DIIES

Dipartimento Ingegneria dell'Informazione, delle Infrastrutture e dell'Energia Sostenibile

Laurea Magistrale in «Ingegneria Elettronica»

Presentazione corso di

« Chimica e Processi per la Microelettronica «

Anno Accademico 2016/2017

Programma del modulo di
“Chimica e Processi per la Microelettronica”

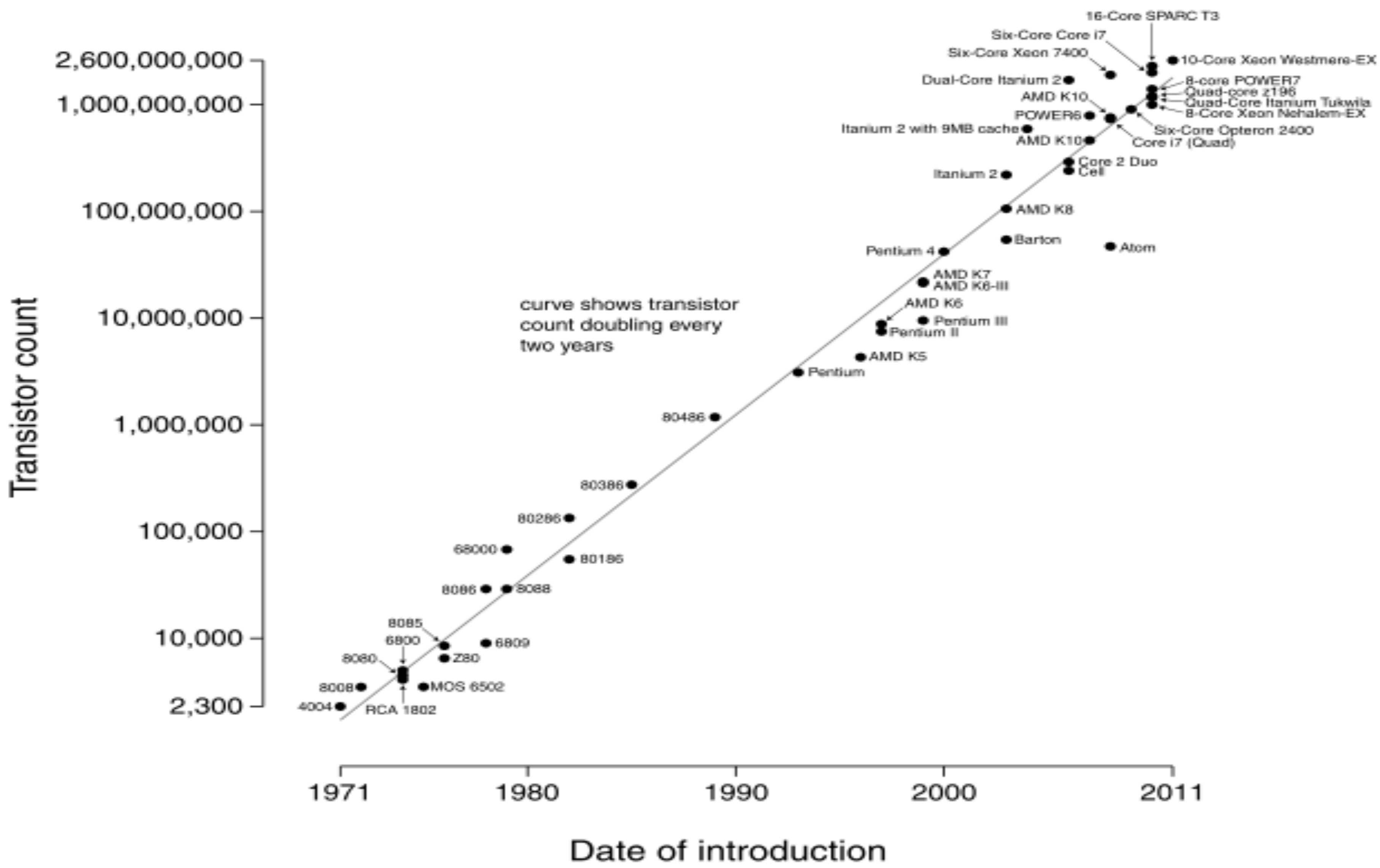
I processi tecnologici utilizzati per la produzione di “Devices” a base di Silicio, GaAs e di materiali polimerici.

Proprietà e caratteristiche dei materiali polimerici per l’elettronica.

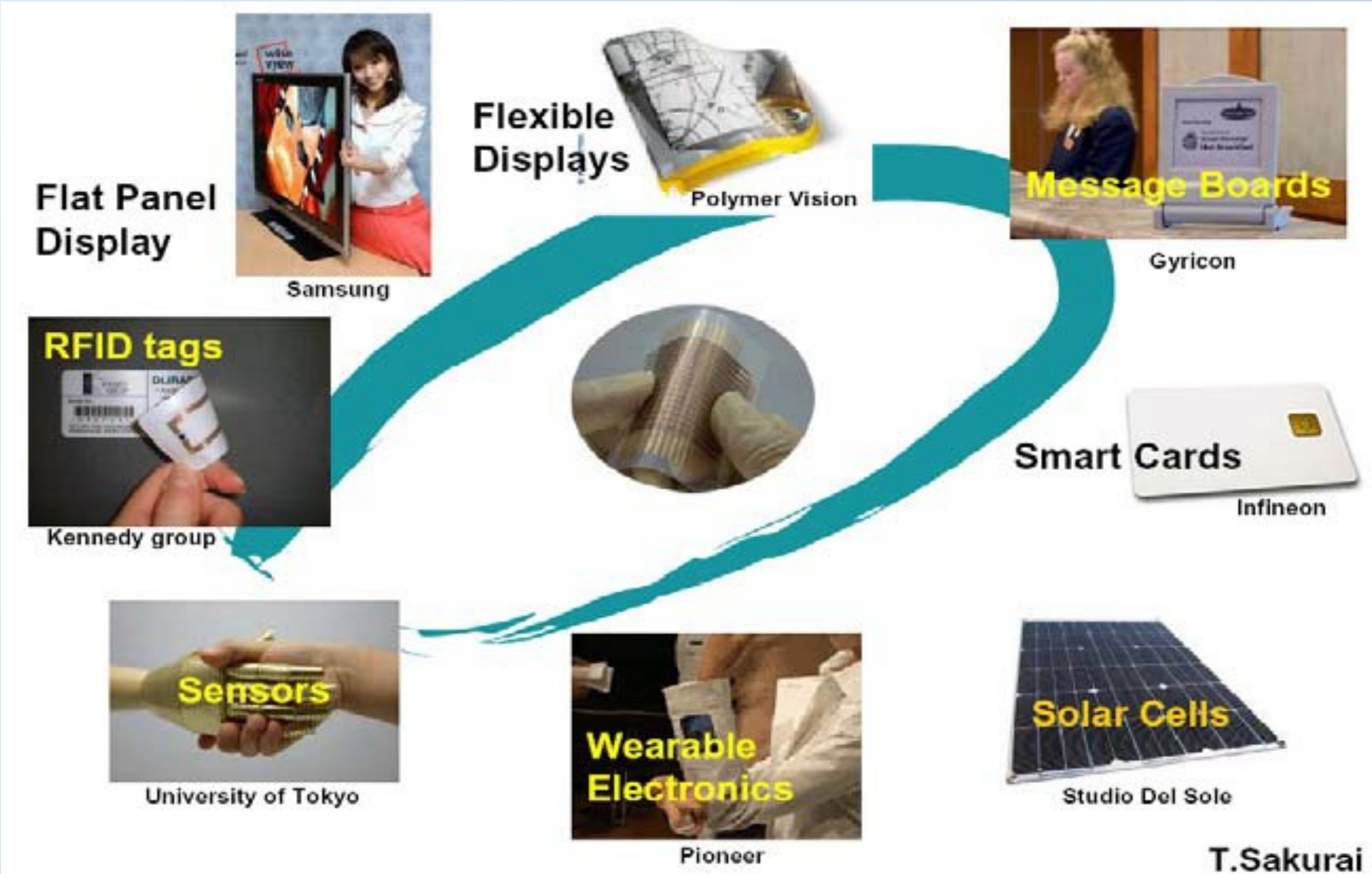
Proprietà fondamentali delle molecole biologiche.

Interfacciamento dei sistemi elettronici con sistemi biologici.

Microprocessor Transistor Counts 1971-2011 & Moore's Law



L' ELETTRONICA ORGANICA



Microelectronics Technologies for Medical Applications

Therapies for arrhythmias

The standard of care for treating bradycardia is an implantable pacemaker. There are approximately 200 000 pacemakers implanted each year in the United States (Thom et al. 2006).

As shown in Figure 1, a pacemaker is implanted under the skin in the pectoral region. The pacemaker is a device about the size of a matchbook that is electrically connected to the heart through wires, called leads, that enter the large vein just below the collarbone and advance into the heart. There are two leads in the illustration. One lead is attached to the wall of the right atrium and the other is attached to the right ventricle.

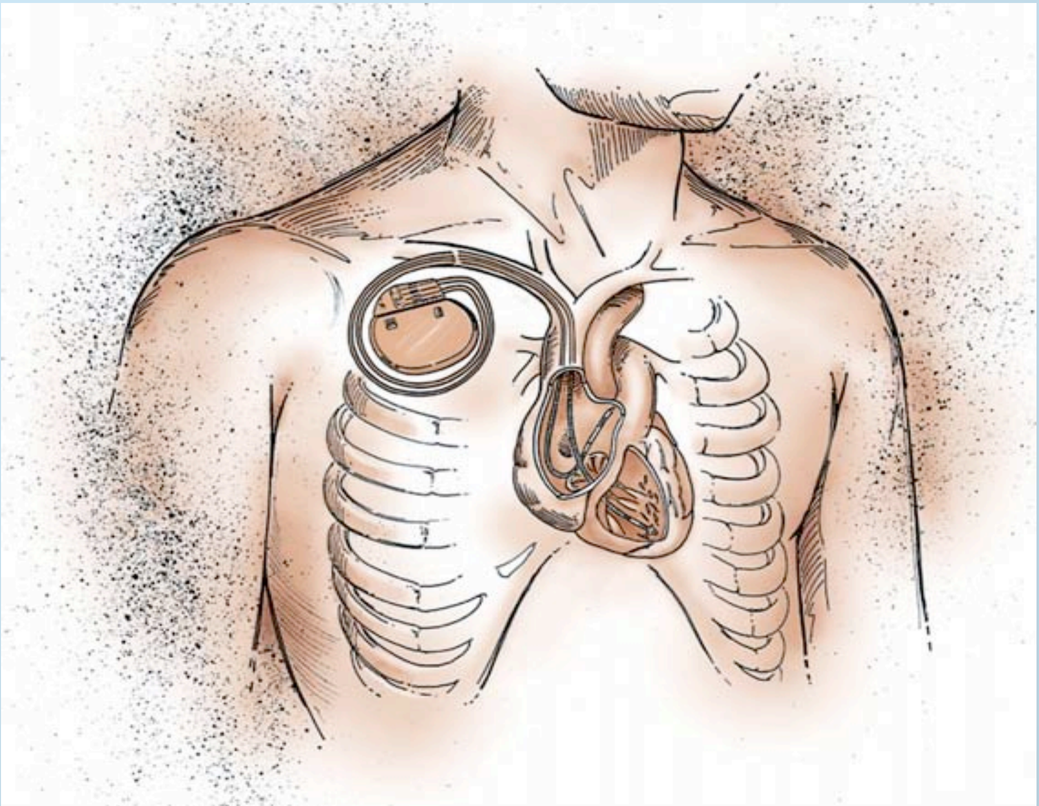


Illustration of implanted pacemaker with two leads into the heart. (Courtesy: Medtronic.)

The pacemaker contains a significant amount of processing capability and other electronics to perform multiple functions. It senses the activity of the heart and can also deliver an electrical stimulating pulse to start the heart contraction. Most pacemakers today also have the ability to estimate the rate at which the patient's heart should be beating in order to supply sufficient blood flow to meet the demands of the patient's activity level. This capability is called rate responsive pacing and requires the input from one or more sensors. The most prevalent method of sensing the patient's demand is through the use of a vibration sensor built into the pacemaker itself. This sensor may be a small piezoelectric crystal attached to the side of the pacemaker or an accelerometer attached to the pacemaker's circuit board. In either case, daily activities like walking or running will generate vibration signals picked up by the sensor. An algorithm inside of the pacemaker converts this level of physical activity into a heart rate for the patient.

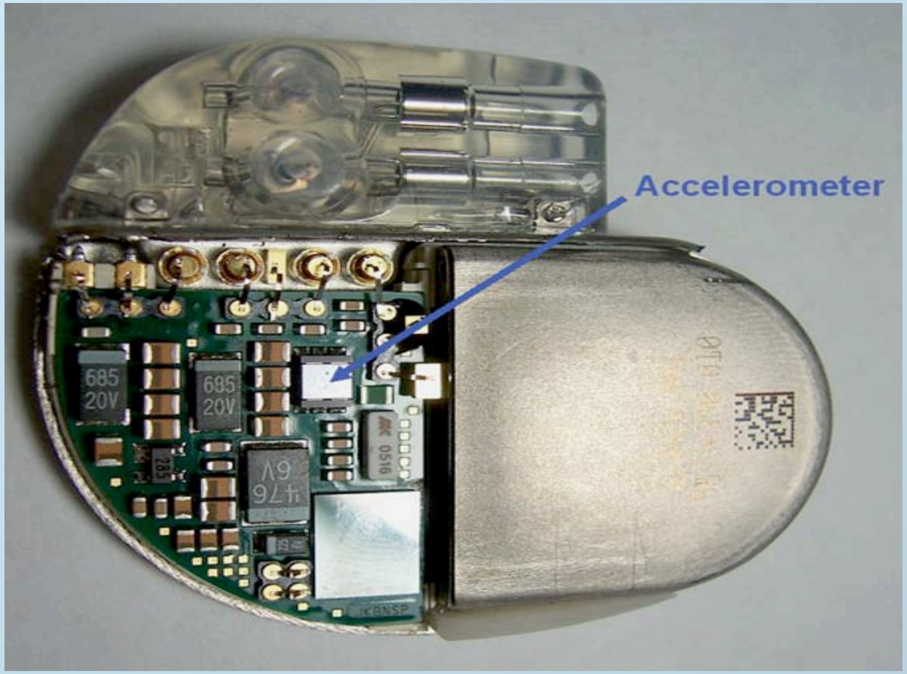


Figure 2 is a photograph of the inside of a rate responsive pacemaker. The accelerometer is attached to the circuit board inside the pacemaker. The large silver object that covers the right half of the pacemaker is the battery. These batteries are primary cells, so when they are depleted, the pacemaker must be replaced. Advances in electronic circuitry and battery technology have made it possible to add valuable features to the pacemaker for therapy and diagnostics while simultaneously increasing the lifetime of the device. Currently, pacemakers generally last between 6 and 12 years before needing to be replaced.

Figure 2 Photograph of the internal circuitry, accelerometer, and battery of a pacemaker. (Courtesy: Medtronic.)

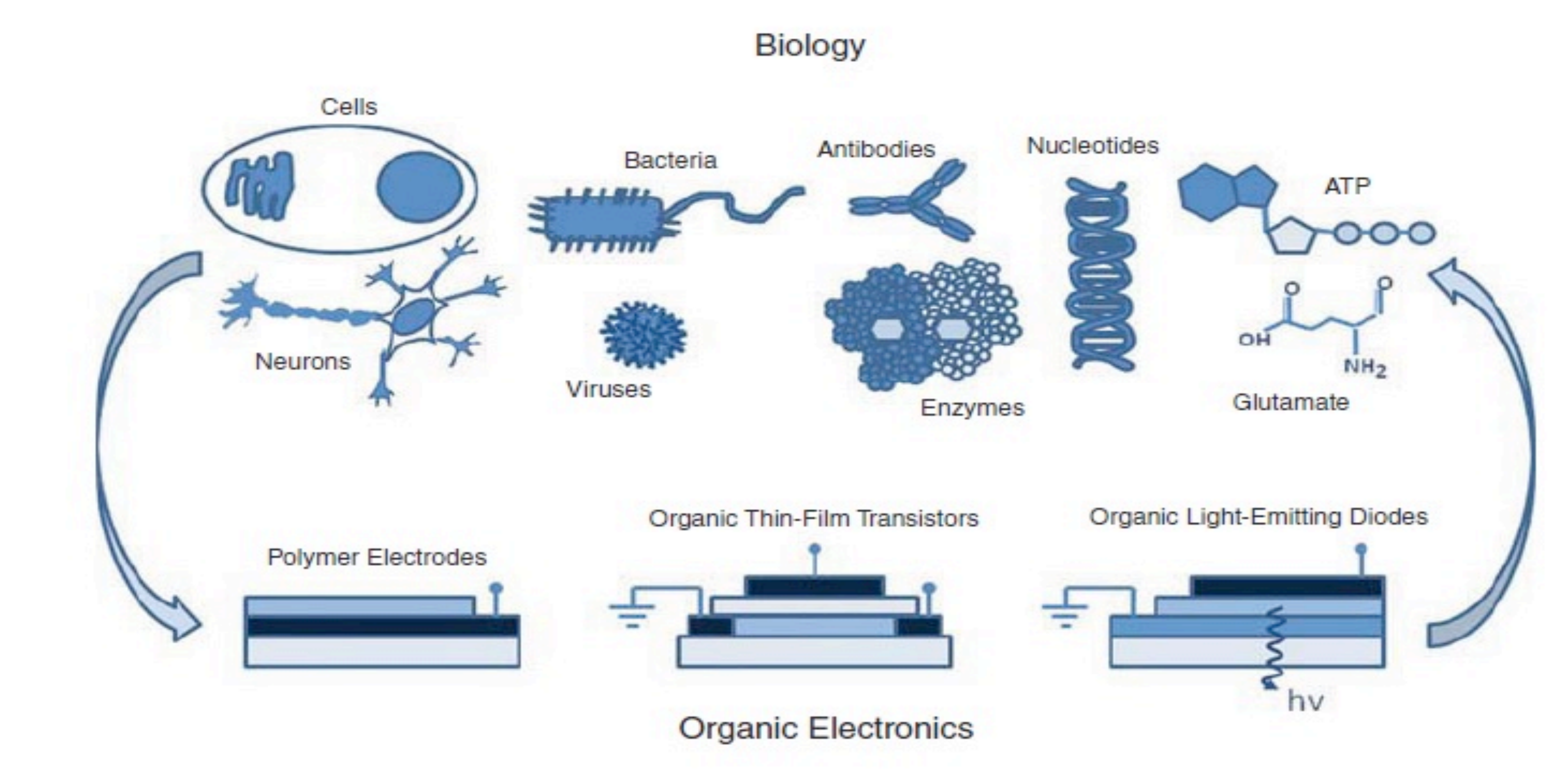
Obesity, Gastroenterology, and Urology Applications

The PillCam™ SB capsule endoscope is a naturally ingested device for use in the GI tract. Natural peristalsis moves the capsule smoothly and painlessly throughout the GI tract (Figure 3).

The capsule contains an optical lens, complementary metal oxide semiconductor (CMOS) imager, white LED illumination, battery and radio transmitter to send color video images as it passes. Information is transmitted via an array of sensors secured to the patient to a Data Recorder worn around the patient's waist. The procedure is ambulatory, allowing patients to continue daily activities throughout the endoscopic examination. The effectiveness of this pill has been investigated for GI bleeding, Crohn's disease, small bowel tumors, pathology, esophageal mucosal pathology, and endoscopy (Given Imaging, Yoqneam, Israel) (Panescu 2005).

Figure 3 Inside the PillcamTM (ª Given Imaging).

A slide cartoon showing the scope of organic bioelectronics.



Biological moieties, including cells, micro-organisms, proteins, oligonucleotides, and small molecules, can be interfaced with organic electronic devices to yield biosensors, medical diagnostics, tools for biomedical research, and bio-electronic implants that will have a major impact in health care.

Sensors for Medicine and Science Inc. (Germantown, MD, USA) is designing and testing an implantable sensor that relies on fluorescence to measure glucose concentration under the skin.

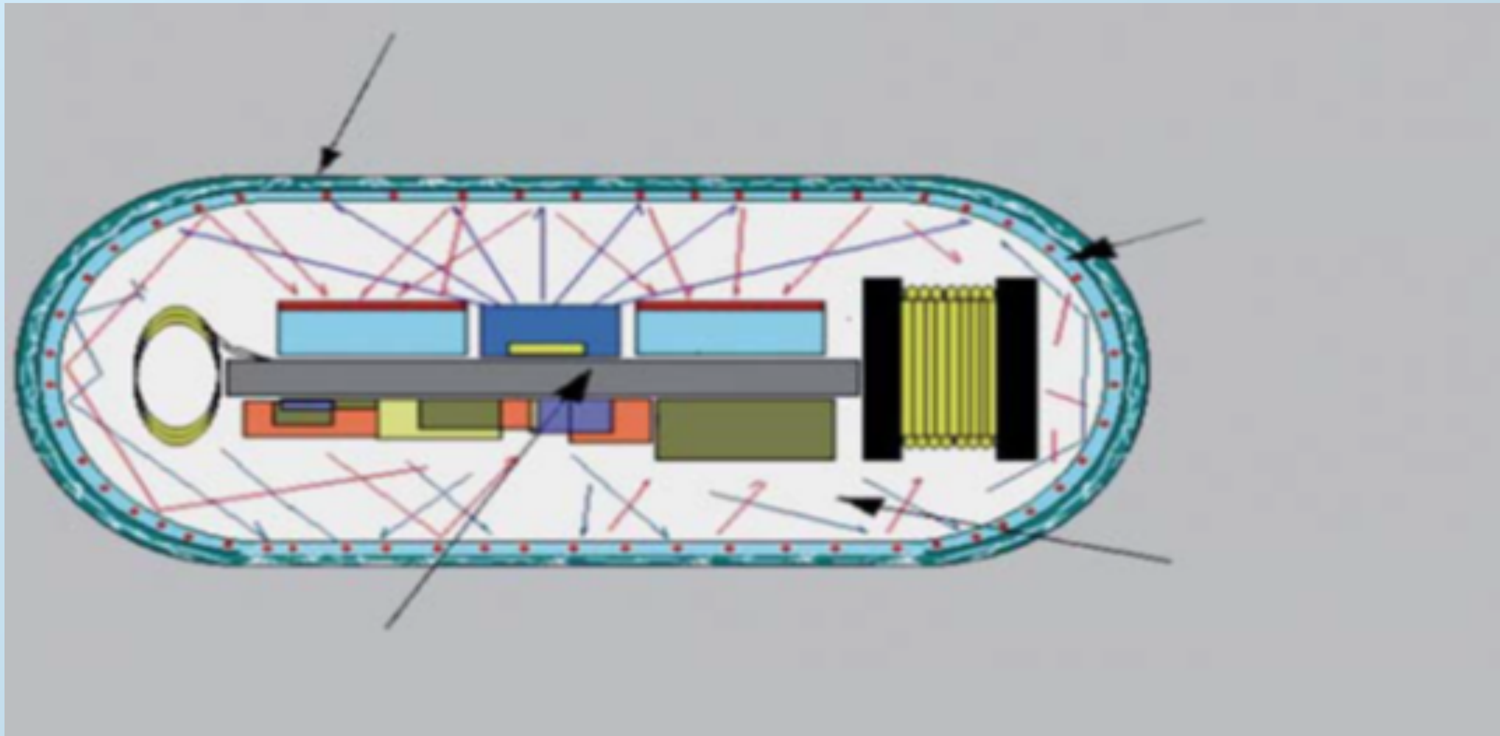


Fig.4 Diagram of a fluorescence-based implantable glucose sensor capsule.
(Courtesy: Sensors for Medicine and Science.)

The sensor capsule contains an LED to excite the fluorophore in the indicator layer, optical detectors to measure fluorescence for both the signal and reference channels, and a circuitry to drive and control the optoelectronic components. The implanted capsule also has a circuitry to harvest energy from an external inductive power source.

GRAZIE PER LA CORTESE ATTENZIONE