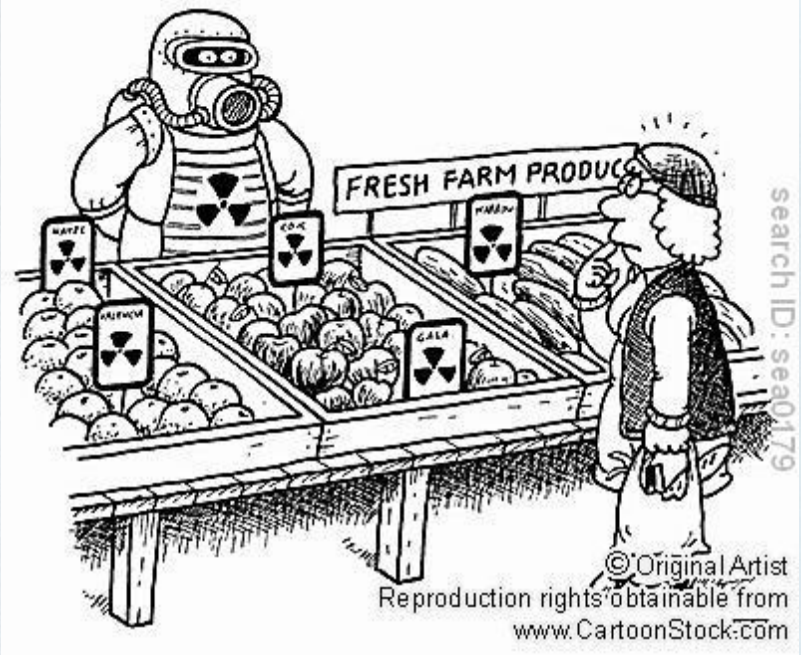
Mizzou Engineering
University of Missouri
Engineering.Missouri.edu

Challenges and Achievements : Food Sensors



Sheila Grant, PhD

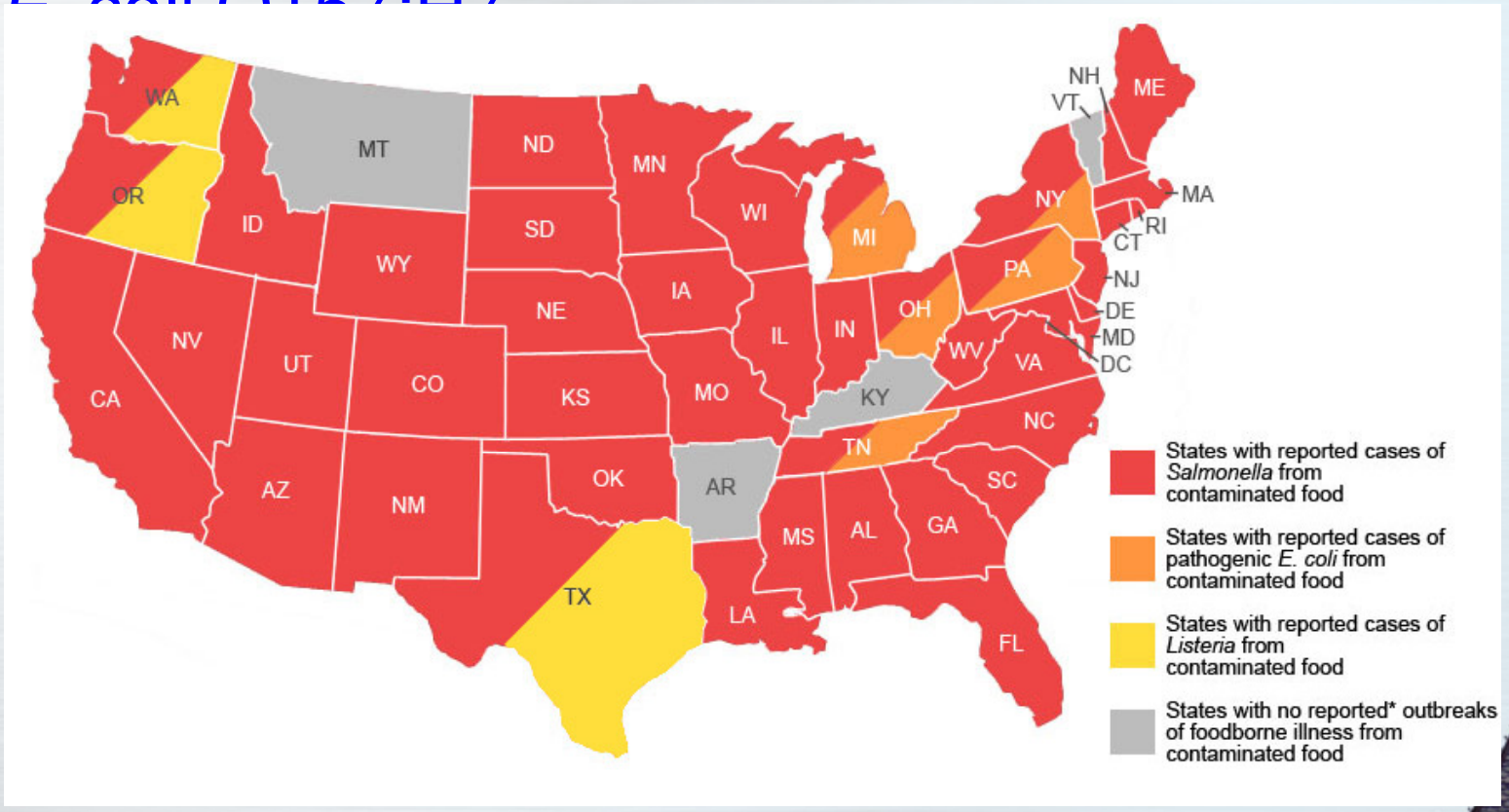
Dept of Biological Engineering

Contamination – Radiation

- Radiation
  - Radioactive particles (iodine 131 and cesium 137)

Contamination – Foodborne Pathogens

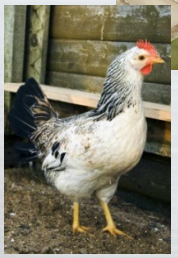
E. coli O157:H7

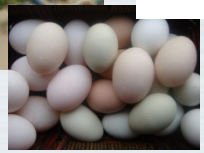


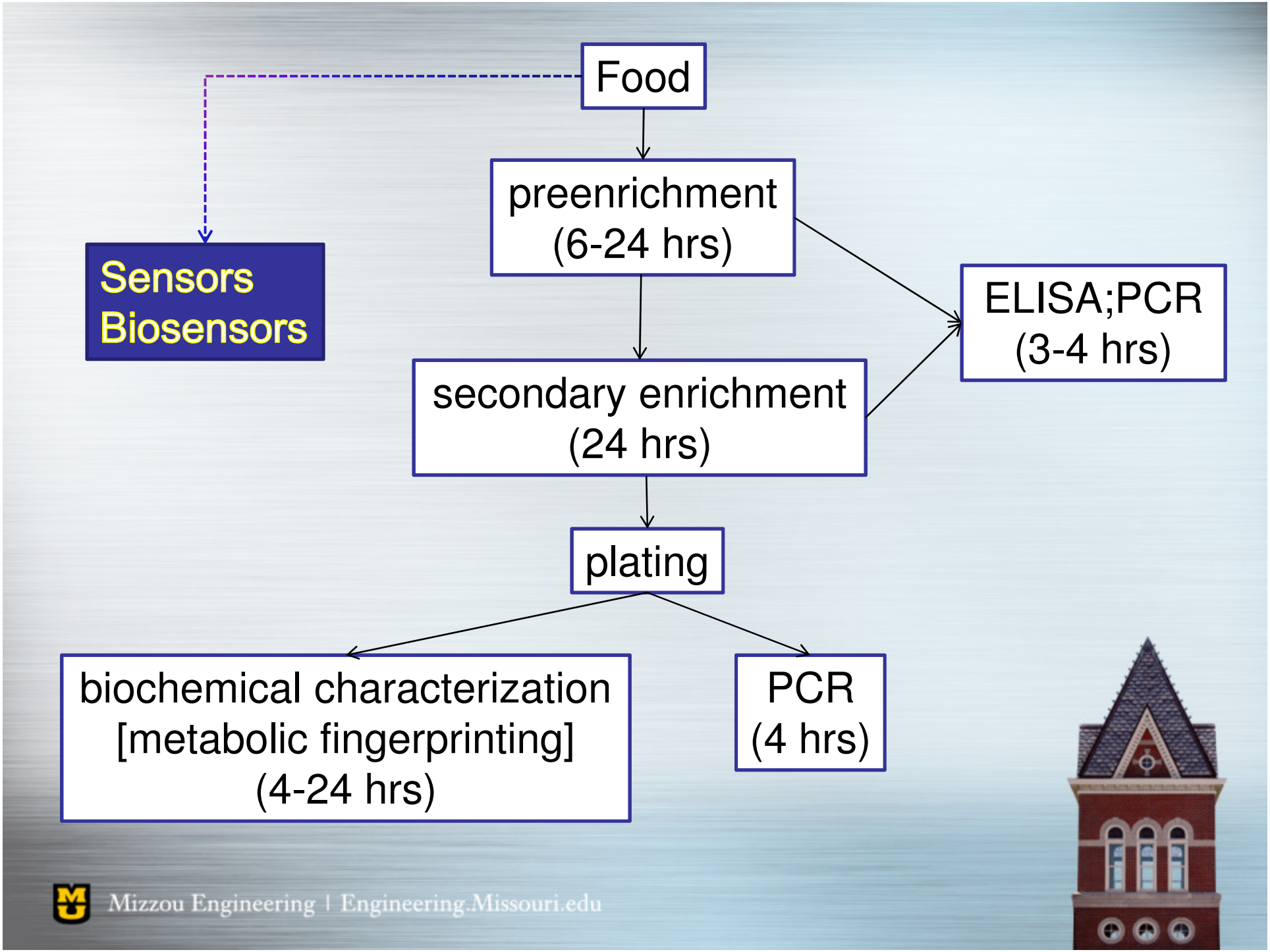
Each year in the US, 76 million people suffer foodborne illnesses with over 5000 deaths;
Yearly costs are estimated to be 5 to 6 billion dollars

Challenges – Tracking the Source

Raw food – contaminated during slaughter, growing, harvest
Processing; Transportation; Storage; Final Preparation





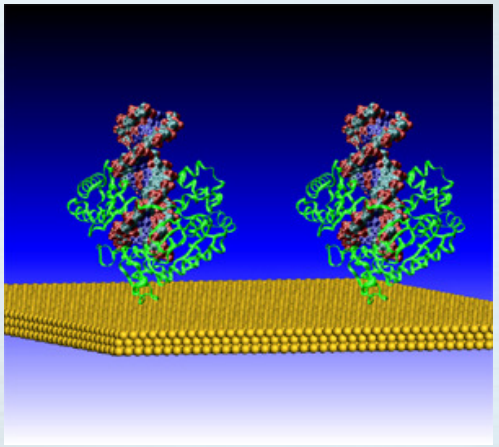

Food
preenrichment
(6-24 hrs)
Sensors
Biosensors
ELISA;PCR
(3-4 hrs)
secondary enrichment
(24 hrs)
plating
biochemical characterization
[metabolic fingerprinting]
(4-24 hrs)
PCR
(4 hrs)
Mizzou Engineering | Engineering.Missouri.edu

Ideal Sensor for Food Pathogen Detection

- Fast response
- Accurate identification of toxin
- Low limit of detection
- No false negatives/false positives
- Inexpensive
- Easy to use
- Multi-Analyte
- Disposal/reusable

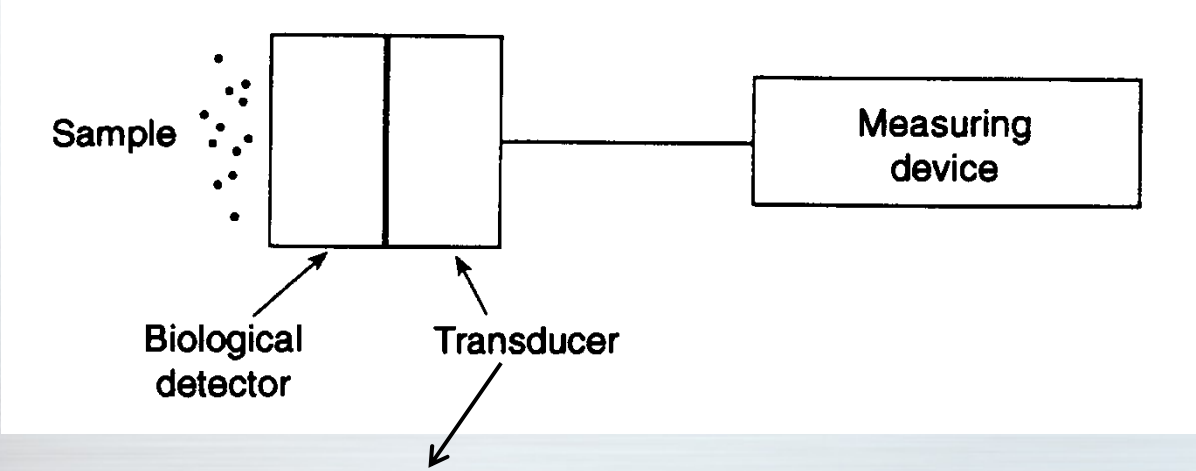
Sensor/Detectors

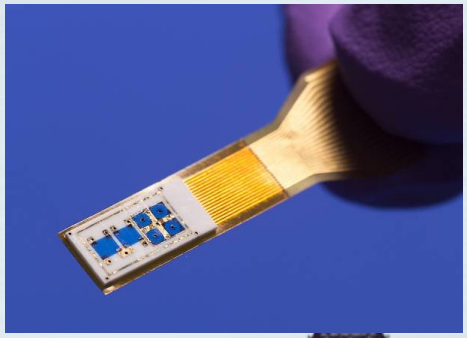
– A device that converts signals of one type of quantity into an equivalent signal of another type of quantity.



Biosensor

– Utilizes a biological agent as the sensor





Electrochemical - potentiometric, voltammetric (amperometric)
conductometric, FET-based
Piezo-electric
Optical – fluorescence, reflectance, absorption
SPR, etc.

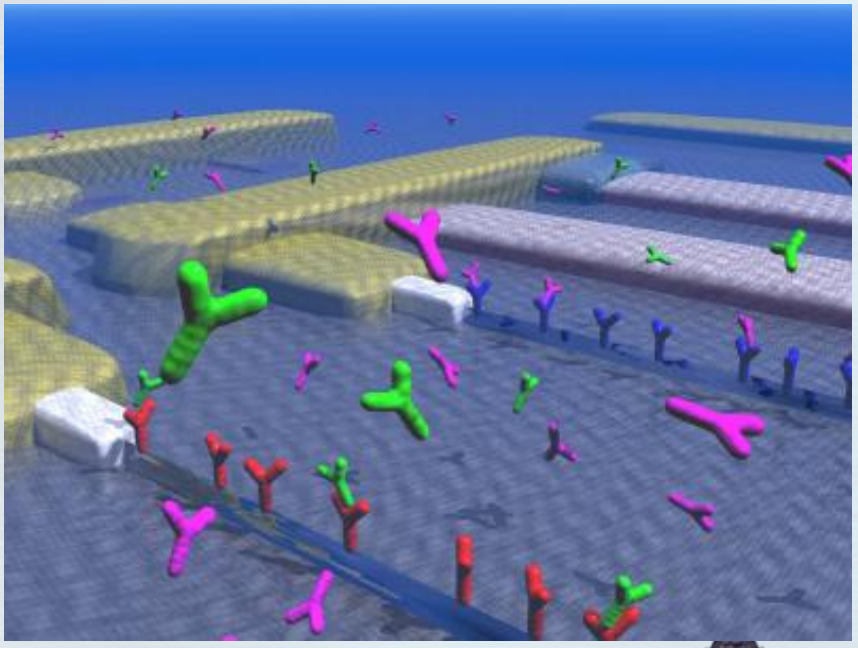
Technology Strength: Nanotechnology

- Sensing Mechanism
  - Nanomaterials
    - Metallic nanoparticles (Au, Ag)
    - Metallic nanorods
    - Carbon nanotubes
    - Quantum dots
- Sensing Platforms
  - Nanofibers
  - Nanoporous substrates
  - Nano-cantilevers
  - Cell-based sensors
- Sensor Packaging
  - microfluidics

Nanowire Sensor Substrates

Advantages

- High surface to volume ratios
- Enhanced sensitivity
- Rapid detection
- Low power demands
- Miniaturization of sensor systems

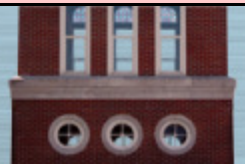


http://biosingularity.wordpress.com/2007/02/02/breakthrough-in-nanodevice-synthesis-revolutionizes-biological-sensors/

Summary of Nanobiosensor Techniques

Sensing Technique	Analyte Type	Limit of Detection	Reference
QD/Nanoparticles	Oligonucleotides	~2 zM	Yeh et al. (2006a)
LSPR	Tau protein in CSF	10 pg/ml	Vestergaard et al. (2008)
Nanowire	Streptavidin	~70 aM	Stern et al. (2007a)
Cantilever	1,1-difluoroethane gas	< 1 attogram	Li et al. (2007)
Nanopore Cell-based	ssDNA Variety of toxins, pathogens	DNA sequences	

J. Kim, et al. Microfluid Nanofluid, In press, 2009



Questions?

Mizzou Engineering
University of Missouri
Engineering.Missouri.edu