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THE GEORGE  
WASHINGTON  
UNIVERSITY

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WASHINGTON, DC



# Radiation Safety Training

*Presented by the Office of Laboratory Safety*

*Email: [Labsafety@gwu.edu](mailto:Labsafety@gwu.edu)*

*Tel #: (202) 994-8258*

*“A safe, healthful, and secure environment for scholarship and research.”*

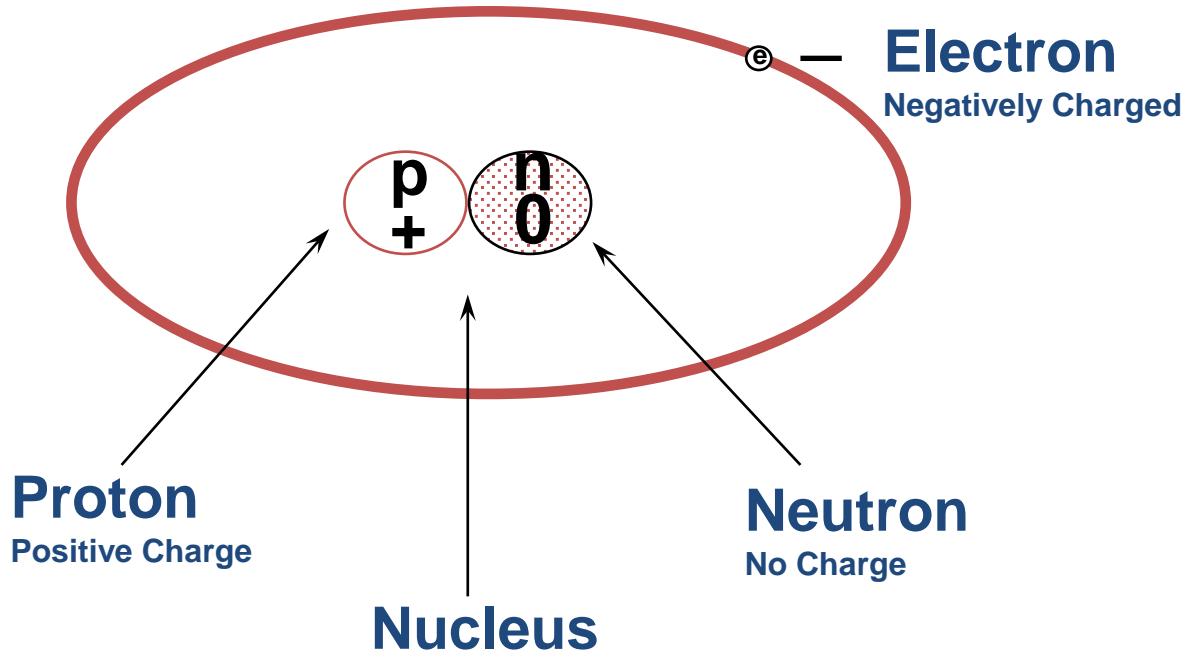
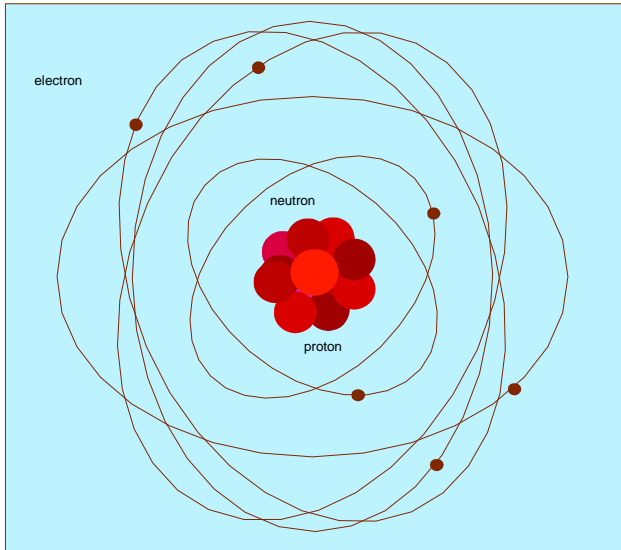
# Training Topics

- **Radiation Basics**
- **Biological Effects of Radiation**
- **Radiation Detection**
- **GWU Radiation Safety**

# Chapter 1

# Radiation Basics

# The Atom

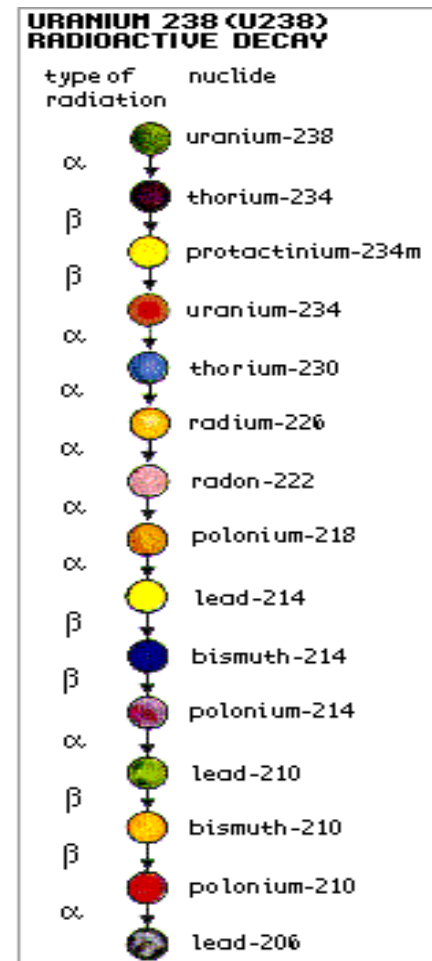


# Unstable Atoms Decay

The number of “decays” that occur per unit time in the radioactive material tell us how radioactive it is.

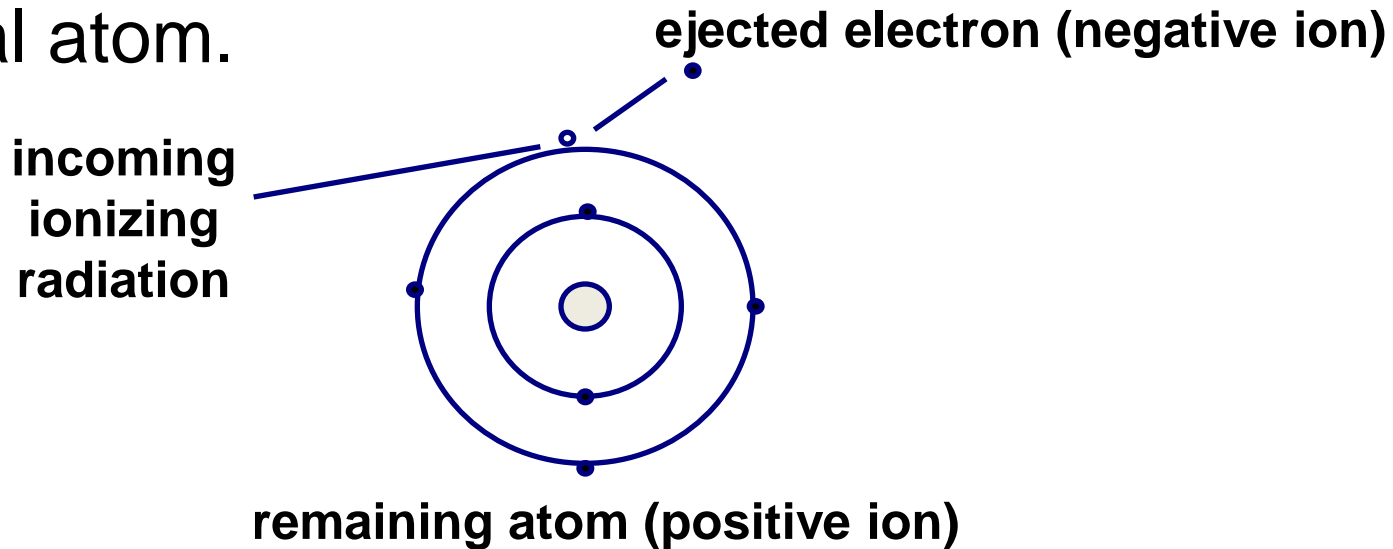
When an unstable atom decays, it *transforms* into another atom and releases its excess energy in the form of radiation.

Sometimes the new atom is also unstable, creating a “decay chain”



# Ionization

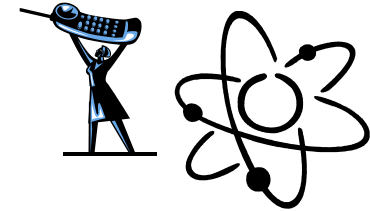
Ionization is the process of removing electrons from a neutral atom.



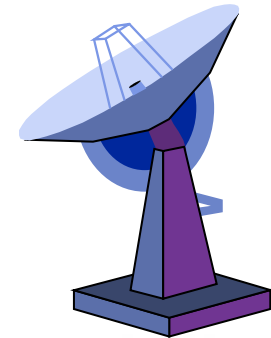
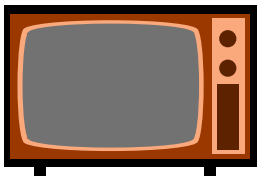
The positively charged atom and the negatively charged electron are called an ion pair.

# Non-Ionizing Radiation

*Radiation that doesn't have the amount of energy needed to ionize an atom.*



Examples of non-ionizing radiation are radar waves, cellular phones, microwaves and visible light.





# Ionizing Radiation

*Radiation which carries enough energy to cause ionization in the atoms with which it interacts.*



## Particulate Radiation

- $\alpha$**  (Alpha Particle)
- $\beta$**  (Beta Particle)
- n** (Neutron Particle)

## Electromagnetic Waves

- X** (X Ray)
- $\gamma$**  (Gamma Ray)



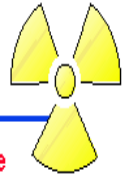
# What is a “Dose” of Radiation?

- When radiation’s energy is deposited into our body’s tissues, we receive a dose of radiation.
- Rem is a unit of measure for radiation dose.
- Small doses are expressed in mrem or urem.  
  
1 rem = 1000 mrem (milli-rem)  
  
1 mrem = 1000  $\mu$ rem (micro-rem)
- Rad & Roentgens are similar units that are often equated to the rem.

# Units of Measure

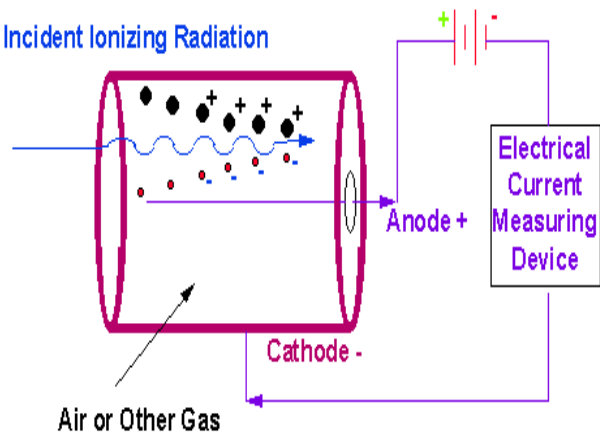
## Roentgen (R)

Radiation Detection  
Gas Filled Detectors



Voltage Source

Incident Ionizing Radiation



- Is a unit for measuring exposure.
- Defined only for ionization in air.
- Applies only to gamma and x rays.
- Not related to biological effects of radiation.
- 1 R (Roentgen) = 1000 milliroentgen (mR)
- 1 mR = 1000 micro roentgen ( $\mu$ R)

# Units of Measure

## rad (Radiation Absorbed Dose)

- Unit for measuring absorbed dose in any material.
- Defined for any material.
- Applies to all types of radiation.
- Does not take into account the potential effect that different types of radiation have on the body.
- 1 Rad = 1000 milli rad (mrad)
- 1 mRad = 1000 micro rad ( $\mu$ rad)

# Units of Measure

## rem (Roentgen Equivalent Man)

- Unit for measuring dose equivalence.
- Most commonly used unit.
- Pertains to man - refers to the amount of biological damage produced by radiation.
- Takes into account the energy absorbed (dose) and the biological effect on the body due to the different types of radiation.
- 1 rem = 1000 mrem (milli rem)
- 1 mrem = 1000  $\mu$ rem (micro rem)

# Background Radiation

- We are constantly exposed to low levels of radiation from outer space, earth, and the healing arts.
- Low levels of naturally occurring radioactive material are in our environment, the food we eat, and in many consumer products.
- Some consumer products also contain small amounts of man-made radioactive material.



Smoke  
Detector



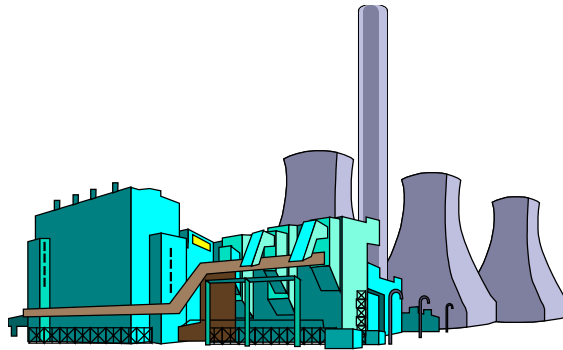
# Background Radiation

There are two main sources of ionizing radiation:

Natural Background



Man Made Sources



# Natural Background Radiation

## Sources

## Average Dose

Cosmic - from the sun and outer space

28 mrem/yr.

Terrestrial - from the earth's crust

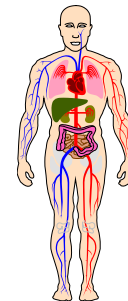
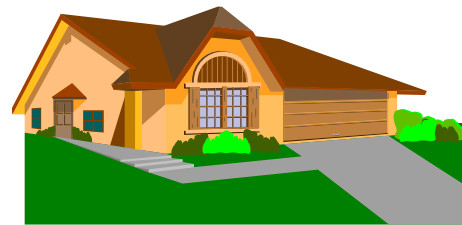
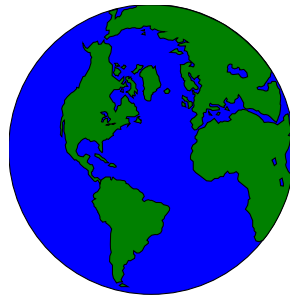
28 mrem/yr.

Radon - from the soil, (decay of uranium)

200 mrem/yr.

Internal - from sources in the body

39 mrem/yr.





# Man-made Radiation Sources

## Sources

## Average Dose

- Medical radiation



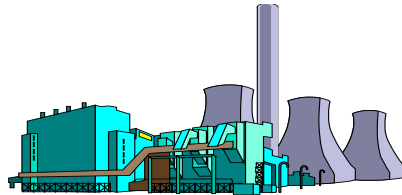
54 mRem/yr.

- Consumer products



10 mRem/yr.

- Industrial uses



< 3 mRem/yr.

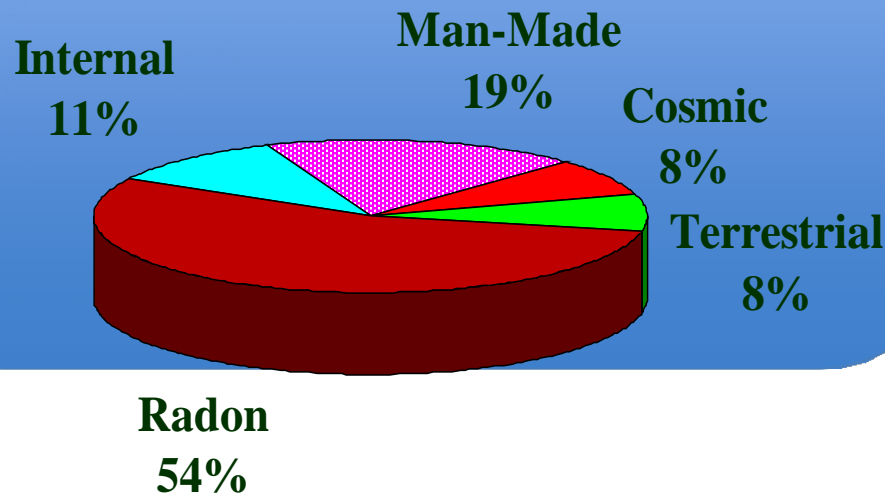
- Testing of nuclear weapons



< 1 mRem/yr.

# Average Annual Exposure

The total from all sources, natural and man made is approximately 360 mrem/year.



# Chapter 2

# Biological Effects of Radiation

# After Exposure



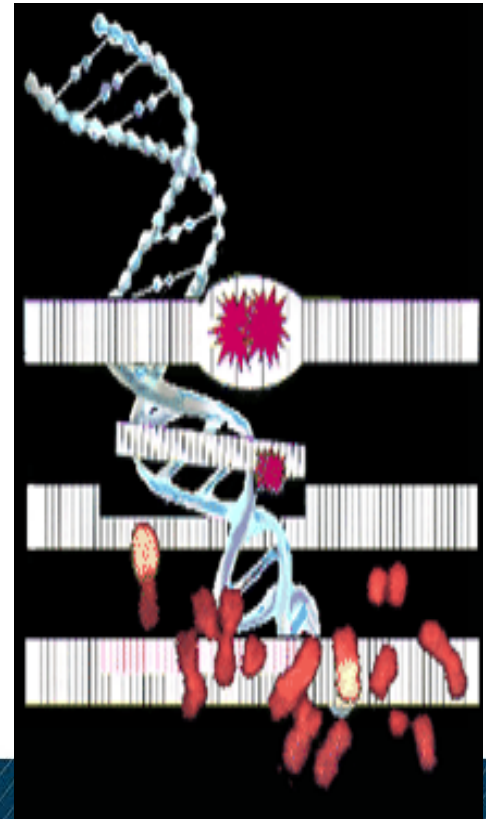
# Our Bodies Are Resilient

Our bodies have highly efficient DNA repair mechanisms

Our body has ~ 60 trillion cells

Each cell takes “a hit” about every 10 seconds, resulting in tens of millions of DNA breaks per cell each year.

BACKGROUND RADIATION causes only a very small fraction of these breaks (~ 5 DNA breaks per cell each year).



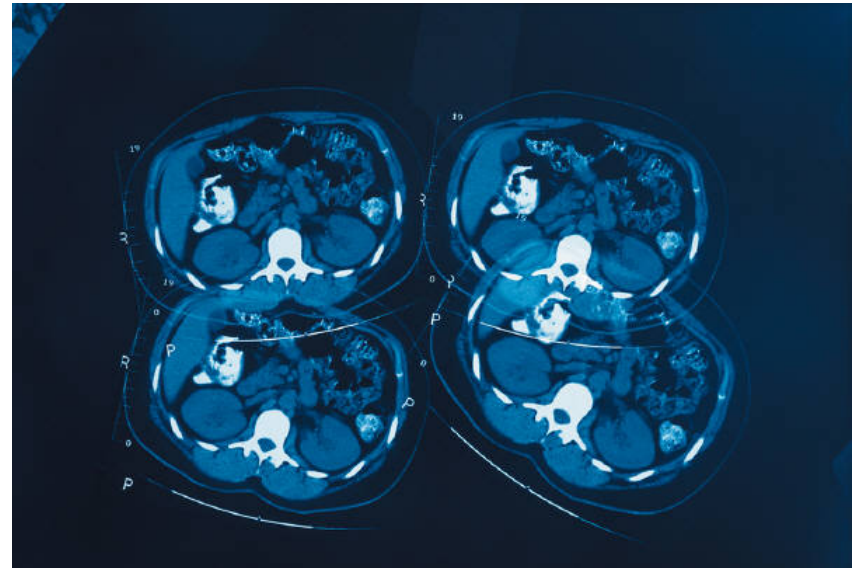


# Effects of Radiation on Cells

- Radiation causes damage to cells by ionizing the atoms in the cells.
- Ionizing radiation may cause damage directly to the nucleus or any other part of the cell.
- The interaction may cause physical damage, chemical damage, or both to occur to the cell.

# Possible Results of Radiation Dose to Cells

- Cells are not damaged
- Cells repair the damage and operate normally
- Cells are damaged and operate abnormally
- Cells die as a result of the damage



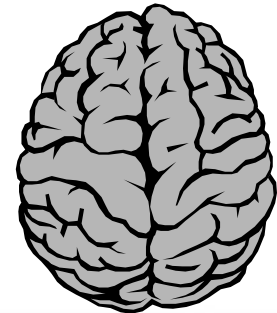


# Factors Affecting Biological Damage

- **Dose Rate**
- **Total Dose**
- **Energy of radiation**
- **Area of the body exposed**
- **Cell sensitivity**
- **Individual sensitivity**

# Cell Sensitivity

- **Radiation damage to cells depends on how sensitive the cells are to radiation.**
- **Cells that are actively dividing are more sensitive to environmental factors such as ionizing radiation.**
  - **Examples: Blood forming cells, intestinal lining, hair follicles, embryo/fetus.**
- **Cells which divide at a less rapid pace or are more specialized are not as sensitive to damage by ionizing radiation.**
  - **Examples: Brain cells, muscle cells, nerve cells**



# Acute and Chronic Radiation Dose

- Potential biological effects of radiation depend on several factors.
- How much and how fast a radiation dose is received are two of them.
- Radiation doses can be grouped into two categories:

**Acute dose**

**Chronic dose**

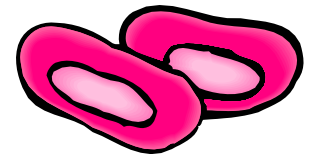


# Acute Doses

Acute doses are large doses of radiation received in a short period of time.

The body can't repair or replace cells fast enough from an acute dose and physical effects such as reduced blood count and hair loss may occur.

Death can occur if the exposure is high enough.

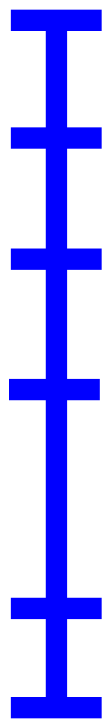


Red Blood Cell

# Chronic Radiation Dose

- Chronic radiation dose is typically a small amount of radiation received over a long period of time.
- *Typical examples of a chronic dose are:*
- The dose we receive from natural background.
- (Avg. 360 mrem/yr)
- The dose we receive from occupational exposure.
- (5000 mrem/yr limit)

# Effects of Acute Exposures

- 
- 5000 rem - Death within 2 - 3 days
  - 1000 rem - Gastrointestinal system damage
  - 450 rem - LD 50/30 (50% will die in 30 days without treatment)
  - 100 - 200 rem – Radiation Sickness
  - 10 - 25 rem - Slight blood changes
  - 5 rem - Federal annual whole body dose limit



# Somatic Effects

**Somatic effects** are effects that occur in the exposed individual.

**An example of a somatic effects:**

Cancer

Tumor

Cataracts



# Potential Prenatal Hazards

Some children who were exposed while in the womb to the radiation from the atomic bomb were born with low birth weights and mental retardation.

It has been suggested, but not proven, that exposures to the unborn may also increase the chance of childhood cancer.

Only when doses exceed 15,000 mrem has there been significant increase in risk.

# Heritable Effects

- A heritable effect is an effect that is inherited or passed on to an offspring.
- Heritable (Genetic) effects from radiation have never been observed in humans but have been observed in studies of plants and animals.
- This includes the 77,000 Japanese children born to the survivors of Hiroshima and Nagasaki. (These are children who were conceived after the atom bomb.)

# Estimated Days Lost Due to Daily Activities

## HEALTH RISK

## AVG DAYS LOST

<b>Unmarried male</b>	<b>3500</b>
<b>Cigarette smoking</b>	<b>2250</b>
<b>Unmarried female</b>	<b>1600</b>
<b>Coal miner</b>	<b>1100</b>
<b>25% overweight</b>	<b>777</b>
<b>Alcohol (U.S. average)</b>	<b>365</b>
<b>Construction worker</b>	<b>227</b>
<b>Driving a motor vehicle</b>	<b>207</b>
<b>100 mRem/yr. for 70 years</b>	<b>10</b>

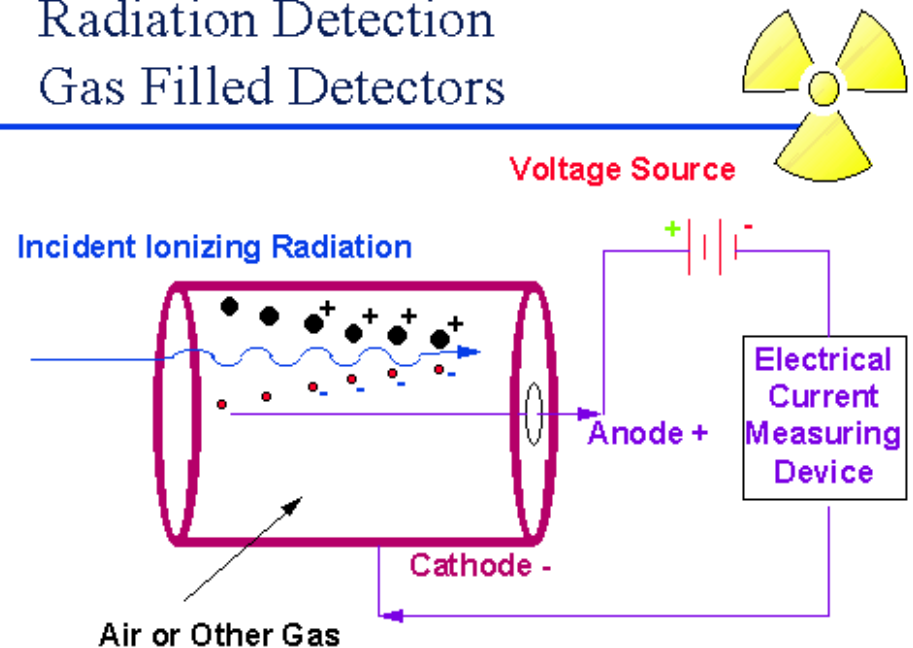
# Chapter 3

# Radiation Detection

# How to Detect Radiation

- The human body cannot detect the presence of radiation
- Radiation detection equipment is used to detect and measure the presence of ionizing radiation
- Remember “Radiation Causes Ionization”

## Radiation Detection Gas Filled Detectors



# Selection of Proper Radiation Detection Instrumentation

**Selection of radiation detection equipment is based on several factors.**

- The type of radiation to be detected and measured
- The energy range of the radiation to be detected
- The intensity or amount of radiation to be measured
- The environmental conditions of the area
- Special features that may be needed (e.g., speaker and/or headset, extended handle, lead shielded probe, remote readout, etc.)



# Instrument Makes and Models





# Instrument Use

**Instruments shall be calibrated to known national standards (NIST) at a minimum of annually.**

## **Prior to Use:**

Perform a battery check of the instrument

Perform a calibration check (check date on sticker is current)

Perform a physical check for damage

Perform a response check in a known radiation field (Source Check)

# Chapter 4

## GWU Radiation Safety

# Radiation Exposure and Doses

- Small quantities of radioactive materials are used at GWU.
- Only very small radiation doses are expected for the users of radiation/radioactive material.
- No doses are expected for any other personnel.
- No biological effects are expected at these low dose levels.

# License

GWU is licensed to use radioactive material (RAM) by the Nuclear Regulatory Commission (NRC).

Our license is a “Broad Scope License” and allows us to use a wide range of isotopes within activity limits, providing that we conduct our Radiation Safety program in accordance with our license application as submitted to the NRC as well as comply with Federal regulations. Some important elements of the program are:

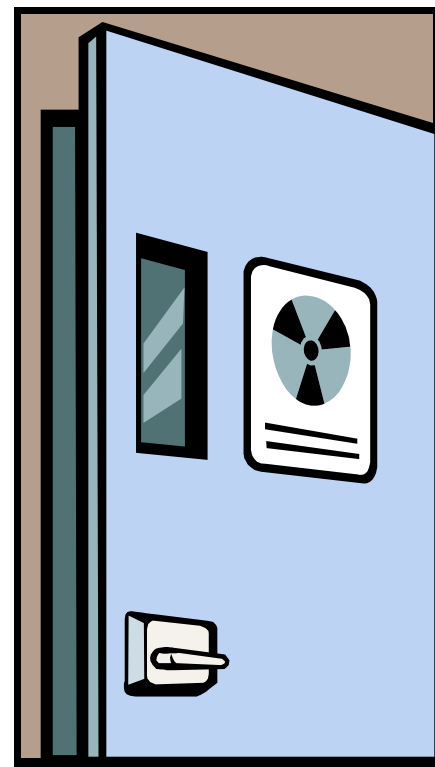
- Radiation Safety Officer (RSO)
- Radiation Safety Committee (RSC)
- Authorized User (AU)
- Training with examination
- Document RAM use and waste
- Security of RAM
- Conduct periodic surveys

# Authorization

- Authorized Users - approved by the Radiation Safety Committee (RSC)
- Only AUs or those under them can use RAM
- AU - principal investigator with the responsibility for ensuring that his/her workers follow procedures.
- Each AU authorization is specific for each isotope, activity limits (on hand and annual), rooms for use.
- All users of RAM must be trained and pass an examination as well as demonstrate competence in handling RAM.
- Authorizations are renewed by the AU and approved by the RSO annually and include a physical inventory of RAM on hand.

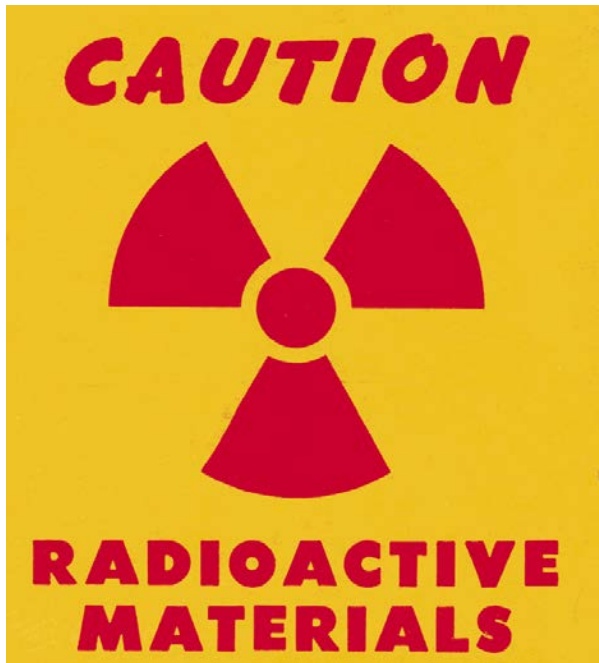
# Authorization (cont.)

- Only rooms on the authorization can have RAM storage or use. These rooms must have:
  - Placard in hall
  - Caution sign on lab door
- AU programs must have means to conduct contamination surveys.
- AUs must maintain the radiation binder which contains at minimum:
  - AU guide
  - Utilization logs
  - Protocols
  - Reg guide 8.29 and 8.13





# Hall Placard













































**George Washington University • Laboratory Hazard Information Sheet**

Room #: \_\_\_\_\_ Department: \_\_\_\_\_ BioSafety Level \_\_\_\_\_ Lab \_\_\_\_\_  
 Principal Investigator: \_\_\_\_\_ Phone: (\_\_\_\_) \_\_\_\_\_ - \_\_\_\_\_  
 24-Hour Emergency Contact Information:  
 Home: (\_\_\_\_) \_\_\_\_\_ - \_\_\_\_\_ Cell: (\_\_\_\_) \_\_\_\_\_ - \_\_\_\_\_ Pager: (\_\_\_\_) \_\_\_\_\_ - \_\_\_\_\_

**Routine Access Information:**

[ ] Housekeeping and Support Services may enter to clean floors and empty trash only  
 [ ] Housekeeping and Support Services may enter the lab only when escorted  
 [ ] NO ROUTINE ACCESS

<table border="1" style="width: 100%; height: 100%; border-collapse: collapse;"> <tr> <td style="background-color: #0056b3; color: white; text-align: center; padding: 5px;">HEALTH HAZARD</td> <td style="background-color: #e31a1c; color: white; text-align: center; padding: 5px;">FIRE HAZARD</td> </tr> <tr> <td style="background-color: #0056b3; color: white; text-align: center; padding: 5px;">SPECIFIC HAZARD</td> <td style="background-color: #e31a1c; color: white; text-align: center; padding: 5px;">REACTIVITY</td> </tr> </table>	HEALTH HAZARD	FIRE HAZARD	SPECIFIC HAZARD	REACTIVITY	<p><b>Special Hazards:</b></p> <table style="width: 100%;"> <tr> <td style="text-align: center;"> IRRITANT <input type="checkbox"/></td> <td style="text-align: center;"> FLAMMABLE <input type="checkbox"/></td> </tr> <tr> <td style="text-align: center;"> CORROSIVE <input type="checkbox"/></td> <td style="text-align: center;"> OXIDIZER <input type="checkbox"/></td> </tr> <tr> <td style="text-align: center;"> RADIATION <input type="checkbox"/></td> <td style="text-align: center;"> TOXIC <input type="checkbox"/></td> </tr> <tr> <td style="text-align: center;"> BIOHAZARD <input type="checkbox"/></td> <td style="text-align: center;"> SC CARCINOGEN <input checked="" type="checkbox"/></td> </tr> <tr> <td style="text-align: center;"> SM MUTAGEN <input type="checkbox"/></td> <td style="text-align: center;"> ST TERATOGEN <input type="checkbox"/></td> </tr> </table>	 IRRITANT <input type="checkbox"/>	 FLAMMABLE <input type="checkbox"/>	 CORROSIVE <input type="checkbox"/>	 OXIDIZER <input type="checkbox"/>	 RADIATION <input type="checkbox"/>	 TOXIC <input type="checkbox"/>	 BIOHAZARD <input type="checkbox"/>	 SC CARCINOGEN <input checked="" type="checkbox"/>	 SM MUTAGEN <input type="checkbox"/>	 ST TERATOGEN <input type="checkbox"/>
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SPECIFIC HAZARD	REACTIVITY														
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<p><b><u>Personal Protective Equipment:</u></b></p> <table style="width: 100%;"> <tr> <td style="text-align: center;"> LAB COAT <input type="checkbox"/></td> <td style="text-align: center;"> GLASSES <input type="checkbox"/></td> </tr> <tr> <td style="text-align: center;"> GLOVES <input type="checkbox"/></td> <td style="text-align: center;"> COVERALL <input type="checkbox"/></td> </tr> </table>		 LAB COAT <input type="checkbox"/>	 GLASSES <input type="checkbox"/>	 GLOVES <input type="checkbox"/>	 COVERALL <input type="checkbox"/>										
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The Office of Research Safety, Bio-Security & Emergency Management is responsible for all University research laboratory facilities and is located in Ross Hall, Suite 617 - PHONE: 4.3282, FAX: 4.2522, EMAIL: [safety@gwumc.edu](mailto:safety@gwumc.edu), WEB: [www.gwumc.edu/research/labsafety.htm](http://www.gwumc.edu/research/labsafety.htm). ORSBSEM is on-call 24x7 to respond to emergencies. Employees are entitled to Material Safety Data Sheets (MSDS) or other information on suspect hazards.

# Authorization

- Renewals – annually you will be sent a renewal form to correct, sign and return to OLS.
- Substantial changes to an authorization such as room change, new isotope, on-hand limit, etc. will need an amendment form (on the website)
- New users
  - Study user manual & Perkin Elmer guide
  - Complete new user/dose eval form
  - Attend training & exam (Wed 10:00)
- Almost everything you need is on the OLS website

# On the Web

The screenshot shows the top navigation bar of The George Washington University website, featuring the university logo and a search bar. Below this is the 'LAB SAFETY' header with the subtitle 'OFFICE OF THE VICE PRESIDENT FOR RESEARCH'. A breadcrumb trail indicates the current location: 'Home / Safety Programs / Radiation Safety / Radiation Safety Committee'. A left-hand navigation menu lists various safety topics, with 'Radiation Safety Committee' highlighted. The main content area is titled 'Radiation Safety Committee' and describes the committee's role in reviewing protocols for radioactive material. It includes a list of forms for application and a 'REGISTER FOR TRAINING' button. A right-hand sidebar contains a 'REQUEST TRAINING' button. The footer provides contact information for Lab Safety, including the address, phone, fax, and email.

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WASHINGTON, DC

SEARCH Lab Safety

GW Home GW Links Info For

## LAB SAFETY

OFFICE OF THE VICE PRESIDENT FOR RESEARCH

You are here: Home / Safety Programs / Radiation Safety / Radiation Safety Committee

- ABOUT US
- SAFETY PROGRAMS
  - Biosafety
  - Laser Safety
  - Nanotechnology Safety
  - Radiation Safety
  - Radiation Safety Committee**
  - Manual
  - Disposal of Radioactive Material
  - Important Safety Resources
- POLICIES & REGULATIONS
- TRAINING
- NEWS
- EMERGENCY PROCEDURES
- CONTACT US

### Radiation Safety Committee

The Radiation Safety Committee (RSC) is responsible for reviewing protocols that involve radioactive material (RAM) at GW. The committee is made up of various authorized users and administrative personnel who meet quarterly. The RSC is regulated by our license application to the NRC, which is available to any member of the RSC. [Contact us](#) if you would like to join the RSC.

#### Apply to Become an Authorized User

If you plan to work with RAM you must submit an application to become an authorized user. Submit the following forms to the [Radiation Safety Officer](#) at least three months in advance of the work to ensure proper review, lab setup, and scheduling of all necessary training.

- New Authorized User Application (DOC)
- Protocol Submission Form (DOC)
- Radiation Laboratory Commissioning Form (DOC)
- Authorization Amendment Form (DOC)

Once we receive all of the forms you will be contacted to schedule the necessary training and exam. For guidance with the forms or if you have any questions please [contact us](#).

**REGISTER FOR TRAINING**

**REQUEST TRAINING**

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**Lab Safety**  
Office of the Vice President for Research

2300 Eye St. NW, Ross Hall Room B05  
Washington, DC 20037  
Phone: 202-994-8258 | Fax: 202-994-8258  
[labsafety@gwu.edu](mailto:labsafety@gwu.edu)

[Contact Us](#) | [Register for Training](#)

<https://labsafety.gwu.edu/radiation-safety-committee>

# Ordering RAM

- Radiation Safety receives quotes from vendors for RAM for agreed prices.
- Your department places order through EAS Oracle. OLS will approve the order if lab is authorized for product and within limits (annual and on-hand)
- Ensure proper:
  - “ship to” address
  - DOT hazard class (7)
  - (supplier) item #,
  - Price
  - shipping charges
  - Location
- When ordering with Perkin Elmer we can set up a blanket PO# for faster service



# Inventory

- Isotopes - received by a user and secured (locked) immediately. You will receive a utilization log sheet with the order (fridge or binder)
- RAM used must be entered on the utilization log (fill in all blanks)
- Stock vial - depleted, decayed or not wanted, call Radiation Safety for disposal (never in sink or trash).
- Stock vials must be kept stored in their container (pig) and it must be labeled with the 4 digit inventory #.



**ISOTOPE RECEIPT and UTILIZATION LOG**

AU: James Pkg #: 2999  
 Supplier: Perkin Elmer Cat. #: BLV 5077  
1.0 mCi of  $^{32}P$  Received on: 1/11/07  
 gross mrem 1 meter: 0.006 Surface: 0.125  
 per hour Detector: 89804 Bkgd: 0.005  
 gross cpm Outside: 48 Inside: 52  
 per 300 cm<sup>2</sup> Detector: KSC15C Bkgd: 57  
 Chem/bio. Hazard? : No RSO Tech: ADS

*Example*

DATE	ACTIVITY REC'D, mCi	ACTIVITY USED, mCi	ACTIVITY LEFT, mCi	STORAGE PLACE	LABELED & LOCKED?	STAFF INITIALS
1/11/07	1.0	None	1.0	Frg 699	Yes / No	ADS
1/21/07	1.0	0.1	0.9	"	Yes / No	ADS
					Yes / No	
					Yes / No	
					Yes / No	
					Yes / No	
					Yes / No	
					Yes / No	
					Yes / No	
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					Yes / No	
					Yes / No	
					Yes / No	
					Yes / No	

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

(This form must be retained for three years after the last date recorded on the form).  
 HN2.3 Rev. 05/15/96



# Waste

## Dry Solid Material (DSM)

- Segregate by isotope in separate boxes (“hat box”), labeled correctly.
- All waste added is entered on the DSM log on waste box.
- Call for pickup when full (or 1 yr)
- NO STOCK VIALS (even if empty).
- NO LIQUIDS
- NO HAZ MAT – ie: lead, mercury, chemicals
- NO SHARPS OR BIOWASTE
- NO FOOD

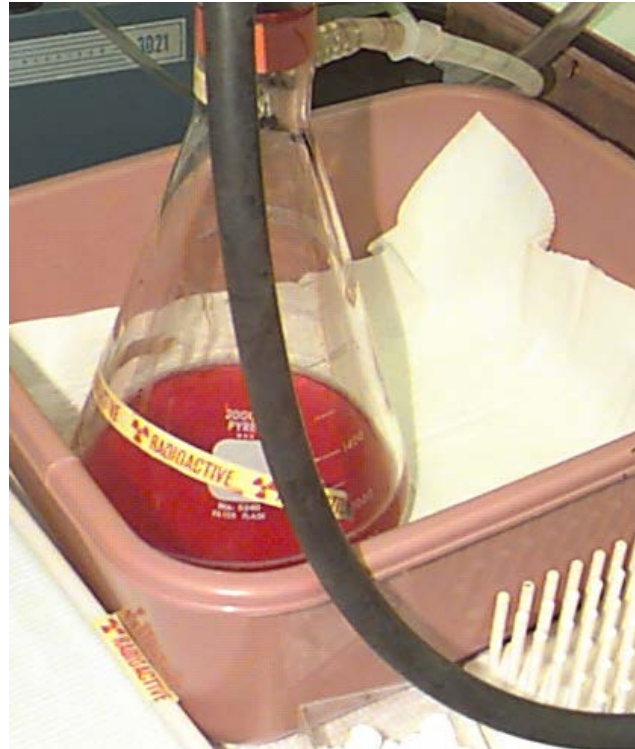
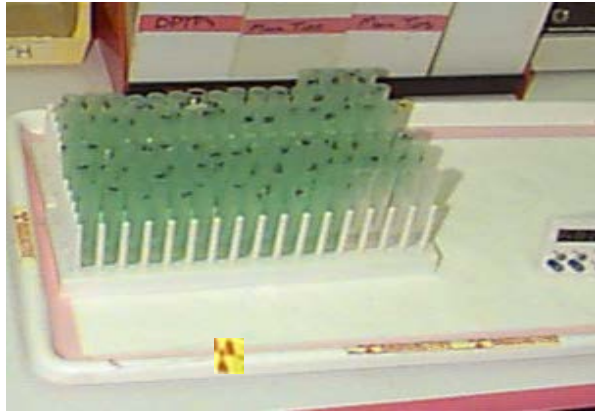


# Waste

## Liquid radioactive waste (non-hazardous waste)

- Liquid waste - disposed of in a designated “Hot Sink” which must be marked with rad tape and have a sign posted.
- Run large amounts of water before, during and after release.
- Don’t splash. No contamination on bench around sink. Limit contamination in basin.
- Estimate activity and record on the Hot Sink disposal log. Logs will be picked up periodically.
- Must not exceed monthly disposal limits per isotope.
- Must be sewer disposable: no hazardous waste (pH 5 - 9)
- No liquid disposed direct from stock vial.

# Secondary Containment for ALL Radioactive Liquids



# Waste

## Stock vials

- To dispose of a stock vial call Radiation Safety. We will collect the vial, sign utilization log and give you a copy.
- Do not discard vials in dry waste or pour in hot sink

## Scintillation vials

- H3 / C14 – If <50,000 cpm discard in “cold trash” waste. Update exempt vial disposal log.
- All other hot vials must be placed upright in trays and labeled “Caution Radioactive Material”, isotope and estimate activity. Call for pickup.
- Never discard vials with DSM waste.



*EXAMPLE* **DISPOSAL LOG** *EXAMPLE*  
**3H and 14C Only**  
**Liquid Scintillation Vials Only**

AFTER REMOVAL OF ALL RADIOACTIVE LABELING, VIALS CONTAINING BIODEGRADABLE LIQUID SCINTILLANTS WITH 111,000 dpm per g of media or less of H-3 and C-14 ONLY MAY BE PUT IN "COLD TRASH" NORMAL TRASH (OR IN MEDICAL WASTE WHEN NEEDED), IN A BAG WITH ABSORBENT. LOG THE DATA OF EACH DISPOSAL BELOW. RADIATION SAFETY WILL RETAIN THIS LOG.

ROOM #: 699 AUTHORIZED USER: JONES


Date	Circle Isotope	Total Activity (dpm)	Number of Vials	Size of Vials	Person Making Disposal Please print name.
1/11/07	(H-3) / C-14	200,000	35	7 mL	GREG JONES
1/15/07	(H-3) / C-14	300,000	40	7 mL	GREG JONES
	H-3 / C-14				
	H-3 / C-14				
	H-3 / C-14				
	H-3 / C-14				
	H-3 / C-14				
	H-3 / C-14				
	H-3 / C-14				
	H-3 / C-14				
	H-3 / C-14				
	H-3 / C-14				
	H-3 / C-14				
	H-3 / C-14				

Date Sheet Collected: \_\_\_\_\_ Approved by: \_\_\_\_\_ Date: \_\_\_\_\_

HR12.2 Revised 1/12/07 (These records must be maintained until the license is terminated).

# Hot Sink Sign

**HOT**



**SINK**

**NOTICE**

1. Maintenance Personnel Contact the Office of Radiation Safety Before Working on Drain Piping.
2. Written Records of All Sewer Disposals of Radioactive Material Are Required BY LAW. Record date, quantity (in microcuries) and radionuclide for each disposal.
3. Disposals May Be Made Only in Conjunction With Projects Approved By Campus Radiological Health Authorities.
4. For Further Information Contact The Office of Radiation Safety at 4-2630



# RAM Use – Work Areas

RAM is only to be used in designated use areas - mark with radiation tape and use plastic backed absorbent paper

Any equipment where RAM is used or stored must be labeled ie: hoods, refrigerators, centrifuges, etc.



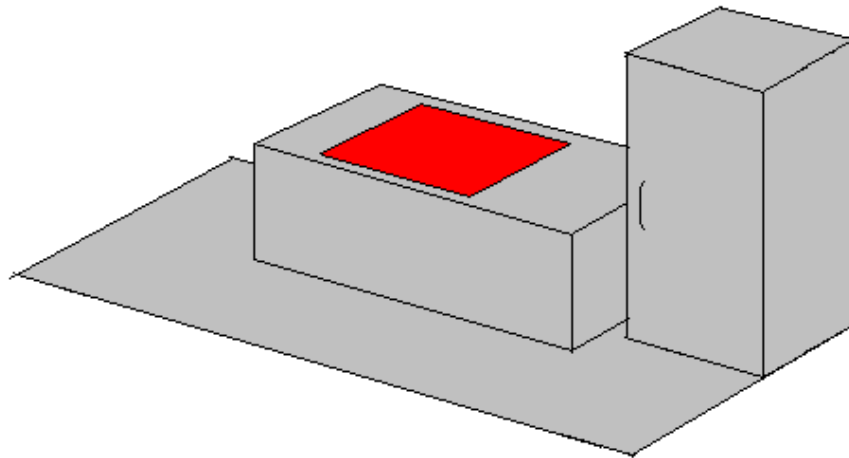
# RAM Use - Surveying

- As you work, survey your gloves to detect any contamination
- The meter must always be on when working with RAM (if detectable)
- When work is finished, benches, clothing, floors and other equipment should be surveyed to detect any contamination (Move the detector slowly)
- Contamination:
  - 2X background (meter)
  - 150 cpm (wipe test)



# RAM Use - Contamination

- No contamination should be present OUTSIDE of rad use areas.
- If contamination is discovered, it should be cleaned up immediately. If you suspect contamination with H3 where meter detection is not feasible, do wipe tests to survey. (S35 & C14 may need wipe tests if low activity).



# RAM Use - Contamination

- Contamination INSIDE work areas should be avoided. if discovered, clean as soon as work is complete (contaminated bench paper goes in DSM)
- Small amounts of contamination may persist in work areas due to residual in equipment and may be unavoidable, but, must be below following levels when measured at the edge of the bench:
  - For I125 and Cr51, using a 44-3 meter < 15000 cpm
  - For all other isotopes, using a GM meter < 1500 cpm
- Dose limit for whole body is 0.5 mRem/hr. The above count rates are designed to keep doses well under this level.



# RAM Use – Clean Up

- Contamination should be cleaned with bubbling spray such as Count-Off or Dow cleaner and paper towels.
- Clean small areas at a time to avoid spreading any contamination
- The area should be surveyed until no removable contamination is detected and discarded in DSM.
- For more than incidental contamination, contact Radiation Safety for assistance and inform your AU. Mistakes will happen, but please get help.



# Safe Lab Practices

- No eating, drinking, chewing gum etc in Rad labs (small amount at desk is OK)
- Never store food in rad storage areas (ie: fridges)
- Wash your hands promptly after handling any radioactive material.
- Wear prescribed dosimeters. Dosimetry will not be prescribed when using tritium



**CAUTION:**  
RADIOACTIVE MATERIAL



## LABORATORY SAFETY PRACTICES:

1. **Never eat, drink, smoke, etc., and never pipette by mouth, in isotope use areas.**
2. Never store isotopes with food or drink (or cups, etc.), incompatible items, or bulk flammables.
3. Never leave items related to food, etc., in any isotope work area, e.g., in any waste receptacle.
4. *A laboratory coat and gloves (latex, etc.) should be worn when using isotopes (button the coat).*
5. **Wash your hands promptly after isotope use**, before eating, and before leaving the lab.
6. Hands, shoes and clothing should be surveyed after isotope use, before leaving the workplace.
7. *Use isotopes in a hood*, unless benchwork is approved for the isotope, activity and protocol used.
8. Use isotopes on a tray (or on any impervious surface for a few ml); *cover it with absorbent paper.*
9. When using isotopes, survey the area whenever contamination is suspected; always survey at least daily, unless weekly survey is approved for the isotope and activity used. *Clean up any "hot spots."*
10. For external radiation, *utilize time, distance and shielding* to reduce exposure whenever possible.
11. *Wear your radiation badge around radiation* (& ring if using isotopes); store these in office areas.
12. Dispose solid radwaste in an approved radwaste container, **in one labeled with the isotope.** Dispose bulk liquid radwaste in the "hot sink" (**nonflammable true solutions  $\leq$  monthly limits**).
13. **Record promptly:** all receipts, all dispensing for use, and all disposals and transfers of isotopes.
14. Each isotope transfer – *to or from another GWU user or off-campus* – requires RSO approval.
15. *Label all isotopes as required*, except containers attended or posted; *deface labels upon disposal.*
16. **Lock all isotope storage areas (freezers, etc.) whenever possible, and always at the end of the day.** Always lock the doors of any isotope lab, at the end of each day, and whenever leaving a lab when isotopes are in use or unlocked. **Report any lost stock!**
17. Report all isotope ingestion, spills and losses to your supervisor *and* to the Radiation Safety Office.
18. Before using isotopes, all lab staff: must know all radiation safety rules, and all relevant protocols; must pass the Radiation Safety Office "Hazards Exam." *Review radiation safety rules frequently.*
19. Always comply with NRC regulations, University radiation safety rules, and approved protocols.
20. *In any emergency involving isotopes, call the Radiation Safety Office .4-2630*

108P26.1 04/25/97



# Personal Protective Equipment



- Lab coat, disposable gloves and eye protection are always required
- Refer to authorization for specific requirements.
- Don't wear baggy clothing or dangling jewelry and cinch up loose long hair.
- Legs must be covered and close toed shoes worn.

# Survey Meters

Survey Meter w/ “end window” Geiger Muller GM detector



Survey Meter w/ “pancake” GM detector >>



Survey Meter w/ low energy gamma detector Ludlum 44-3 (for use with I125 and Cr51) >>



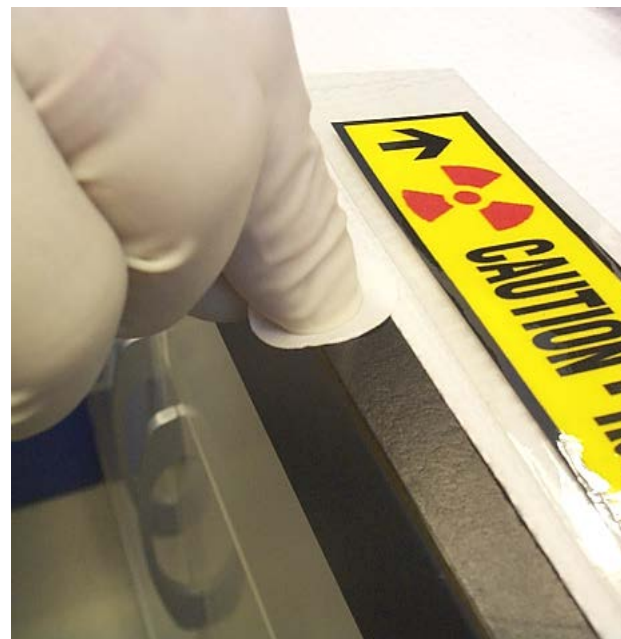
# Survey Meters

- Will not detect H3 (must use liquid scintillation to detect)
- Are calibrated annually
- Always check batteries to make sure they are in range.
- Check the meter before each use by holding the probe against the check source. It should closely match calibration number on sticker.
- A properly working GM meter has a background count rate of about 40 cpm. If it is not working contact OLS.



# Wipe Surveys

- The only way to determine if contamination is removable or fixed
- Use 2.5 cm filter disc for LSC counting
- Cover a 100 cm<sup>2</sup> of surface
- Limits are based on 100 cm<sup>2</sup>
- Only way to detect <sup>3</sup>H





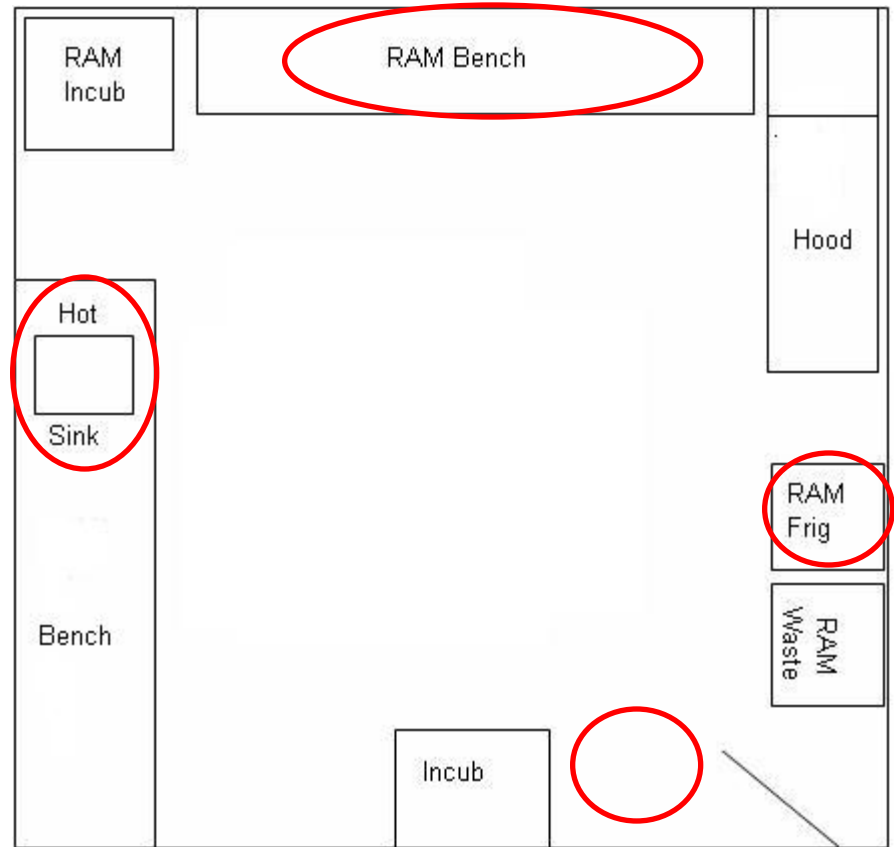
# Monthly Surveys

- A documented survey must be done each month when RAM was used with a meter and LSC swipes
- Labs not using that month still must fill out a survey form

AU RADIATION SAFETY SURVEY		SURVEY DATE: _____	
Authorized User: <u>Doe</u>	Surveyor: _____		
RAM Used in Last 30 d and Since Previous Survey:	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Initials: _____
Isotopes Used: 3H 14C 32P 35S 125I 86Rb Other _____			
Authorized Laboratory Room Numbers	<b>705b</b>		
Diagram of Survey Areas:			
Survey Meter Readings: Bkgd _____ cpm A _____ B _____ C _____ D _____ E _____			
LAB PRACTICES: Each OK?	Yes	No	
RAM secure from all routes of access			
RAM & non-RAM areas clearly separated			
No trace or sign of food, drink or tobacco			
Assigned dosimetry worn/stored properly			
Gloves and lab coats worn properly			
Survey procedure & meter work properly			
RAM stocks, containers & areas in order			
RAM utilization logs in order & complete			
Radwaste area, containers & logs in order			
No labels, liquids or sharps in radwaste			
RAM hood, "Hot Sink" & sink log in order			
"Cold" trash has no radioactivity or labels			
No area > 0.5 mR/h			
Please note correction of "No" items: _____			
Survey Meter: Make/Model _____		Serial Number _____	
LSC: Make <u>Beckman</u>		Model _____	
Serial Number _____			
All Wipe Test Results <200 dpm (150 cpm gross counts-wide window)			
Yes <input type="checkbox"/>			
No <input checked="" type="checkbox"/>			
Attach LSC Print Out			
Attach LSC Print Out of Post Decon			

# Monthly surveys

Take swipes of areas that are likely to have contamination such: hot sink, rad bench, rad area floors, door handles, floors near exit, equipment such as fridges and centrifuges.





# ALARA

As low as reasonably achievable (ALARA) – To minimize dose from external sources there are 3 primary methods:

- Time
- Distance
- Shielding

# ALARA

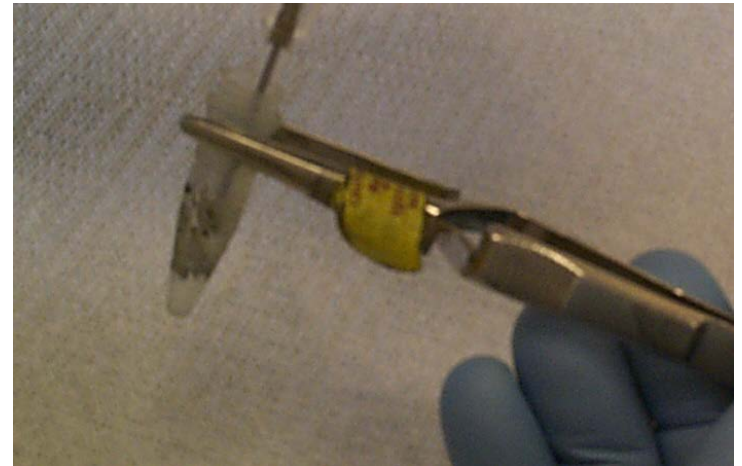
## **TIME - minimize the time spent receiving a dose**

- Plan your experiment and have all materials present before introducing RAM
- Work methodically and at a good pace but don't rush as this could cause accidents
- Put stocks away soon after you are finished with them

# ALARA

## **DISTANCE – keep as much distance between you and the source as possible**

- Doubling the distance from the source reduces the dose to one quarter
- Set stock vials away from you when not handling them
- Use tongs or tweezers to hold containers when feasible
- Store waste in a low traffic area



# ALARA

## **SHIELDING – block radiation with a suitable material**

- Use an appropriate material at an adequate thickness to stop radiation.
- Protects your body when working and protects those nearby from stocks or waste.
  - High energy beta emitters (P32) – plexiglass (1cm)
  - Gamma emitters (I125) – lead (sheets, foil or bricks)
- Put vials back in protective packaging, such as plastic vials or lead foil, when finished.

# Security

- Radioactive material is only to be used by those who are authorized by OLS.
- RAM must never be left unattended, rooms must be locked and RAM must be locked in a fridge or cabinet.
- Access must be limited to those who have a need to be there and all must wear identification
- If someone is not wearing a badge ask if you can help them and direct them and escort them to the front desk for assistance.
- Report any suspicious activity to security





# Procedure if Individuals are Contaminated

If you find personnel contamination, take the following steps:

1. Have someone call OLS, 4-2630
2. Remove clothing that is contaminated (take measures for modesty if someone must disrobe)
3. Start washing area.
4. Complete a GWU incident form and submit it to MC safety. Medical treatment is available if necessary



# Decontamination



## To decontaminate skin:

1. If a large area, wash with mild soap and water right in the sink.
2. If only a small area, use a wet towel and mild soap to start decontaminating.
3. Check towel with meter.
4. Avoid spreading the contamination to other areas.

# Decontamination



Don't scrub contaminated area!

Your skin turning red is a way of letting you know to stop

**DO NOT USE ANYTHING EXCEPT MILD SOAP!**

# Emergency Contacts

Office of Laboratory Safety

4-8258

Also check “NRC Notice to Employees” posted in the radiation use and storage areas



# More Information

Refer to the NRC REGULATORY GUIDE 8.29 on "Instruction Concerning Risks from Occupational Radiation Exposure," and NRC REGULATORY GUIDE 8.13 on "Instruction Concerning Prenatal Radiation Exposure".

These documents are available from the Office of Laboratory Safety (call 202-994-2630).

The OLS will provide confidential advice to those who are pregnant. A pregnant person need not declare their pregnancy in order to receive this advice.