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Chest X-ray Taking Procedures Training for X-ray Technicians/ Radiographer

"Radiation Hazard"

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Content

Radiation Hazard

"The harmful effect caused by the penetration of the radiation in the body is called radiation hazard."

Reference: 10e **RADIOLOGIC SCIENCE FOR** TECHNOLOGISTS: PHYS, BIOL PROTECTION By **Bushong** ScD FACR FACMP, Stewart.

Radiobiological Effects:

When radiation passes through the body, it produces moving electrons.

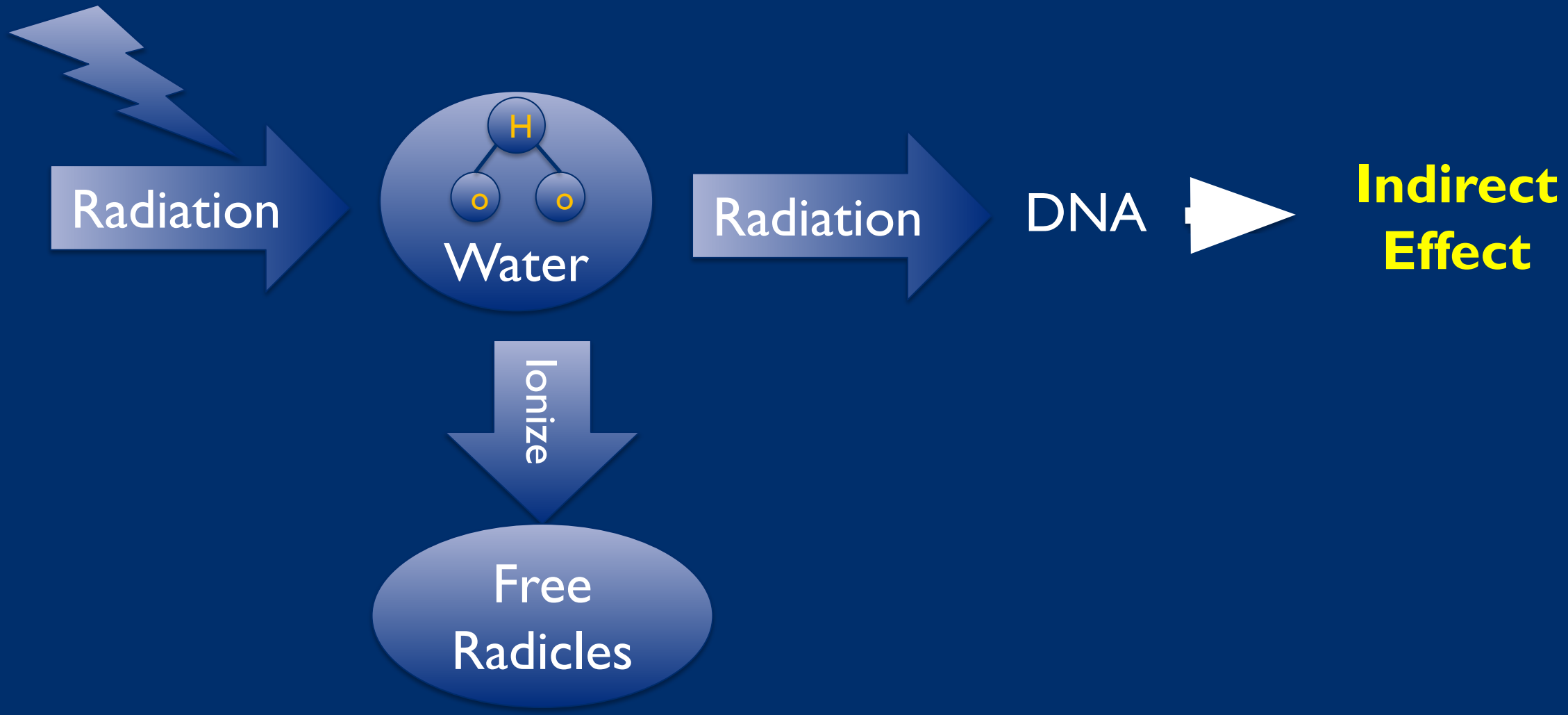
1. **Direct Effect**
2. **Indirect Effect**

Reference: 10e **RADIOLOGIC SCIENCE FOR** TECHNOLOGISTS: PHYS, BIOL PROTECTION By **Bushong** ScD FACR FACMP, Stewart.

1. Direct Effect

Photo reference: Author, mstroeck
Access for free at (https://commons.wikimedia.org/wiki/File:DNA_Overview2.png)

2. Indirect Effect



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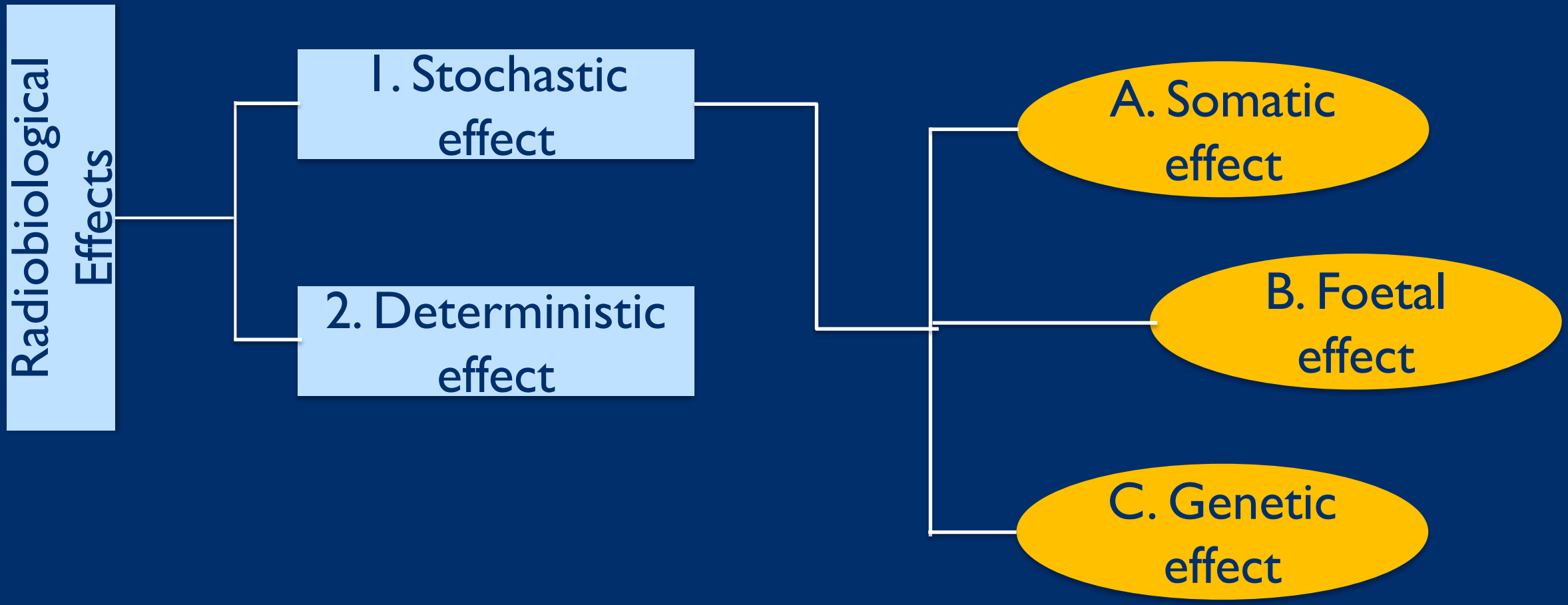
Classification of Radiobiological effects:



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1. Stochastic effect (Late effect / Chronic effect)

- The effect that appears after a period (latent period)
- Occurs at low dose less than 0.5 Gy
- Has no threshold dose
- E.g., carcinogenesis, skin necrosis

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1. Stochastic effect (Late effect / Chronic effect) – Cont.

Somatic Effect

- This effect appears in the life span of a particular individual
- Does not pass the next generation

Genetic Effect

- This effect alters the DNA sequence of the individual and results in mutations, which can be passed to the next generation.

Foetal Effect

- Depends on the gestation period of the pregnancy (40 weeks)

3 phases of foetal effect:

1) Pre-implantation period (1-9 days)
2) Period of major organogenesis (9-45 days)
3) Foetal period (45-252 days)

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Risk of stochastic effects

- Linked to the effective dose.

e.g. an abdominal x-ray - 1 mSv effective dose

- Children have a higher probability of radiation damage as they are developing and growing

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2. Deterministic Effect

- Appears soon after the penetration of radiation.
- Has a minimum threshold dose
- Increases severity of disease when increased in absorbed dose in the affected individual
- Appears at high dose that is greater than 0.5 Gy

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Deterministic effect thresholds

No	Exposed tissue	Net effect	Absorbed dose required for effect (Gy)	Time for effect to develop
1	Skin	Initial erythema	2	2-24 hours
		Erythema	3-6	1-4 weeks
		Hair-loss	3-4	2-3 weeks
2	Lens of eye	Cataract	3-5	Years
3	Bone marrow	Depression of blood formation	0.5	3-7 days

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Deterministic effect thresholds

No	Exposed tissue	Net effect	Absorbed dose required for effect (Gy)	Time for effect to develop
4	Gonads	Temporary sterility in males	0.15	3-9 weeks
		Permanent sterility	3.5-6	3 weeks

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Differences between Stochastic and Deterministic Effects

Stochastic effect	Deterministic effect
No threshold dose	Threshold dose
Mortality rate is less	Mortality or lethality rate is more
Latent period vary from few months to years ago e.g, cancer	Does not have latent period within days of the exposure e.g. erythema
Probability of disease increases with increase in absorbed dose	Severity of disease increases with increase in absorbed dose
Late effect	Early effect

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Measuring radiation dose (Absorbed dose)

Name	Definition / formula	Pros and cons	Units
Absorbed dose	Energy deposited per unit mass of tissue	Doesn't take into account effect for different types of radiation or sensitivity of different organs irradiated	Gray (Gy) (1 Gray = 1 joule/kg)

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Measuring radiation dose (Equivalent dose)

Name	Definition / formula	Pros and cons	Units
Equivalent dose	Absorbed dose to tissue x radiation weighting factor	Takes into account effectiveness of different radiation types in producing biological damage	Sievert (Sv)

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Measuring radiation dose (Effective dose)

Name	Definition / formula	Pros and cons	Units
Effective dose	Sum of (equivalent dose x tissue weighting factor)	Sensitivity of different tissues to radiation taken into account	Sievert (Sv) *Chest - 0.14 mSv

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THANK YOU !