



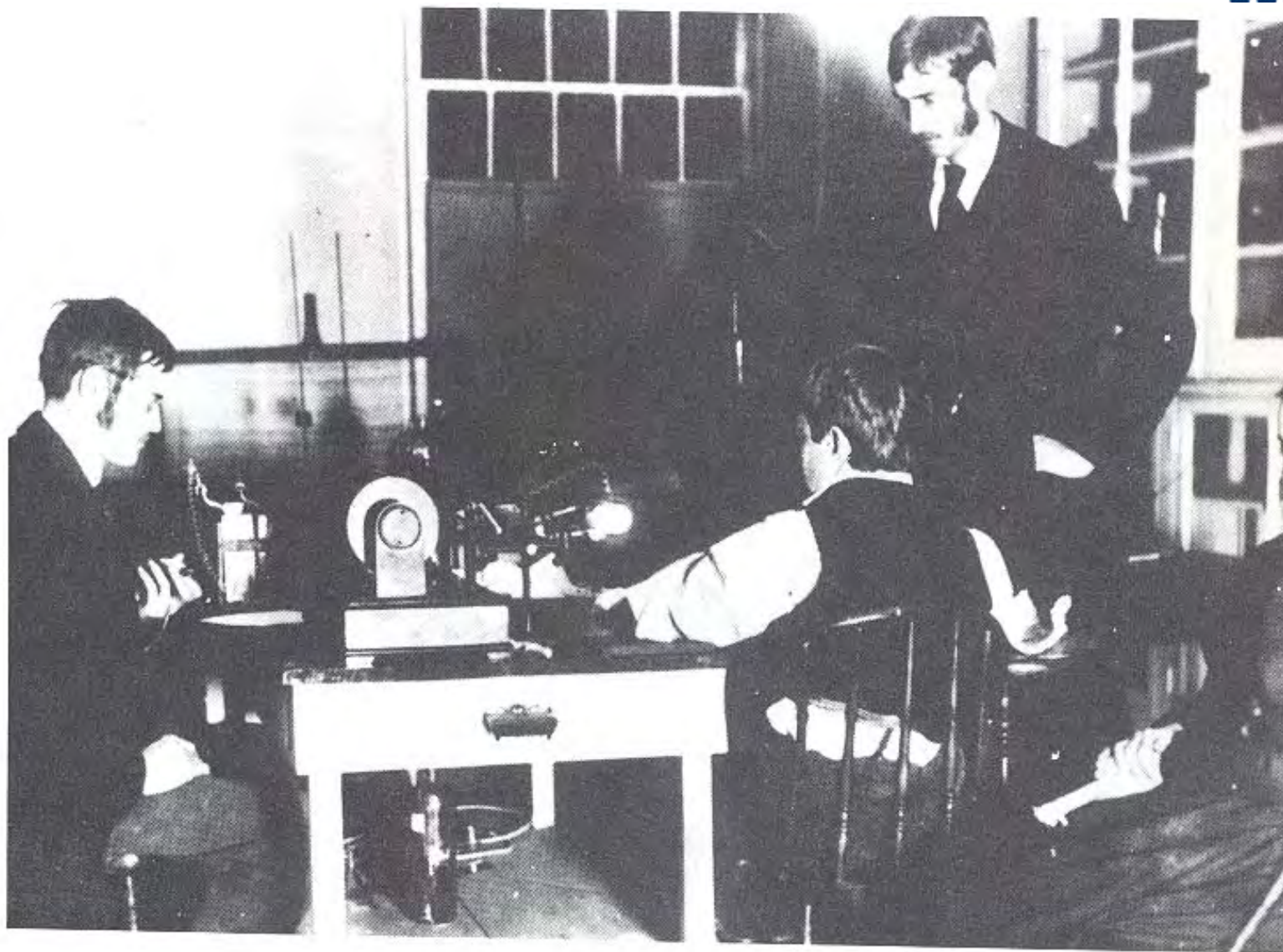
Basic Radiation Safety/Protection
for
The Radiologic Technologists
Presented by
Jay M. Yoder, MS

Radiologic Technologist

- **Diagnostic Technologists
(Radiographers)**
- **C.T.**
- **Nuclear Medicine**
- **Radiation Oncology**

Radiation

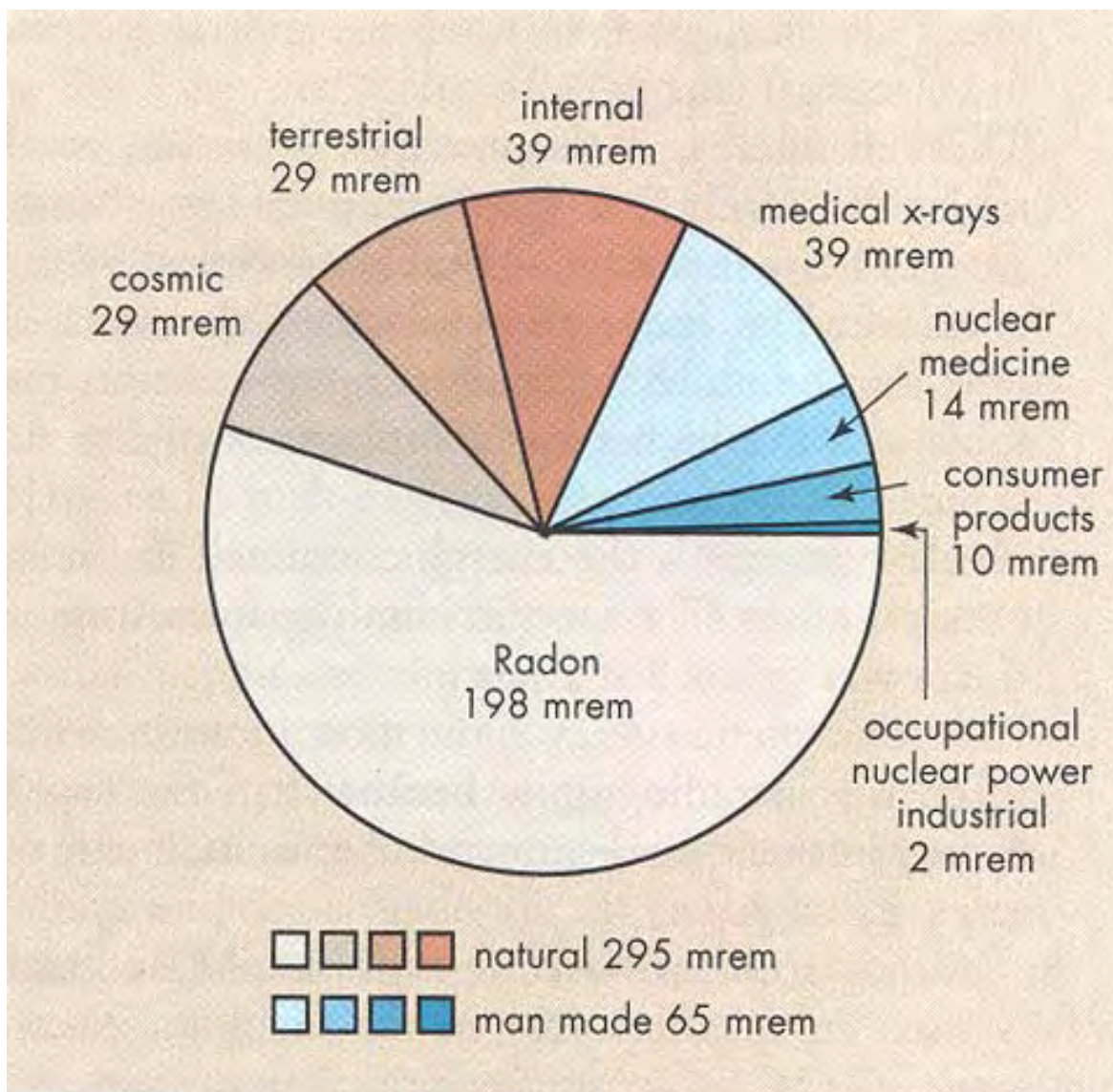
What is it?





Radiation

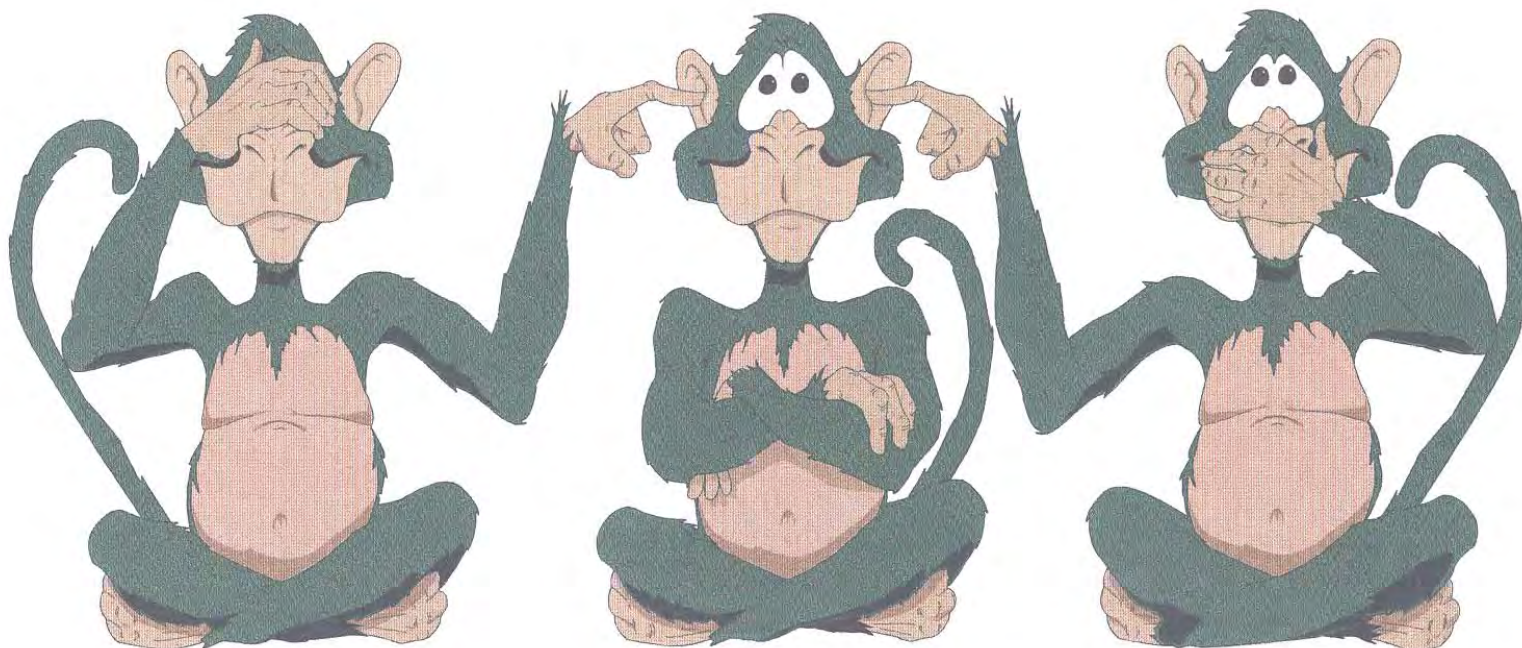
- Is an electromagnetic radiation that is an energy that is emitted by a source and transferred through space.



Characteristics of X-Radiation

- Energy
- Velocity
- Travels in waves
- Travels in a straight line
- *Penetration*
- *Photographic abilities*
- **Affects living tissue**

SENSELESS



Units of Radiation

- **Roentgen**
 - **Rad**
 - **Rem**
 - **Curie**

Roentgen (R)

- Measures **QUANTITY** of x-ray
in air

mR/hr

mR

mR/ma-min

RAD

- Radiation Absorbed Dose
- mRad
- Measures **absorption of tissue**
- Fetal dose
- Bone marrow dose
- Gray (Gy)

REM

- **R**adiation **E**quivalent **M**an

Measures **occupational dose**

- **mRem**
- **Film badge (personnel monitoring)**
 - **Sievert (Sv)**

Curie (Ci)

- Measures amount of radioactivity

uCi **microCurie**

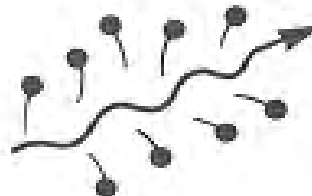
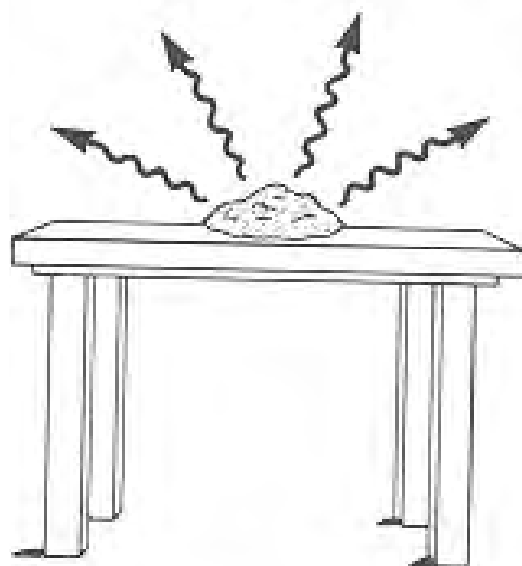
In Nuclear Medicine

Exposure of
radiation monitor
measured in
rems

Intensity of
gamma rays
measured in
roentgens

Absorbed
radiation
measured
in rads

Radioactive
material measured
in curies





Characteristics of X-Ray

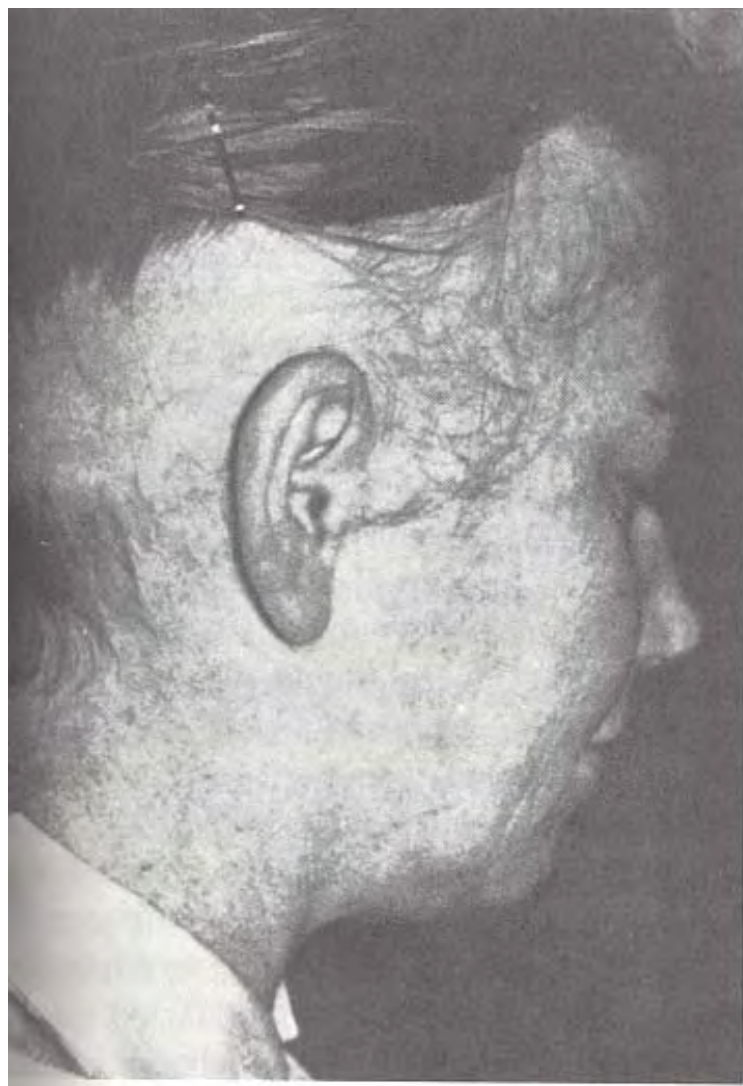
- Affects living tissue
 - Radiobiology





Figure 7-5

Actinic keratosis and its complications. (Dorland)



Biological Effects

- There are **two** effects of living tissue when interacts with radiation.

1. Non-stochastic Effect

2. Stochastic Effect

Non-Stochastic Effect

- 1. (also called deterministic effect)
- 2. Effects are increased in **severity with increase in dose.**
- 3. A certain amount of radiation is required before tissue/cells are affected (**Threshold**)

Non-Stochastic Effects

- a. Non-malignant damage to skin**
- b. Cataracts**
- c. Impairment to fertility**

Non-Malignant damage to skin

- **Skin erythemia**
- Single Dose of radiation of 300 rad or more can cause erythemia within 1 to 2 days up to 2 weeks
- 300 rad = 300,000 mRAD
- (considered early effect)

Cataract Induction

- **Threshold ~ > 200 rad
single dose**
- **1,000 rad exposure 100 %
will develop cataracts**
- **(considered late effect)**

Fertility Issues

1. Males

- **10 RAD minimal aspermia**
- **200 RAD Temporary infertility**
- **500 RAD Sterility**
- **(Abstain from intercourse)**

Females

- **Single exposure direct at ovaries**
- **10 rad may result in delay or suppression of menstruation**
- **200 rad pronounced temporary sterility**
- **500 rad permanent sterility**

- **How do we protect from Non-stochastic effects?**

Regulatory Bodies

- **Establishes thresholds for radiation worker and for general public**

TEDE

- **Total effective dose equivalent**
- **Is the sum of the deep dose equivalent, DDE, (for external exposure) and the committed effective dose equivalent, CDE, (for internal exposure)**

Annual Effective Dose Limits

- **Was once called maximum permissible dose or MPD**

Annual Effective Dose Limits

Radiation Worker

Whole Body

5.0 Rem or

5,000 mRem

Annual Effective Dose Limits

Radiation Worker

Skin and Extremities

50.0 Rem or

50,000 mRem

Annual Effective Dose Limits

Radiation Worker

Eyes

15.0 Rem or

15,000 mRem

Annual Effective Dose Limits

Radiation Worker

Fetus

0.5 Rem

500 mRem

Annual Effective Dose Limits

General Public

0.1 Rem

100 mRem

- **MONITORING
LIMITS ARE WELL
BELOW
THRESHOLDS**

•Luxel Total Body Badge



•T.L.D. Ring Badge



LANDAUER®

WALTER L ROBINSON & ASC
2624 SPRING VALLEY ROAD
LANCASTER PA 17601

Landauer, Inc. 2 Science Road Glenwood, Illinois 60425-1586
Telephone: (708)755-7000 Facsimile: (708)755-7016
www.landauerinc.com



RADIATION DOSIMETRY REPORT

ACCOUNT NO.	SERIES	ANALYTICAL WORK ORDER	REPORT DATE	DOSIMETER RECEIVED	REPORT IN WORK	TIME DAYS	PAGE NO.
			10/11/00	10/02/00		7	1 OF 1

PARTICIPANT NUMBER	NAME			DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW			YEAR TO DATE DOSE EQUIVALENT (MREM)			LIFETIME DOSE EQUIVALENT (MREM)			RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
	ID NUMBER	BIRTH DATE	SEX				DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE		
FOR MONITORING PERIOD:							07/01/00 - 09/30/00			2000							
00006	OLLEY JACK			P	WHBODY	+P	32	33	34	48	50	52	519	521	534	3	01/91

M: MINIMAL REPORTING SERVICE OF 1 MREM

QUALITY CONTROL RELEASE: JS

1 - PR 7077 - RPT131 - N1

- 27613

* - NO CONTROL SUBTRACTED

Stochastic Effect

- **Probability of occurrence of effects increases in proportion to increases of radiation dose of the entire population**
- **Any amount of radiation can produce the effect**

Induction of cancers

- **Leukemia**
- **Could be as low as 50 rad more likely 200 rad (A bomb patients)**
- **Thyroid cancer, Bone cancer, Skin cancer**
- **Lung cancer, liver cancer**

Genetic Mutations

- **Females (10 RAD in utero)**

- 1. 0-2 weeks

- Spontaneous abortion

- 25% natural; 0.1% radiation response

- 2. 2-10 weeks

- Congenital abnormalities 5% 1.0%

- 3. 2-15 weeks

- Mental Retardation 6 % 0.5%

- **How much radiation does the patient get?**

**Primary beam interacts with
patient**

- A. Absorbed (all energy)**
- B. Scatter (some energy)**
- C. All goes through (no
absorption or scatter)**

Scatter from patient

- **1. In all directions**
- **2. 0.1% of intensity of primary beam**
- **3. 100 mR going in only 0.1 mR out as scatter**
- **4. (of course depends on patients built etc)**

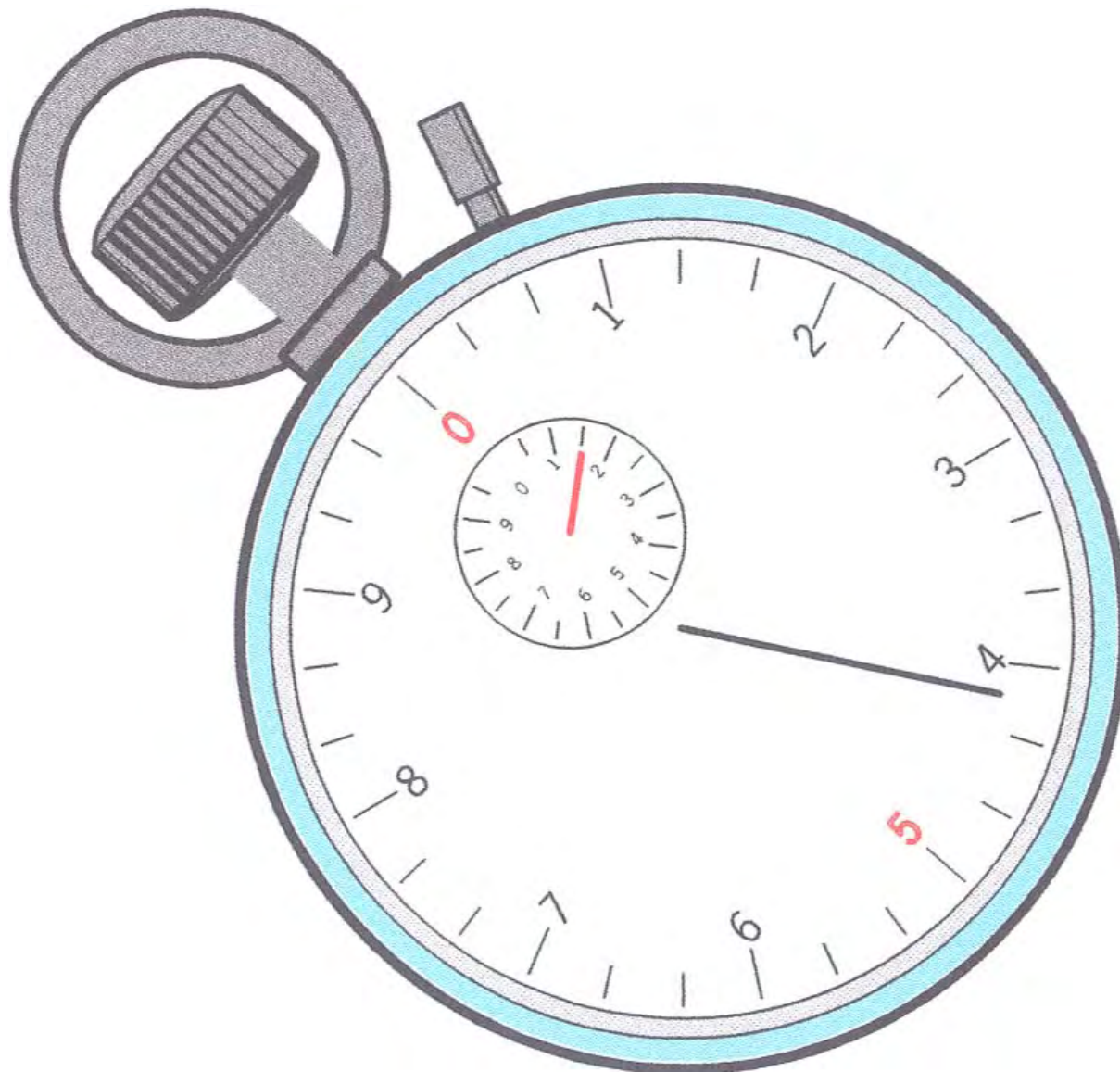
Common exposures for common procedures

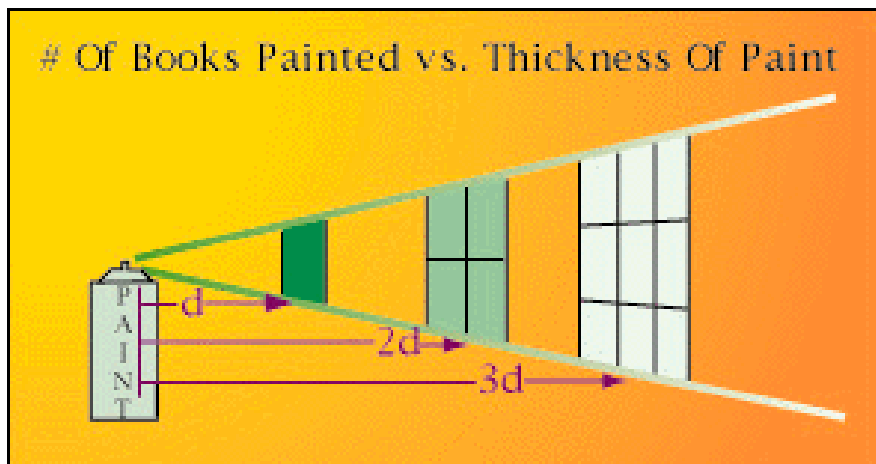
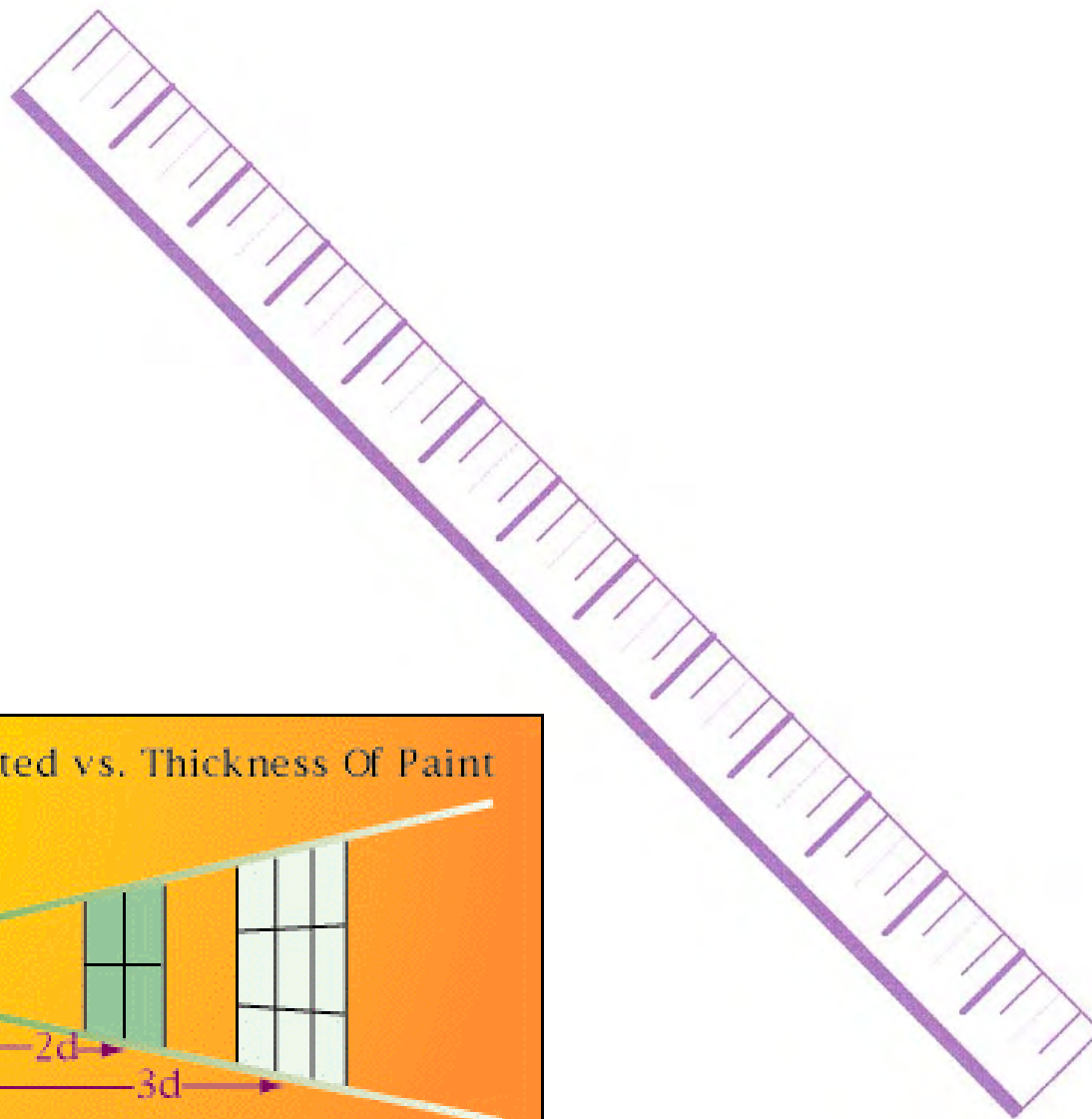
- | | | |
|-------------------|-----------|--------------|
| • Skull (lateral) | 70 mR ESE | 0 mRad fetal |
| • Cervical Spine | 110 mR | 0 |
| • Shoulder | 90 | 0 |
| • Chest (PA) | 10 | 0 |
| • T-Spine (AP) | 180 | 1 |
| • L-Spine (AP) | 250 | 80 |

- **Abdomen (AP KUB) 220 70**
- **IVP 210 60**
- **Hip 220 50**
- **Wrist/foot 5 0**
- **CT (2-3 rad)**

- **How do we protect ourselves from Stochastic effects?**











Also *we* can (should)

- **Analyze the patient**
- **Explain to the patient**
- **Utilize the correct technique**
- **Utilize immobilization techniques**
- **Use common sense**

Remember

**Any time you repeat an
X-ray (or study)**

**The patient [and you] will get
double the amount of
radiation**

A.L.A.R.A.

As Low As Reasonably
Achievable

- 1. A radiation “mission statement” or commitment to keep radiation exposures As Low As Reasonably Achievable.**
- 2. R.S.C. Quarterly**
- 3. Radiation Safety Officer**

• **Do you know who your**

R.S.O.

is?

Role of medical health physicist

- 1. Annual evaluation on all x-ray tubes**
- 2. Outputs on all fluoro tubes**
- 3. Calculate patient entrance skin doses**
- 4. Attend Radiation Safety Committee**
- 5. Perform QC tests in NM**
- 6. Consult on radiation safety issues**

New Construction

- 1. Review blue prints for new room**
- 2. Inspect construction of new room**
- 3. Radiation safety survey of new room**

SAFE???

- **YOU BET IT IS !!!!!**

