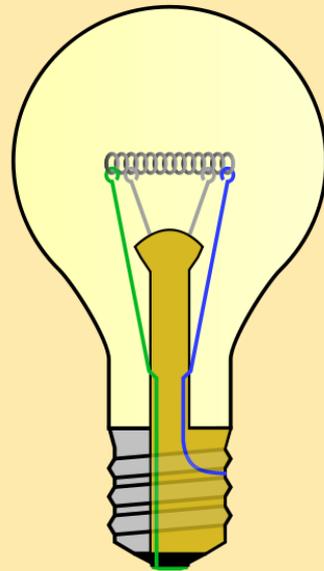
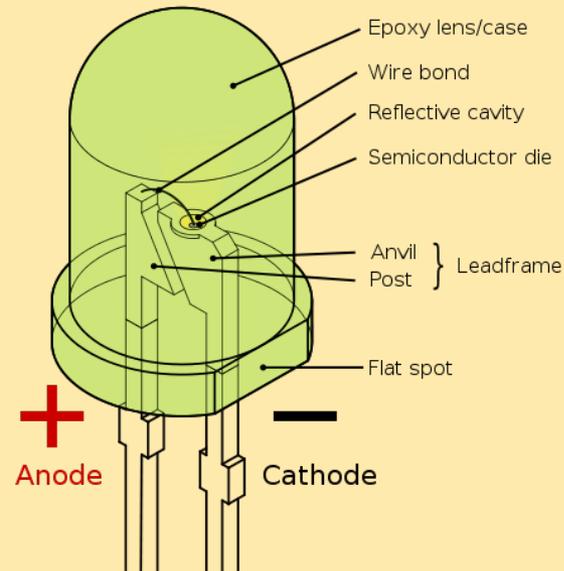


# INTRODUCTION TO TRANSDUCERS



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:

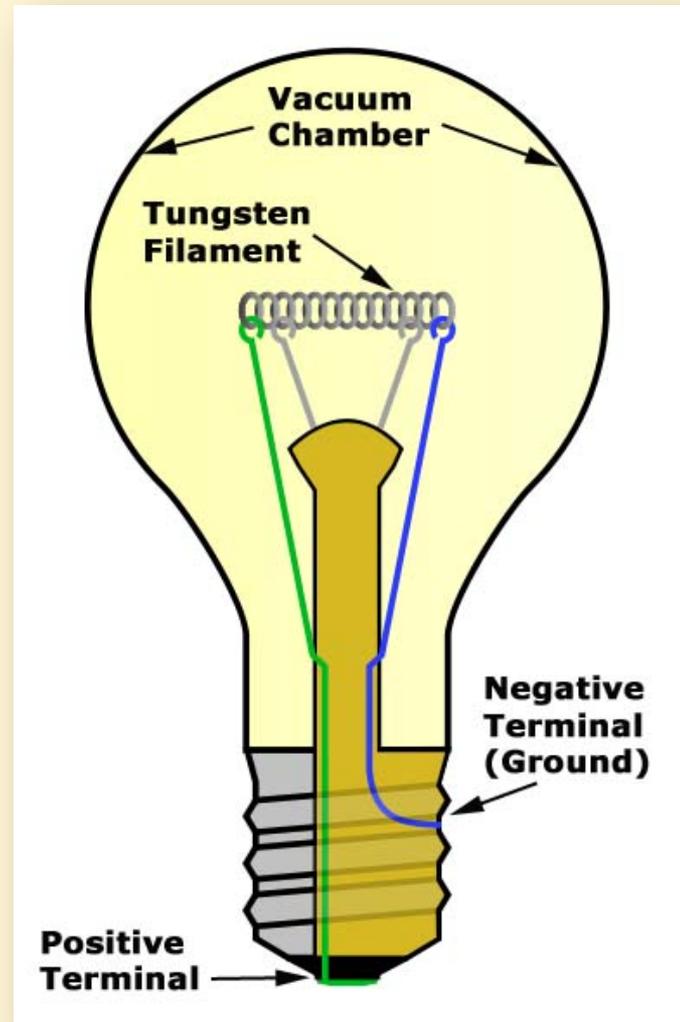
*What are some sensors that you are familiar with?*

# 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.

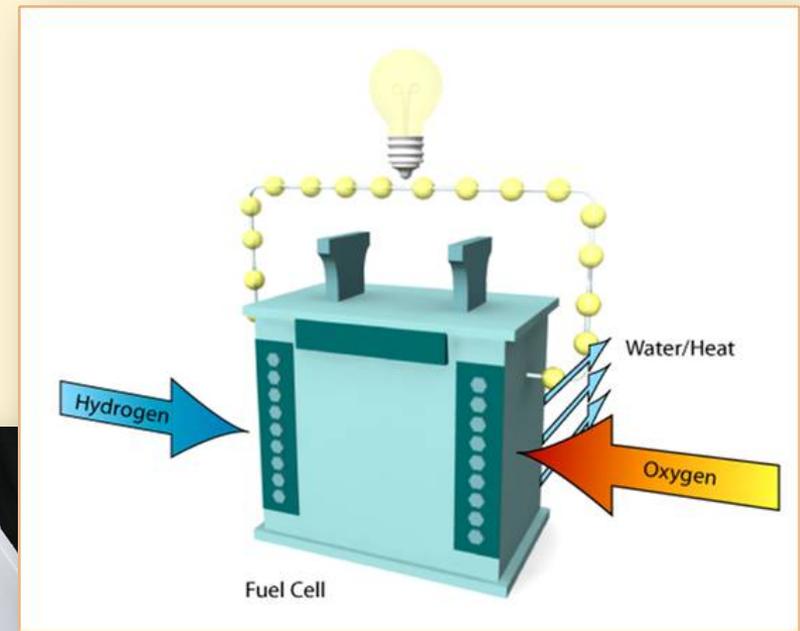
- ❖ Variables - speed, pressures, temperatures and sound.
- ❖ Transducers measure variables.

*The incandescent light bulb*



# Electrochemical Transducers

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



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

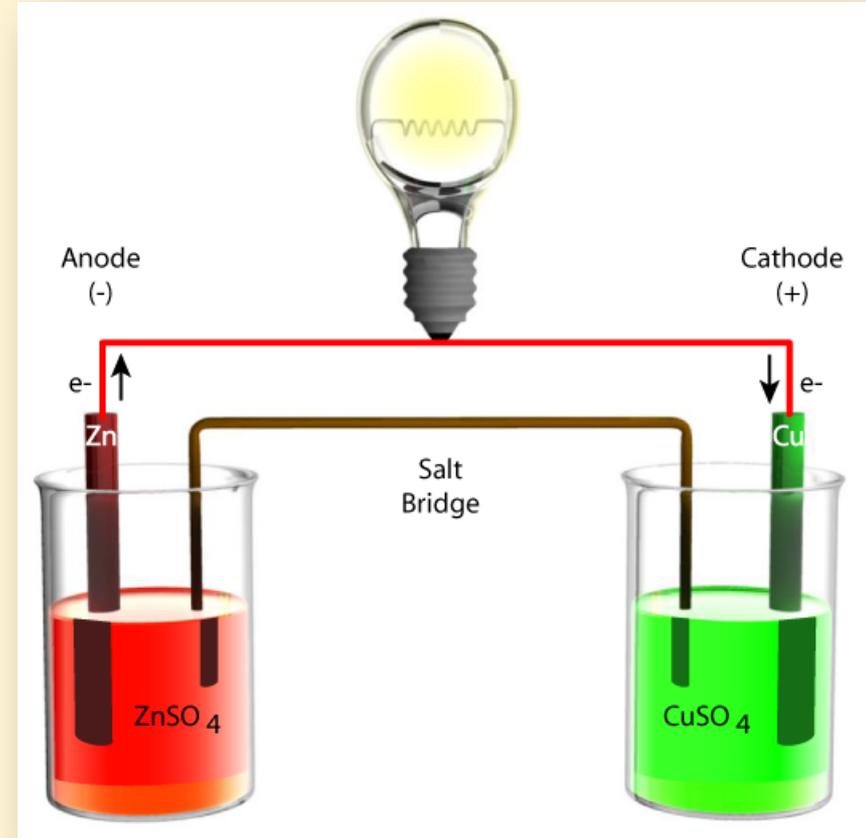
**pH meter**

[Courtesy of Ildar Sagdejev through  
Creative Commons License]



# Electrochemical Transducer - Battery

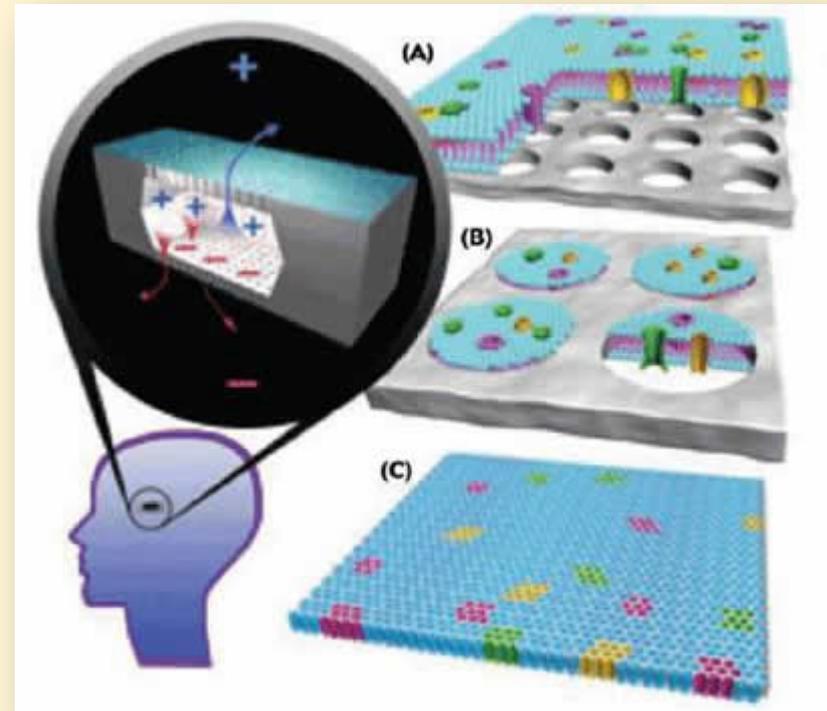
- ❖ Consists of anode, cathode and salt bridge partially immersed in an electrolyte solution.
- ❖ Ions flowing through the salt bridge creating a voltage (potential difference) between the electrodes.



*Converting a Chemical Reaction to Electrical Energy (Battery)*

# Micro-Electrochemical Transducers

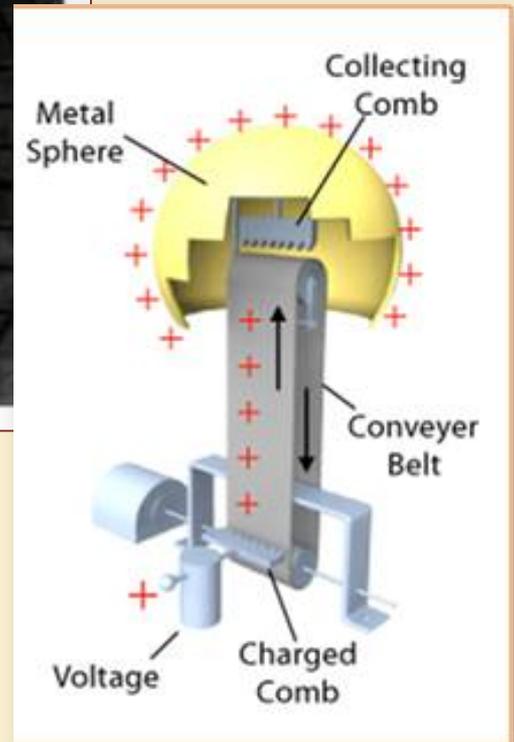
- ❖ Micro-sized components require micro-sized batteries
- ❖ Microelectromechanical systems exist on the ocean floors, in roadways and bridges, and in medical devices such as pacemakers and insulin pumps.



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

# Electroacoustic, Electromagnetic, & Electrostatic Transducers

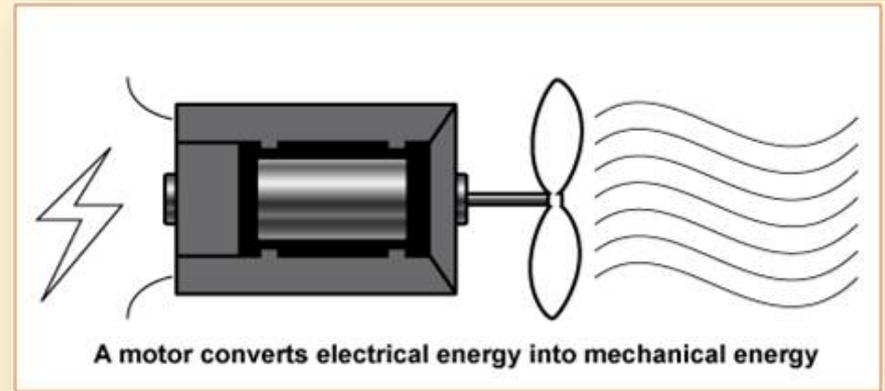
- ❖ Electroacoustic
  - Loudspeaker
  - Microphone
  - Hydrophone
- ❖ Electromagnetic
  - Magnetic cartridge
  - Generator
- ❖ Electrostatic
  - Electrometer
  - Van de Graaf generator



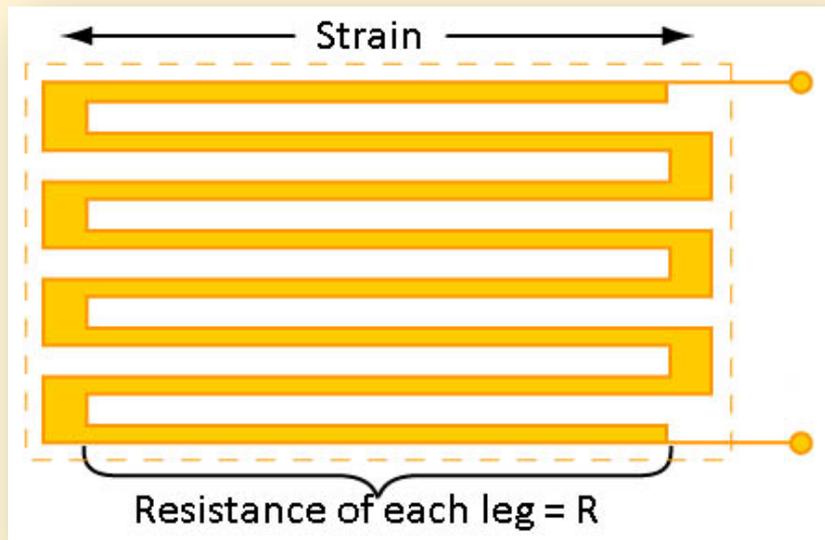
*Van de Graaf Generator:  
Converting Static into High Voltage*

# Electromechanical Transducers

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



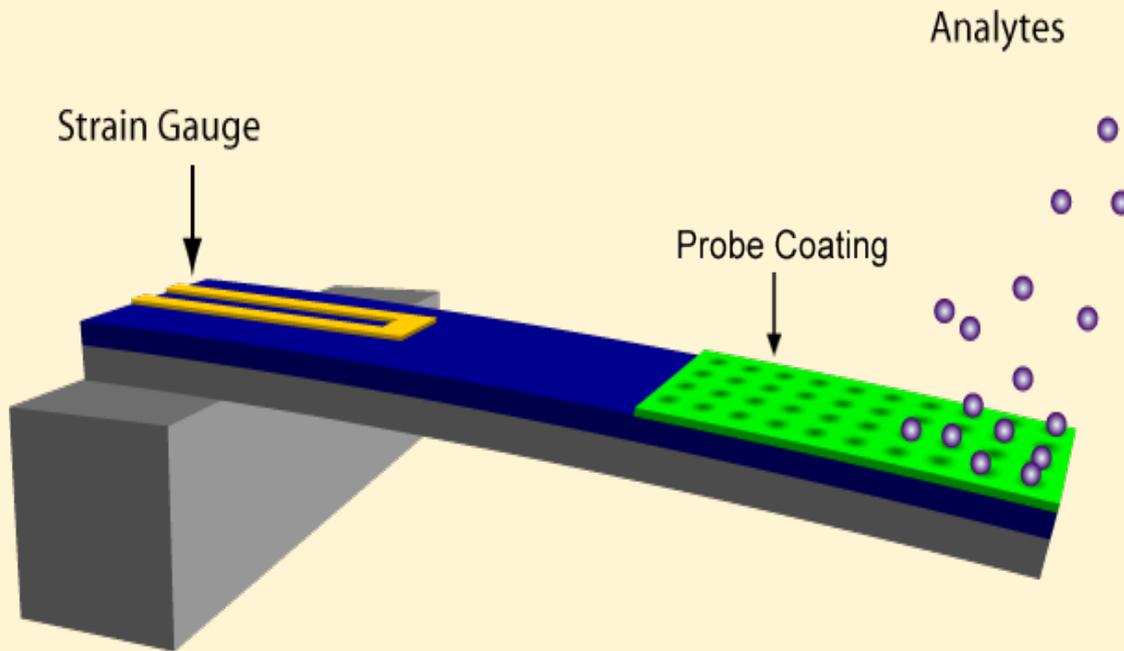
***Motors - Convert electrical energy to mechanical energy***



***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

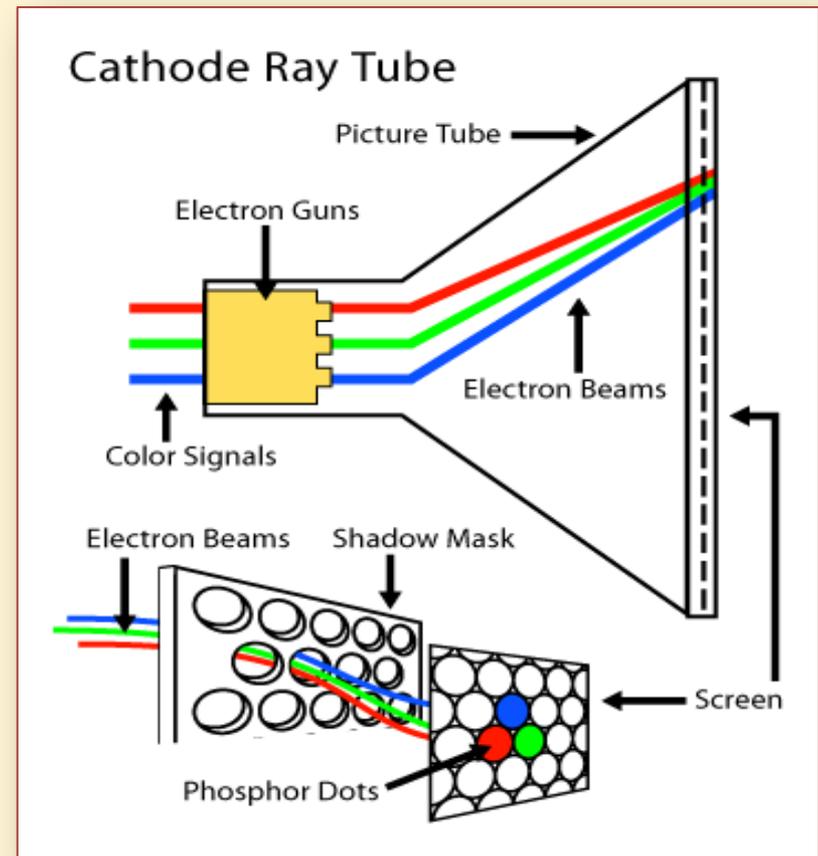


*A strain gauge used to measure an increase in cantilever mass.*

# 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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