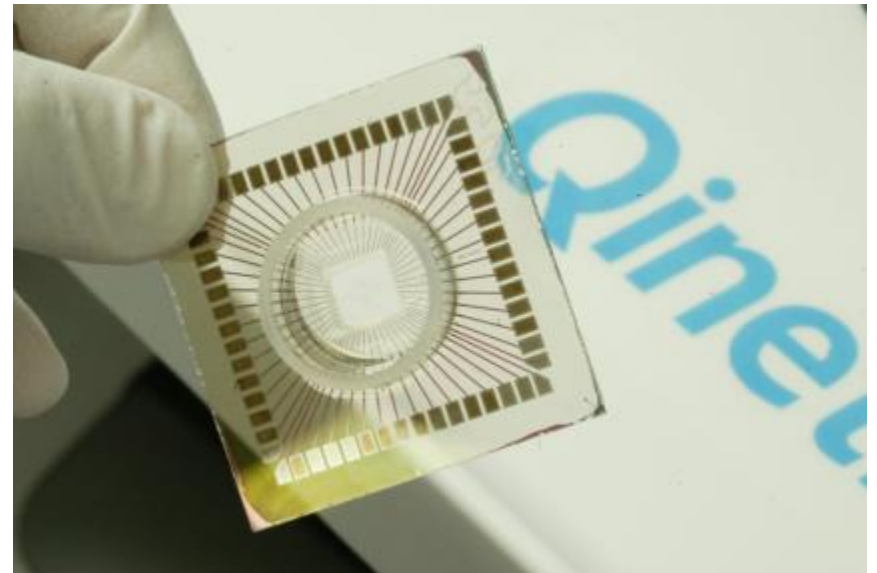


Chapter 5 Biosensor



Outline:

- 5.1 Introduction
- 5.2 Major components of biosensor
- 5.3 Working principle of biosensor
- 5.4 Characteristics of a good biosensor
- 5.5 Applications of biosensor

Learning outcomes:

- Define biosensors.
- Describe the working principle and applications of biosensor.

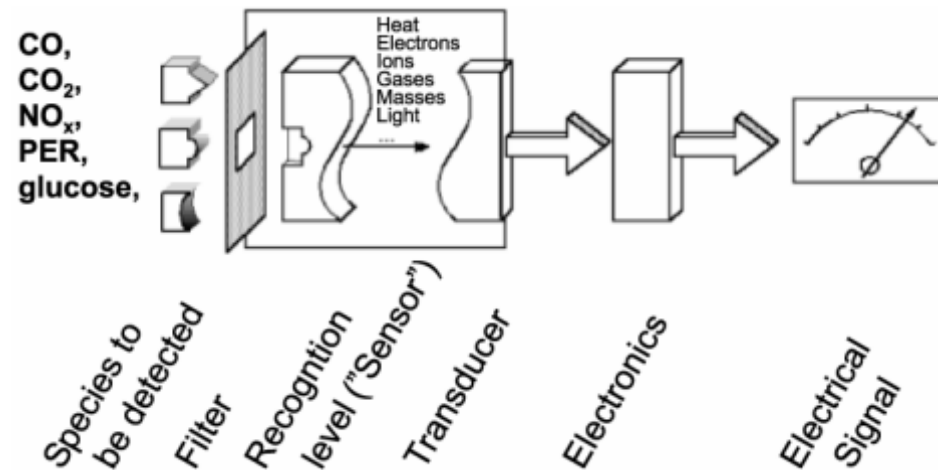
5.1 Introduction

- **Biosensor** - a device that utilises biological components e.g. enzymes to indicate the amount of a biomaterial



5.1 Introduction

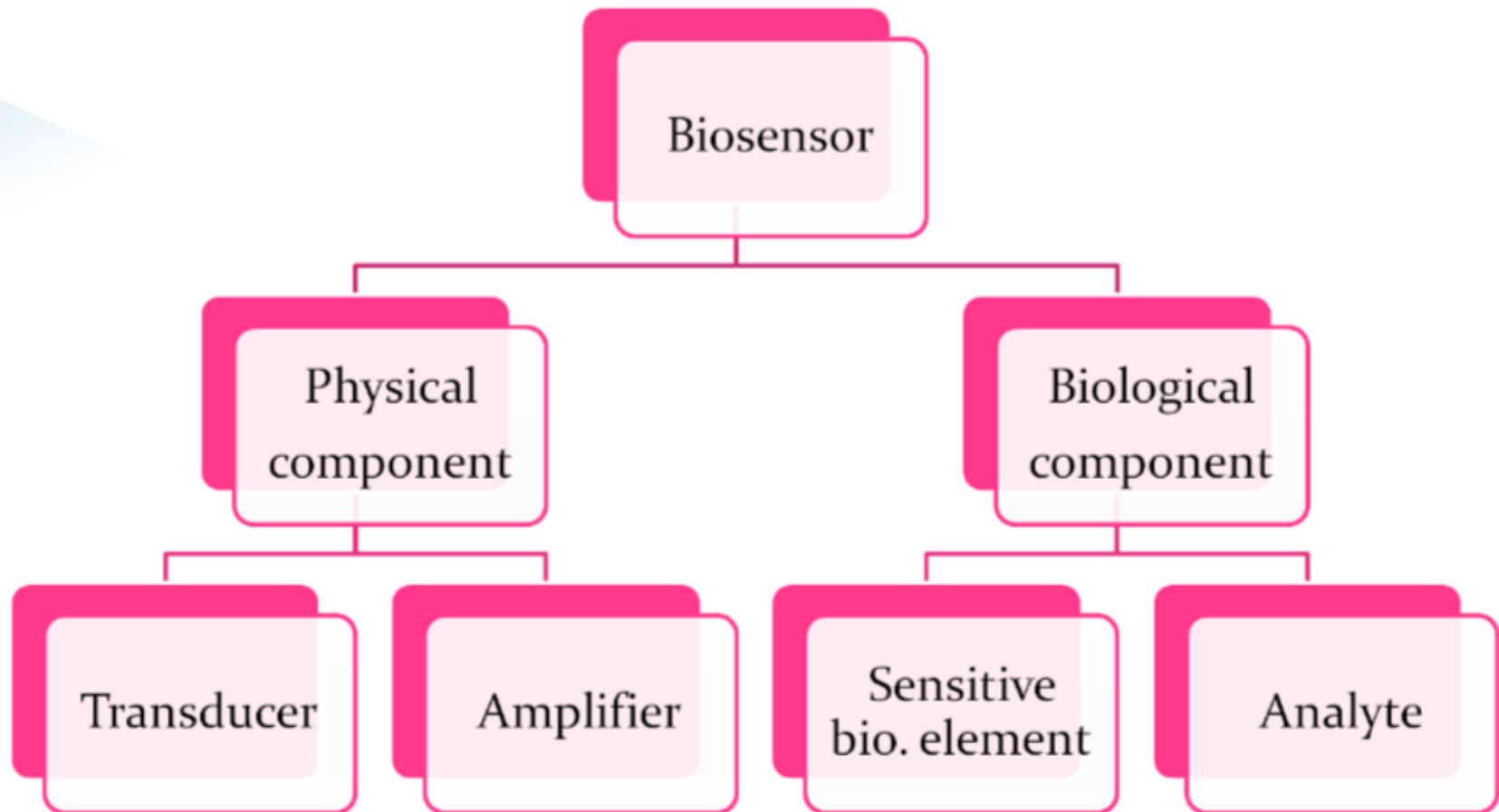
- Biosensor - a self-contained integrated device, which is capable of providing **specific quantitative or semi-quantitative analytical information** using a **biological recognition element** (biochemical receptor) which is retained in direct spatial contact with an **electrochemical transduction element**.



5.1 Introduction

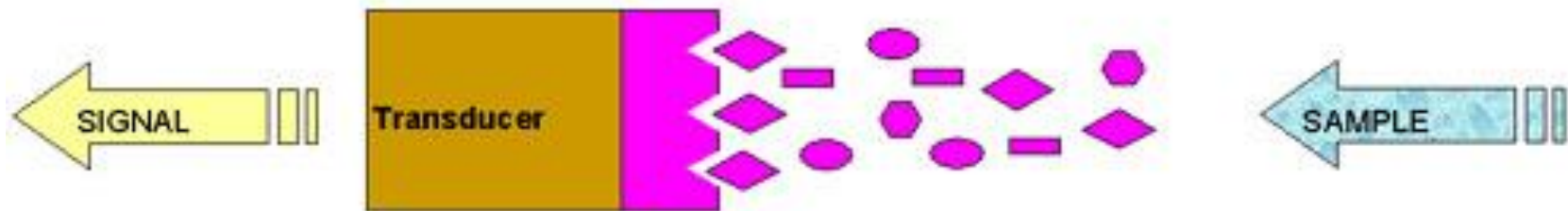
S.N.	Type of biosensor	Type of change detected	Biological component	Example/ Remarks
1	Calorimetric/ thermometric	Temperature	Enzyme	Can detect temp. difference of 0.0001 C
2	Potentiometric	Consumption of a gas	Enzyme	Urea detection
3	Amperometric	Redox reaction	Enzyme	Glucose biosensor
4	Conductimetric	Electrical conductivity	Enzyme	Urea detection
5	Optical	Fluorescence/ absorbance	Enzyme, Ab, DNA/RNA	Luciferase for bacteria detection
6	Piezoelectric	Resonant frequency	Antibodies	Cocaine detection
7	Whole cell	Based on 1, 2, 3 biosensor	Live/ dead microbial cells	Nicotinic acid detection using Lact. arabinosus

5.2 Major components of biosensor

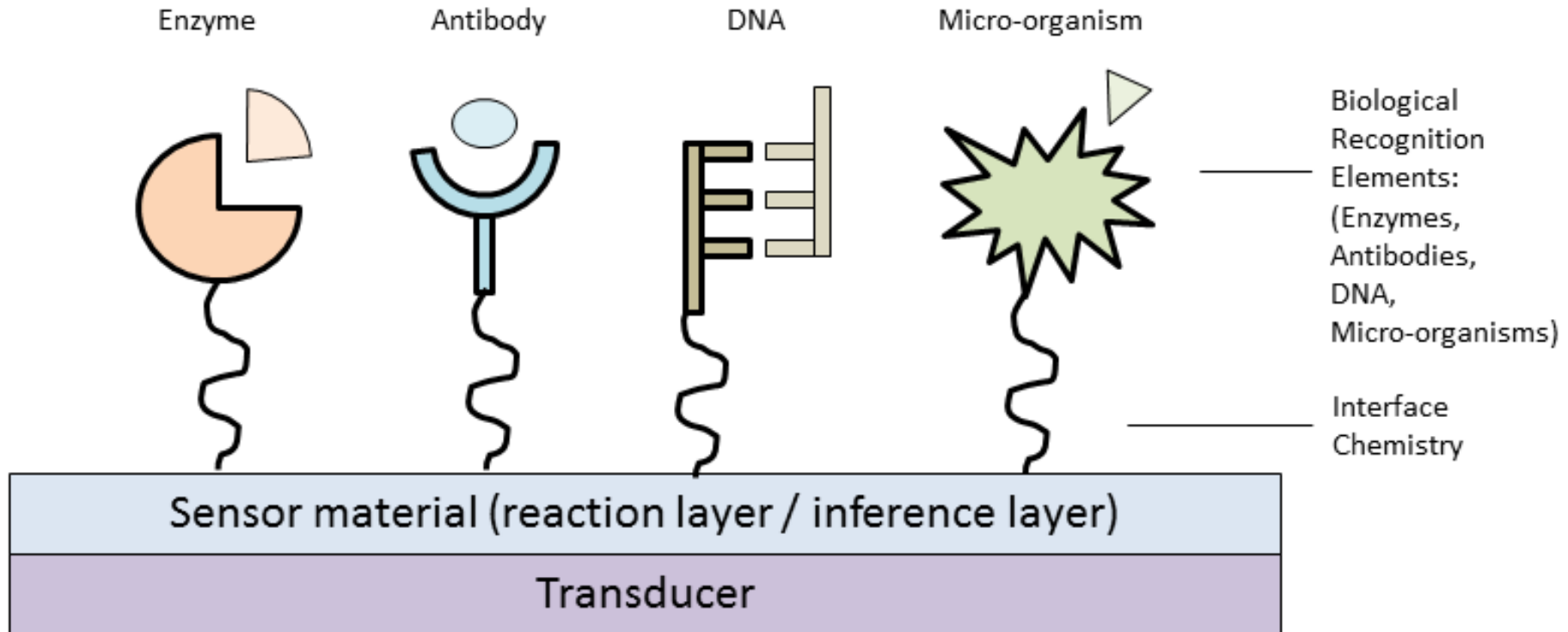


5.2 Major components of biosensor

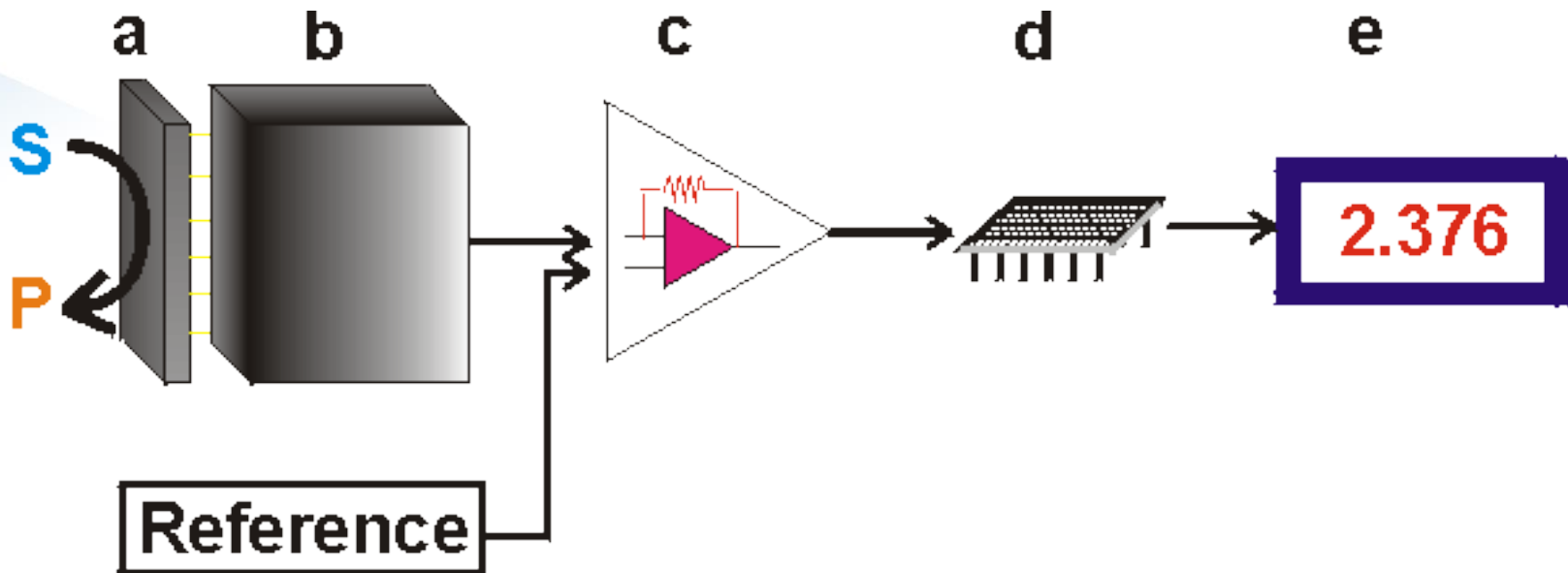
- 3 importance parts of a biosensor:
 - **Sensitive biological element & analyte.**
 - **Transducer or the detector element.**
 - **Electronic or signal processor / Amplifier.**



5.1 Major components of biosensor



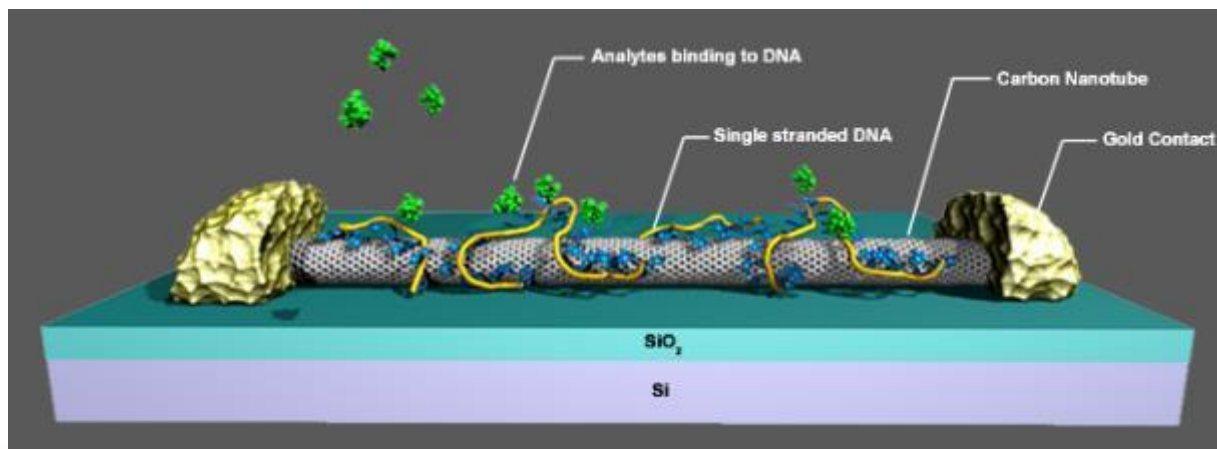
5.2 Major components of biosensor



Schematic diagram showing the main components of a biosensor. The biocatalyst (a) converts the substrate to product. This reaction is determined by the transducer (b) which converts it to an electrical signal. The output from the transducer is amplified (c), processed (d) and displayed (e).

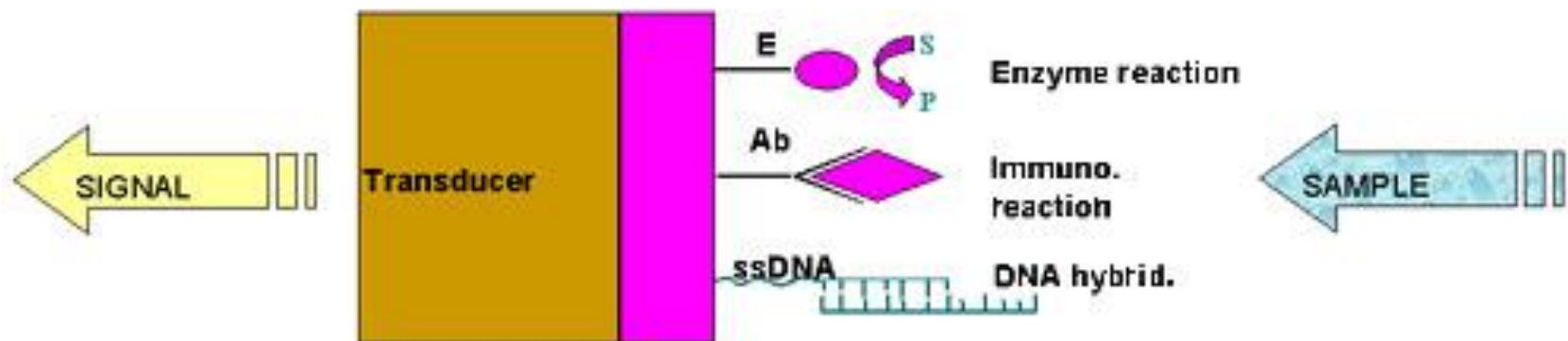
5.2 Major components of biosensor

- Sensitive biological element:-
 - **Biological material**: a biologically derived material or can be created by biological engineering.
 - E.g. tissue, cell receptor, enzymes, antibodies, nucleic acid etc.



5.2 Major components of biosensor

- Sensitive biological element:-
 - two key **functions** of biological element:
 - specifically **recognizes** the analyte .
 - **Interacts** with analyte, which produces some physical change detectable by the transducer.



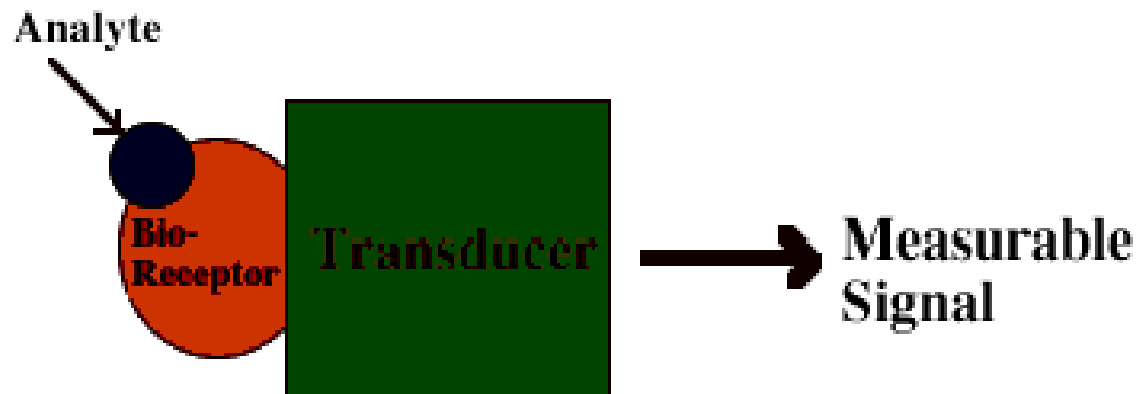
5.2 Major components of biosensor

- Analyte

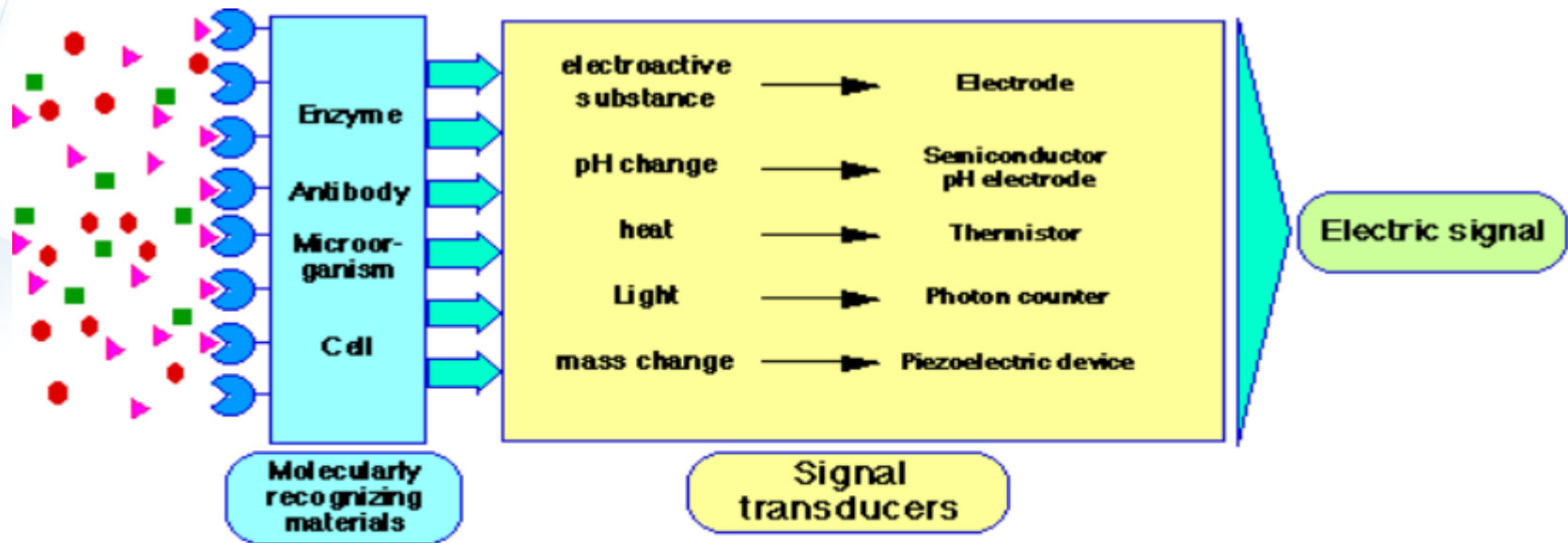
- An **analyte** is a compound whose concentration is to be determined by the biosensor.
- The nature of interaction between the analyte and the biological material used, the biosensor may be of two types :
 1. Analyte converted into a new chemical molecule - **catalytic biosensor**.
 2. Analyte bind to the biological material- **affinity biosensor**.

5.2 Major components of biosensor

- Transducer or the detector element
 - Transducer **detects & measures** this change and **converts** it into an electrical signal.
 - measure the change that occur in the bioreceptor reaction



5.3 Working principle of biosensor



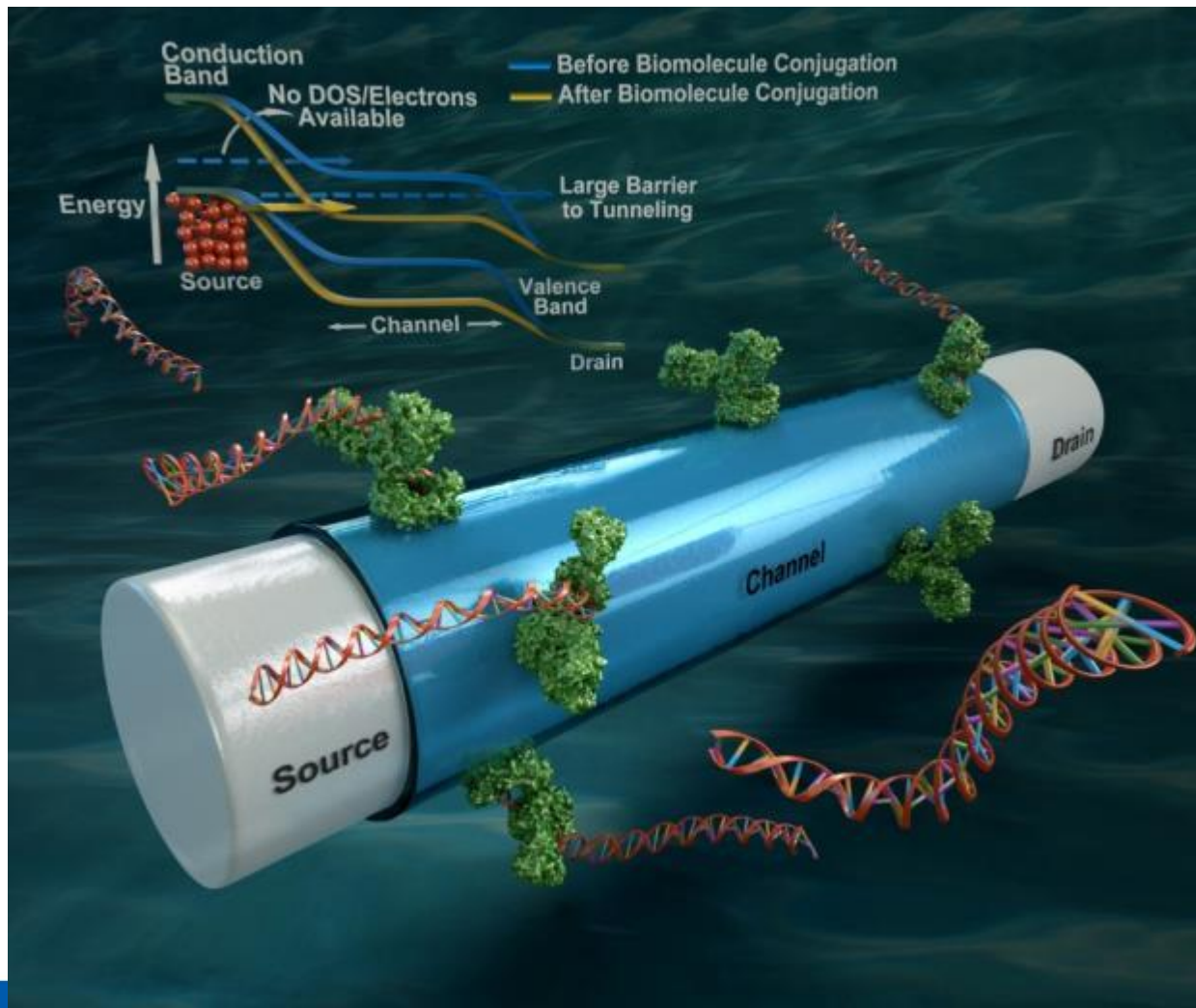
Principle of Biosensors

- 1) Diffusion of analyte
- 2) Reaction with bio. Element
- 3) Change in physicochemical properties
- 4) Change in optical/ electronic properties
- 5) Measurement, amplified and display

5.3 Working principle of biosensor

- The analyte **diffuses** from the solution to the surface of the biosensor.
- The analyte **react** specifically & efficiently with the biological component of the biosensor.
- This reaction **change** the physicochemical properties of the transducer surface.
- This leads to a **change** in the optical/electronic properties of the transducer surface.
- The change in optical/electronic properties is **measured/ converted** into electrical signal, which is amplified, processed and displayed.

5.3 Working principle of biosensor



Discussion

- CSI case
- Describe how the biosensor for *E. coli* work if DNA is used as analyte.

5.4 Characteristics of a good biosensor

- Highly specific for analyte.
- Independent of factors like stirring, pH, temp., etc.
- Linear response, tiny and biocompatible.
- Cheap, easy to use & durable/repeated use.
- Cost is lower than that of conventional tests.
- Require small sample volume.
- Rapid, accurate, stable, & sterilizable.

5.5 Applications of biosensor

- Medical diagnostics
- Agriculture and food industry
- Environment monitoring
- Toxicology tests using biosensor
- Military and defense industry

Extra reading

- http://www.sirebi.org/open/Intro_Biosensing.pdf
- <http://www.ias.ac.in/resonance/Dec2004/pdf/Dec2004p33-44.pdf>
- http://www.gatewaycoalition.org/files/Hidden/sensr/ch1/1_3f.htm

ACTIVITY

- EACH GROUP NEED TO DEVELOP A PROTOTYPE USING BIOLOGICAL APPROACH.
- DISCUSS:
 - PROBLEM STATEMENT
 - YOUR APPROACH, DETAILS OF EACH COMPONENT IN BIOSENSOR
 - WHY YOUR PROTOTYPE IS SPECIAL
 - PRICE

THANK YOU