BIOSENSORS

B.Pharma 6th sem

Pharmaceutical Biotechnology(605 T)

BIOSENSORS

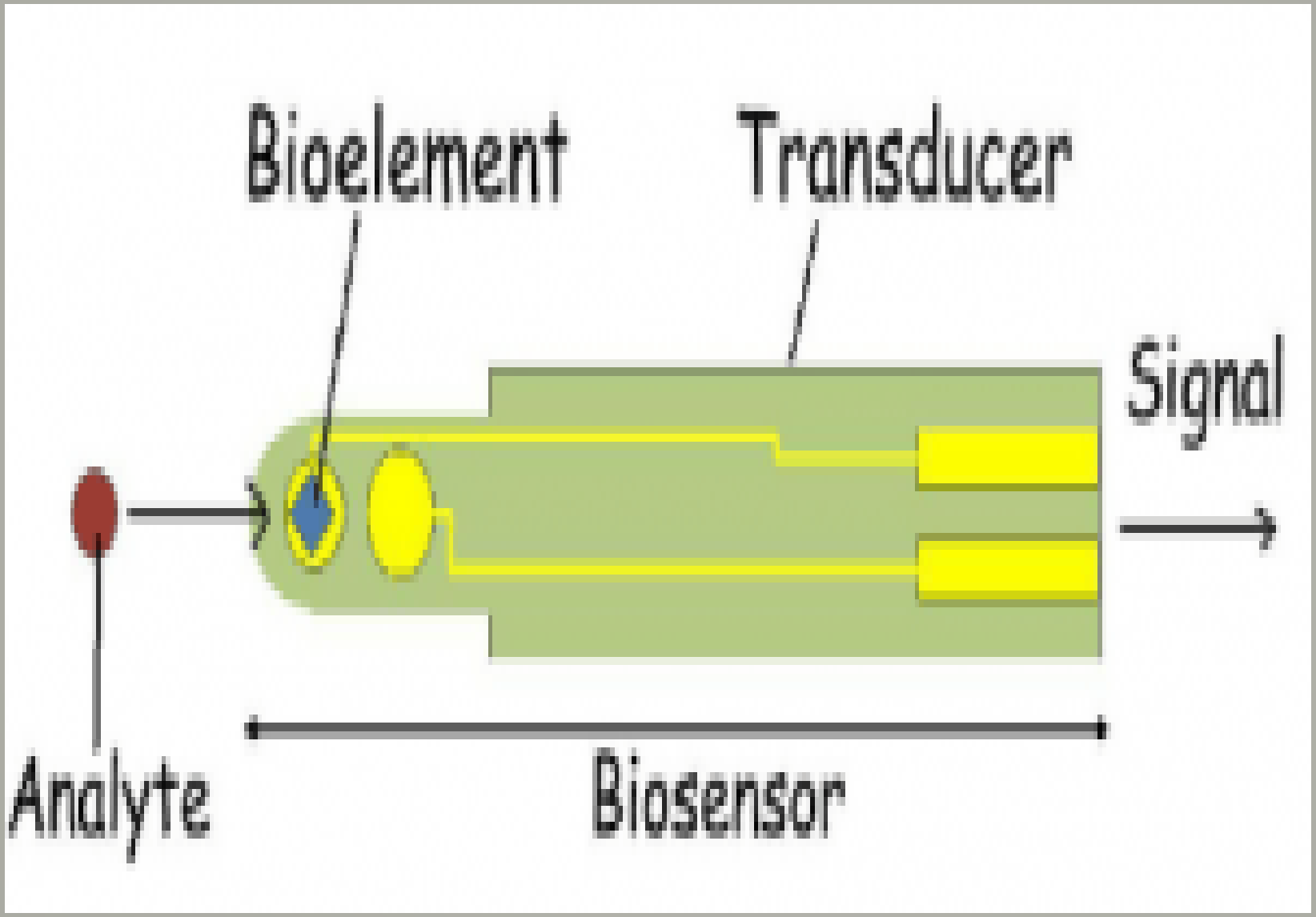
- A biosensor is an analytical device which converts a biological response into an electrical signal.
- Professor Leland C Clark is the father of Biosenor

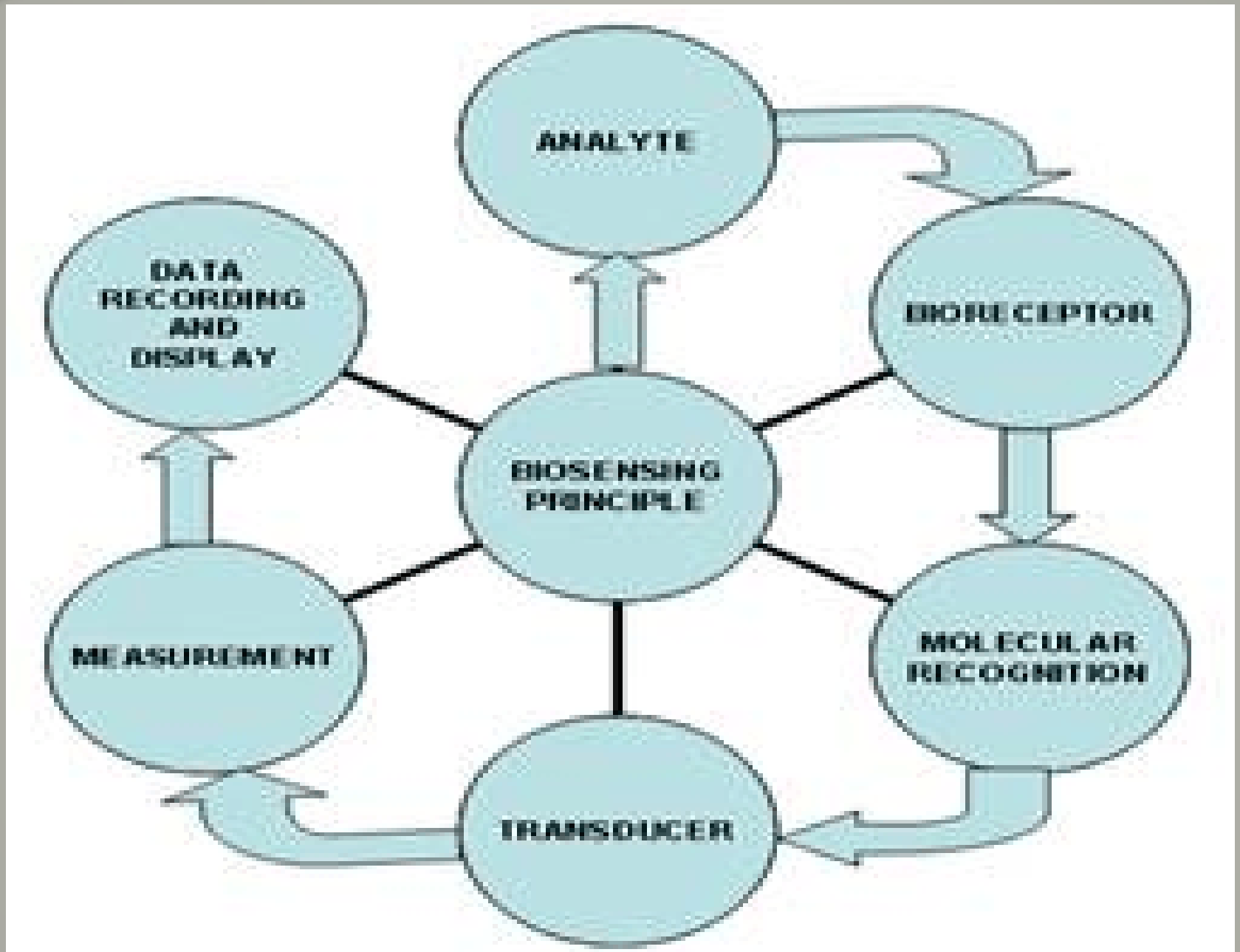
A good biosensor

- 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).

Working of Biosensors

The preferred biological material like enzyme is preferred for conventional methods like physical or membrane entrapment and non-covalent or covalent binding. The preferred biological material is in contact with the transducer. To produce a bound analyte through the analyte binds to the biological material which produces the electrical response to be measured. In some cases, the analyte changed to a product and have some probability to associate with the release of heat, gases like oxygen, electrons or hydrogen ions.


Bioelement
Transducer
Signal
Analyte
Biosensor


ANALYTE
BIORECEPTOR
BIOSENSING PRINCIPLE
MOLECULAR RECOGNITION
TRANSDUCER
MEASUREMENT
DATA RECORDING AND DISPLAY

Parts of biosensor

- Bioreceptors
- Transducer
- Signal processor

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.

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.

Types of biosensors

- Based on the type of transducer the Biosensor are classified as-
- 1) Electrochemical Biosensor
- 2) Amperometric Biosensor
- 3) Blood Glucose Biosensor
- 4) Potentiometric Biosensor
- 5) Conductometric Biosensor
- 6) Thermometric Biosensor
- 7) Optical Biosensors
- 8) Fiber Optic Lactate Biosensor
- 9) Optical Biosensors for Blood Glucose
- 10) Piezoelectric Biosensors
- 11) Immuno–Biosensors

Electrochemical Biosensor

- Electrochemical Biosensor is a simple device. It measures the measurement of electronic current, ionic or by conductance changes carried by bio-electrodes.

Amperometric Biosensor

- The Biosensors are based on the movement of the electron, i.e. electronic current determination as a reaction of the enzyme-catalyzed redox reaction. Generally, a normal contact voltage passes through the electrodes to analyze. In the enzymatic reaction which produces the substrate or product can transfer the electrons with the surface of electrodes to be reduced. As a result, an alternate current flow can be measured. The substrate concentration is directly proportional to the magnitude of the current. The reduction of oxygen is acquired through the oxygen electrodes and it is a simple way to form an Amperometric biosensor. The example is the determination of glucose by glucose.
- The above description is about the first generation of Amperometric biosensor and it has a direct transfer of electrons that are released from the electrodes are having some difficulties. The second-generation Amperometric biosensors are developed in a mediator takes the electrons and transfer to the electrodes.

Blood Glucose Biosensor

Blood glucose Biosensors are used widely throughout the world for diabetic patients. It has a single-use disposable electrode with glucose oxide and derivatives of a mediator (Ferrocene) and the shape of the blood glucose Biosensor looks like a watch pen. With the help of hydrophilic mesh, electrodes are converted. Blood glucose Biosensor is a good example of an Amperometric Biosensor.

Potentiometric Biosensor

In this type of Biosensors changes the concentration of ionic is determined by the ion-selective electrodes in this pH electrodes are used most commonly. Hence a large amount of enzymatic reactions is involved in the release of hydrogen ions. Ammonia-selective and Corbondioxide selective electrodes are some other important electrodes.

Continued……

- The Potentiometric electrode and the reference electrode can be measured with the help of potential difference and it is directly proportional to the substrate concentration. The Potentiometric Biosensors is the sensitivity of enzymes to ionic concentration like H+ and NH+4
- The ion-selective field-effect transistors are lower-price devices. It can be used in the miniaturization of Potentiometric Biosensors. An example of the ISFET Biosensor is to monitor intra-myocardial for open-heart surgery.

Conductometric Biosensor

In the biological system, there are several reactions that change the ionic species. The electronic conductivity can be measured with the help of anionic species. The example of the conductometric Biosensor is the urea Biosensor which utilizing the immobilized areas.

Thermometric Biosensor

There are many more biological reactions are connected with the production of heat and it forms the basis of thermometric Biosensors.

Optical Biosensors

The optical Biosensor is a device, it utilizes the principle of optical measurements like fluorescence, absorbance and etc. They used in fiber optics and Optoelectronic transducers. The optical Biosensors are safe for non-electrical remote sensing of materials. In the transducer elements, primarily optical Biosensors involves in the enzymes and antibodies. Usually, the Biosensors is not required any reference sensors and the comparative signals are generated by using the sampling sensor.

Fiber Optic Lactate Biosensor

- The working of the fiber optic lactate Biosensor is based on the measurement of change in oxygen concentration, molecular by identifying the effects of oxygen in the fluorescent dye.

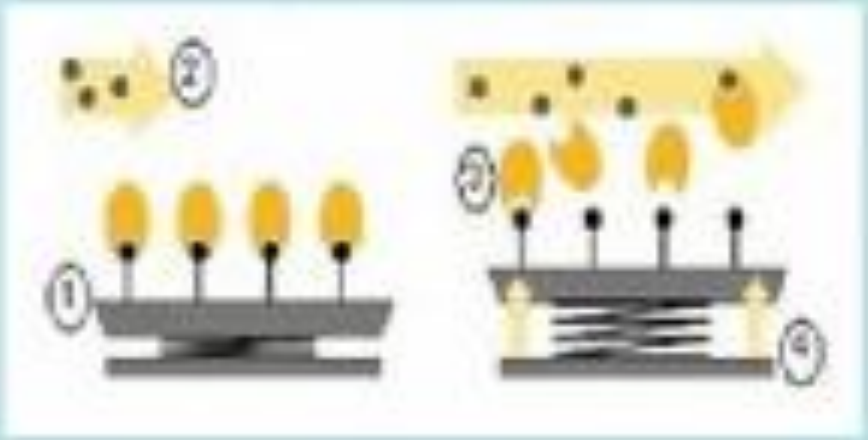
Optical Biosensors for Blood Glucose

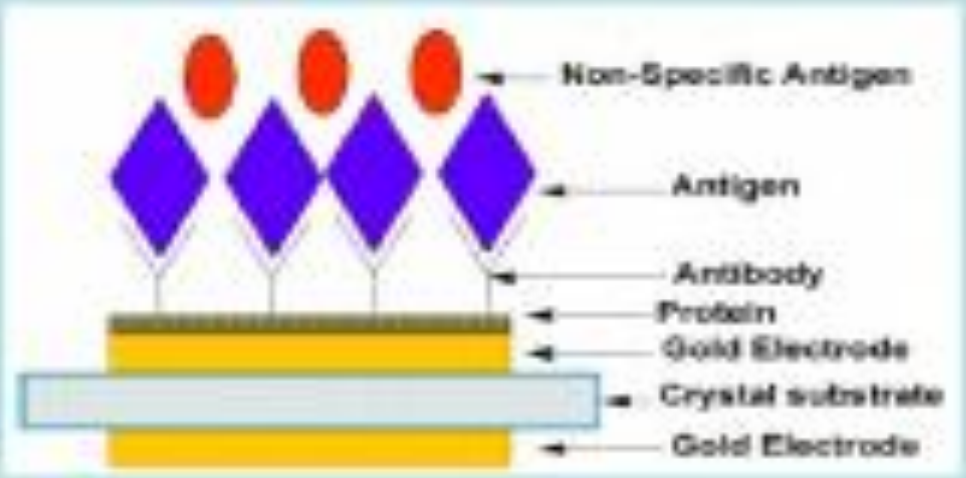
- The enzyme glucose oxiadase is used by blood glucose biosensor to break down of blood glucose. First it oxidizes glucose and uses two electrons to reduce the FAD (a component of the enzyme) to FADH2 which in turn is oxidized by the electrode in a number of steps. The resulting current is a measure of the concentration of glucose. In this case, the electrode is the transducer and the enzyme is the bioreceptor.

Piezoelectric Biosensors

The principle of piezoelectric Biosensor is used in sound vibrations, hence it is called acoustic Biosensors. The basics of the Biosensors are formed by the piezoelectric crystals and the characteristic frequencies are trembling with the crystals of positive and negative charge. By using the electronic devices we can measure the certain molecules on the crystal surface and alters the response frequencies using these crystals we can attaché the inhibitors. The Biosensors for cocaine in the gas phase have been developed by attaching the antibodies cocaine to the surface of the crystal.

Piezoelectric





Immuno –Biosensors

- The immune Biosensors work on the principle of immunological specificity and mostly coupled with measurement on the Potentiometric Biosensors.

APPLICATION OF BIOSENSORS

- Food analysis
- Study of Biomolecules and their interactions
- Drug development, crime detection
- Medical diagnosis
- Environmental field monitoring
- Industrial process control
- Manufacturing of pharmaceuticals and replacement of organs