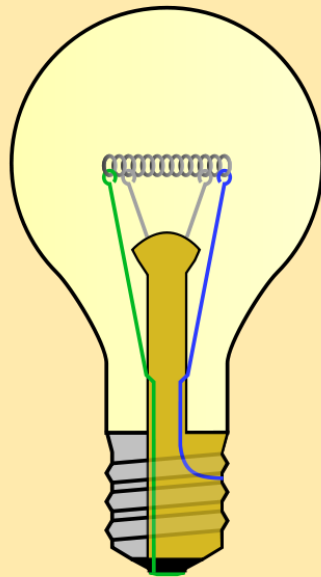
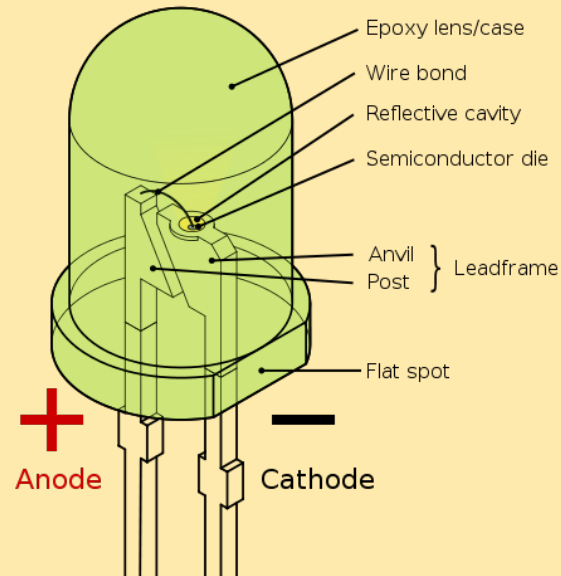


INTRODUCTION TO TRANSDUCERS



Macro-sized
Incandescent
light bulb



Micro-sized
light emitting
diode

Unit Overview

The following topics are discussed:

- ❖ What are Transducers?
- ❖ Types of Transducers in both the macro and micro-scales

Introduction

A transducer converts one form of energy into another

- ❖ A microphone converts sound into electrical impulses
- ❖ An incandescent light bulb converts electrical energy into light
- ❖ An electric motor converts electrical energy into motion.



Three transducers: light bulb, microphone, and electric motors

Actuators

An actuator is a device that actuates or moves something.

It is a specific type of a transducer.

Question

Which of the previously mentioned transducers is an actuator?

Sensors

A sensor is a device that receives and responds to a signal.

- ❖ The signal is some type of energy; for example, heat, light, motion, or chemical.
- ❖ A sensor detects a signal and converts it into a readable output signal.



Thermometers

Question:

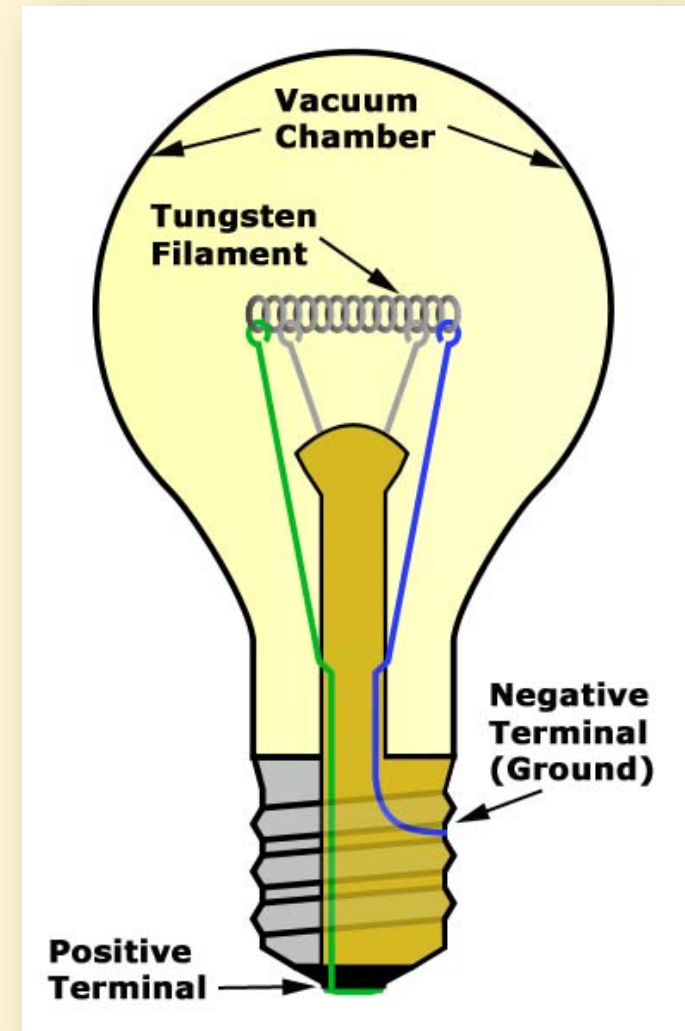
What are some sensors that you are familiar with?

Basic Concepts of Transducers

A transducer is defined as a substance or a device that converts (or transfers) an input energy into a different output energy.

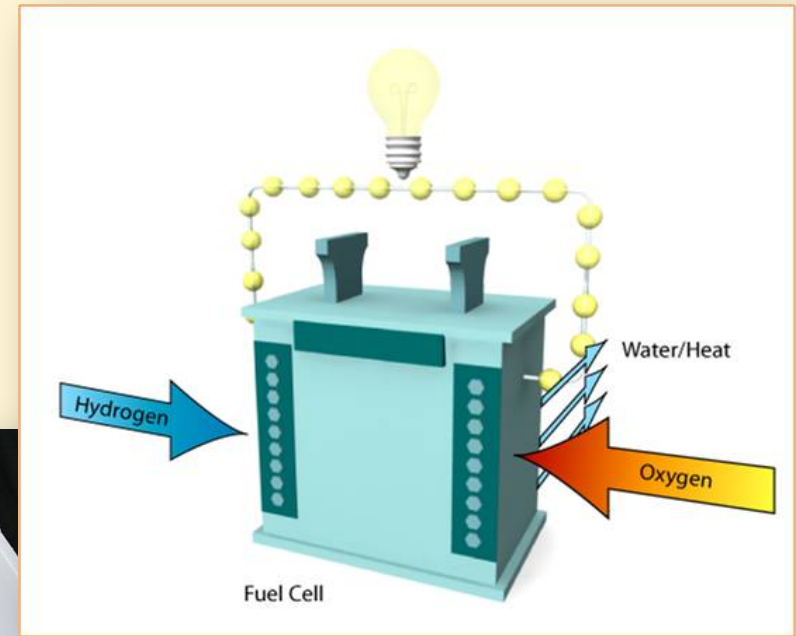
- ❖ Variables - speed, pressures, temperatures and sound.
- ❖ Transducers measure variables.

The incandescent light bulb



Electrochemical Transducers

- ❖ pH probe
- ❖ Molecular electric transducers (MET)
- ❖ Fuel cell
- ❖ Battery



**Converting a
Chemical Reaction to
Electrical Energy
(Fuel Cell)**

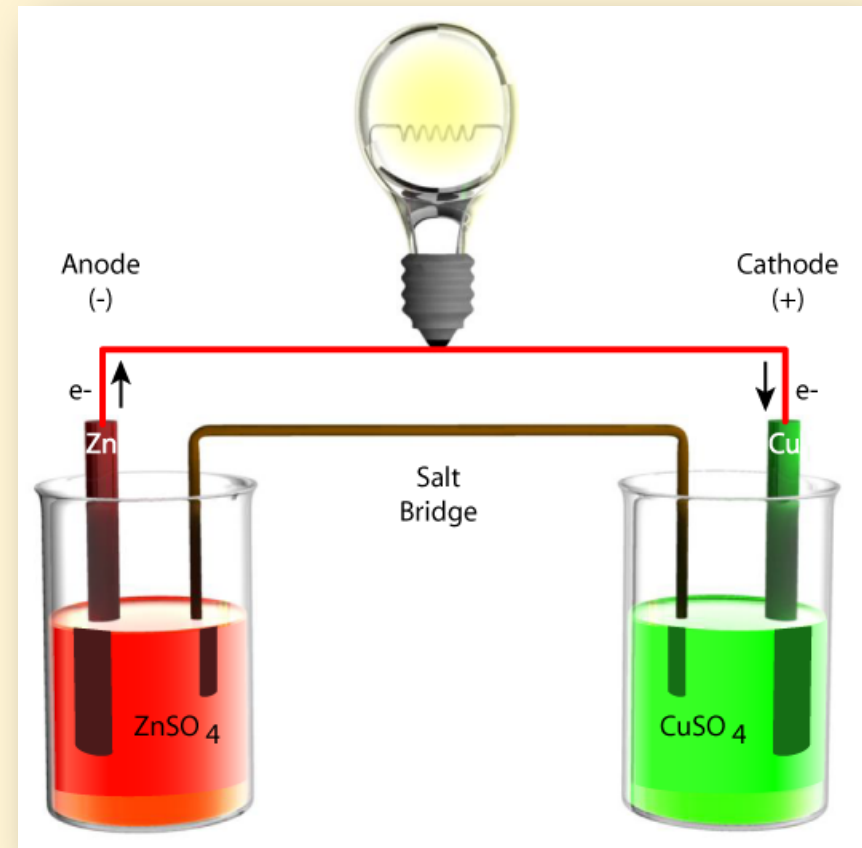
pH meter

[Courtesy of Ildar Sagdejev through
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Electrochemical Transducer - Battery

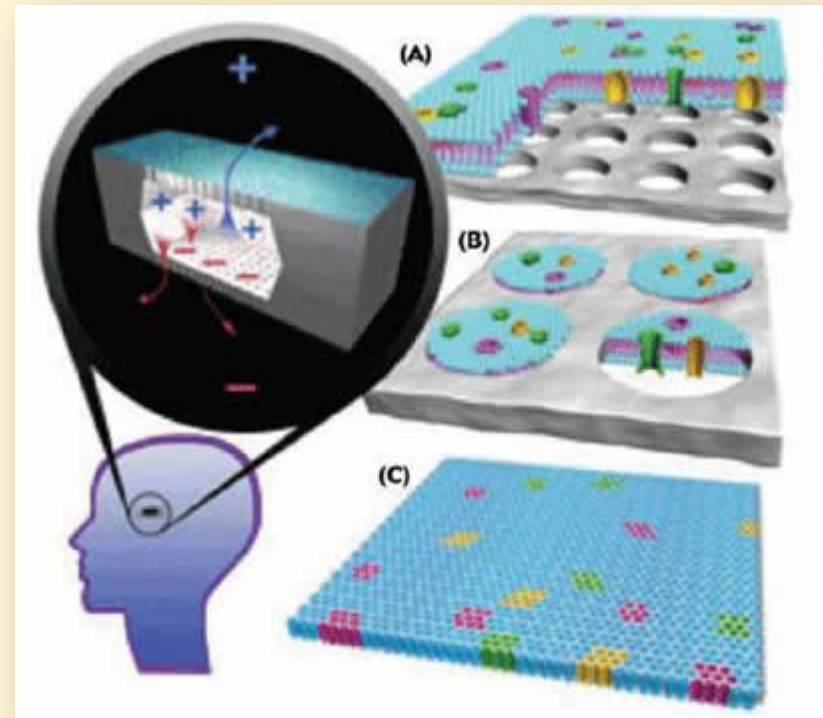
- ❖ Consists of anode, cathode and salt bridge partially immersed in an electrolyte solution.
- ❖ Ions flowing through the salt bridge creating a voltage (potential difference) between the electrodes.



Converting a Chemical Reaction to Electrical Energy (Battery)

Micro-Electrochemical Transducers

- ❖ Micro-sized components require micro-sized batteries
- ❖ Microelectromechanical systems exist on the ocean floors, in roadways and bridges, and in medical devices such as pacemakers and insulin pumps.



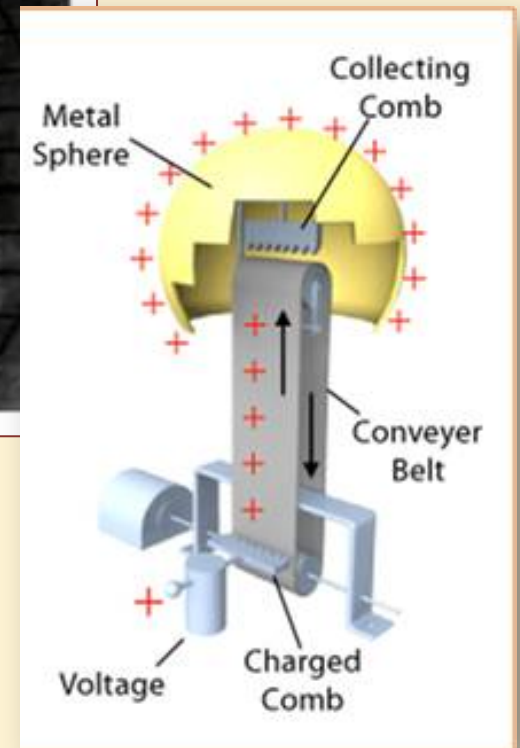
*Battery Pack for Artificial Retina system
[Courtesy of Sandia National Laboratories]*

Electroacoustic, Electromagnetic, & Electrostatic Transducers

- ❖ Electroacoustic
 - Loudspeaker
 - Microphone
 - Hydrophone
- ❖ Electromagnetic
 - Magnetic cartridge
 - Generator
- ❖ Electrostatic
 - Electrometer
 - Van de Graaf generator

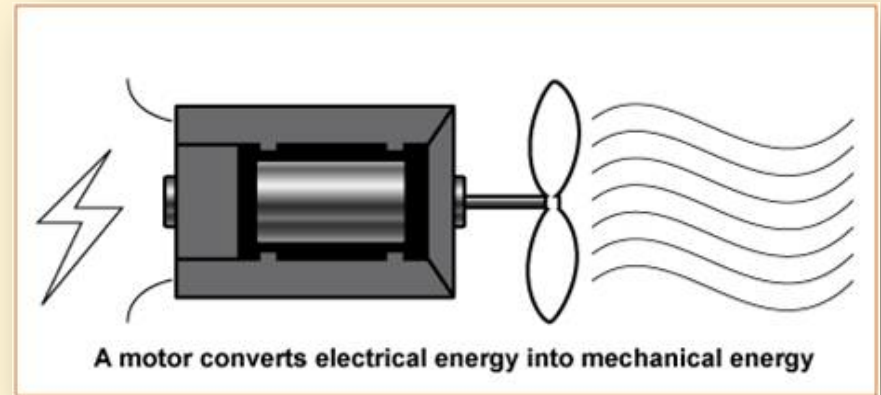


*Van de Graaf Generator:
Converting Static into High Voltage*

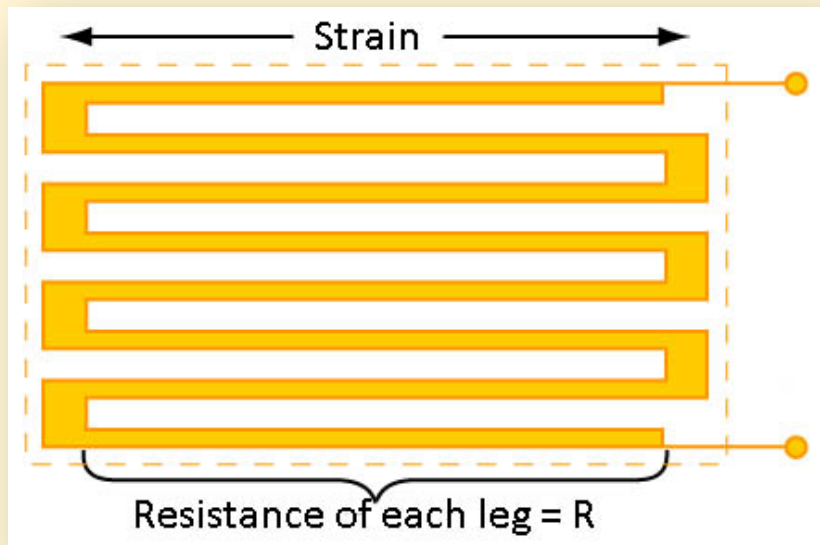


Electromechanical Transducers

- ❖ Generators
- ❖ Galvanometer
- ❖ Motor
- ❖ Strain gauge



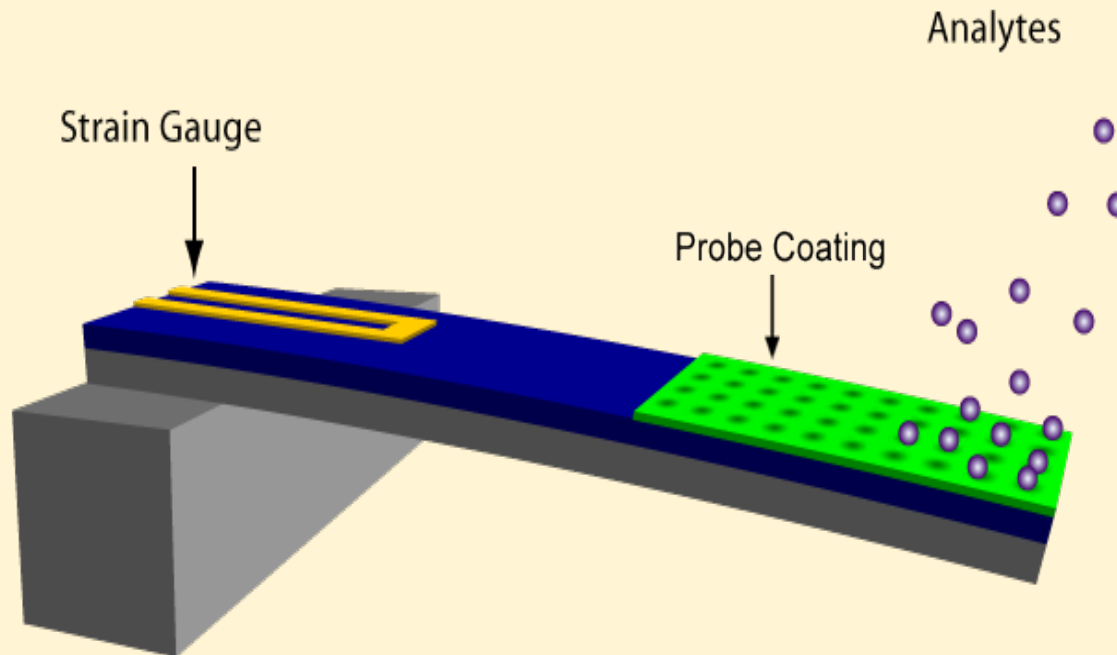
Motors - Convert electrical energy to mechanical energy



Strain Gauge – converts strain or a change in material length and width to a change in resistance and thus a change in electrical energy through the material.

Strain Gauges

- ❖ Transducers commonly incorporated into MEMS devices.
- ❖ Use the piezoelectric properties of materials

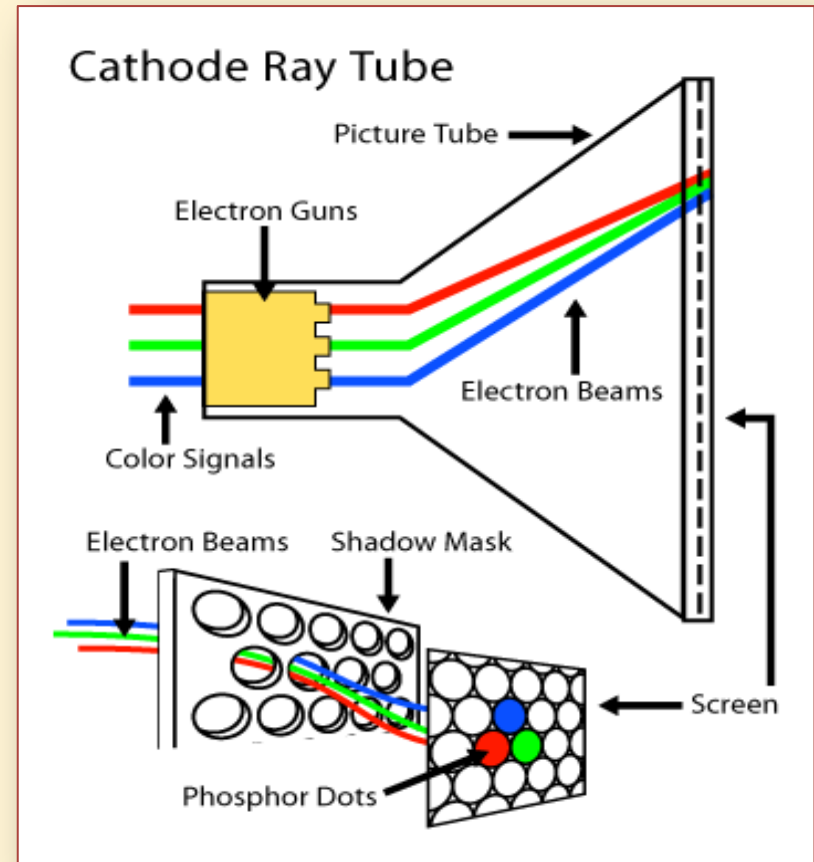


A strain gauge used to measure an increase in cantilever mass.

Other Types of Transducers

- ❖ Photoelectric – light energy to electrical energy or vice versa.
- ❖ Thermoelectric – heat energy to electrical energy or vice versa.

Converts Electrical Signals into Light Energy
(Cathode Ray Tube)



Question

- ❖ *What type of transducers are you familiar with?*
- ❖ *Explain how these transducer affect your life on a daily basis.*

Summary

- ❖ A transducer is a device that converts one form of energy into another.
- ❖ If the output energy is motion, the transducer is also an actuator.
- ❖ Sensors make sense from a transducer's output.
- ❖ There are many, many different kinds of transducers.

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