



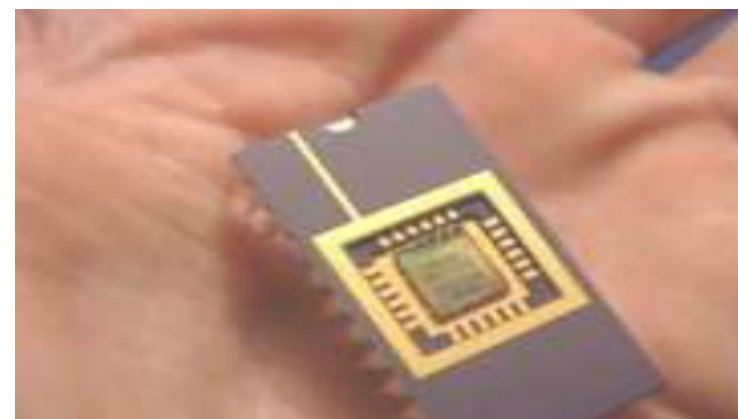
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# Biosensor



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# INTRODUCTION

- A biosensor is an analytical device which converts the **biological signal** into a **measurable electrical signal**.
- Self-contained integrated device that is capable of providing specific qualitative or semi-quantitative analytical information using a biological recognition element which is in direct-spatial contact with a transduction element.



Professor Leland C Clark is the father of Biosenor. **1918–2005**



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# A good biosensor

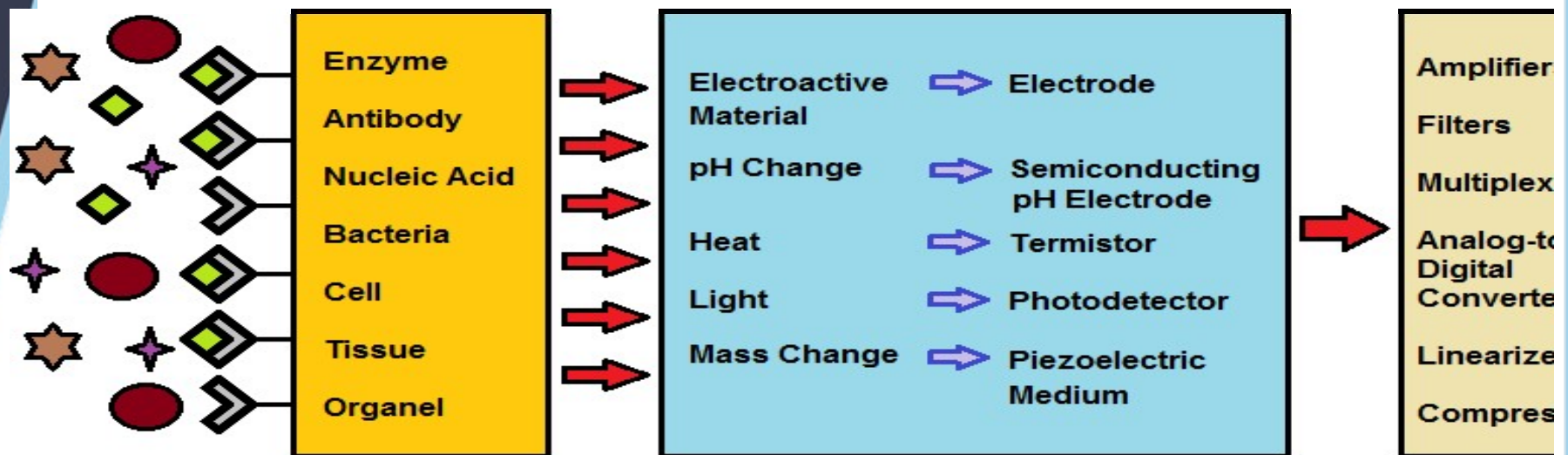
- It should provide accurate, precise, reproducible results.
- It should be free from electrical noise.
- It should be cheap, small, portable and capable of being used by semi-skilled operators.
- The reaction should be independent from physical parameters (stirring, pH and temperature).



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# Parts of biosensor

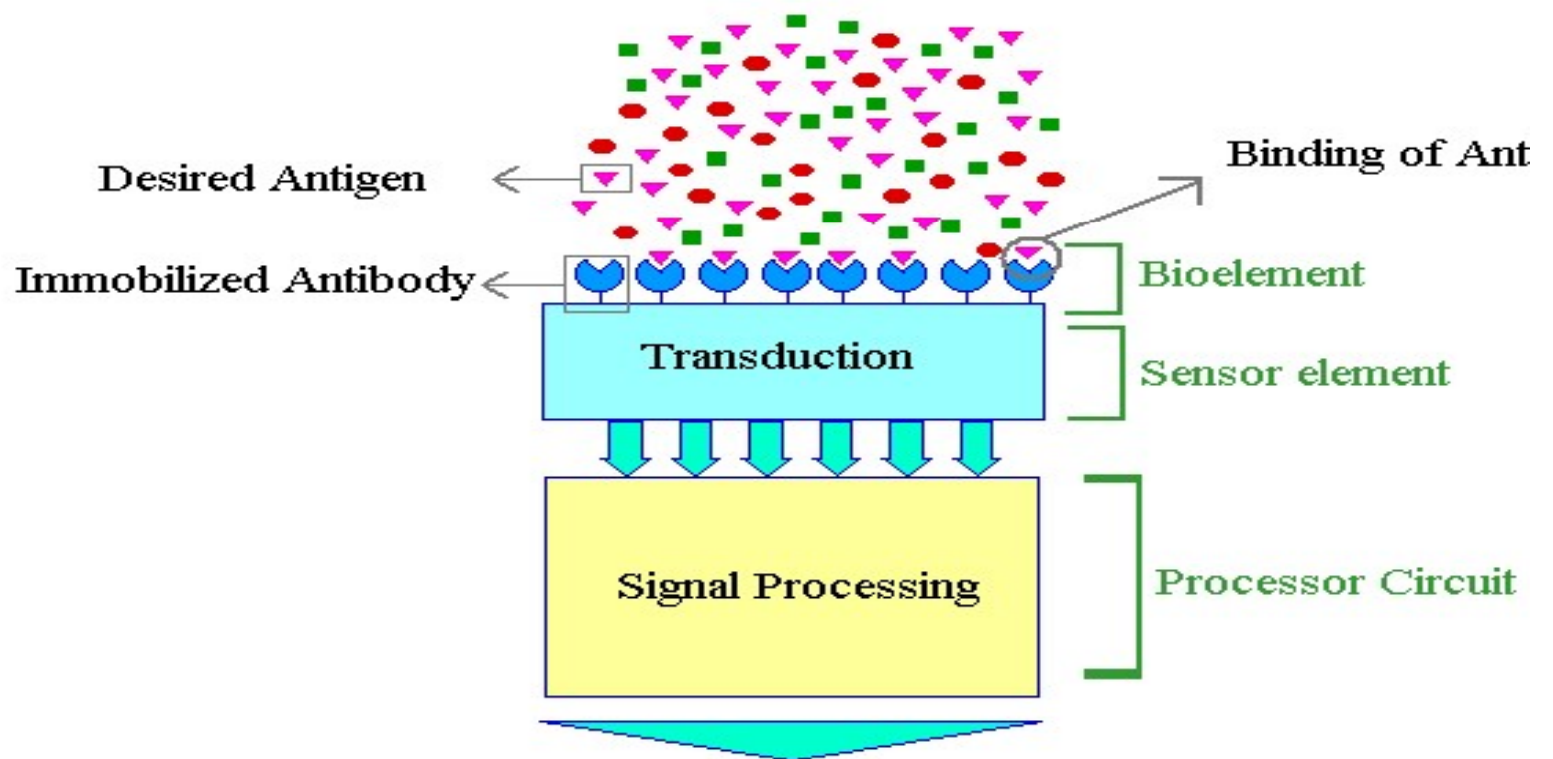
- Bio receptors
- Signal Transducer
- Signal processor





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# Function Principle





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# Bioreceptor

- The bioreceptor is a biologically derived material such as tissue, microorganisms, organelles, cell receptors, enzymes, antibodies, nucleic acids etc.

OR

- Biomimetic component that binds or recognizes the analyte of interest.



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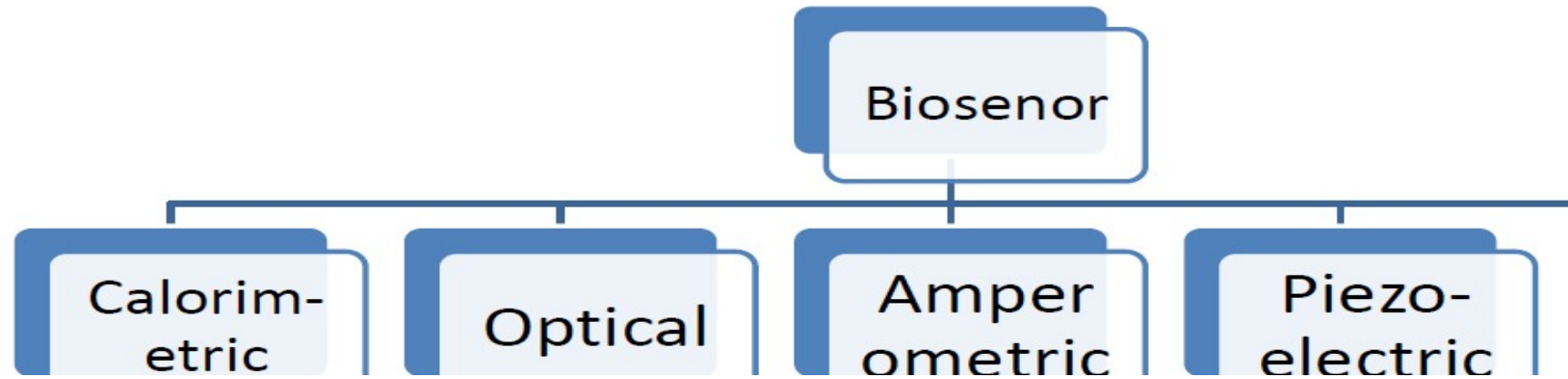
# Transducer

- When the analyte interacts with the bioreceptor, change in biological signals such as change in temperature, electrical charge occurs.
- The transducer transforms these signal into another signal which is easily measured and quantified.



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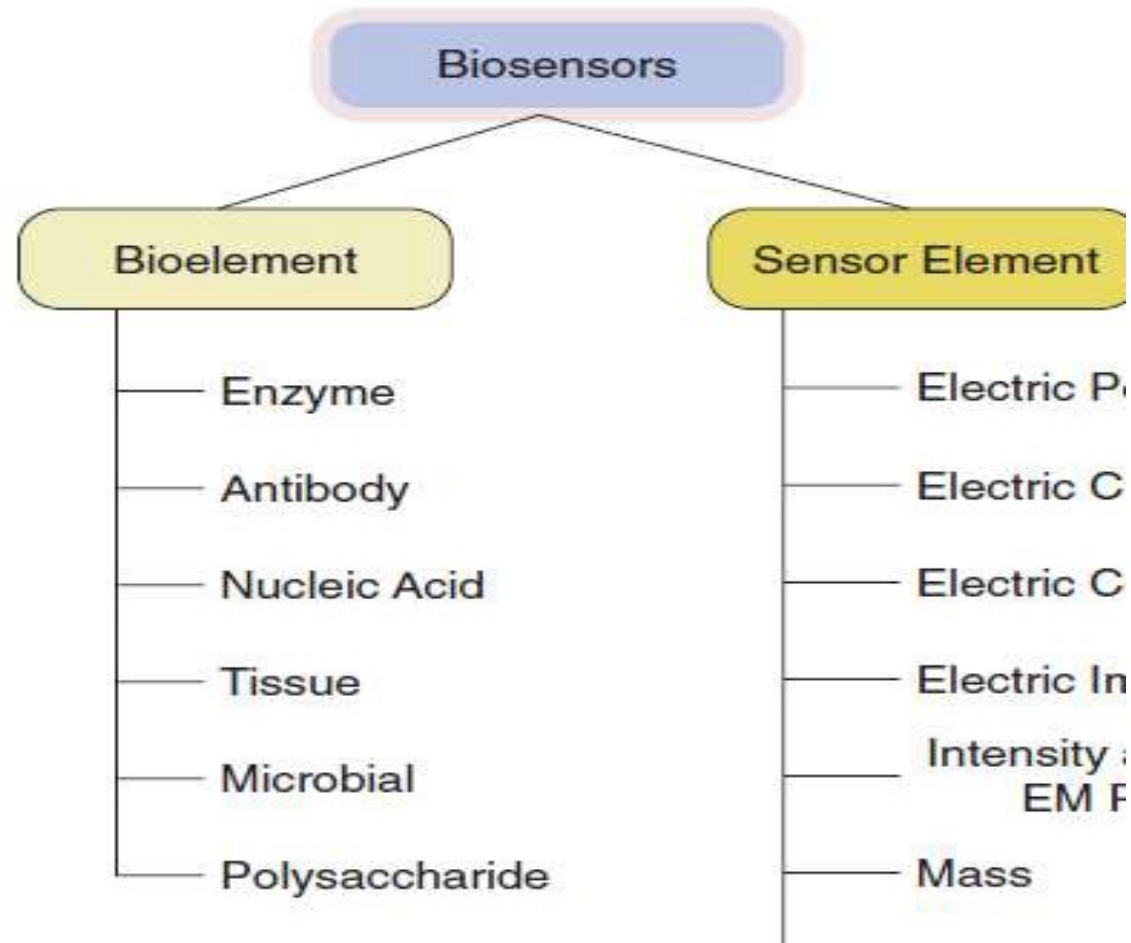
- Based on the type of transducer the Biosensor are classified as







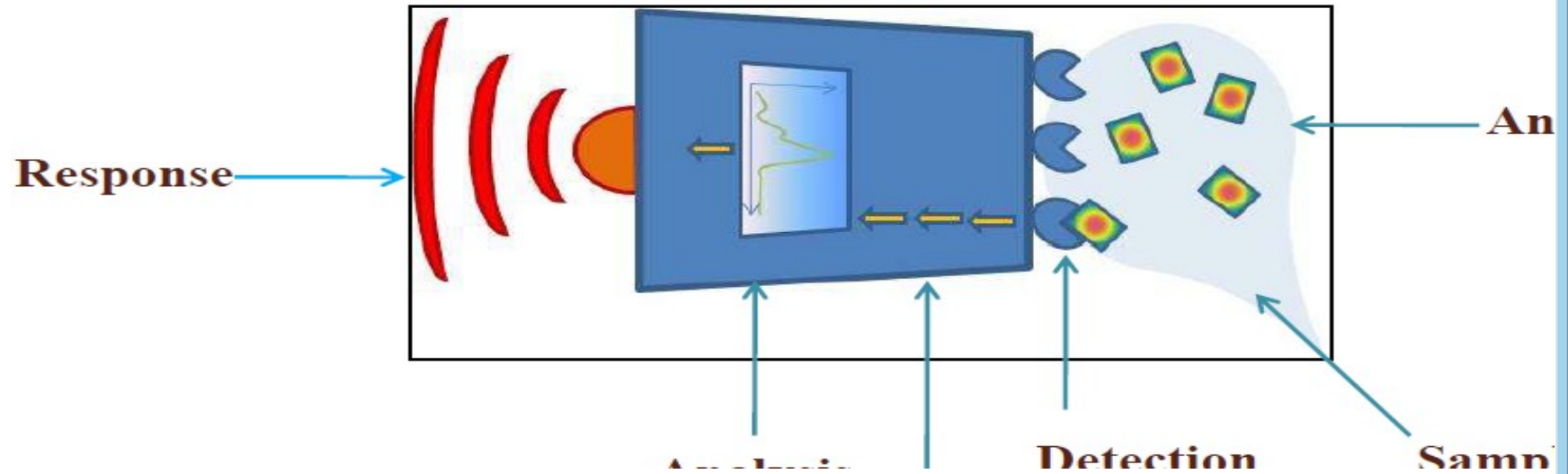
# ELEMENTS OF BIOSENSORS





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# BIOSENSOR



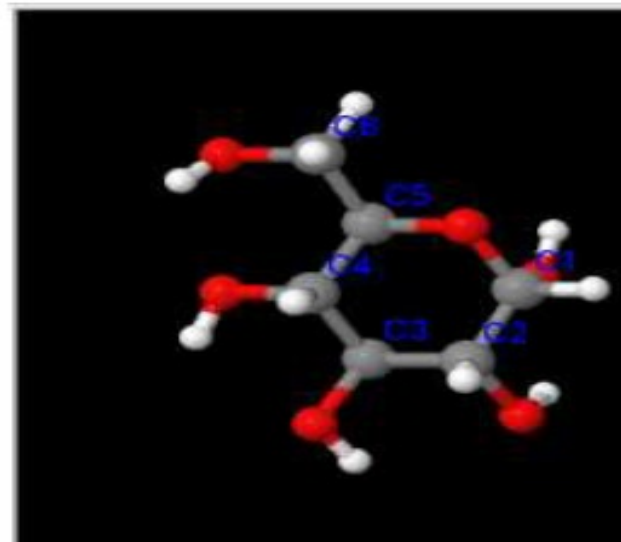
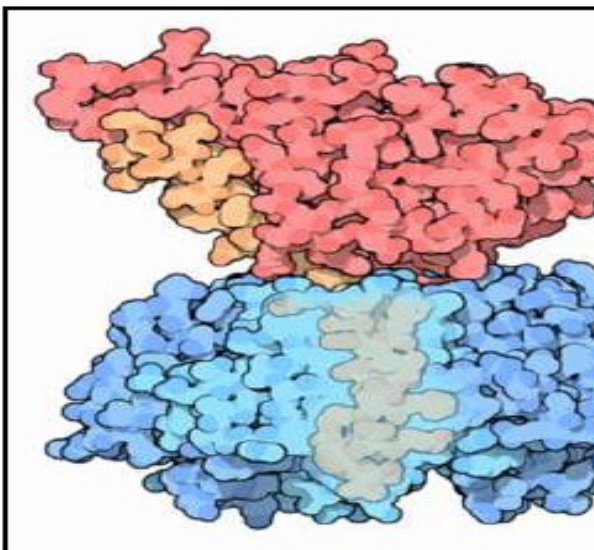


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# THE ANALYTE

(What do you want to detect?)

- Molecule
- Protein, toxin, peptide, vitamin, sugar, metal ion



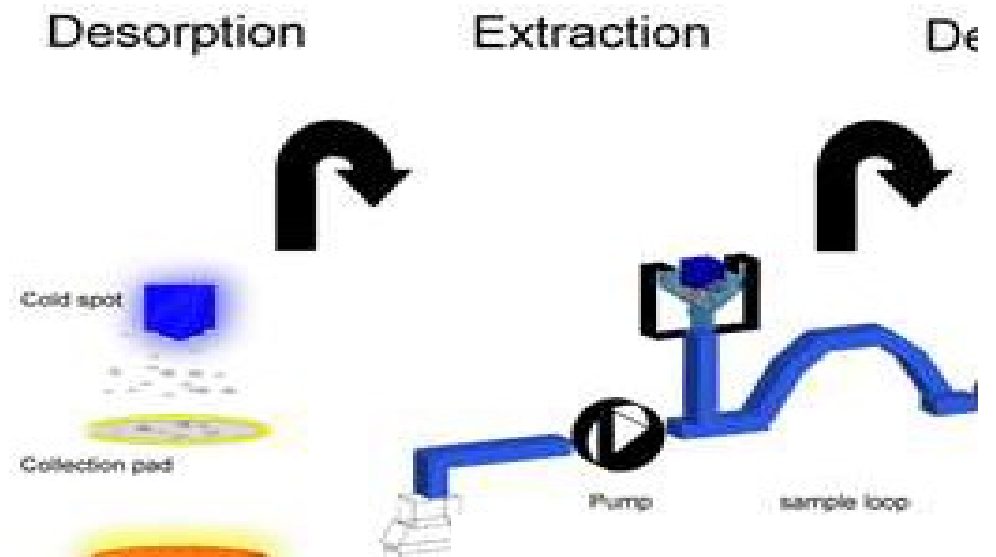
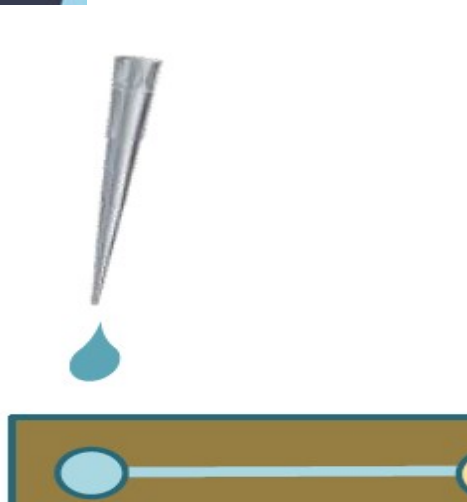


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# SAMPLE HANDLING

(How to deliver the Analyte to the Sensitive Region?)

- (Micro) fluidics
- Concentration (increase/decrease)
- Filtration/selection

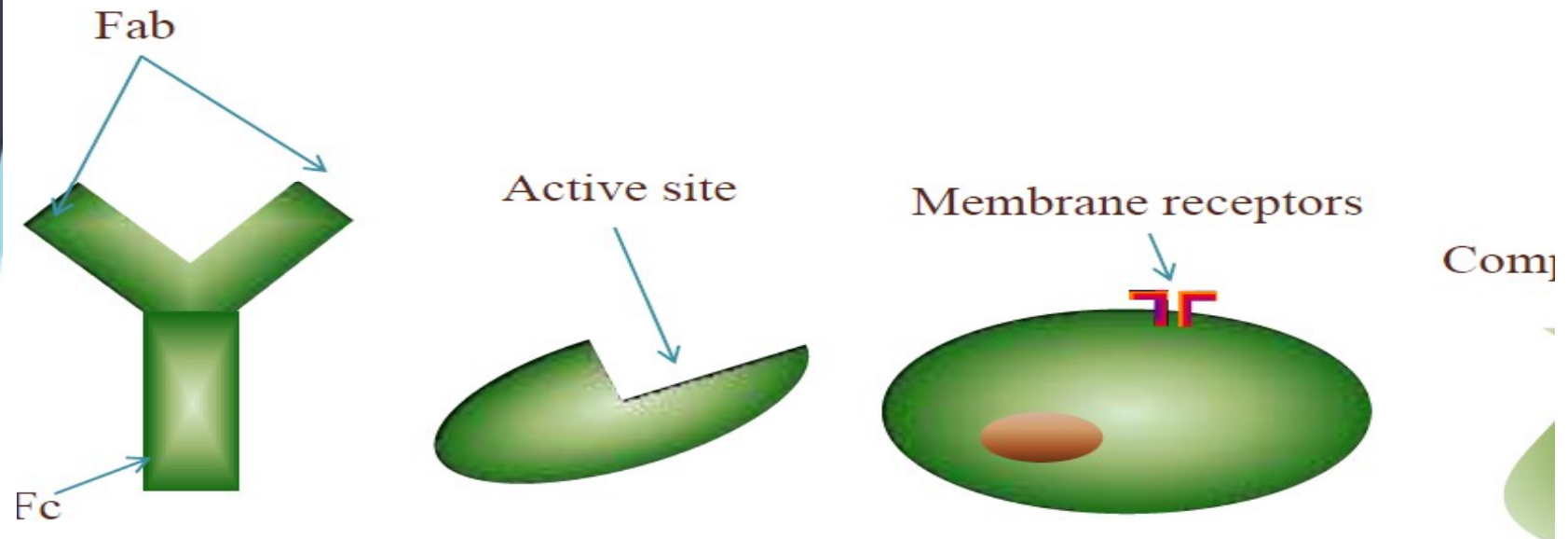




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# DETECTION/RECOGNITION

(How do you specifically recognize the analyte?)





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# SIGNAL

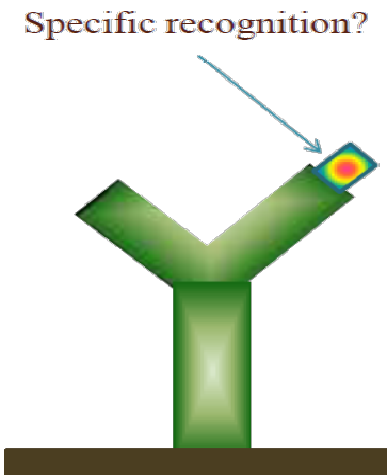
(How do you know there was a detection?)

## Common Signalling Principles

- Optical (SPR (Surface plasmon resonance), IR).
- Electrical (Voltametry, Potentiometry, Conductivity).
- Electromechanical (QCM quartz crystal microbalance).
- Thermal.
- Magnetic.
- Pressure.

**Often the detector is immobilized on a solid support/sensor.**

**(The immobilisation permits repeated use of the costly Biological Molecule.)**





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## WORKING PRINCIPLE

- Analyte diffuses from the solution to the surface of the Biosensor.
- Analyte reacts specifically & efficiently with the Biological Component of the Biosensor.
- This reaction changes the physicochemical properties of the Transducer surface.
- This leads to a change in the optical/electronic properties of the Transducer Surface.
- The change in the optical/electronic properties is measured/converted into electrical signal, which is detected.



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## ADVANTAGES

- Highly Specific.
- Independent of Factors like stirring, pH, etc.
- Linear response, Tiny & Biocompatible.
- Easy to Use, Durable.
- Require only Small Sample Volume.
- Rapid, Accurate, Stable & Sterilizable.





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## **Calorimetric biosensors**

- The heat produced (or absorbed) by the reaction.

**(MECHANISM)**

## **Potentiometric biosensors**

- Changes in the distribution of charges causing an electrical potential.

## **Amperometric biosensors**

- Movement of electrons produced in a redox reaction.

## **Optical biosensors**

- Light output during the reaction or a light absorbance difference between the reactants and products .

## **Piezo-electric biosensors**

- Effects due to the mass of the reactants or products .

# Signal processors

- Signal processor process the data obtained from the transducer and displays the result in user friendly way.

Example:

- **Pregnancy test**
- **Detects the hCG (Human chorionic Gonadotropin) protein in urine.**



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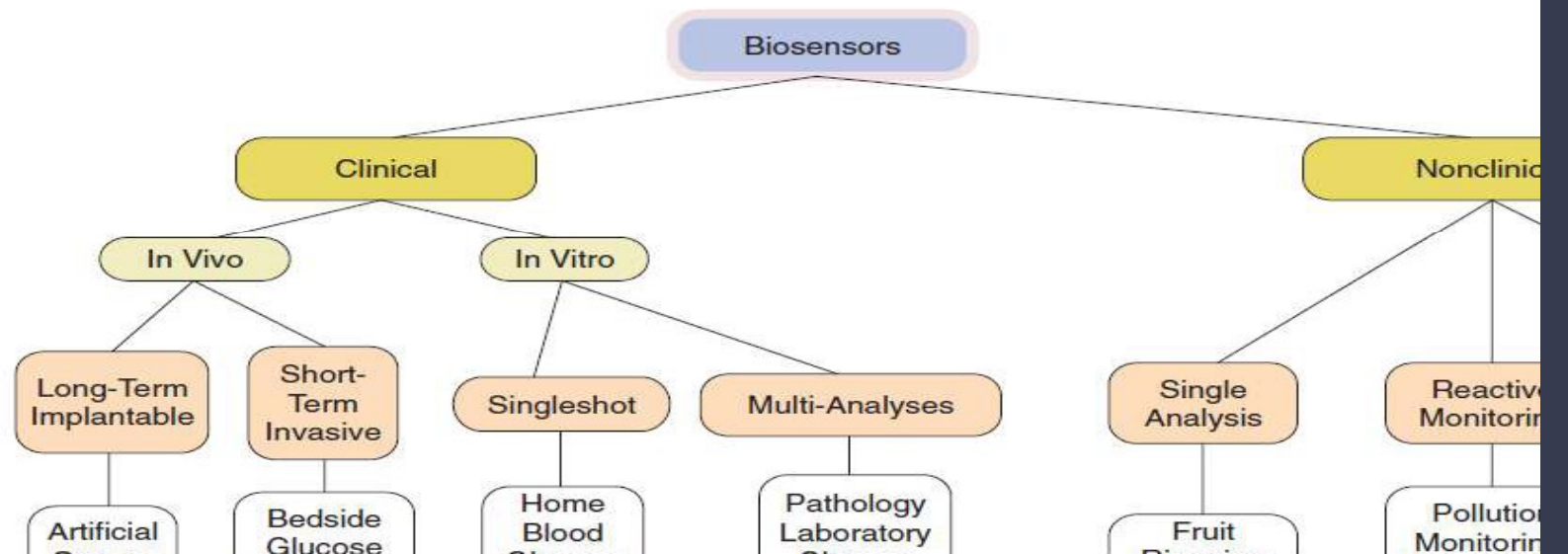
# Glucose monitoring device (for diabetes patients)

- Monitors the glucose level in the blood.
- The enzyme glucose oxidase is used by blood glucose biosensor to break down of blood glucose.
- First it oxidizes glucose and uses two electrons to reduce the FAD (**flavin adenine mononucleotide**) a component of the enzyme to  $\text{FADH}_2$  which in turn is oxidized by the electrode in a number of steps.
- The resulting current is a measure of the concentration of glucose.
- In this case, the electrode is the transducer and the enzyme is the bioreceptor.





# APPLICATIONS





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# APPLICATIONS

- Food Analysis.
- Study of Biomolecules & their Interaction.
- Drug Development.
- Crime Detection.
- Medical Diagnosis (Clinical & Laboratory).
- Environmental Field Monitoring.
- Quality Control.
- Industrial Process Control.
- Detection Systems for Biological Warfare Agents.
- Manifestations of Pharmaceuticals & Replacement organs



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# Example of Biosensors



**The DNA capture  
element instrument- for  
hereditary diseases**



**Glucometer- for measurement of  
glucose in blood.**



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Old time coal miners' Biosensor.  
*Data analysis and interpretation  
performed by the coal miner.*



Pregnancy Test.

- *Detects the hCG protein in urine.*
- *Interpretation and data analysis performed by the user.*



Infectious Disease Biosensor.

- *Data analysis and interpretation performed by a microprocessor.*



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Biosensor platform.  
***General and flexible, good tool for  
development of specific biosensors.***





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# NEW GENERATION BIOSENSOR





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# THANK YOU

**Happy to answer if you have any question.....?**