# Biosensors

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# Welcome
# to the world of
# Biosensors

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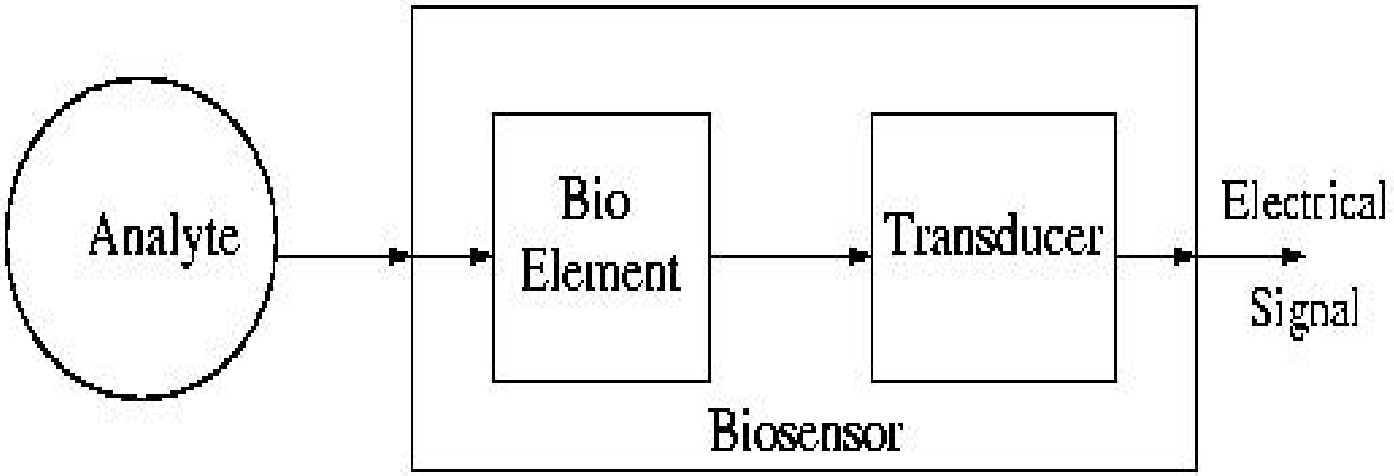
# Outline of the presentation

1. Introduction to biosensors
2. Working principle of biosensors
3. Different types of biosensors
4. A biosensor to monitor cell morphology
5. Lab-on-a-chip systems (DNA detection)
6. Glucose biosensors
7. Conclusions

# What is a Biosensor ??

A biosensor is a analytical device incorporating a deliberate and intimate combination of a specific biological element (that creates a recognition event) and a physical element (that transduces the recognition event).

# Biosensor …… ??




Basic Concepts of Biosensor

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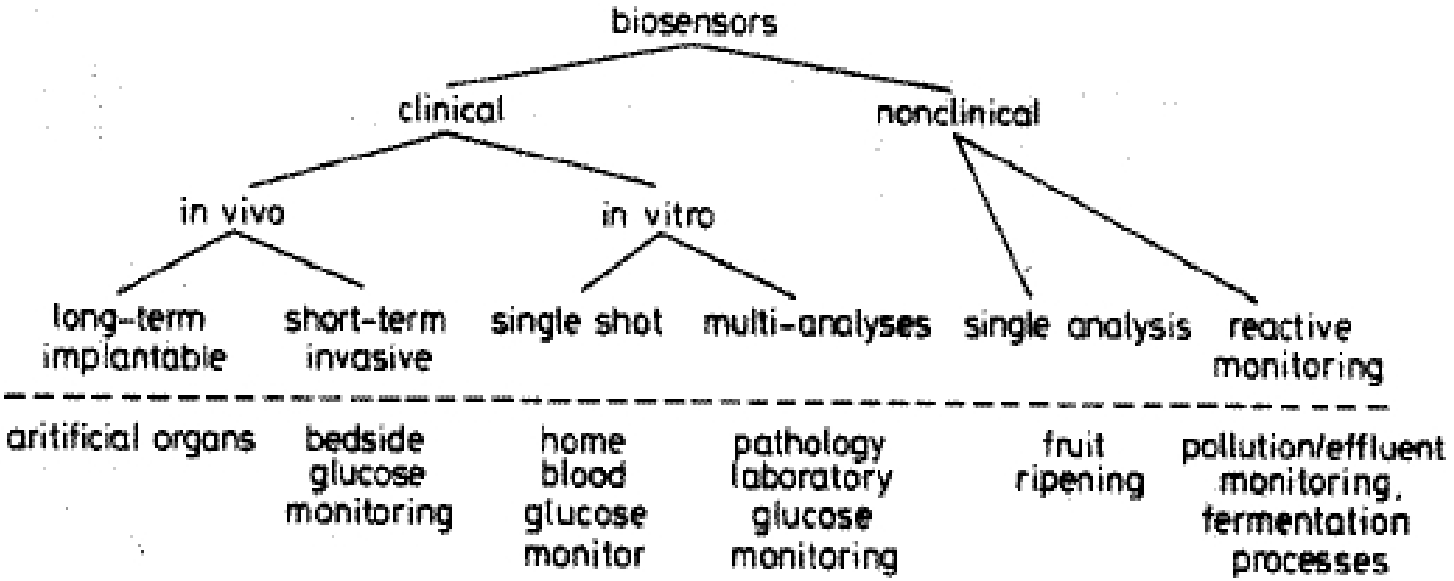
# Applications of Biosensors





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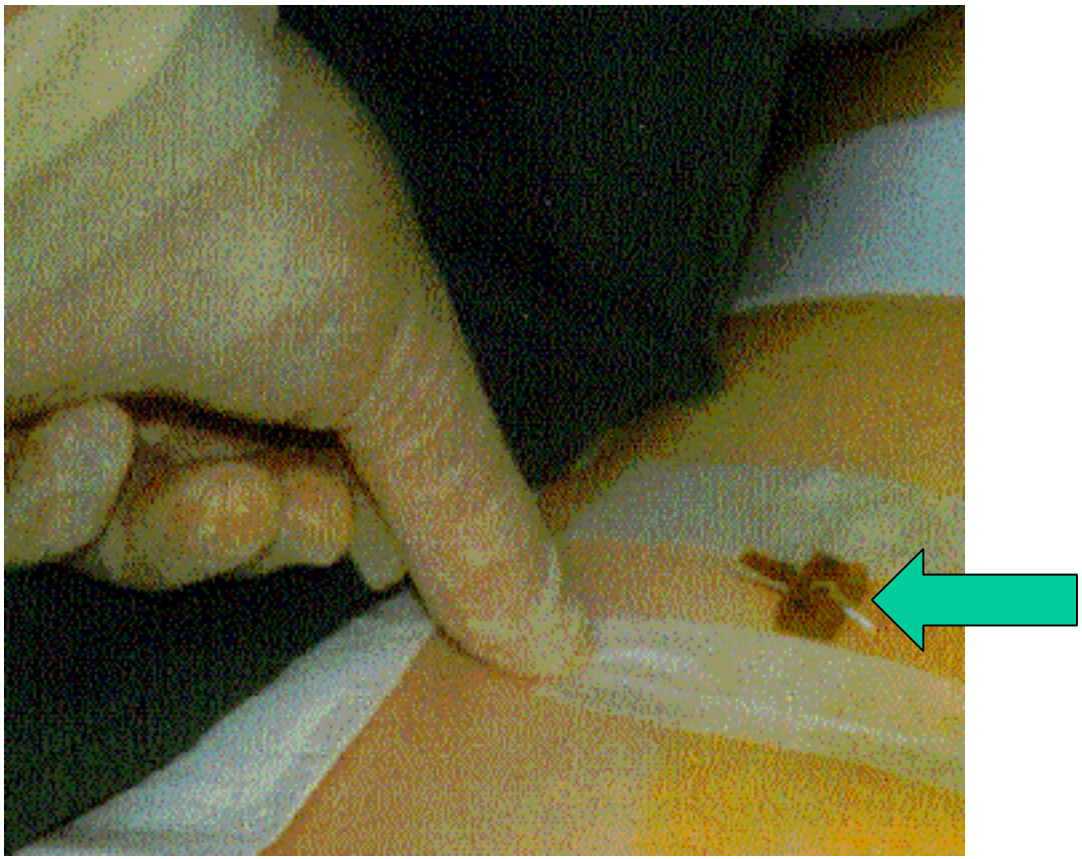
# Biosensor : Products



A needle-type glucose biosensor implanted tissue

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# Products …….(Pen)

Medisense glucose biosensor Pen

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# Products …….(Big Display)


Medisense glucose biosensor : Big digital display

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# Products …….(Biodetector)


A handheld biodetector

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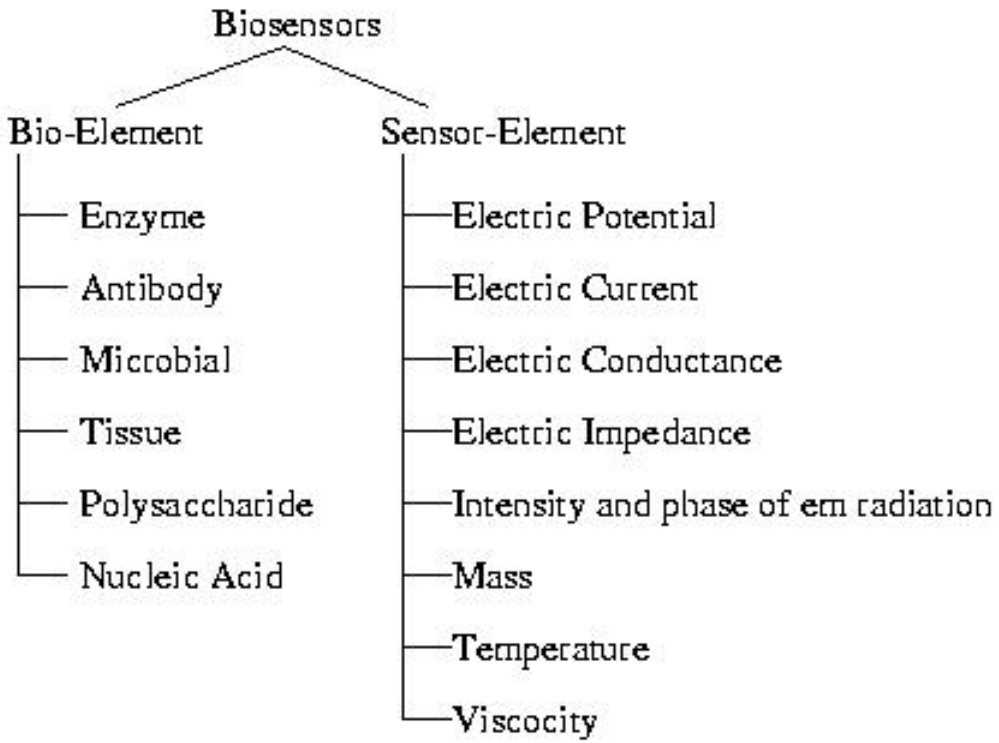
# Elements of Biosensor

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# Different types of Biosensor

- Resonant biosensors
- Optical-Detection biosensors
- Thermal-Detection biosensors
- Ion-Sensitive FETs (ISFETs) biosensors
- Electrochemical biosensors



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# Biosensor types ……

- Conductimetric
- Amperometric
- Potentiometric

| Characteristics | Conductimetric | Amperometric | Potentiometric |
|---|---|---|---|
| Measured Parameter | Conductance/ Resistance | Current | Potential/ Voltage |
| Applied Voltage | Sinusoidal (AC) | Constant Potential (DC) | Ramp Voltage |
| Sensitivity | Low | High | |
| Governing Equation | Incremental Resistance | Cottrell Eqn. | Nesrt Eqn. |
| Fabrication | FET+Enzyme | FET+Enzyme 2 elctrodes | FET+Enzyme oxide electrode |

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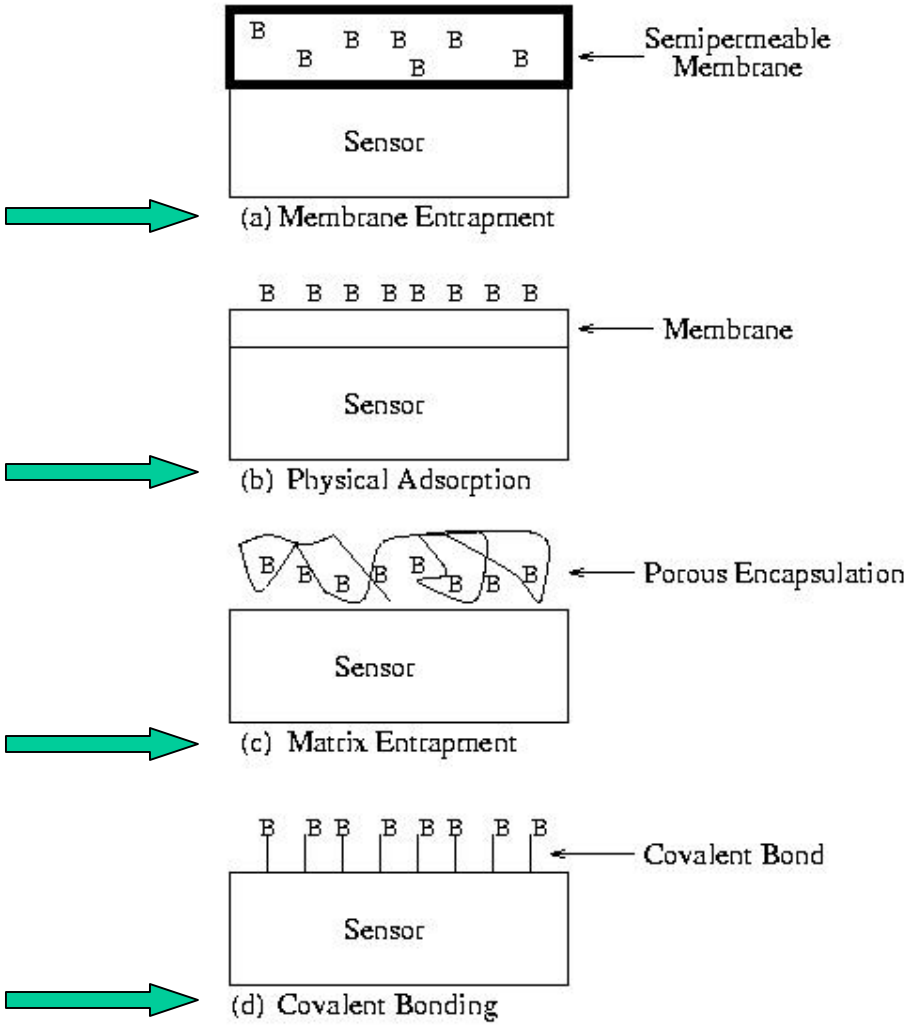
# Bio+sensor coupling : 4 types

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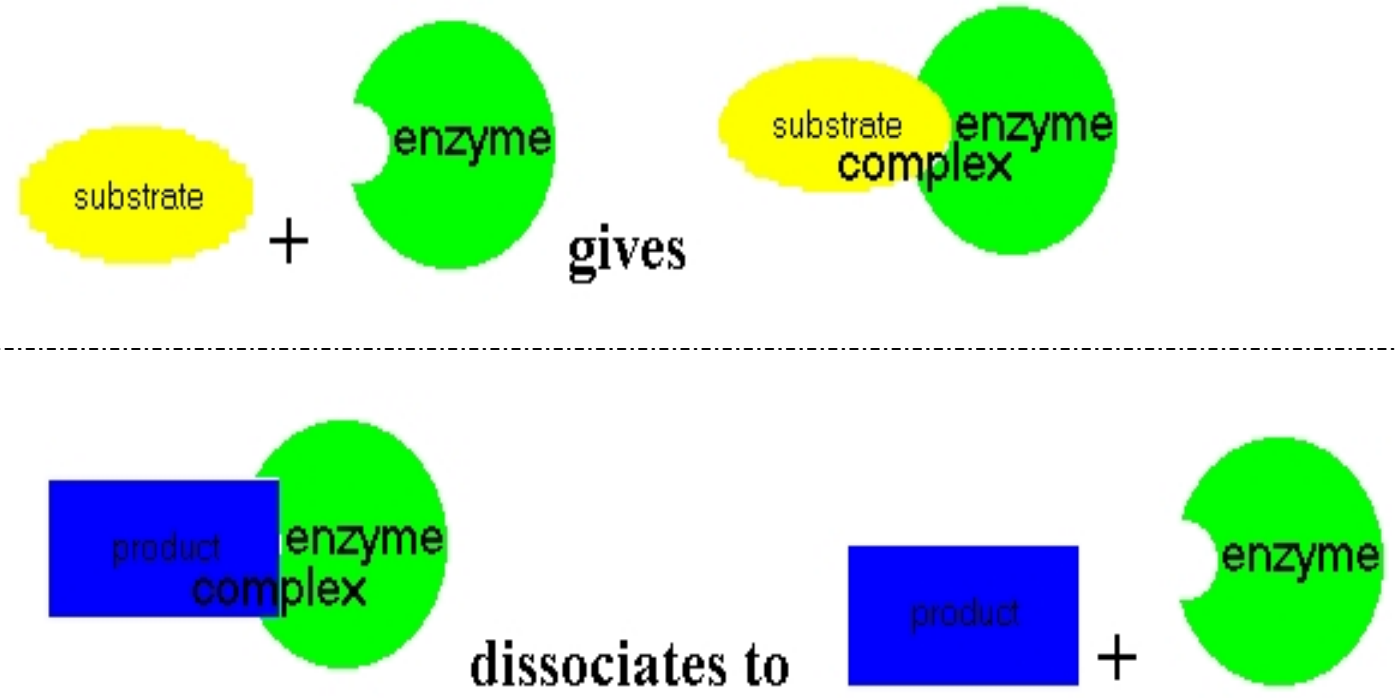
# Biosensor : Enzymes




Working Principle of Enzymes

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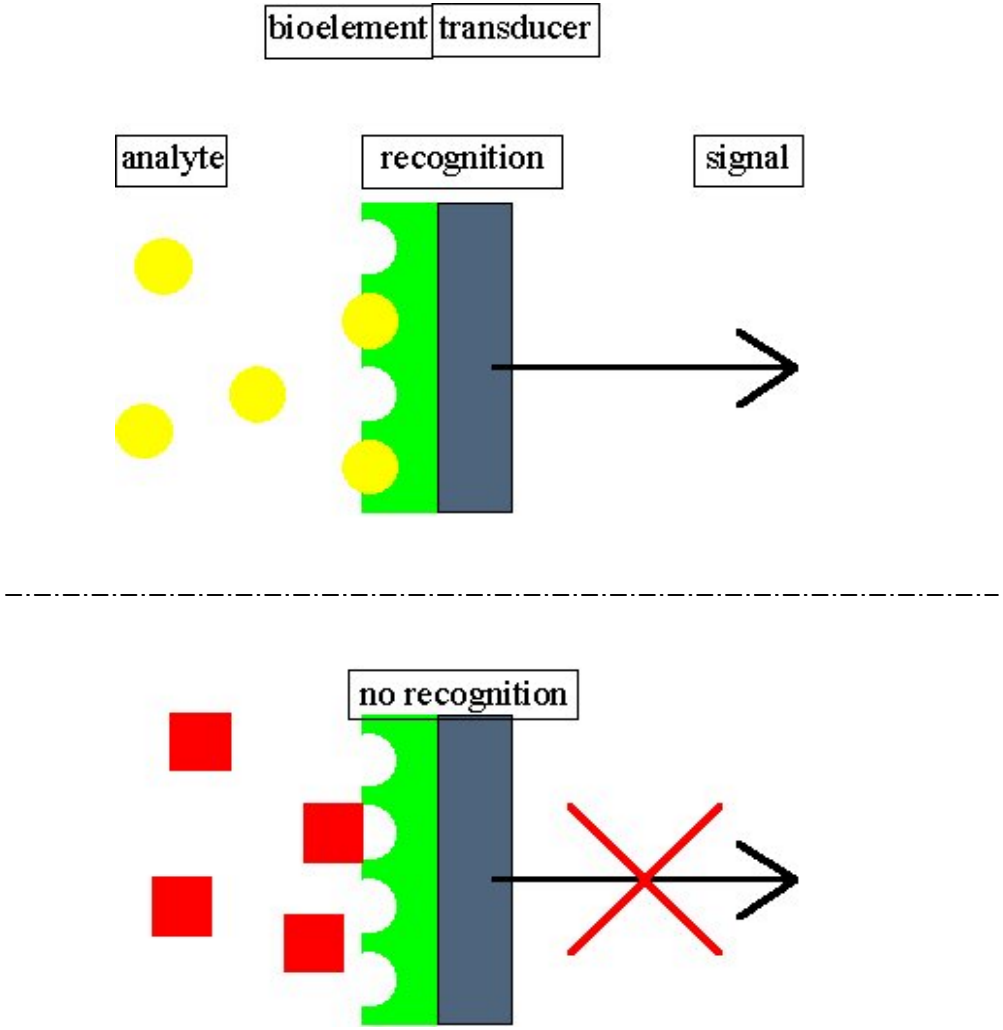
# Biosensor : Specificity




This specificity action is the basis of biosensors

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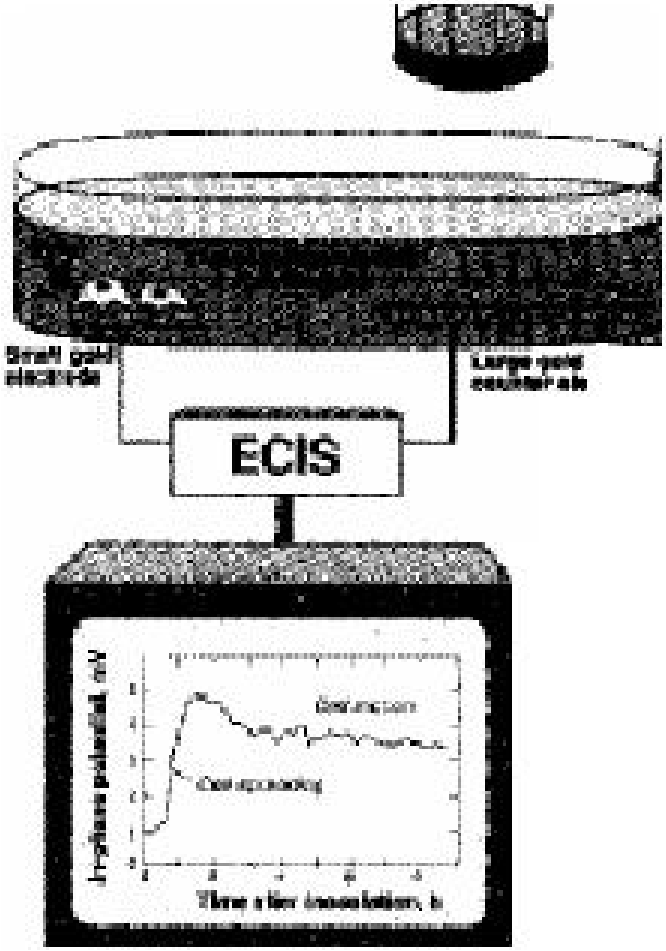
# A Biosensor to monitor cell morphology

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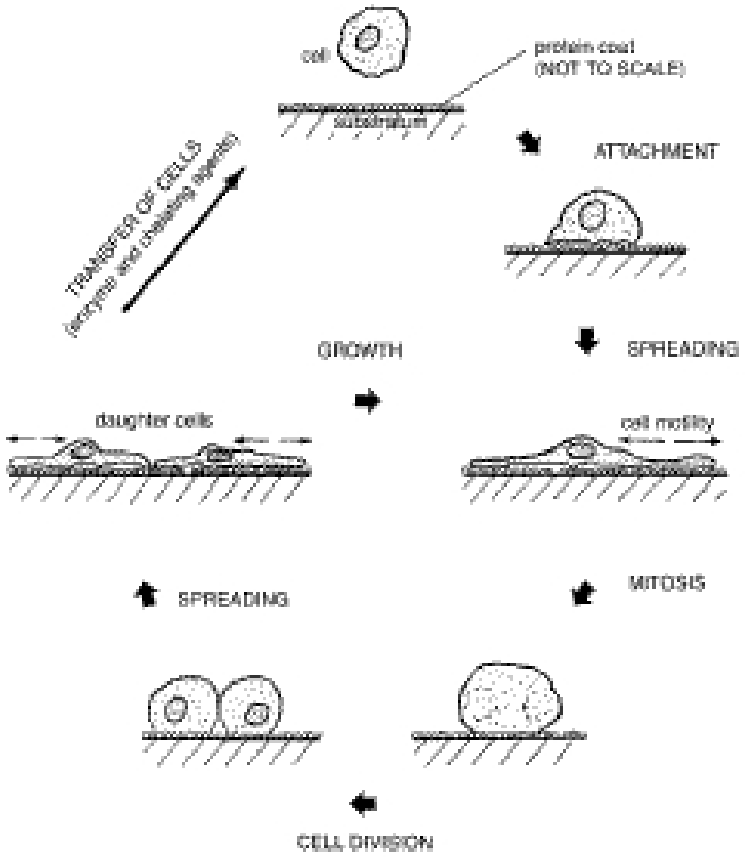
# To monitor cell morphology ……




A cell in tissue culture medium

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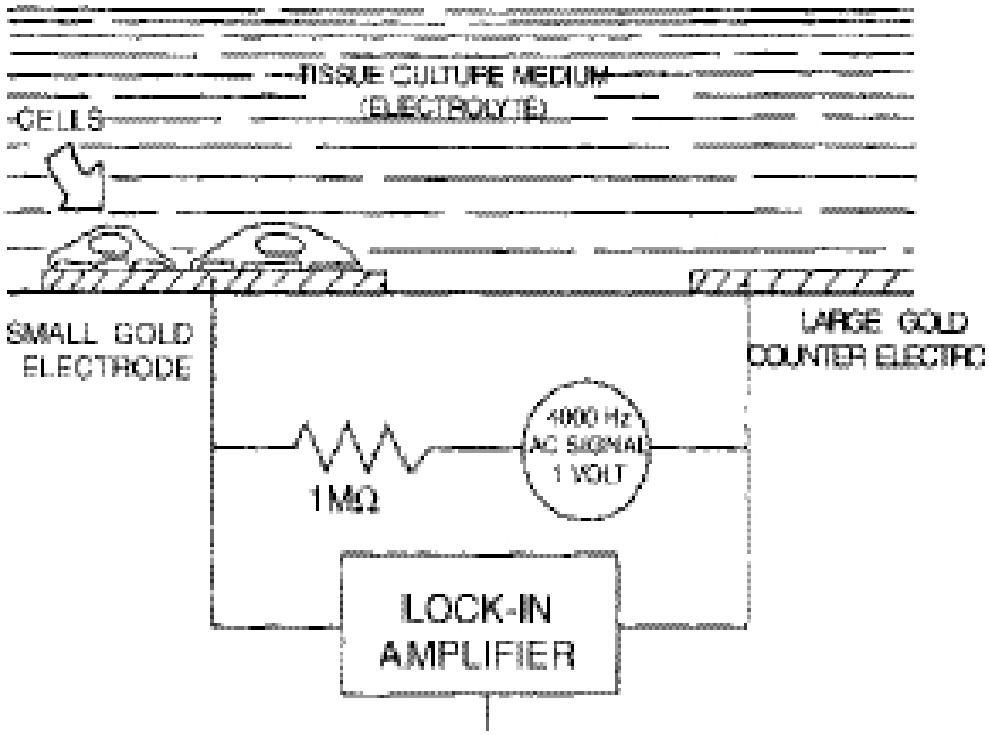
# To monitor cell morphology ……




ECIS schematic diagram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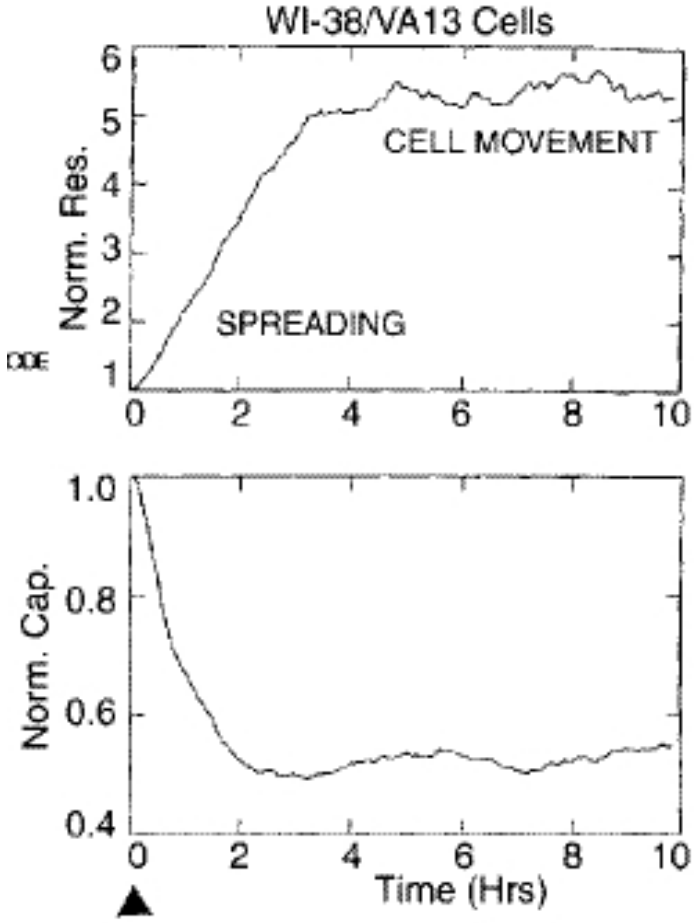
# To monitor cell morphology ……




ECIS : resistance and capacitance measurement

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# Biosensor for cell morphology……

## The advantages :

- The biosensor is less time consuming compared to the conventional methods.
- It is possible to automate and quantify cell morphology measurement.
- The fluctuating pattern can be used as signature for a cell.



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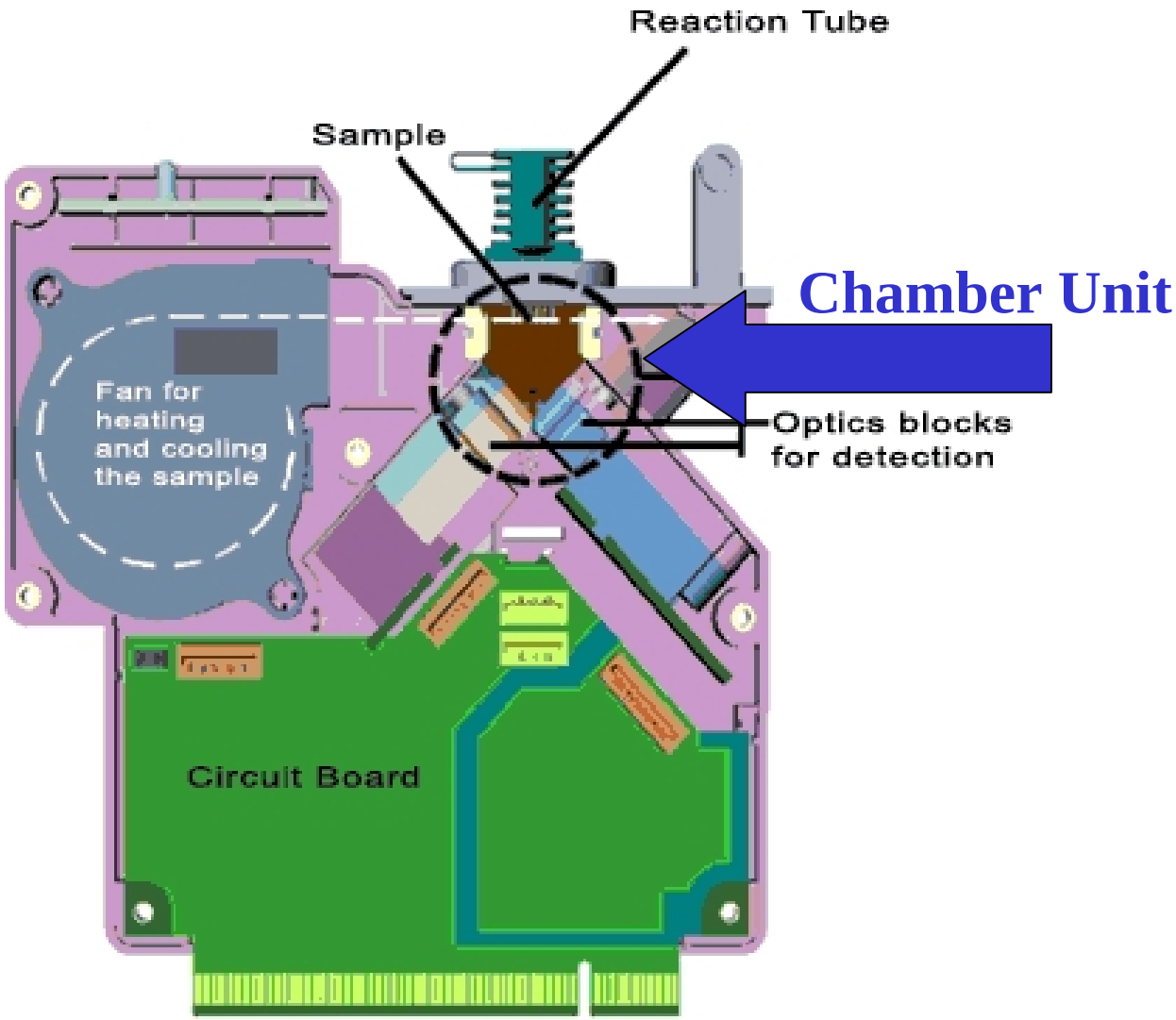
# Biosensor for cell morphology……

## The disadvantages :

- The accuracy of the biosensor is doubtful, it may happen two cells can have almost similar pattern.
- If the average impedance is to be taken as a measure then it is possible that two entirely different patterns can have same average value.
- It is not clear if the biosensor is useful for non-mammalian cells and plant cells.

# A microfluidic biodetector

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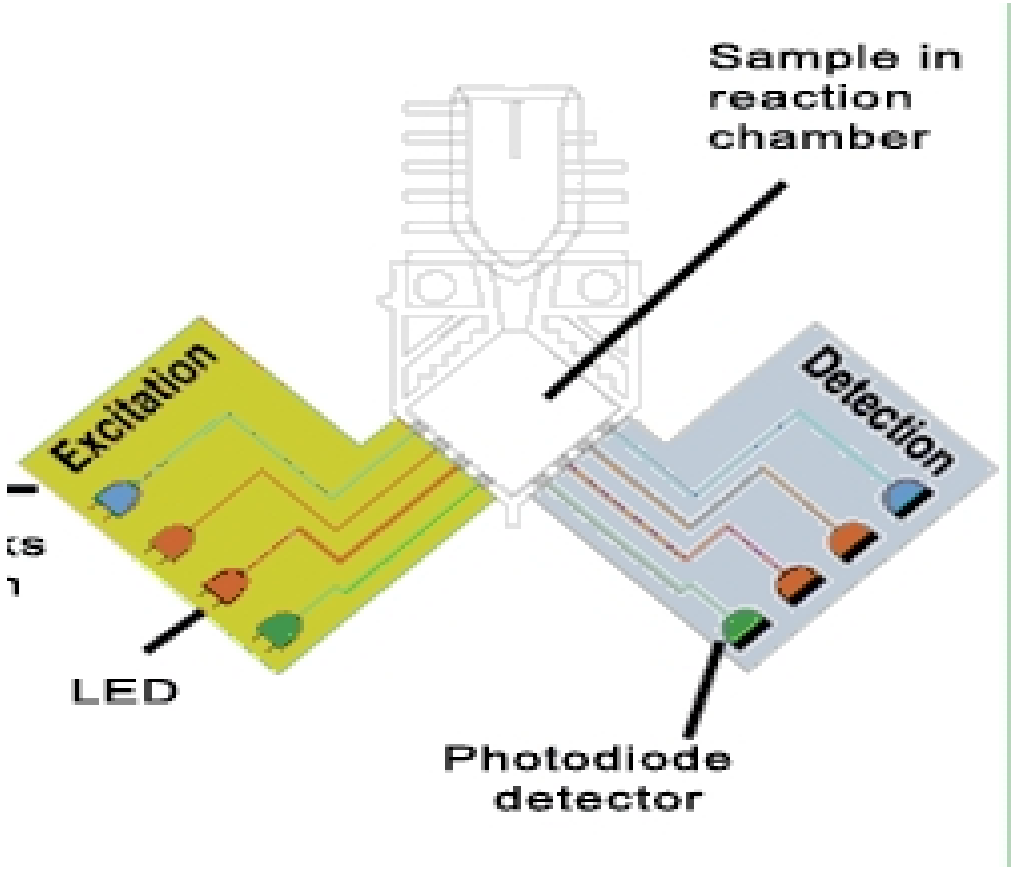
# A microfluidic …….




Magnified view of chamber unit

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# A microfluidic …….

## Detection steps :

- Some milliliters of sample solution are pumped into the chamber.
- The sample is concentrated to a volume of a microliter.
- Sample DNA are now extracted from sample solution.
- PCR is performed.
- Flouroscence probe DNAs bind the sample DNA.
- When the LEDs cause the probe DNAs to fluorescent the glow is captured by photodiodes.

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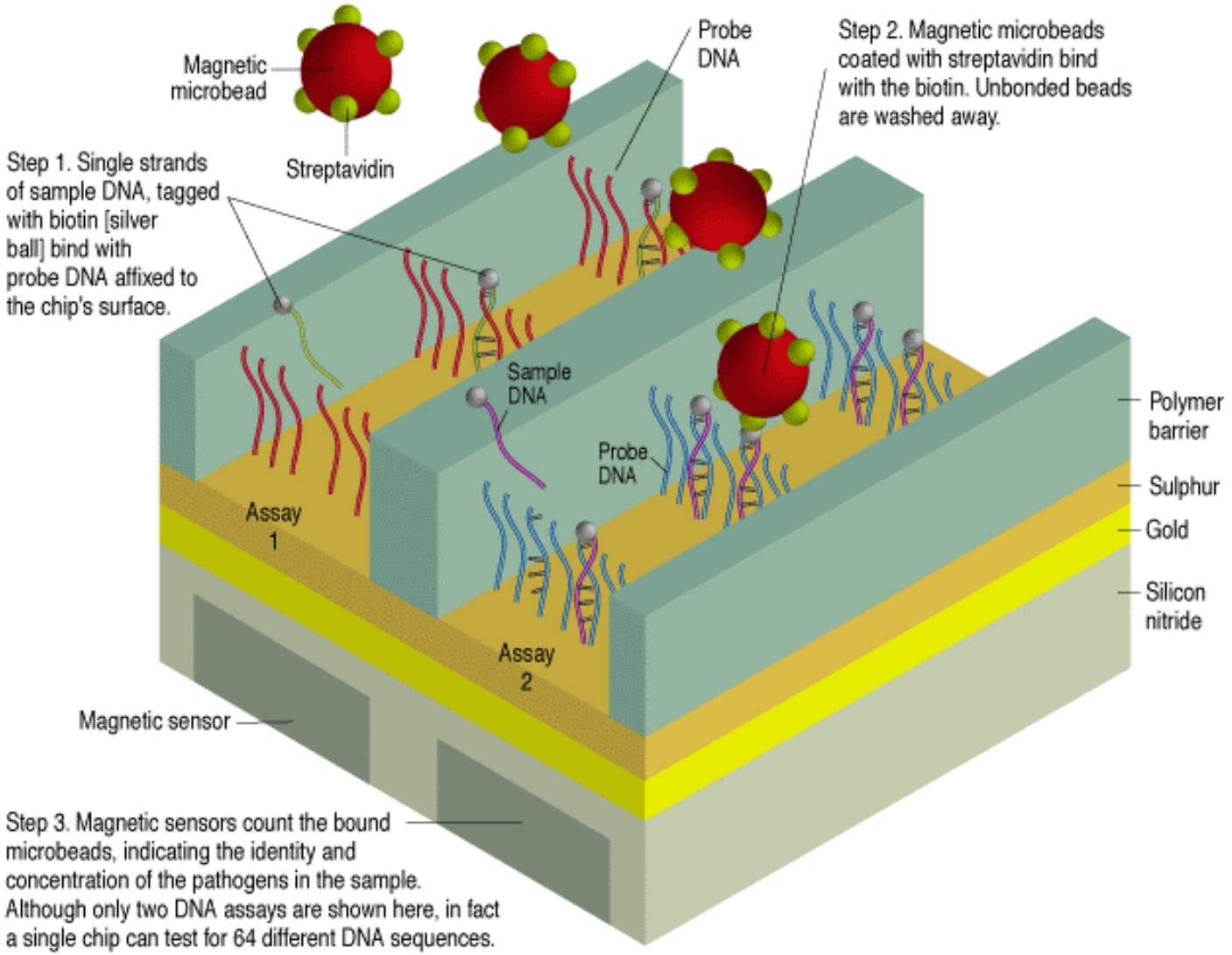
# A magnetic biodetector

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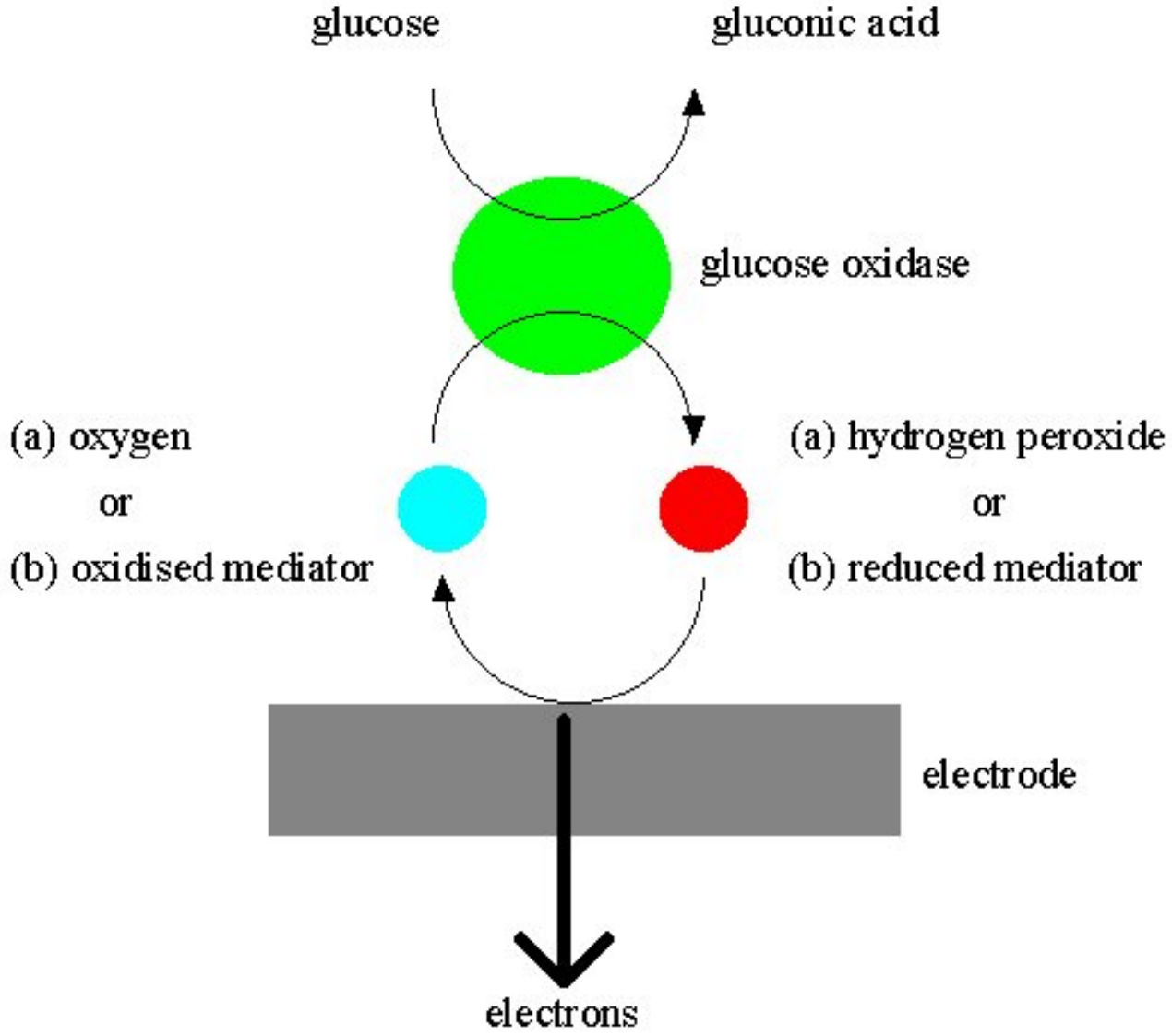
# Glucose Biosensor : Clark's Experiment

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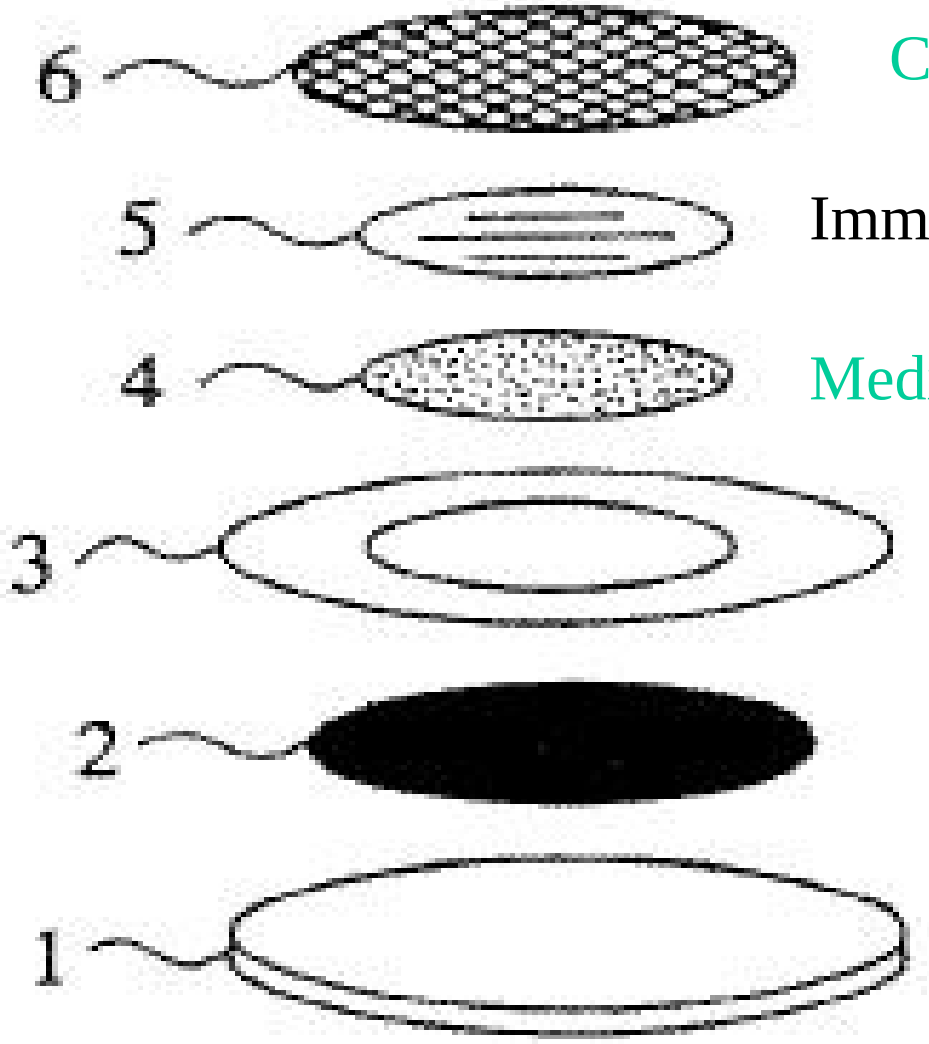
# A disposable glucose biosensor




Cellulose acetate membrane

Immobilized enzyme membrane

Mediator modified membrane

Isolating layer

Graphite layer

Metalic substrate

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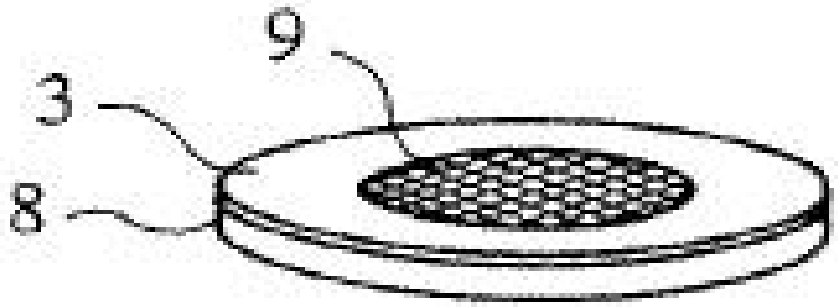
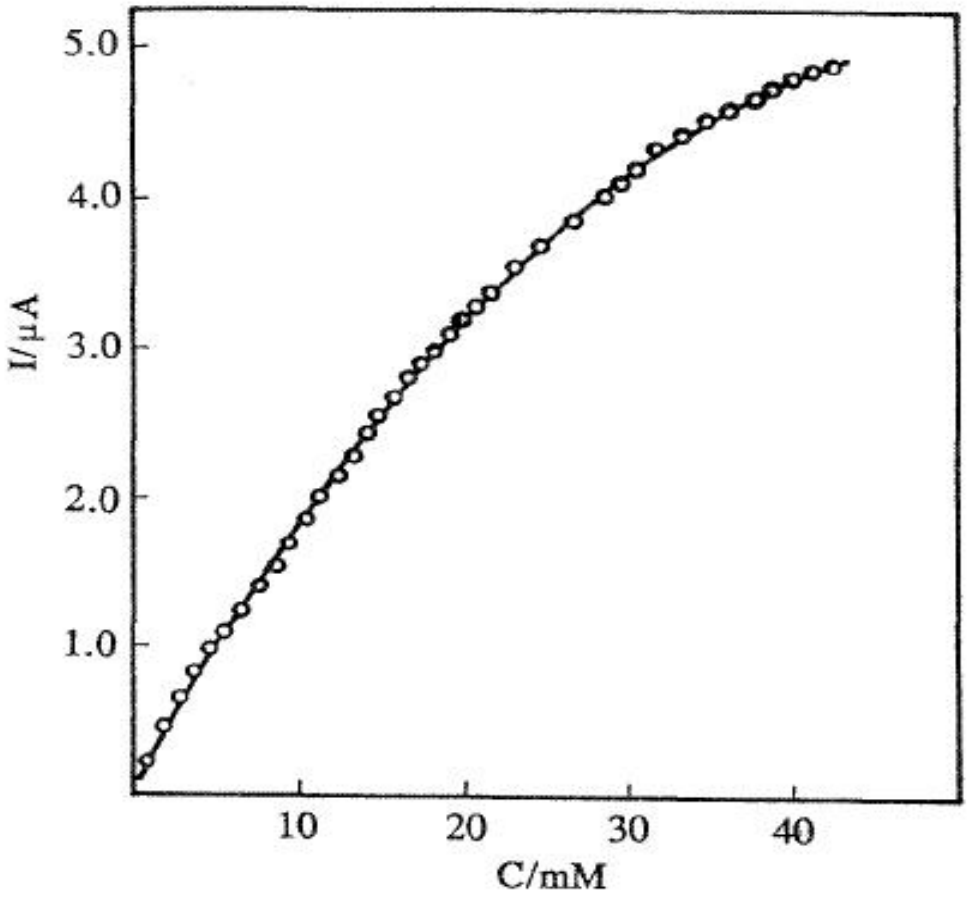
# A disposable ……..




Assembled layers : the biosensor

# A disposable ……..




**Calibration curve**

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# Biosensor : Difficulties

- Contamination
- Immobilisation of biomolecules
- Sterilization
- Uniformity of biomolecule preparation
- Selectivity and detection range

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# Conclusions

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# THANK YOU

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