	Water/Tissue:	0.32 mm [0.015 inches]
	Plastic:	0.25 mm [0.010 inches]

II. RADIOLOGICAL DATA

Radiotoxicity[1]:	2.48 mrem/uCi [CEDE] of ^{35}S inhaled
	0.733 mrem/uCi of ^{35}S ingested
Critical Organ:	Testis
Exposure Routes:	Ingestion, inhalation, puncture, wound, skin contamination absorption
Radiological Hazard:	External Exposure - None from weak ^{35}S beta
	Internal Exposure & Contamination - Primary concern

III. SHIELDING

None required - mCi quantities not an external radiation hazard

IV. DOSIMETRY MONITORING

Urine bioassay is the most readily available method to assess intake [for ^{35}S, no intake = no dose]
Provide a urine sample to Radiation Safety whenever your monthly ^{35}S use exceeds 5 mCi, or after any accident/incident in which an intake is suspected

V. DETECTION & MEASUREMENT

Portable Survey Meters: Geiger-Mueller [e.g. Bicron PGM, ~10% efficiency]
Beta Scintillator [e.g. Ludlum 44-21, ~5% efficiency]

Wipe Test: Liquid Scintillation Counting is the best readily available method for counting ^{35}S wipe tests

VI. SPECIAL PRECAUTIONS

- Avoid skin contamination [absorption], ingestion, inhalation, & injection [all routes of intake]
- Many ^{35}S compounds and metabolites are slightly volatile and may create contamination problems if not sealed or otherwise controlled. This occurs particularly when ^{35}S amino acids are thawed, and when they are added to cell culture media and incubated. Therefore vent thawing ^{35}S vials in a hood by inserting the needle of a charcoal packed syringe through the septum seal, and vent incubated ^{35}S-labelled tissue culture through charcoal-impregnated filter paper.

[1] Federal Guidance Report No. 11 [Oak Ridge, TN; Oak Ridge National Laboratory, 1988], p. 122, 156

Miscellaneous

Orthopedics

Dentistry

X-ray machines are widely used in medicine for diagnosis and treatment.
Examples: (C-arm above used in orthopedics; x-ray machine for dentistry)

Because of this extensive use, x-rays are the largest source of manmade radiation exposure. Due to their very short wavelength, x-rays can pass through materials, such as wood, water, and flesh. They have essentially the same properties as gamma rays, but are generally lower in energy and therefore less penetrating than gamma rays. A few millimeters of lead can stop most diagnostic x-rays.
Example: (Lead aprons worn by technicians above)

Miscellaneous

Irradiators

A device containing Curie quantities of radioactive material capable of giving potentially lethal radiation levels if it were not shielded with lead and fitted with safety interlocks.

Gamma Cell 40

JL Shepherd

Irradiators

Source type

- ❖ Cesium - 137 ***(Gamma Emission)***

Activity

- ❖ Gamma Cell 40
- ❖ JL Shepherd Mark 1

Half - life

- ❖ 30.22 years

LSU Health Sciences Center
NEW ORLEANS

Radioactive Material Laboratory Survey and Wipe Test Form

PI: ____________________ Department: ______________ Building & Lab #: ______________________

Gamma Counter - Manufacturer/Model/Serial #: ____

LSC - Manufacturer/Model/Serial #: ____

Survey Meter - Manufacturer/Model/Serial #: ____

Background: ______ mR/Hr or cpm Battery Check: ______ Calibration Date: __________________
(Circle One)
Counter Information Type (gamma counter or LSC):

Wipe Test Results
(Circle One) **cpm** or **dpm**

Lab Diagram

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Rewipe of # _____
Rewipe of # _____
Rewipe of # _____
(Contaminated areas must be decontaminated immediately and documented)
(* **Contamination needs to be less than 200 dpm**)

Performed By ________________ Date ______________

NOTICE TO EMPLOYEES

LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY
REGISTRATIONS AND CERTIFICATIONS SECTION
RADIATION NOTICE

STANDARDS FOR PROTECTION AGAINST RADIATION
NOTICES, INSTRUCTIONS & REPORTS TO WORKERS; INSPECTIONS

In the Louisiana Administrative Code LAC 33:XV (Louisiana Radiation Regulations), the Secretary has established standards for your protection against radiation hazards and has established certain provisions for the options of workers engaged in work under a license or registration certificate issued by the Department.

YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to—

1. Apply these regulations and the conditions of his/her license or registration certificate to work involving sources of radiation.
2. Post, or otherwise make available to you, a copy of LAC 33:XV (Louisiana Radiation Regulations), licenses, registration certificates and operating procedures which apply to work in which you are engaged and to explain their provisions to you. These documents are available at

Environmental Health & Safety – LSUHSC-NO – 504-568-6585

3. Post all notices of violation involving radiological working conditions, proposed imposition of civil penalties and orders.

YOUR RESPONSIBILITY AS A WORKER

You should familiarize yourself with those provisions of LAC 33:XV (Louisiana Radiation Regulations) and the operating procedures which apply to the work in which you are engaged. You should observe their provisions for your own protection and the protection of your co-workers.

WHAT IS COVERED BY THESE REGULATIONS

1. Limits on exposure to radiation and radioactive material in restricted and unrestricted areas;
2. Measures to be taken after accidental exposure;
3. Personnel monitoring, surveys and equipment;
4. Caution signs, labels and safety interlock equipment;
5. Exposure records and reports;
6. Options for workers regarding Department inspections; and
7. Related matters.

REPORTS ON YOUR RADIATION EXPOSURE HISTORY

1. LAC 33:XV (Louisiana Radiation Regulations) require that your employer give you a written report if you receive a radiation dose in excess of any applicable limit as set forth in the regulations or in the license or registration certificate. The basic limits for radiation dose to employees are set forth in Chapter 4 of the regulations. This chapter specifies limits on radiation dose and exposure to concentrations of radioactive material in air and water.
2. If you work where personnel monitoring is required, and if you request information on your radiation doses,

   (a) Upon termination of your employment, your employer must give you a written report of your radiation doses, and
   (b) Your employer must advise you annually of your dose from radiation.

INSPECTIONS

All licensed or registered activities are subject to inspection by representatives of the Department. In addition, any worker or representative of workers who believes that there is a violation of the Louisiana Nuclear Energy and Radiation Control Law, the regulations issued thereunder, or the terms of the employer's license or registration certificate with regard to radiological working conditions in which the worker is engaged, may request an inspection by sending a notice of the alleged violation(s) to the Department. The request must set forth the specific grounds for the notice and must be signed by the worker or a representative of the worker. During inspections, Department inspectors may confer privately with workers, and any worker may bring to the attention of the inspectors any past or present condition which he believes contributed to or caused any violation as described above.

INQUIRIES

Inquiries dealing with the matters outlined above can be directed to:

PERMITS DIVISION
P.O. BOX 4313
BATON ROUGE, LOUISIANA 70821-4313
225-219-3041

AFTER HOURS EMERGENCY
TELEPHONE NUMBER
225-765-0160

Copies of this notice must be posted in a sufficient number of places in every establishment where employees are employed in activities licensed or registered by the Department, pursuant to Chapters 2 and 3 of LAC 33:XV (Louisiana Radiation Regulations), to permit employees working in or frequenting any portion of a restricted area to observe a copy on the way to or from their place of employment.

DRC-3 (Rev. 9/03)