

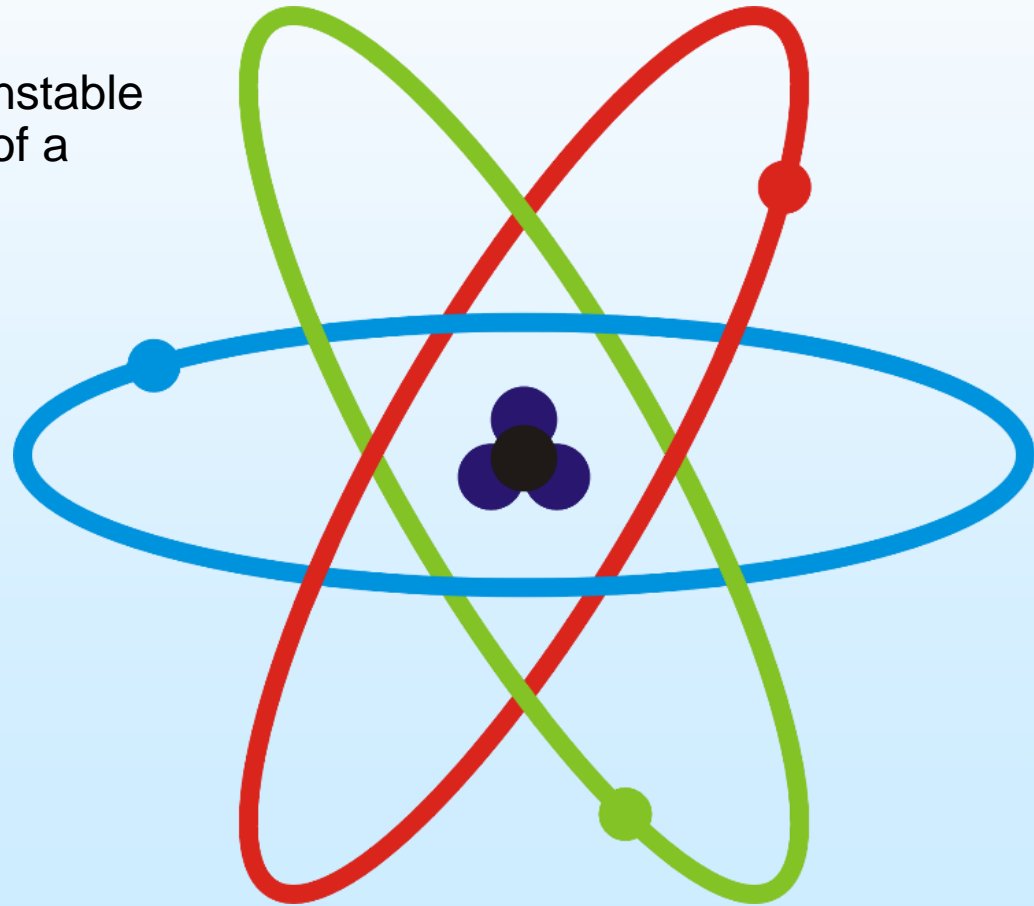
RADIOACTIVITY and RADIOACTIVE POLLUTION

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محاضرة رقم 6

Basic terms

Radiation: Energy in transit in the form of high speed particles or electromagnetic waves.

Radioactivity: A characteristic of an unstable atom that releases energy in the form of a particle or electromagnetic wave.



Radiation and Radioactive Material are a Natural Part of Our Lives

- 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.

Types of Radiation

- Radiation is classified into:
 - Ionizing radiation
 - Non-ionizing radiation

Ionization

- Ionizing radiation is produced by unstable atoms. Unstable atoms differ from stable atoms because they have an excess of energy or mass or both.
- Unstable atoms are said to be radioactive. In order to reach stability, these atoms give off, or emit, the excess energy or mass. These emissions are called radiation.

Ionizing Versus Non-ionizing Radiation

■ Ionizing Radiation

- Higher energy electromagnetic waves (gamma) or heavy particles (beta and alpha).**
- High enough energy to pull electron from orbit.**

■ Non-ionizing Radiation

- Lower energy electromagnetic waves.**
- Not enough energy to pull electron from orbit, but can excite the electron.**

Ionizing Radiation

■ Definition:

“ It is a type of radiation that is able to disrupt atoms and molecules on which they pass through, giving rise to ions and free radicals” .

The **international radiation symbol** (also known as the (**trefoil**) first appeared in 1946

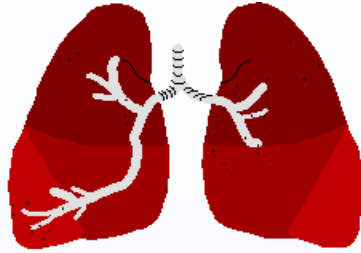


Sources of radiation

Humans are exposed to radiation from a number of different sources.



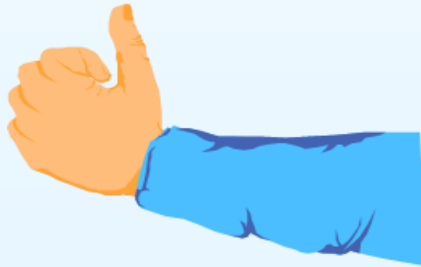
Pathways of internal exposure



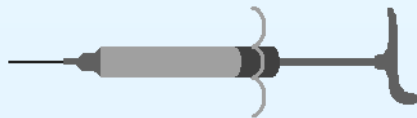
Inhalation



Ingestion



Absorption



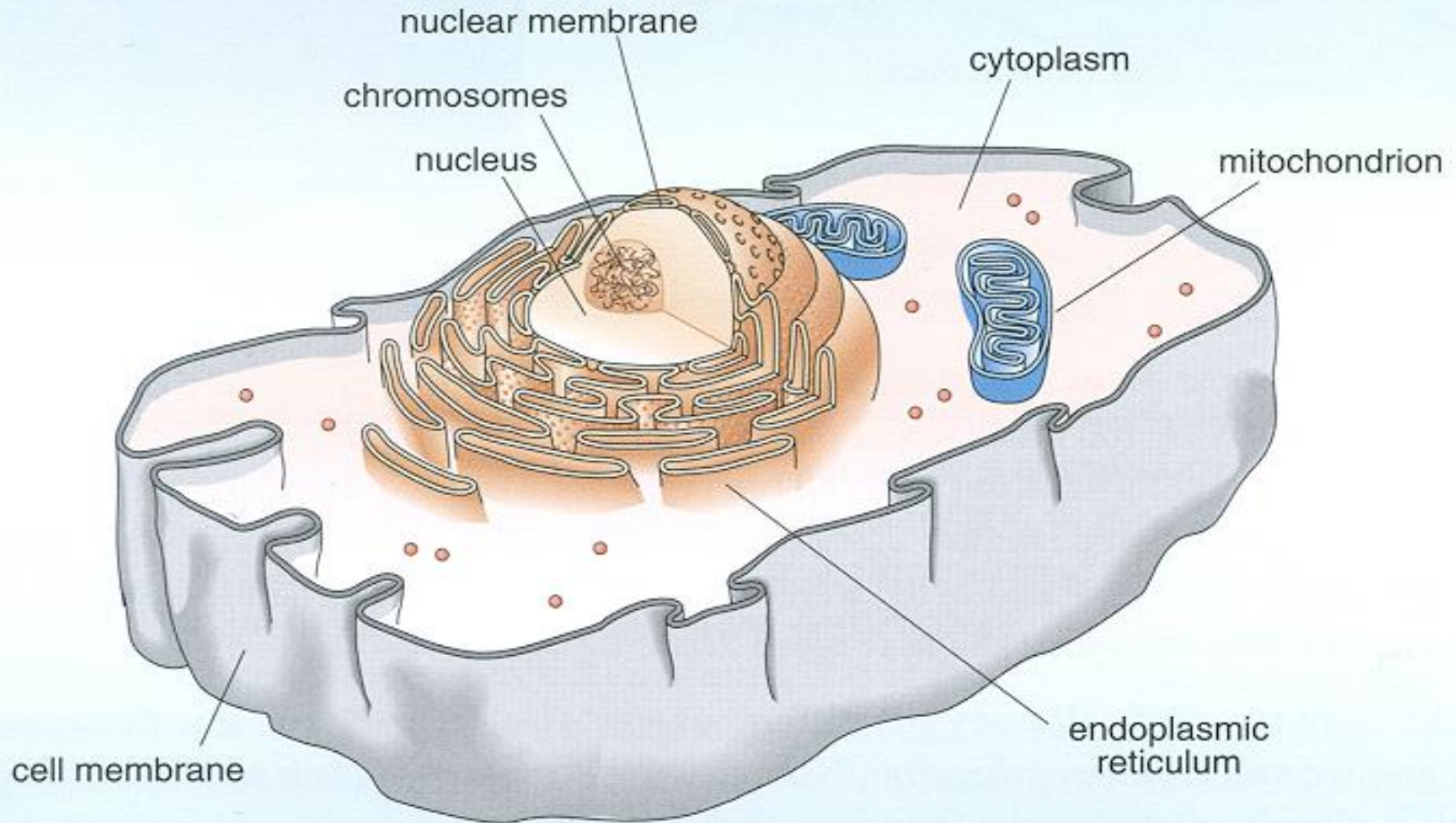
Puncture

Health effects of contamination

Biological effects

Radioactive contamination by definition emits ionizing radiation, which can irradiate the human body from an external or internal origin.

Animal Cell

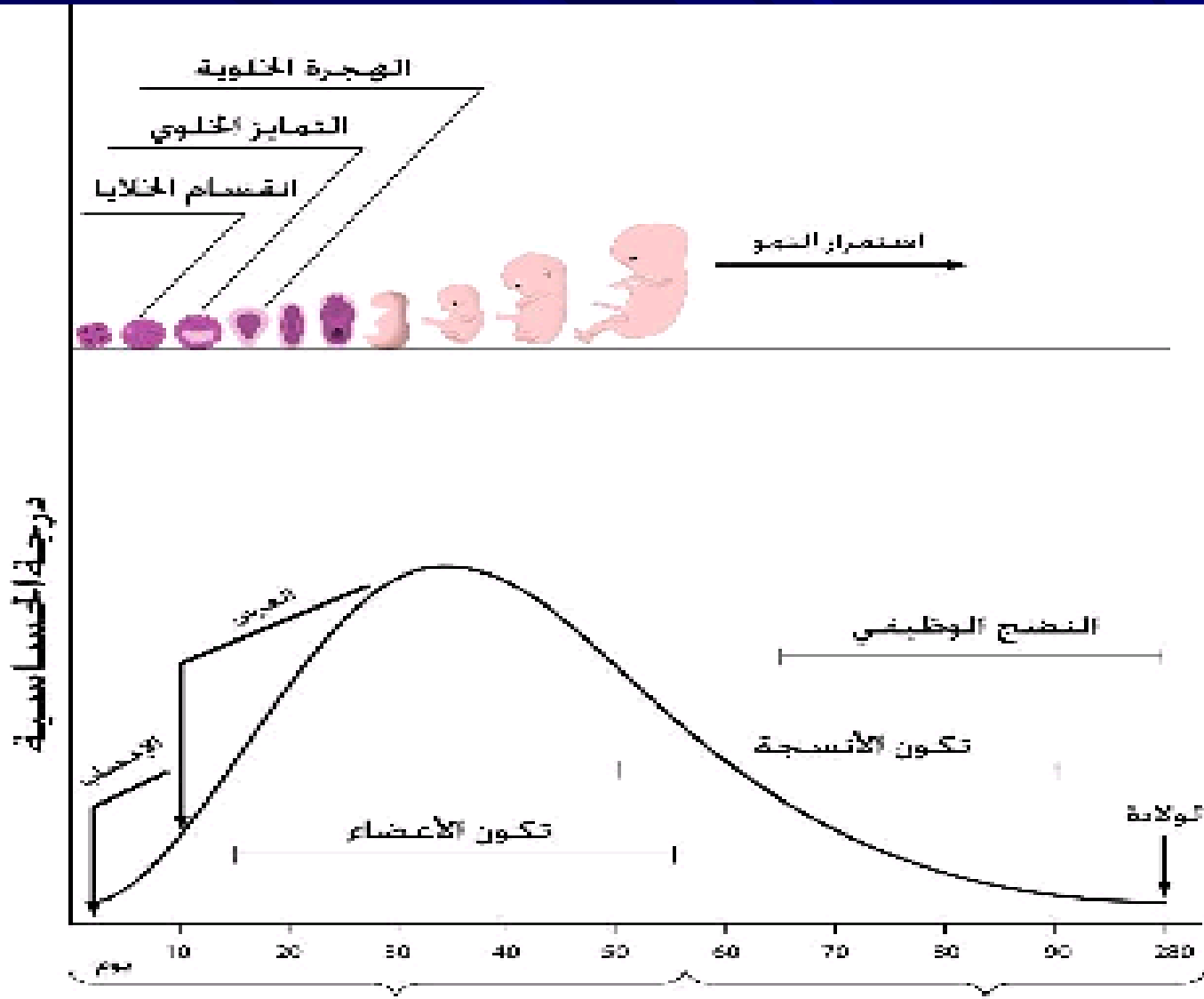


Dividing Cells are the Most Radiosensitive

- Rapidly dividing cells are more susceptible to radiation damage.
- Examples of radiosensitive cells are:
 - Blood forming Cells
 - The intestinal lining
 - Hair follicles
 - A fetus



This is why the fetus has a exposure limit (over gestation period) of 500 mrem (or 1/10th of the annual adult limit)



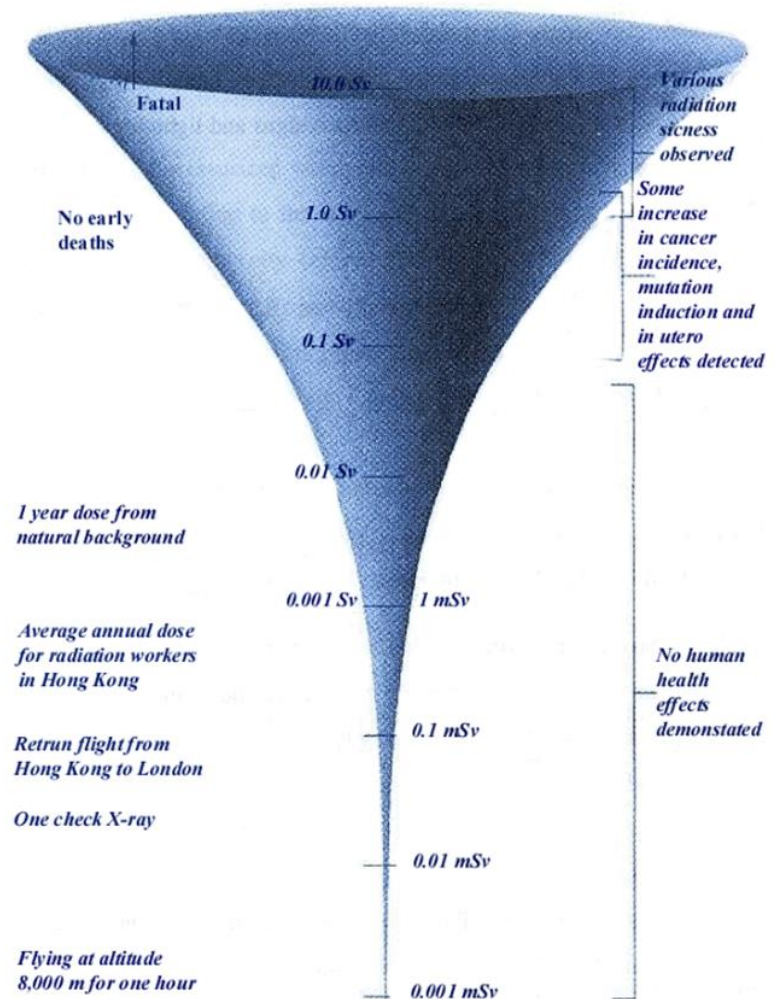
المراحل الجنينية في الحيوانات الثديية مع توضيح المدد الأكثر حساسية لحدوث التشوهات الخلقية بسبب التلوث الإشعاعي

Biological effects of radiation

Biological effects of radiation can be defined as **Non-Stochastic** or **Stochastic**.

Non-Stochastic Health Effects: result from exposure to high levels of radiation in a short period of time (also known as acute exposure). These effects become more severe as the exposure increases, and include skin damage, central nervous system effects, gastrointestinal effects and even death.

Effects of radiation



Biological effects of radiation, continued

Stochastic Health Effects: are biological effects associated with long-term, low-level (chronic) exposure to radiation.

These may include cancer, cataracts, birth abnormalities and other genetic effects as a result of damage to the DNA.



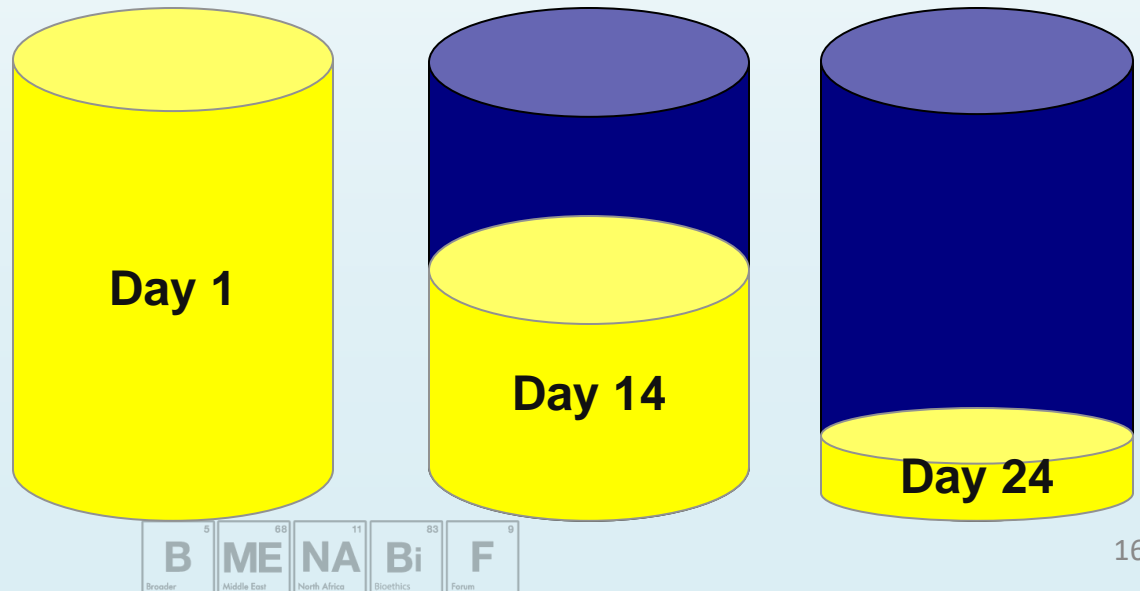
Radioactive decay: half-life

Half-life is the time it takes for the radioactivity for a given isotope, undergoing radioactive decay, to decrease to half its original value.

Half life is a unique property of each isotope, and can range from a fraction of a second to million of years.

Half life is commonly displayed as: $T_{1/2}$

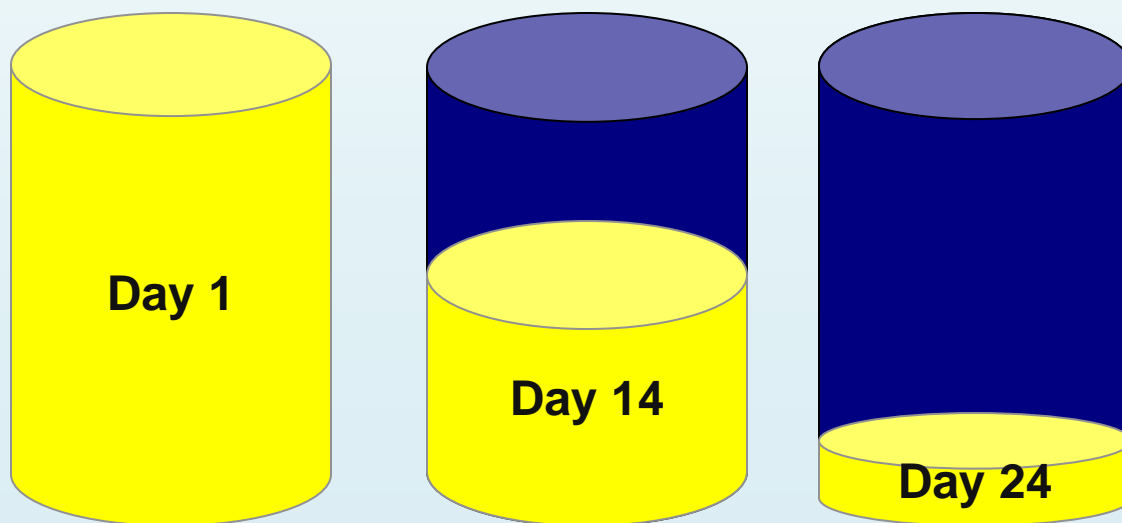
Radioactive
P-32 Atoms
 $T_{1/2} = 14$ days



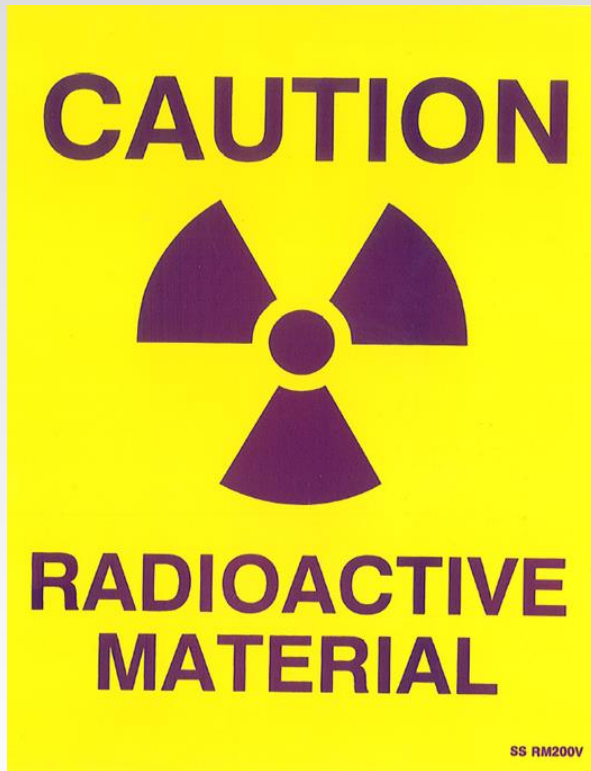
Examples of half lives ($T_{1/2}$)

Nuclide	Symbol	Half Life
Sodium 24	^{24}Na	15 hours
Phosphorus 32	^{32}P	14.3 days
Phosphorus 33	^{33}P	25.4 days
Sulfur 35	^{35}S	87.5 days
Iodine 125	^{125}I	60.1 days
Tritium	^3H	12.3 years
Carbon 14	^{14}C	5,730 years

Radioactive
P-32 Atoms
 $T_{1/2} = 14$ days



Labeling



Use for identifying areas where radioactive materials are used or stored.



Use for labelling areas where radiation sources are present.

TERATOGENIC EFFECTS IN ANIMALS





An Example of Human Teratogenic Effect



HIROSHIMA , JAPAN
1945

The Second World War

**Photograph of the atomic bomb dropped on Hiroshima
by USA Army**



Hiroshima in 1945



Hiroshima 55 years later



Another survived woman of Hiroshima bomb



A survived woman of Hiroshima bomb



