

# BIOLOGICAL DOSIMETRY. APPLICATIONS

**Medical Imaging and Instrumentation**

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# BIOLOGICAL DOSIMETRY: DEFINITION

Technique which allows the evaluation of the **degree of exposure to ionizing radiation** through the study of the related biological effects

## OBJECTIVES

Predict the  
**health effects**

Evaluate the  
**risks**

Achieve  
**protection**  
against ionizing  
radiation

# BIOLOGICAL DOSIMETER

Biological effect that can be used as a “quantitative” system in the estimation of received dosage

The most used biological dosimeter is the study of **chromosomal alterations**



# WHAT ARE THE EFFECTS OF IONIZING RADIATION?

## Chromosomic aberrations

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graph TD; A[Chromosomic aberrations] --> B[UNSTABLES<br/>- dicentric chromosomes<br/>- micronucleus]; A --> C[ESTABLES<br/>translocaciones];
```

UNSTABLES  
- dicentric  
chromosomes  
- micronucleus

ESTABLES  
translocaciones

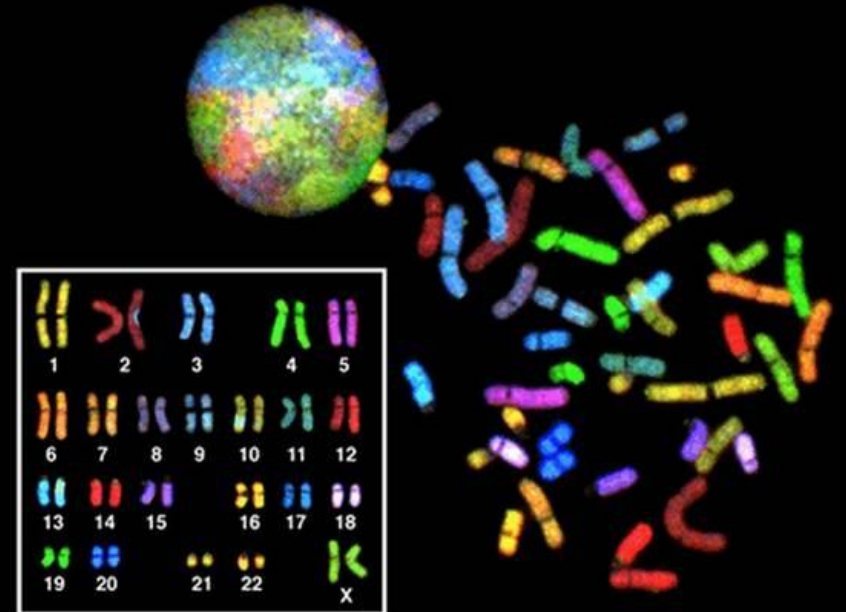
# THE MAIN BIOLOGICAL TECHNIQUES USED AS BIOLOGICAL DOSIMETERS

STABLE ALTERATIONS (chronic exposure or acute recurrent exposure)

1. Chromosomic banding
2. FISH

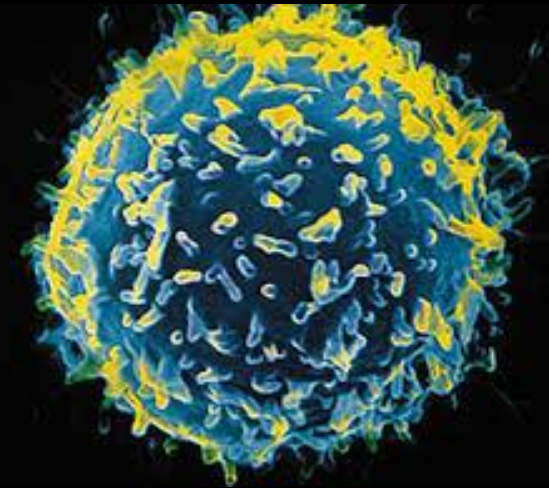
UNSTABLE ALTERATIONS (acute exposure)

1. Dicentric chromosomes analysis
2. Binucleated cells or micronucleus analysis



Which cells are analyzed?

# LINFOCITES



WHY?

G0 permanent status

Continuous circulation around  
the body

Phytohemagglutinin test (PHA)

# TECHNIQUE CHOICE FACTORS:

- Time of exposure
- Exposed body area
- Time passed between the exposure and the measurement

Exposure to nuclear accidents or long time exposure



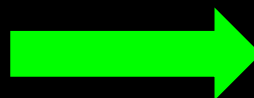
Dicentric chromosomes or micronucleus analysis

Longer time exposure



FISH

If the received radiation is not homogeneous in the whole body



There is not a most adequate technique for the cytogenetic study



Nuclear accidents



Medical exposure

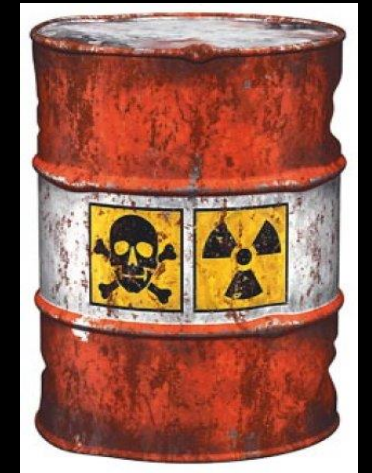
Missions to the Poles



Space missions



Long time exposure



**APPLICATIONS**



# MEDICAL APPLICATIONS: EXAMPLES

Establish a **dosage-effect relationship** for patients who are exposed to radiation in order to **treat cancer (radiotherapy)**



Measure the radiation absorbed by **medical staff**

# LIMITATIONS

- ✓ It is difficult to establish a direct **dosage-effect relationship**
- ✓ **Accumulated radiation** is not considered
- ✓ Many of the measured effects are **unstable in time**



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