SENSOR NETWORKS AND DATA COMMUNICATIONS

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Masdar INSTITUTE

BIOGRAPHY

- **Daniel Choi received his B.S. in Metallurgical Engineering from Seoul National University (South Korea) and Ph.D. in Electrical Engineering from UCLA. Dr. Choi worked as a staff member for three years at the Aerospace Corporation in California, where developed high-trans conductance / low-noise nanometer-scale MOSFET and GaN high-speed electronic devices. Dr. Choi joined Jet Propulsion Laboratory (JPL)/NASA in 1999 as a task manager, leading a number of space-related projects for nine years. He worked on development of high sensitivity gas sensors,MEMS-gyroscopes, and novel microfluidic ion mobility chromatograph for Mars Science Laboratory (MSL) project.**
- **Prior to joining the Masdar Institute, he was an associate professor of the Materials Science and Engineering (MSE) programfor 2007-2013 at University of Idaho (USA). Currently, he is the Department Head of the Mechanical and Materials Engineering Department at the Masdar Institute of Science and Technology, Abu Dhabi, the United Arab Emirates.**

RESEARCH INTERESTS

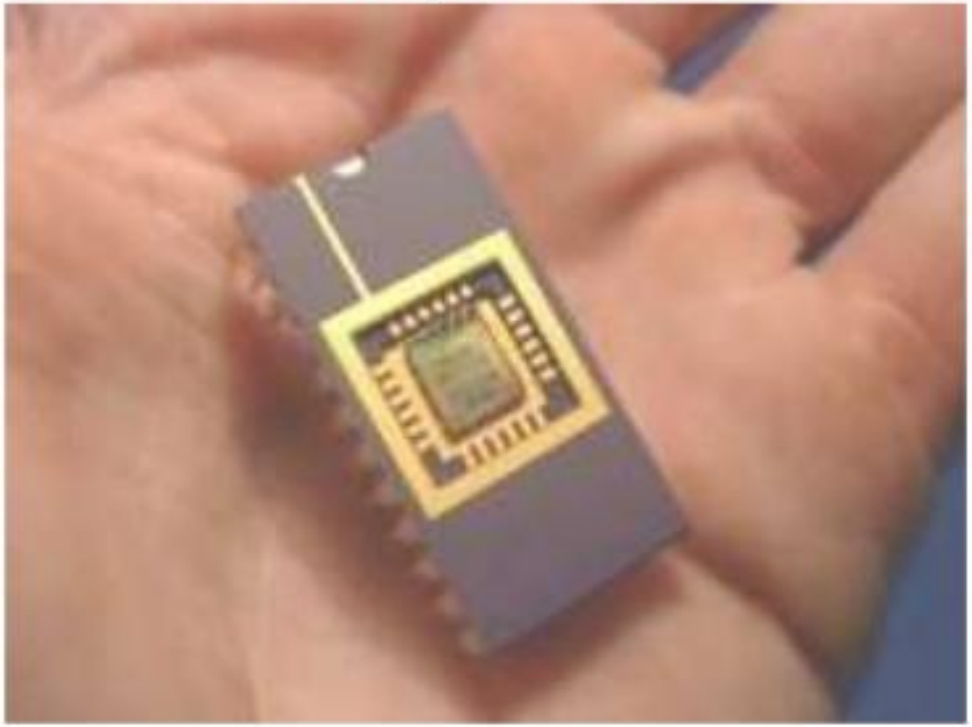
- Graphene - based Nano electronics
- 3D-electronics
- Nanomaterial-based energy storage devices (Li-ion batteries and ultra-capacitors)
- Thermo electrics
- Novel materials for low-energy nuclear reactions (LENR)
- Bio-medical sensors/drug delivery systems

BIOSENSORS

- **A biosensor is an analytical device, used for the detection of an analyte, that combines a biological component with a physicochemical detector.**

CURRENT DEFINITION

A sensor that integrates a biological element with a physiochemical transducer to produce an electronic signal proportional to a single analyte which is then conveyed to a detector.

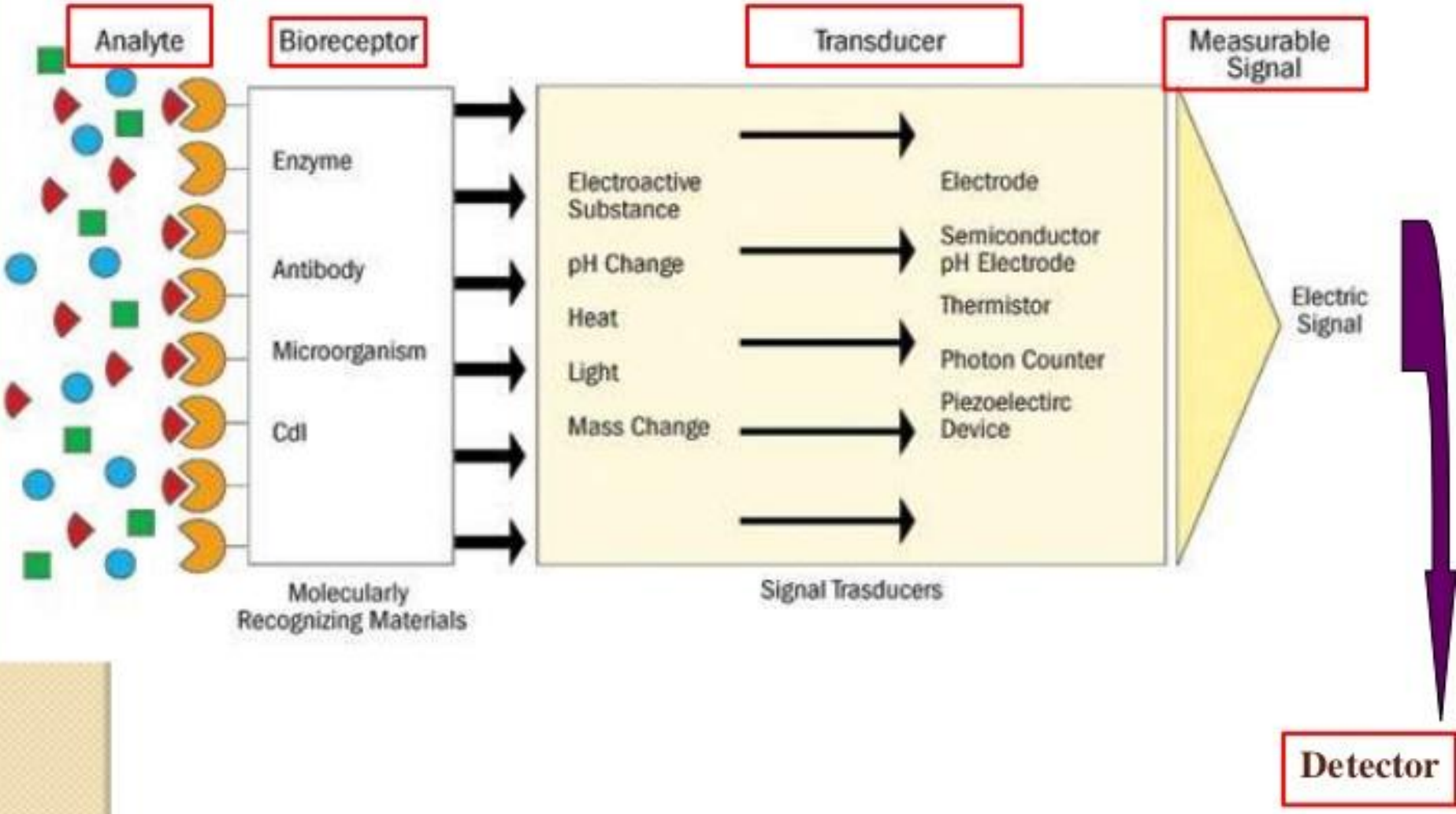


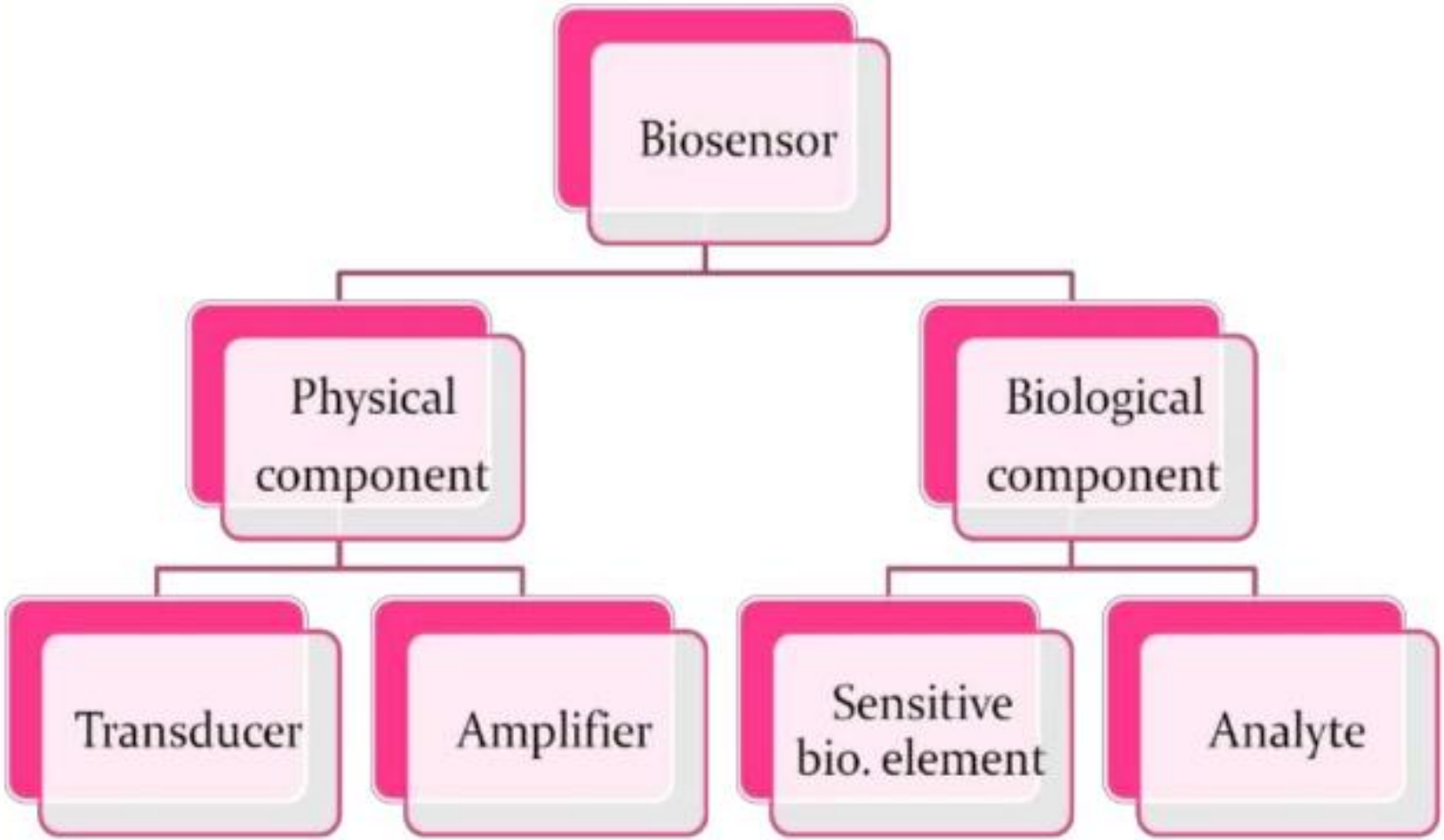
- Any device that has specific biochemical reactions to detect chemical compounds in biological samples.

FATHER OF BIOSENSOR.

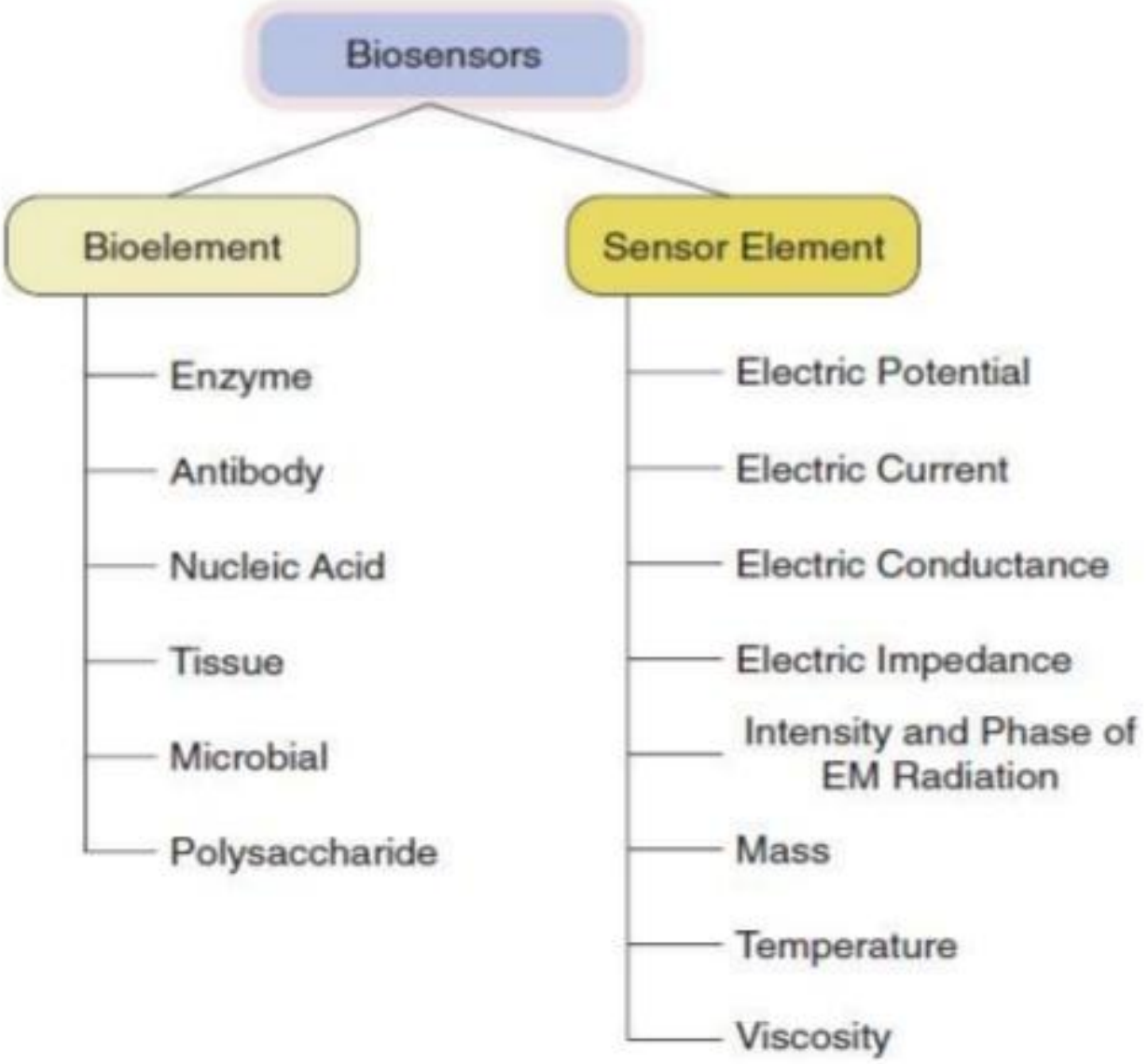
Professor Leland C Clark Jnr (1918–2005)

COMPONENTS

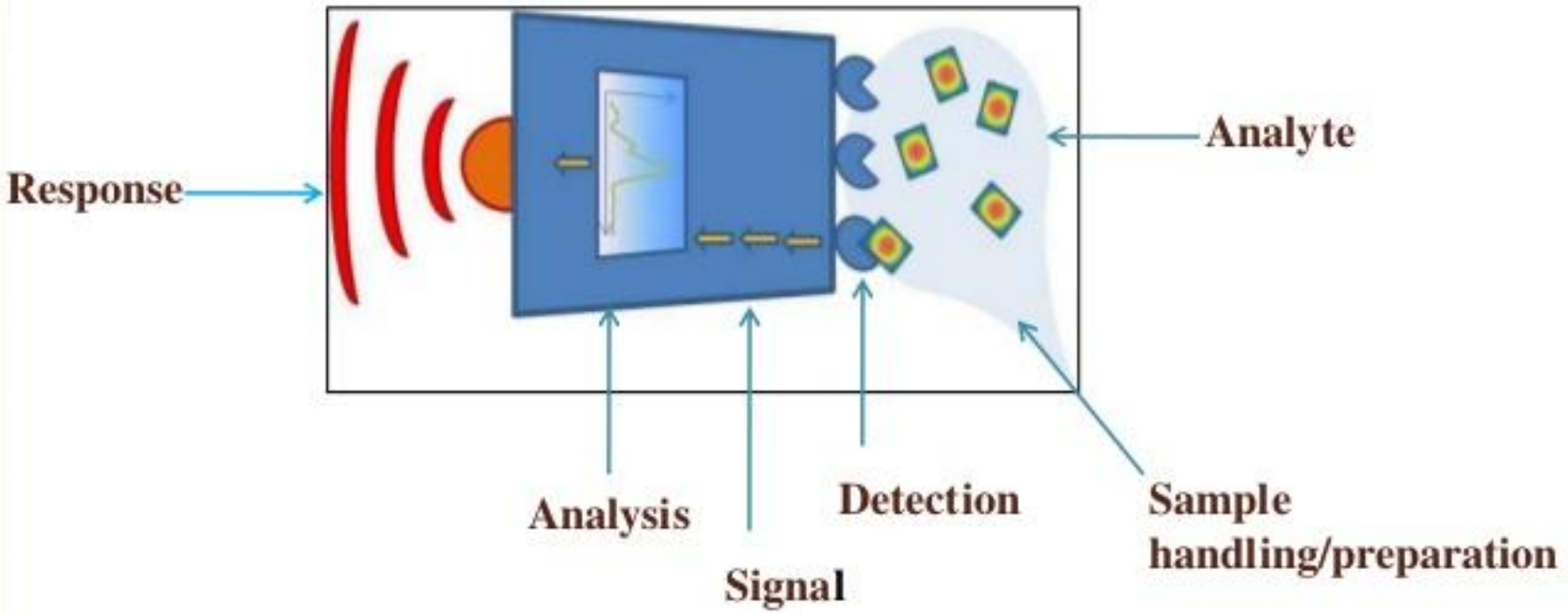

Analyte
Bioreceptor
Transducer
Measurable Signal
Enzyme
Antibody
Microorganism
Cdl
Electroactive Substance
pH Change
Heat
Light
Mass Change
Electrode
Semiconductor pH Electrode
Thermistor
Photon Counter
Piezoelectirc Device
Electric Signal
Molecularly Recognizing Materials
Signal Trasducers
Detector


Biosensor
Physical component
Biological component
Transducer
Amplifier
Sensitive bio. element
Analyte

ELEMENTS OF BIOSENSORS



BIOSENSOR.

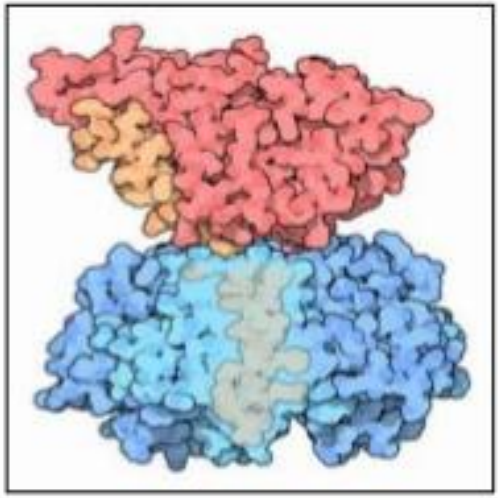

Response
Analyte
Analysis
Signal
Detection
Sample
handling/preparation

THE ANALYTE.

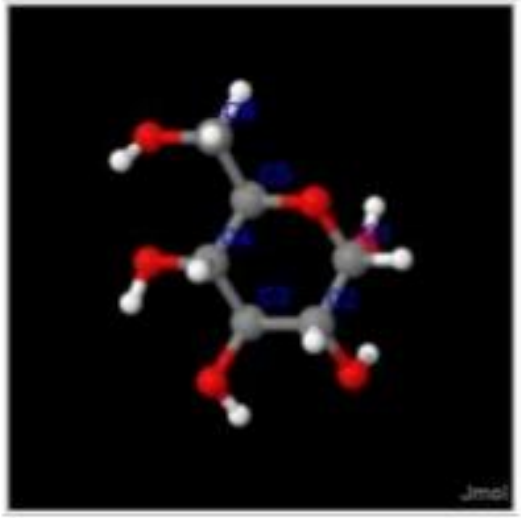
(What do you want to detect?)

- Molecule

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



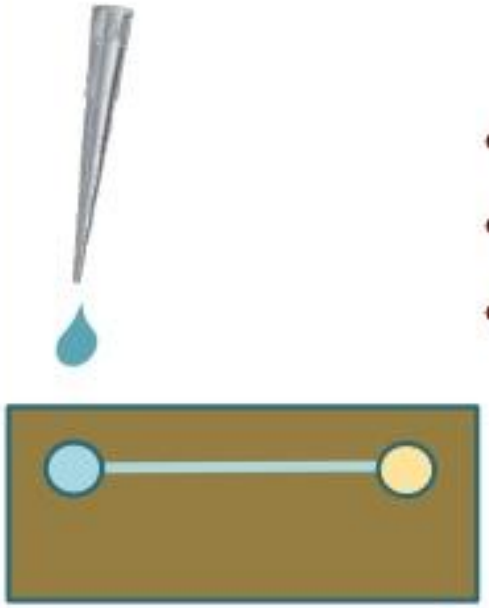
Cholera toxin



Glucose

SAMPLE HANDLING.

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



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

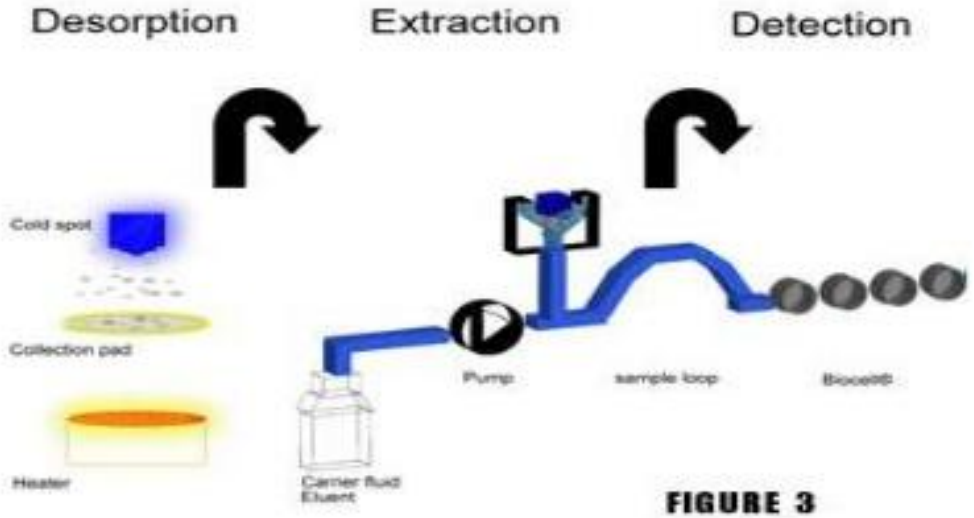
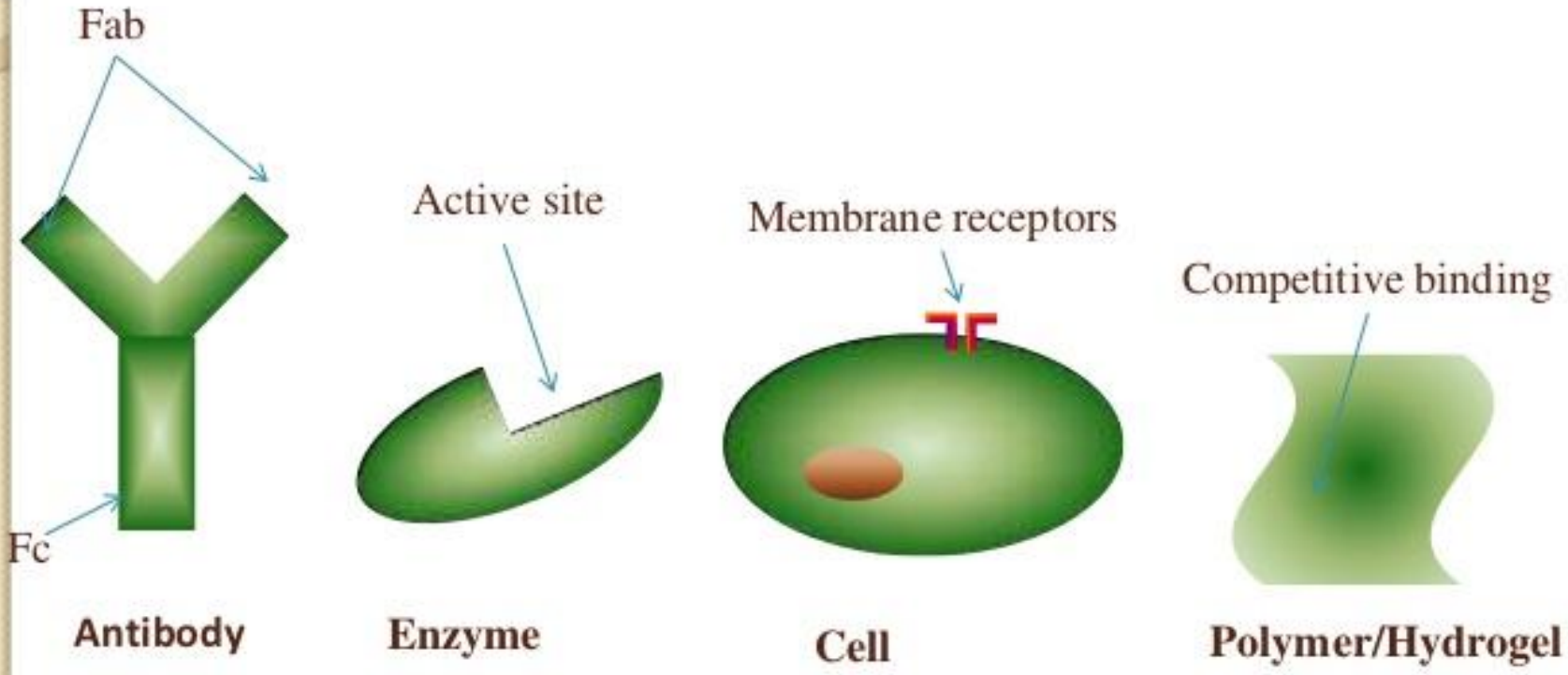


FIGURE 3

DETECTION/RECOGNITION.

(How do you specifically recognise the analyte?)



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 physicochmical 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.

BASIC CHARACTERESTICS

- LINEARITY - Should be High – For the detection of High Substrate Concentration.
- SENSITIVITY - Value of Electrode Response per Substrate Concentration.
- SELECTIVITY - Chemical Interference must be minimised for obtaining Correct Result.
- RESPONSE TIME – Time necessary for having 95% of the Response.

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.

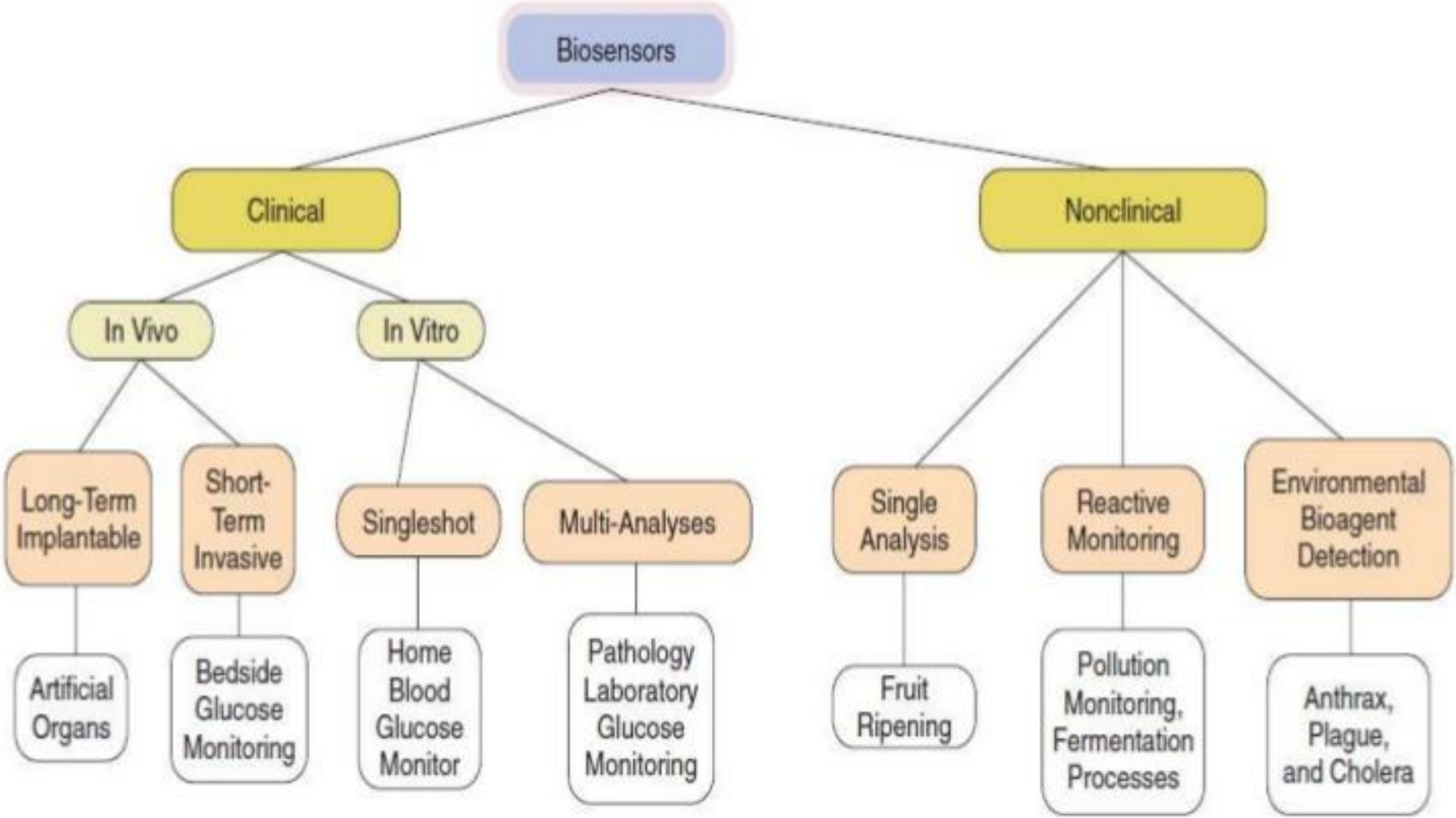
TYPICAL SENSING TECHNIQUES

- Fluorescence.
- DNA Microarray.
- SPR (Surface Plasma Resistance).
- Impedance Spectroscopy.
- SPM (Scanning Probe Microscopy, AFM, STM).
- QCM (Quartz Crystal Microbalance).
- SERS (Surface Enhanced Raman Spectroscopy).
- Electrochemical.

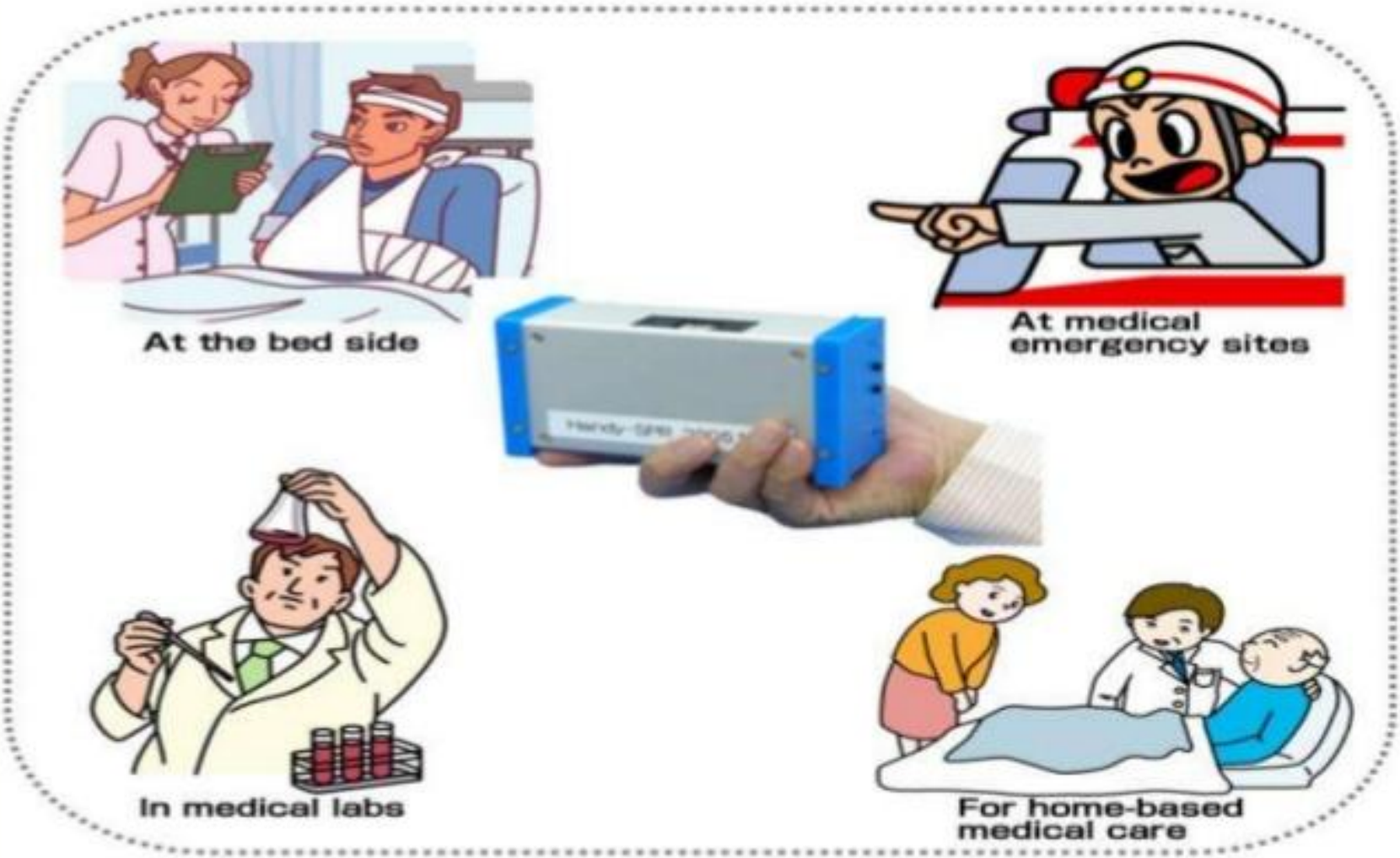
TYPES

- Calorimetric/Thermal Detection Biosensors.
- Optical Biosensors.
- Resonant Biosensors.
- Piezoelectric Biosensors.
- Ion Sensitive Biosensors.
- Electrochemical Biosensors.
  - Conductimetric Sensors.
  - Amperometric Sensors.
  - Potentiometric Sensors.

APPLICATIONS



ig. 2 Potential applications of biosensors


At the bed side
At medical emergency sites
In medical labs
For home-based medical care

The DNA capture element instrument- for hereditary diseases

Glucometer- for measurement of glucose in blood.

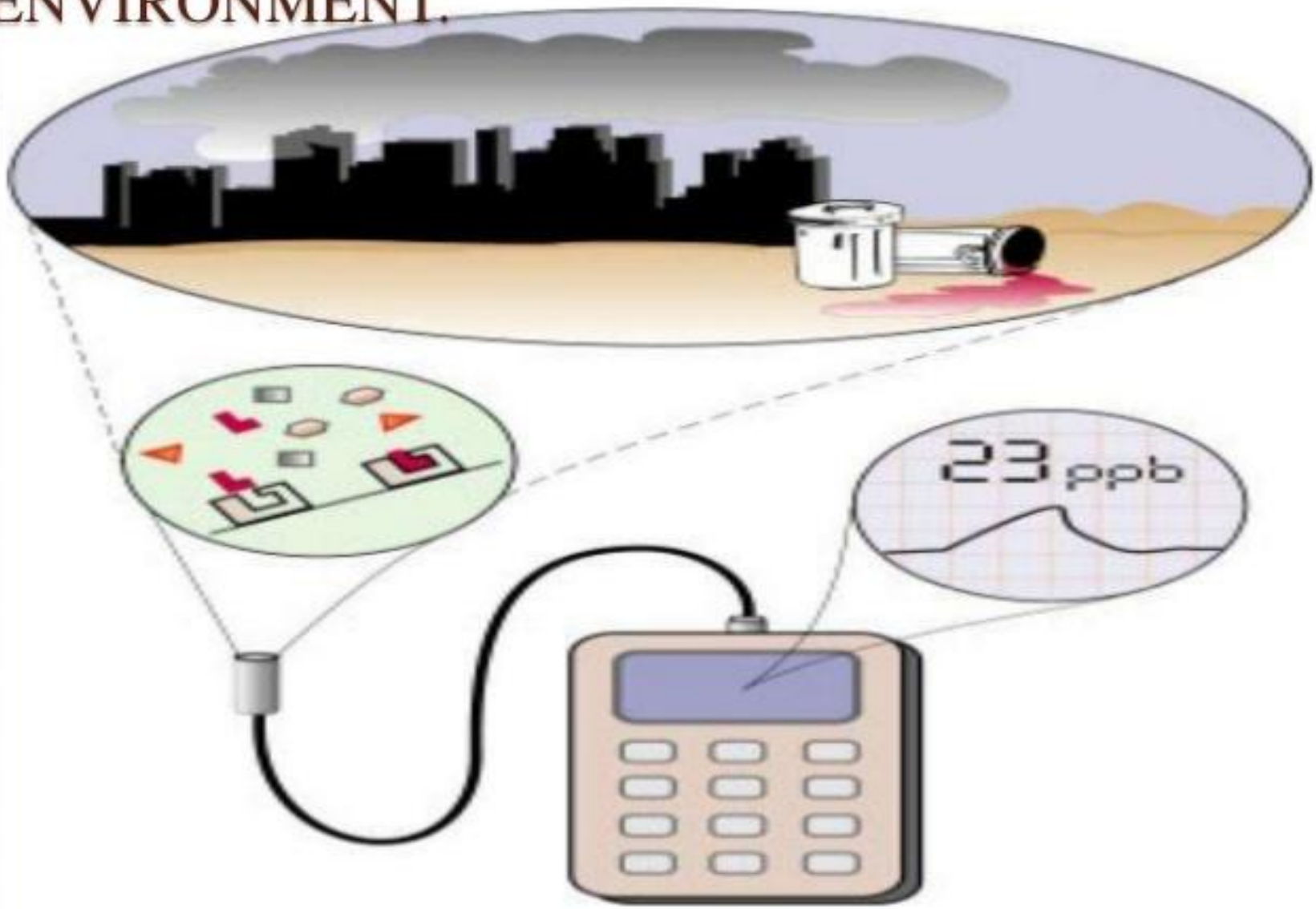
Pregnancy Test.

- ***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.***

BIOSENSOR FOR DETECTION OF POLLUTION & OF THE CHEMICALS PRESENT IN THE ENVIRONMENT.



RECENT PUBLICATIONS

- J. Min, J. Cho, B. An, **D. Choi** and Y. Kim, “Magnetic nanodiscs fabricated from multilayered nanowires”, *Journal of Nanoscience and nanotechnology* (in press).
- I. Jeon, M. Cho, J. Cho, B. An, J. Wu, R. Kringel, **D. Choi**, and Y. Kim, "Synthesis of magnetic-optical core-shell nanowires and observation of cellular responses," *Journal of Applied Physics* (in press).
- **Daniel Choi (corresponding author)**, Jungrae Park, Ke Xu, Rose Kringel, John Choi, In Tak Jeon, and Young Keun Kim, “Dynamic microcontainers as microvacuums for collecting nanomaterials after clinical treatments”, *IEEE Transactions on Magnetics*, 49, 7, 3464-3467, 2013.
- **Daniel Choi (corresponding author)**, Xiaoping Hopkins, Rosemarie Kringel, Jung-rae Park, In Tak Jeon, and Young Keun Kim, "Magnetically-driven spinning nanowires as effective materials for eradicating living cells," *Journal of Applied Physics,* 111, 07B329, 2012.
- In Tak Jeon, Moon Kyu Cho, Jin Woo Cho, Boo Hyun An, Jun Hua Wu, Rosemarie Kringel, **Daniel S. Choi (co-corresponding author)**, and Young Kun Kim, "Ni-Au core-shell nanowires: Synthesis, microstructures, biofunctionalization, and the toxicologic effects on pancreatic cancer cells," *Journal of Materials Chemistry*, 21, 12089-12095, 2011.

SENSOR NETWORKS AND DATA COMMUNICATIONS RELATED JOURNALS

- Biosensors & Bioelectronics
- Biosensors Journal

SENSOR NETWORKS AND DATA COMMUNICATIONS RELATED CONFERENCES

- Global Summit on Electronics and Electrical Engineering, November 03-05, 2015 Valencia, Spain
- 4th International Conference and Exhibition on Biometrics & Biostatistics, November 16-18, 2015 San Antonio, USA
- 2ndInternational Conference on Big Data Analysis and Data Mining, November 30-December 02, 2015 San Antonio, USA
- 2nd International Conference and Business Expo on Wireless & Telecommunication April 21-22, 2016 Dubai, UAE

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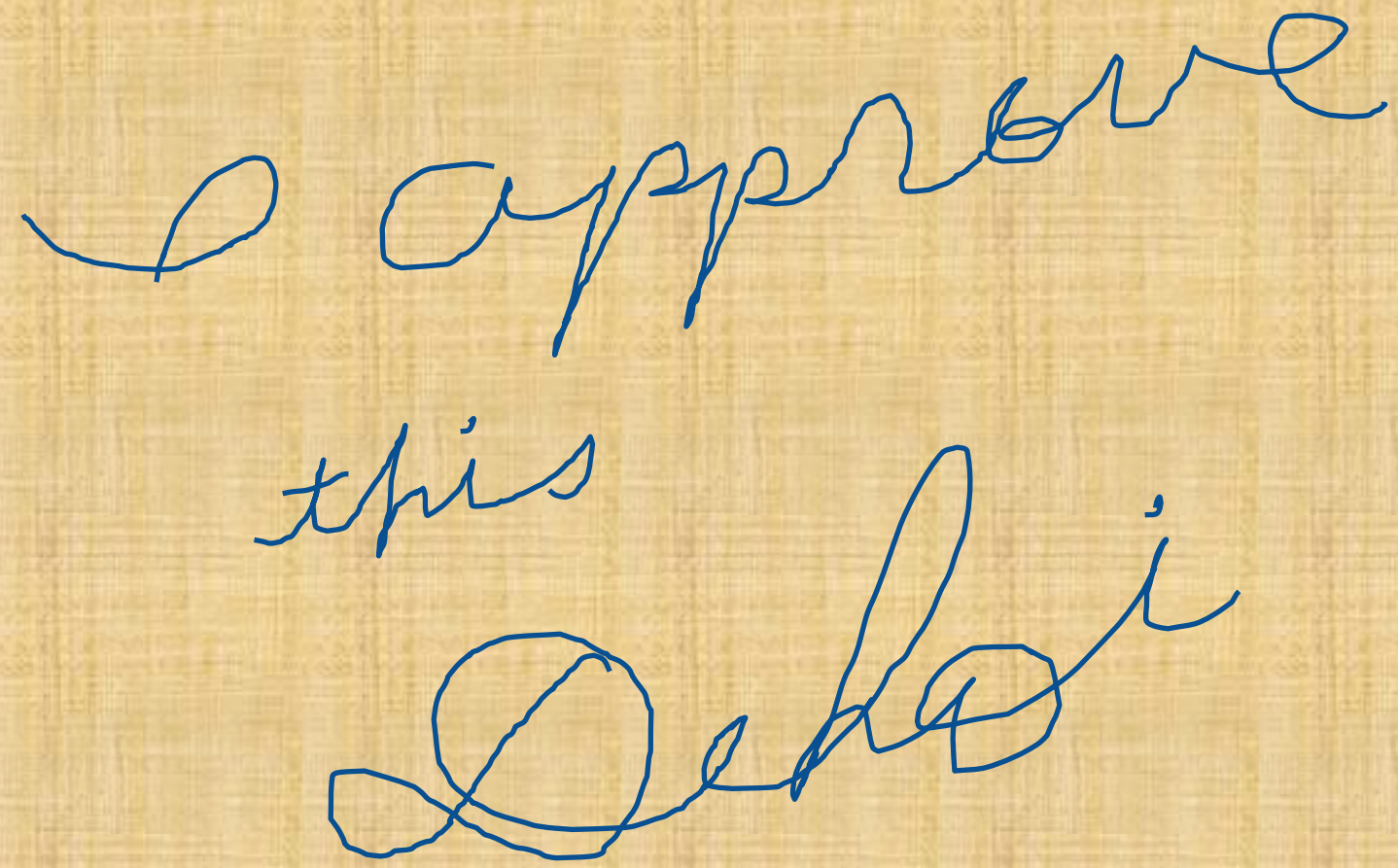


Thank You!