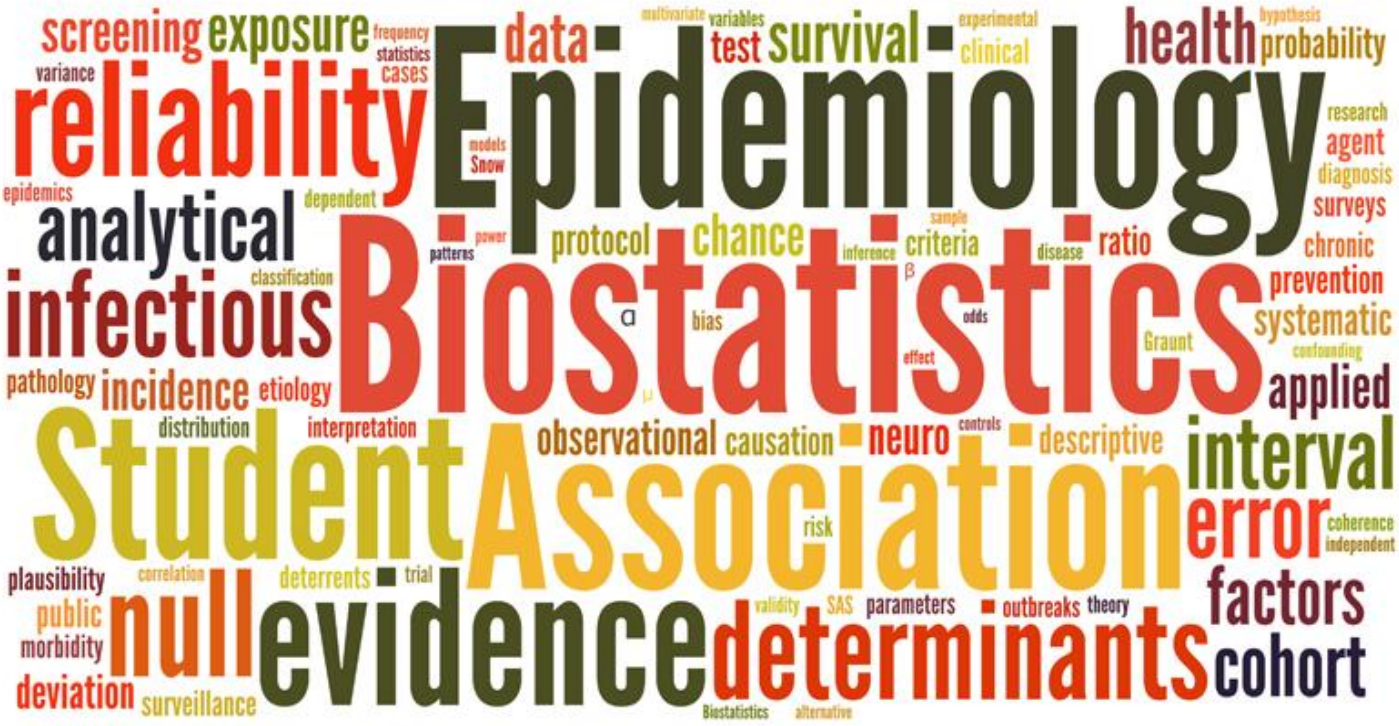
University of Jordan
Faculty of Medicine



☐ Sheet ☑ Slide ☐ Handout

Number: 6

Subject: Radiation in Occupational Health

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Price:

Date:

Radiation in Occupational Health

Why is occupational health and safety important?

- Work plays a central role in people's lives, since most workers spend at least eight hours a day in the workplace, whether it is on a plantation, in an office, factory, etc.
- Therefore, work environments should be safe and healthy. Yet this is not the case for many workers.
- Every day workers all over the world are faced with a multitude of health hazards, such as: dusts; gases; noise; vibration; & extreme temperatures.

Occupational Health, History

- The first written discussions specifically directed toward matters of occupational safety and health were those of **Paracelsus**, in the fifteenth century.
- In the early eighteenth century, **Bernadino Ramazzini** wrote the first bookt on occupational medicine, *De morbis artificium diatribe (**Diseases of Workers**)*, and he is generally regarded as the "father of occupational medicine."
- Ramazzini wrote about the health hazards for dozens of occupations.

Occupational Health, History

- In the United States, in the early twentieth century, Dr. Alice Hamilton became the first woman physician appointed to a faculty position at Harvard University, where she worked at the School of Public Health promoting safe and healthful work practices in the United States.
- She has been recognized as the leader of the occupational medicine movement in the United States, which came relatively late compared with that in Europe.

So, what is there problem with occupational health?

- Unfortunately some employers assume little responsibility for the protection of workers' health and safety.
- In fact, some employers do not even know that they have the moral and often legal responsibility to protect workers.
- As a result of the hazards and a lack of attention given to health and safety, work-related accidents and diseases are common in all parts of the world.

Identifying Safety and Health Hazards

The terminology used in OSH varies between states, but generally speaking:

- A **hazard** is something that can cause harm if not controlled.
- The outcome is the harm that results from an uncontrolled hazard.
- A **risk** is a combination of the probability that a particular outcome will occur and the severity of the harm involved.

Identifying Safety and Health Hazards

- In the context of OSH, “harm” generally describes the direct or indirect degradation, temporary or permanent, of the physical, mental, or social well-being of workers.
- For example, repetitively carrying out manual handling of heavy objects is a hazard.
- The outcome could be a musculoskeletal disorder (MSD) or an acute back or joint injury.
- The risk can be expressed numerically (e.g. a 0.5 or 50/50 chance of the outcome occurring during a year), in relative terms (e.g. "high/medium/low"), or with a multi-dimensional classification scheme (e.g. situation-specific risks).

Common workplace hazard groups

1- Mechanical hazards.

By type of agent:

- Impact force
- Confined space
- Slips and trips
- Falling on a pointed object
- Compressed air/high pressure
- Entanglement
- Equipment-related injury
- *By type of damage:*

- Crushing, Cutting, Friction and abrasion, Shearing , Stabbing and puncture

2- physical hazards .

- Noise
- Vibration
- Lighting
- Barotrauma (hypobaric/hyperbaric pressure)
- **Ionizing radiation**
- Electricity
- Asphyxiation
- Cold stress (hypothermia)
- Heat stress (hyperthermia)

3- Biological hazards: include

- Bacteria
- Virus
- Fungi
- Blood-borne pathogens
- Tuberculosis

4- Chemical hazards .

- include:

Acids

Bases

Heavy metals

Solvents

Particulates

Fumes (noxious gases/vapors)

Highly-reactive chemicals

Fire, conflagration and explosion hazards.

5- Psychosocial issues include

- Work-related stress, whose causal factors include excessive working time and overwork .
- Violence from outside the organisation .
- Bullying, which may include emotional and verbal abuse
- Sexual harassment
- Burnout
- Exposure to unhealthy elements during meetings with business associates, e.g. tobacco, uncontrolled alcohol

Radiation….
Historical Background

- 1895 - Wilhelm Conrad Roentgen discovered X-rays and in 1901 he received the first Nobel Prize for physics.
- 1903 - Marie Curie and Pierre Curie, along with Henri Becquerel were awarded the Nobel Prize in physics for their contributions to understanding radioactivity, including the properties of uranium.
- 1942 - Enrico Fermi and others started the first sustained nuclear chain reaction in a laboratory beneath the University of Chicago football stadium.
- 1945 – Nuclear bombs dropped on Japan.

Radium Girls

Not to worry," their bosses told them. "If you swallow any radium, it'll make your cheeks rosy.“

The women at Radium Dial sometimes painted their teeth and faces and then turned off the lights for a laugh.

From: 'Radium Girls' By Martha Irvine, Associated Press, Buffalo News, 1998

Case Study: Radium

1898 – Discovered by Marie Curie

1900-1930 – Radium Therapy - used to treat arthritis, stomach ailments and cancer

Accepted by American Medical Association

WWI – Use of radium on watch dials

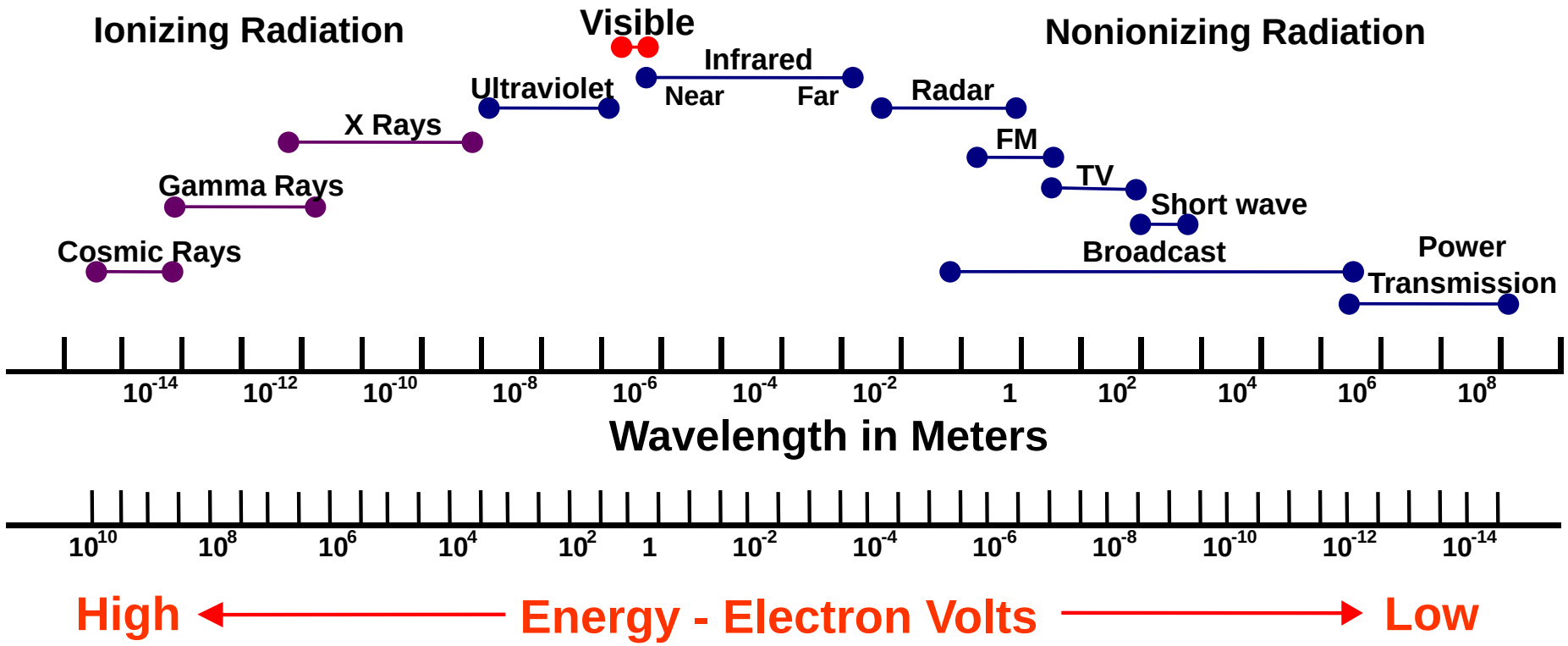
1920s – U.S. Radium corporation employed young women to paint watch dials

Late 1920s – Radium girls sue, win and receive compensation

Life & Radiation

- All life is dependent on small doses of electromagnetic radiation.
- For example, photosynthesis and vision use the suns radiation.

Electromagnetic Spectrum



Radiation

Nonionizing

Ultraviolet, visible light, infrared, microwaves, radio & TV, power transmission

Ionizing

Radiation capable for producing ions when interacting with matter – x-rays, alpha, beta, gamma, cosmic rays

Nonionizing Radiation

- **Sources**
  - Ultraviolet light
  - Visible light
  - Infrared radiation
  - Microwaves
  - Radio & TV
  - Power transmission

Ultraviolet - Sources

- Sun light
- Most harmful UV is absorbed by the atmosphere
- Fluorescent lamps
- Electric arc welding
  Can damage the eye (cornea)
- Germicidal lamps

Eye damage from sun light
Skin cancer

Ultraviolet - Effects

- High ultraviolet – kills bacterial and other infectious agents
- High dose causes - sun burn – increased risk of skin cancer
- Pigmentation that results in suntan
- Suntan lotions contain chemicals that absorb UV radiation
- Reaction in the skin to produce Vitamin D that prevents rickets

Visible Light

- Energy between 400 and 750 nm
- High energy – bright light produces of number of adaptive responses
- Standards are set for the intensity of light in the work place (measured in candles or lumens)

Infrared Radiation

- Energy between 750 nm to 0.3 cm
- The energy of heat – Heat is the transfer of energy
- Can damage – cornea, iris, retina and lens of the eye (glass workers – “glass blower’s cataract”)

Microwaves & Radio Waves

- Energy between 0.1 cm to 1 kilometer
- Varity of industrial and home uses for heating and information transfer (radio, TV, mobile phones)
- Produced by molecular vibration in solid bodies or crystals
- Health effects – heating, cataracts
- Long-term effects being studied

Electrical Power

- Standard in homes and businesses
- Highest level of exposure from electric-power generation and distribution system (high voltage power lines)
- Medical system – Magnetic imaging
- Acute health effects – shock
- Long-term health effects appear to be few but may some data do suggest adverse effects

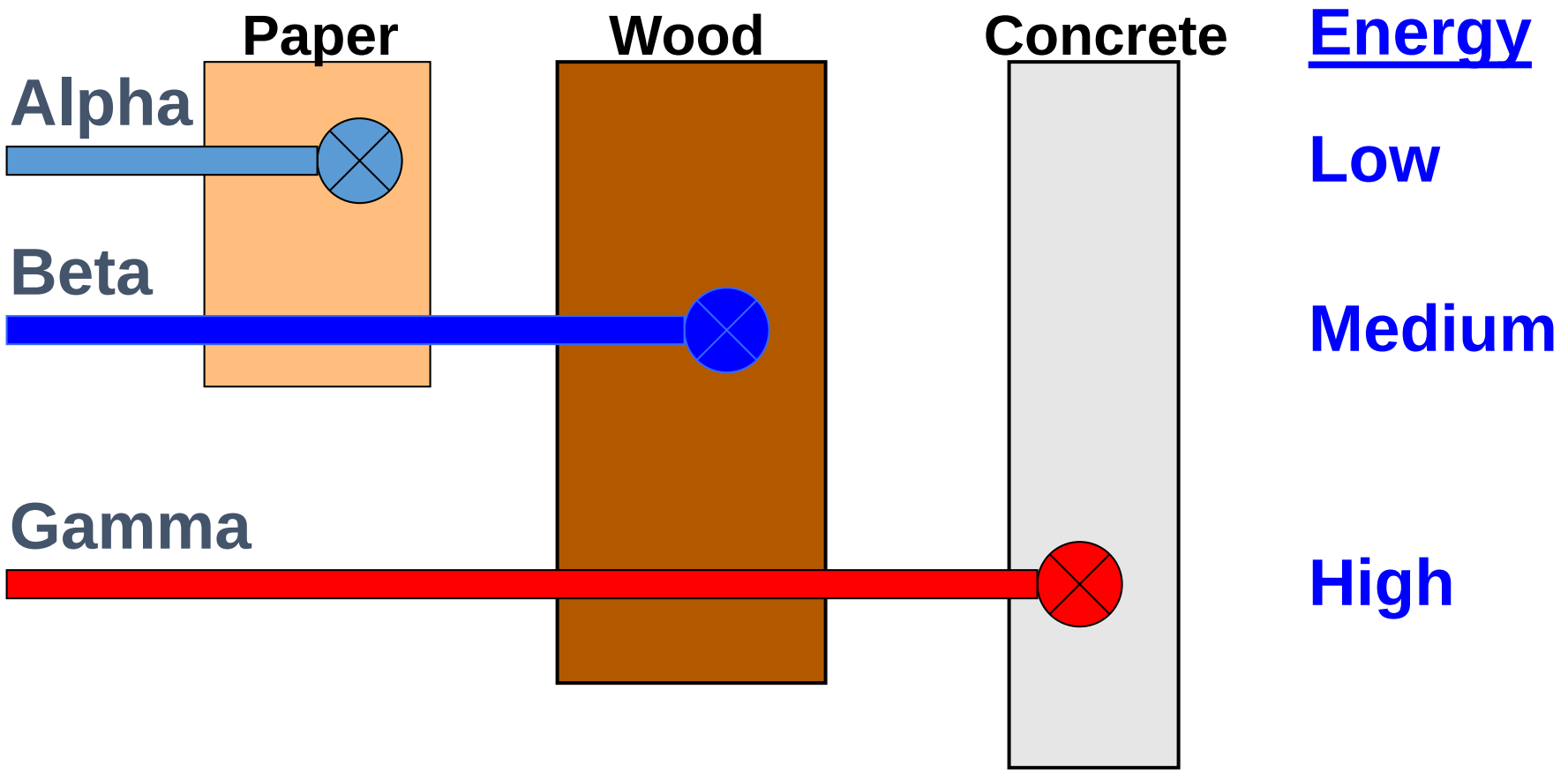
Ionizing Radiation

Ionization Defined

Radiation capable for producing ions when interacting with matter – in other words enough energy to remove an electron from an atom.

Sources – x-rays, radioactive material produce alpha, beta, and gamma radiation, cosmic rays from the sun and space.

Ionizing Radiation



Radioactive Material

- Either natural or created in nuclear reactor or accelerator
- Radioactive material is unstable and emits energy in order to return to a more stable state (particles or gamma-rays)
- Half-life – time for radioactive material to decay by one-half

Gamma-rays

- Electromagnetic photons or radiation (identical to x-rays except for source)
- Emitted from nucleus of radioactive atoms – spontaneous emission
- Emitted with kinetic energy related to radioactive source
- Highly penetrating – extensive shielding required
- Serious external radiation hazard

X-rays

- Overlap with gamma-rays
- Electromagnetic photons or radiation
- Produced from orbiting electrons or free electrons – usually machine produced
- Produced when electrons strike a target material inside and x-ray tube
- Emitted with various energies & wavelengths
- Highly penetrating – extensive shielding required
- External radiation hazard
- Discovered in 1895 by Roentgen

Ionizing Radiation Health Effects

We evolved with a certain level of naturally occurring ionizing radiation from cosmic radiation, and radioactive materials in the earth.

We have in our bodies mechanisms to repair damage.

Radiation Units

Exposure – X (joul/kg)

(Related to energy)

Absorbed Dose – Gray (Gy)

(amount of energy absorbed)

Equivalent Dose – Sievert (Sv)

(makes different sources of radiation equivalent)

Regulations … Standards

Occupational Exposure Guidelines

100 mSv over 5 years (average 20 mSv/year) with a maximum of 50 mSv in any one year

General public – back ground about 3 mSv/year – Guideline 1 mSv/year

Recommended exposure limits are set by the US National Council on Radiation Protection (NCRP) and world wide by International Council on Radiation Protection (ICRP).

Dose Response Tissue

Examples of tissue Sensitivity

Very High	**White blood cells (bone marrow)** **Intestinal epithelium** **Reproductive cells**
High	**Optic lens epithelium** **Esophageal epithelium** **Mucous membranes**
Medium	**Brain – Glial cells** **Lung, kidney, liver, thyroid, pancreatic epithelium**
Low	**Mature red blood cells** **Muscle cells** **Mature bone and cartilage**

Dose Response Issues

Dose (Sv)	Effects / organ	Time to death	Death (%)
1-2	Bone marrow	Months	0-10
2-10	Bone marrow	Weeks	0-90
10-15	Diarrhea, fever	2 weeks	90-100
>50	Neurological	1- 4 hrs	100

Half-life

- Rate of decay of radioisotope
- How long it takes to lose half their strength

- Can range from very short to billions of years

- Carbon – 5730 years, which makes it valuable for dating

Reducing Exposure

- **Time**
  Reduce the time spent near the source of radiation.

- **Distance**
  Increase the distance from the source of radiation.

- **Shielding**
  Place shielding material between you and the source of radiation.