**Session No 10**

**Radiation Pollution**

**1/ What is Radiation?**

Radiation is the emission or transmission of energy in the form of **waves** or **particles**. **Particles** جسيمات refer to tiny, discrete units of matter or energy with physical properties like mass, charge.

In the context of radiation, particles are subatomic entities الكائنات دون الذرية that are emitted during nuclear reactions or other high-energy processes.

**2/ Types of Particles in Radiation**

1. **Alpha Particles (α)**
   * Consists of 2 protons and 2 neutrons (essentially a helium **nucleus النواة**).
   * Heavy and positively charged.
   * Low penetration power (can be stopped by paper or skin).
   * Harmful if ingested or inhaled.
2. **Beta Particles (β)**
   * High-speed electrons emitted from the nucleus during radioactive decay.
   * Lighter and more penetrating than alpha particles but can be stopped by a thin aluminium sheet.
   * Can cause damage to living tissues upon direct exposure.
3. **Neutrons**
   * Neutral particles found in the nucleus of atoms.
   * Emitted in nuclear reactions (e.g., in **nuclear** reactors).
   * Can penetrate deeply into materials used in industrial and medical applications.
4. **Protons**
   * Positively charged particles found in the nucleus of atoms.
   * Rarely emitted directly but play a role in certain types of radiation.
   * Penetration depends on their energy.
5. **Gamma Rays and X-rays (Wave-Particle Duality)**
   * Although considered electromagnetic waves, they exhibit particle-like properties called photons (packets of energy).
   * Highly penetrating and require dense materials like lead الرصاص for **shielding** الوقاية ,التدريع through space.

**3/ Types of Radiation**

* **Ionizing Radiation**: الإشعاع المؤين
* Ionizing radiation can cause changes in living matter
* الإشعاع المؤين يمكن أن يسبب تغييرات في المادة الحية
* Includes alpha particles, beta particles, gamma rays, X-rays.
* These are high-energy particles capable of ionizing atoms تأيين الذرات and molecules الجزيئات, causing damage to living tissues.
* **Non-Ionizing Radiation**: Includes visible light, microwaves, radio waves, and ultraviolet radiation (lower-energy radiation that doesn't ionize atoms).
* **الإشعاع غير المؤين**: يشمل الضوء المرئي، والموجات الدقيقة، والموجات الراديوية، والإشعاع فوق البنفسجي.

**4/ Radiation Units of Measurement**

* Sieverts (Sv) and millisieverts (mSv) for biological effects of radiation.
* **سيفرت (Sv) وميلي سيفرت (mSv)** لتأثيرات الإشعاع البيولوجية.
* Gray (Gy) and becquerels (Bq) for radiation absorbed and emitted by materials.
* **غراي (Gy) وبيكريل (Bq)** للإشعاع الممتص والمنبعث من المواد

**5/ Sources of Radiation Pollution**

**Natural Sources**

* Cosmic radiation from the sun and outer space.
* الإشعاع الكوني من الشمس والفضاء الخارجي.
* Terrestrial radiation from naturally occurring radioactive materials (e.g., radon gas, uranium).
* الإشعاع الأرضي الناتج عن المواد المشعة الطبيعية (مثل غاز الرادون، اليورانيوم).
* Internal radiation from natural isotopes present in the human body.
* **الإشعاع الداخلي الناتج عن النظائر الطبيعية الموجودة في جسم الإنسان.**
* Natural isotopes are found in nature and are present in various materials, including air, water, soil, and even living organisms. The radiation from some natural isotopes (like radon, uranium, and potassium

**2.2 Anthropogenic (Human-Made) Sources**

* Nuclear power plants and nuclear fuel cycle.
* محطات الطاقة النووية ودورة الوقود النووي
* Medical procedures (X-rays, radiotherapy, nuclear medicine).
* Industrial applications (e.g., radiography, food irradiation, smoke detectors).
* التطبيقات الصناعية (مثل الأشعة السينية، إشعاع الطعام، كاشفات الدخان).
* Military activities (e.g., nuclear testing, uranium-based weapons).
* Consumer products (e.g., old luminous watches, certain building materials).
* المنتجات الاستهلاكية (مثل الساعات المضيئة القديمة، بعض مواد البناء).

**2.3 Accidental Releases of Radiation**

* Chernobyl disaster (1986).
* Fukushima Daiichi disaster (2011).
* Accidents during transport of radioactive materials.

**Environmental and Health Impacts of Radiation Pollution**

**Environmental Impact**

* Contamination of air, water, and soil with radioactive materials.
* Effects on ecosystems, including radiation-induced mutations in plants and animals.
* Long-term contamination of agricultural lands.

**3.2 Health Impacts on Humans**

* **Acute Health Effects**: Radiation sickness (nausea, vomiting, hair loss, skin burns).
* **Chronic Health Effects**: Increased risk of cancer (especially leukemia, thyroid, lung, and breast cancers), genetic mutations, and developmental issues.
* **Radiation Exposure and the Immune System**: Decreased immune function and potential for increased susceptibility to infections.
* انخفاض وظيفة الجهاز المناعي وزيادة القابلية للإصابة بالعدوى.

**3.3 Vulnerable Populations الفئات الضعيفة**

* Pregnant women, children, and individuals with weakened immune systems.
* Occupational risks for workers in nuclear industries or radiological fields.

**Detection and Measurement of Radiation Pollution**

**كشف وقياس تلوث الإشعاع**

**4.1 Radiation Detection Methods**

* **Dosimeters**: Personal and environmental radiation dose measurement.
* جهاز قياس الجرعة: قياس جرعة الإشعاع الشخصية والبيئية.
* **Geiger-Muller Counter**: Detecting ionizing radiation such as alpha, beta, and gamma radiation.
* **Scintillation Counters**: Used for detecting gamma radiation.
* عدادات الوميض: تُستخدم للكشف عن الإشعاع الجاما.
* **Ionization Chambers**: Used to measure environmental radiation levels.
* غرف التأين: تُستخدم لقياس مستويات الإشعاع البيئي.

**Monitoring Techniques**

* Remote sensing and satellite-based methods for detecting radiation in large areas (e.g., Chernobyl exclusion zone).

The **Chernobyl Exclusion Zone** refers to the area surrounding the site of the **Chernobyl nuclear disaster** in 1986, specifically a 30-kilometer radius around the nuclear power plant in northern Ukraine. This zone was established to limit human exposure to harmful levels of radiation released during the accident.

* Air, water, and soil sampling for radioactive contamination.

**Mitigation and Prevention of Radiation Pollution**

**6.1 Prevention Strategies**

* Reducing the use of radioactive materials in industrial and medical applications.
* Alternative energy sources to reduce reliance on nuclear power.
* Improved safety standards in nuclear power plants.

**6.2 Decontamination and Remediation**

* Methods for cleaning contaminated environments (soil decontamination, water treatment, etc.).
* Safe disposal of radioactive waste.
* Long-term containment of radiation sources (e.g., deep geological disposal for nuclear waste).الحجز طويل الأمد لمصادر الإشعاع (مثل التخلص العميق في الطبقات الجيولوجية للنفايات النووية).

**6.3 Public Health Initiatives**

* Health surveillance for populations near nuclear power plants and accident zones.
* Screening for radiation-induced diseases.الفحص للكشف عن الأمراض الناتجة عن الإشعاع
* Community education on radiation risks and safety practices.

**Radiation in Medical Treatments**

* Use of radiation in cancer therapy (radiotherapy).
* Safety protocols for radiation therapy patients and healthcare workers.
* Advances in radiation protection in medical settings.