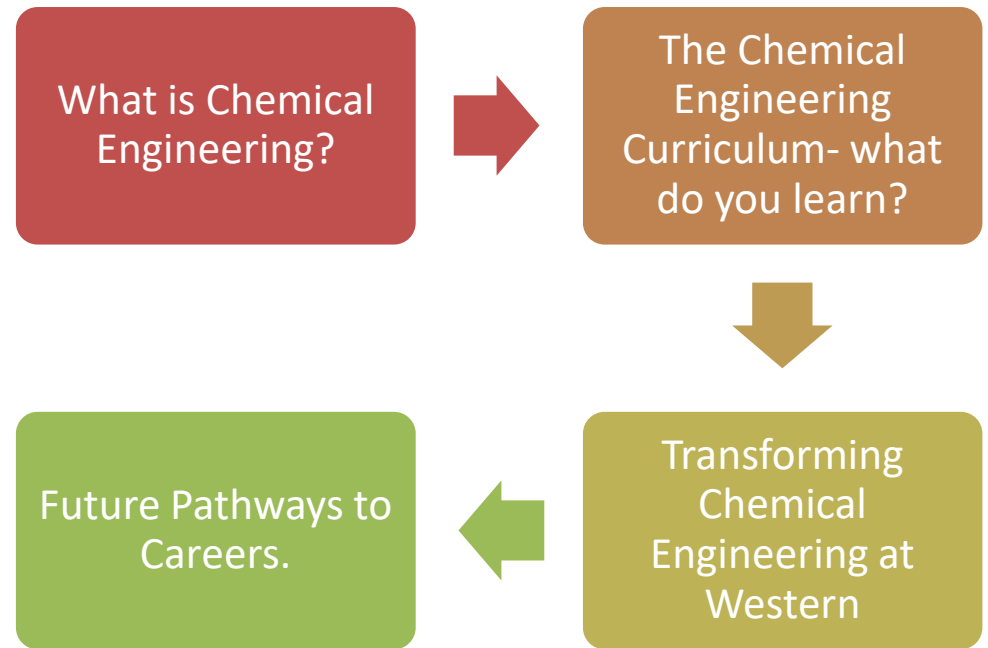




# Chemical Engineering



# Overview



# Chemical Engineering: A broad based discipline



Chemical processes



Environmental processes



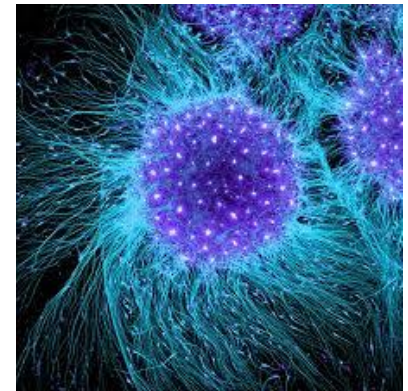
Fuels and Energy



Food manufacturing



Bioprocesses & Pharmaceuticals



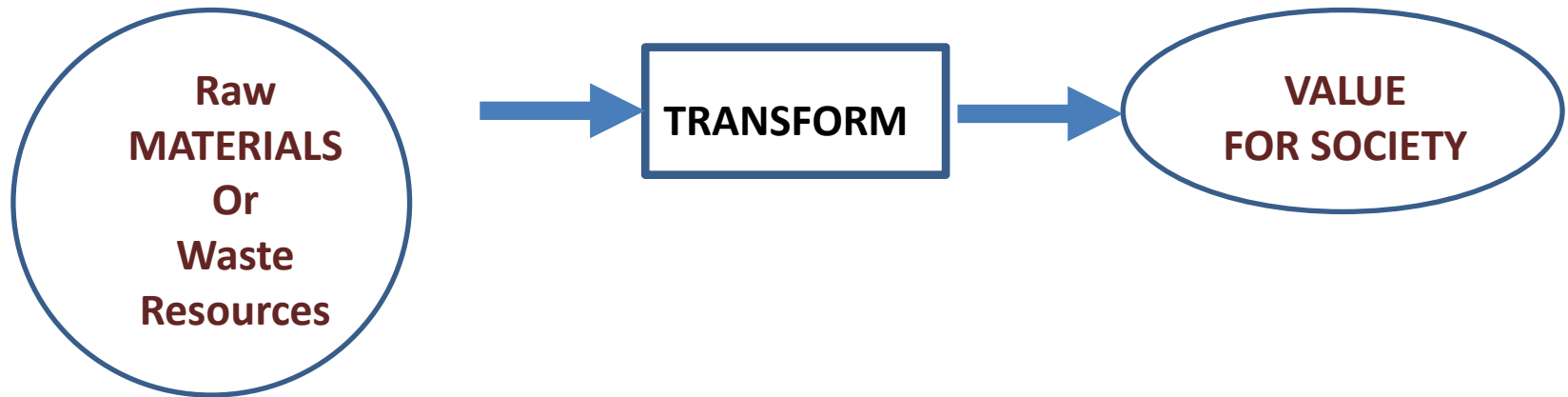
Biomaterials & Regenerative Medicine

# What is Chemical Engineering?

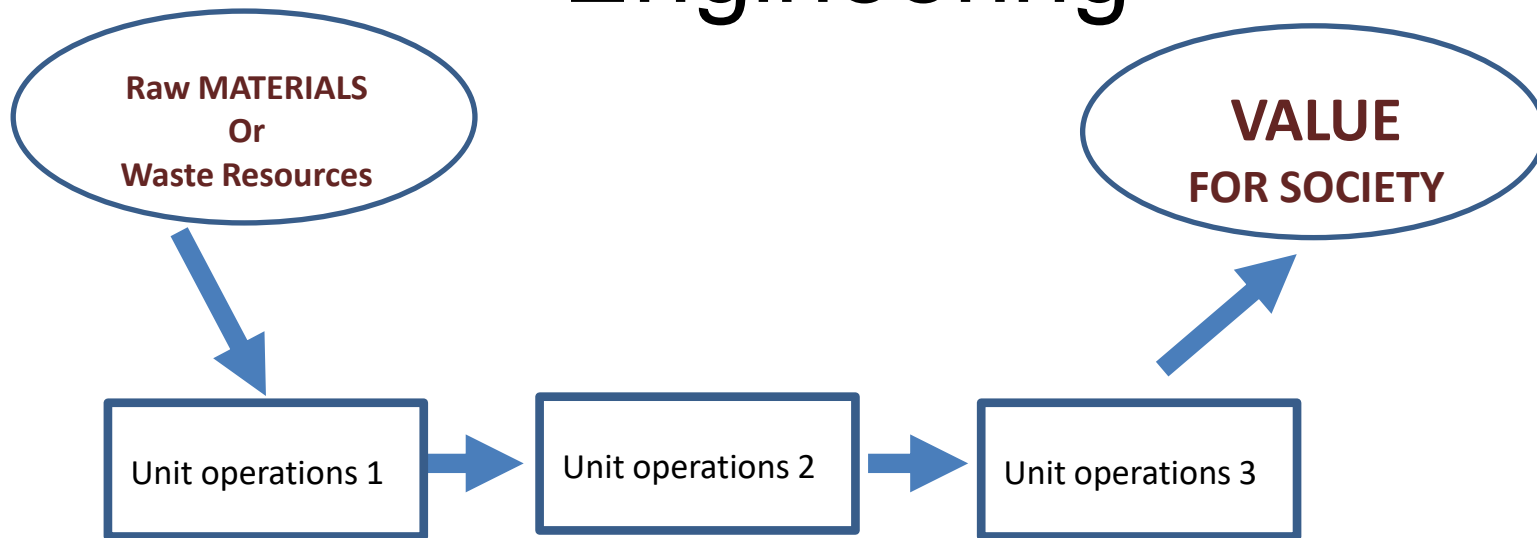
Chemical Engineering is  
Process Engineering

Chemical Engineers  
TRANSFORM Raw materials to  
Value for the Benefit of Society  
in A Sustainable Fashion

# Chemical Engineering is **Process Engineering**



# Chemical Engineering is Process Engineering



# The Bio-chemical Engineering of Pfizer Covid-19 m-RNA vaccine

EXAMPLE 1:



Biochemistry lab provides genetic materials (plasmid DNA) coding for spike proteins of COVID-SARS 2

**Covid-19 vaccine**  
1-3 million doses per production run

Cultivation of genetically engineering bacteria in bioreactors

Unit operations 1

DNA template Extraction and purification

Unit operations 2

In vitro (cell-free) m-RNA from DNA templates

Unit operations 3

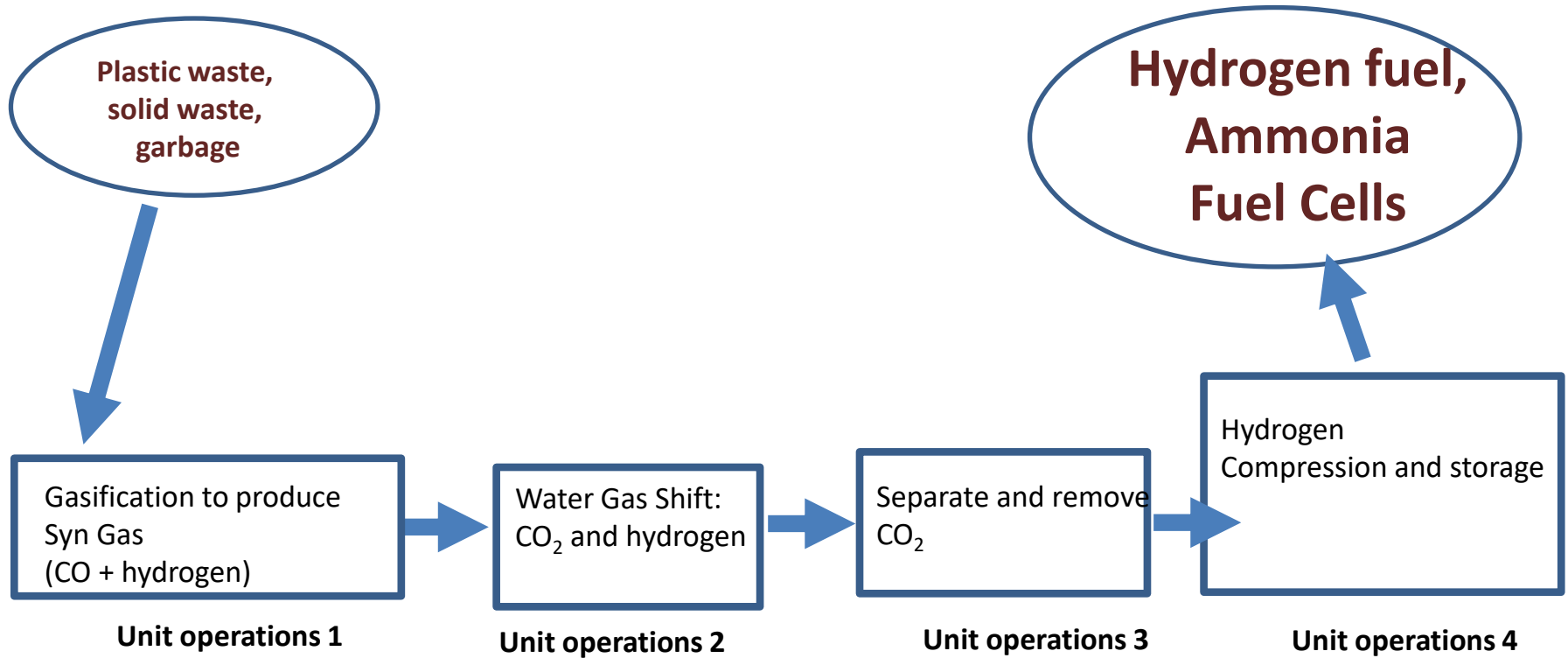
m-RNA vaccine Formulation in nano-particles; packing, Shipping, storage

Unit operations 4

*“Chemical Engineering is Process Engineering”*

# Carbon capture –Negative Emissions Technology

EXAMPLE 2:



*“Chemical Engineering is Process Engineering”*



# The Chemical Engineer's Training

Year 1:  
Common  
first Year

## Year 2:

- APPLIED MATH;
- ORGANIC CHEMISTRY;
- BIOLOGY FOR ENGINEERS;
- THERMODYNAMICS;
- PROCESS MATERIAL AND ENERGY BALANCES;
- FLUID FLOW;
- COMPUTATIONAL METHODS IN CHEMICAL ENGINEERING;
- STATISTICS;
- WRITING

## Year 3:

- UNIT OPERATIONS LAB;
- HEAT TRANSFER;
- MASS TRANSFER
- REACTION AND BIOREACTION ENGINEERING
- PROCESS CONTROL
- PROCESS SIMULATION
- PROCESS SAFETY AND DESIGN;
- SUSTAINABILITY AND LIFE CYCLE ANALYSIS
- OPTION SPECIFIC: TECHNICAL ELECTIVES;
- NON- TECHNICAL ELECTIVES

## Year 4:

- PROCESS AND PLANT DESIGN;
- ETHICS , LAW AND SUSTAINABILITY;
- TECHNICAL ELECTIVES;
- NON TECHNICAL ELECTIVES

# Western's Chemical Engineering Program- Fall 2022

- **Options:**
  - Chemical Engineering
  - Biochemical and Environmental Engineering
- **Dual Degrees:**
  - Chemical Engineering + Biomedical Eng,
  - Chem Engineering + Business,
  - Chem Engineering + Law
  - Chemical Engineering + Artificial Intelligence Systems Engineering (AISE) (Senate approval pending)
- **At review or approval stage:**
  - Brescia + Western: concurrent degrees (Chemical Engineering + Food & Nutrition)
  - **Micro-credentials** Certificate in Industrial Biotechnology (Western Chemical Engineering/Brescia/Fanshawe)

# Future pathways for you!

- Biotechnology, Biopharmaceuticals and Biomedical Engineering
- Environmental (pollution control, waste resource recovery, clean water and air)
- Energy sector such as Carbon Capture and Hydrogen economy
- AI/Chemical Engineering
- Nanotechnology
- Traditional chemical engineering fields: oil/gas/polymers/bulk chemicals

# Chemical Processes

## Chemical Products and Processes

### Commodity chemicals:

- Petrochemicals, solvents
- Gasoline, diesel, natural gas
- Fertilizer (ammonia)



### Polymers:

- Polyethylene (PE, LDPE, HDPE)
- Polyvinyl chloride (PVC)
- Polypropylene (PP)



### Specialty chemicals:

- Purified industrial gases
- Adhesives, sealants, coatings

### Consumer products:

- Detergents
- Synthetic fibers, dyes
- Acids for batteries
- Construction materials



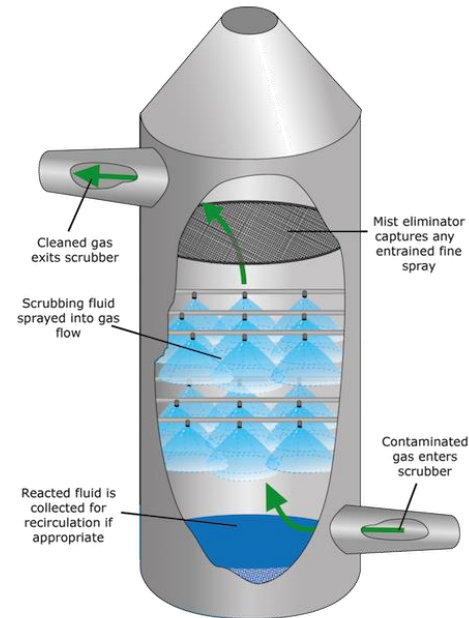
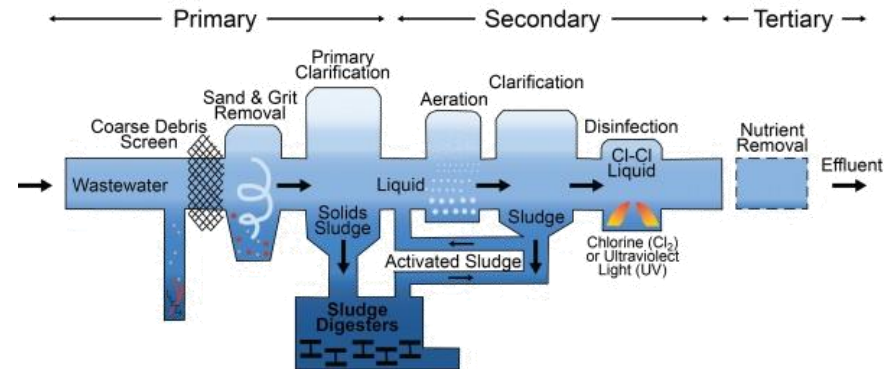
# Environmental Processes

## Study, modelling and design of biochemical environmental processes:

- Domestic wastewater biotreatment (almost all the domestic wastewater in the world is treated biologically)
- Industrial wastewater biotreatment
- Soil and groundwater bioremediation
- Biological removal of toxicity from air

## Study, modelling and process design of chemical environmental processes :

- Physicochemical wastewater treatment
- Physicochemical methods for the treatment of contaminated soil
- Physicochemical contaminated air treatment



# Bioprocess Engineering

## Microbial Products and Processes

### Industrial Bioproducts:

- Solvents, enzymes
- Biopolymers

### Biofuels:

- Bioethanol, biobutanol, biogas, bio-H<sub>2</sub>

### Medical Products:

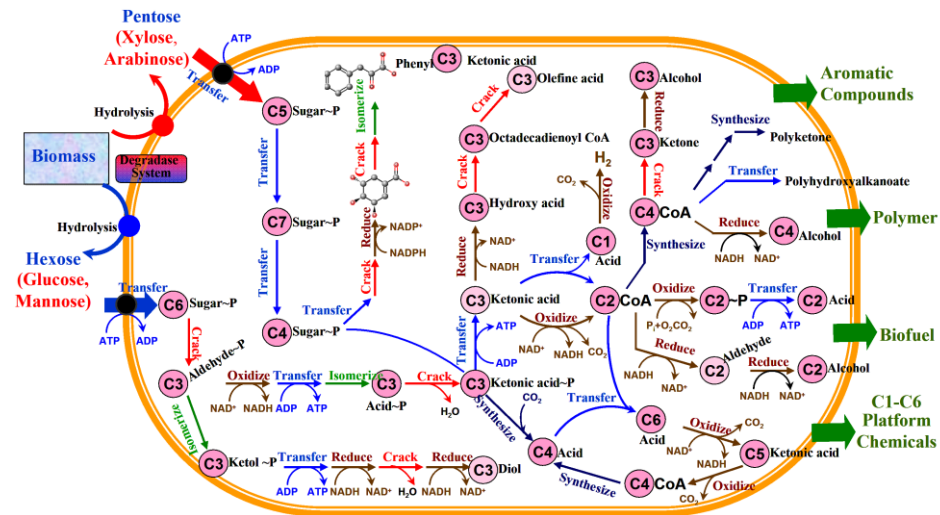
- Biopharma: accounts for 30% of medicines on the market (global sales: \$280 Billion)
- Recombinant DNA technology (e.g. insulin, hormones, protein-based cancer therapies)

### Food Products & Additives:

- Brewing, fermented foods, vitamins, polysaccharides

### Agricultural Products:

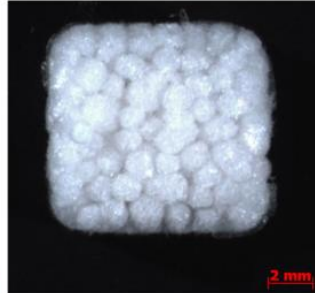
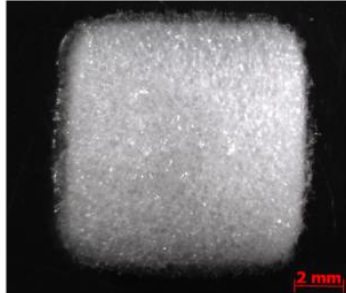
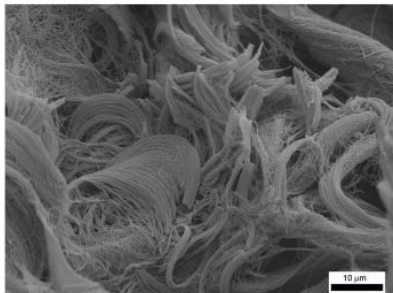
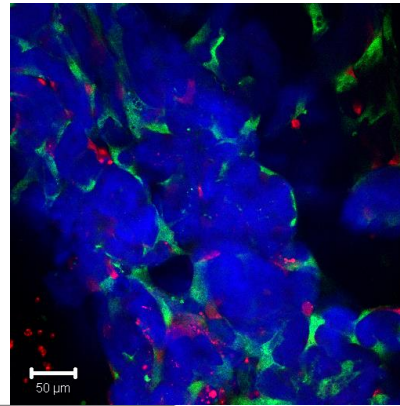
- Biopesticides, Biofertilizers
- Genetically-engineered crops



<http://www.intechopen.com/books/progress-in-molecular-and-environmental-bioengineering-from-analysis-and-modeling-to-technology-applications/cofactor-engineering-enhances-the-physiological-function-of-an-industrial-strain>

# Biomedical Engineering

- Stem cells & regenerative medicine
- Bioreactor design
- Biomaterials
- Nanotechnology
- Medical device design
- Drug delivery systems
- Drug screening platforms
- 3-D bioprinting
- Biosensors



# Careers in Chemical Engineering





# Careers in the Environmental and Energy Sectors



# Careers in Bioprocess Engineering



# Careers in Biomedical Engineering

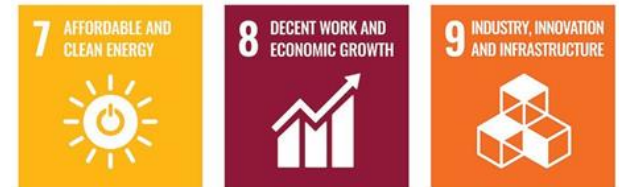


# Job Functions of Chemical Engineers

Improve food **processing techniques**, and methods of producing fertilizers, to **increase the quantity and quality** of available food.



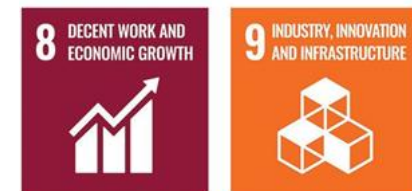
Construct the synthetic fibers that make our clothes more comfortable and water resistant; develop **methods to mass-produce** drugs, making them **more affordable**; and they create **safer, more efficient methods** of refining petroleum products, making energy and chemical sources **more productive and cost effective**.



Develop **solutions to environmental problems**, such as **pollution control and remediation**.



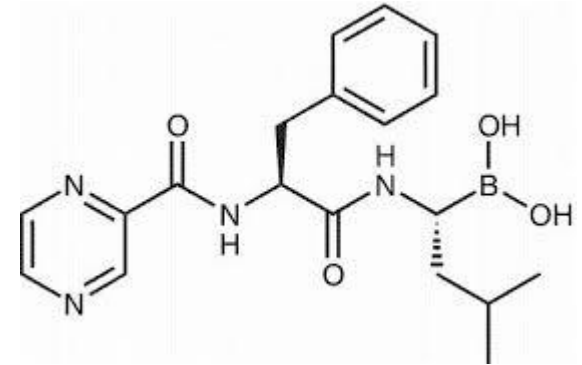
Process chemicals, which are used to make or improve just about everything you see around you.



# How is Chemical Engineering different from Chemistry?

## A Chemist works with these questions:

- What molecular structure is needed to obtain a desired property?
- How can we make a reaction occur between two different molecules?
- What reaction steps are needed to obtain the desired product from specific reactants?



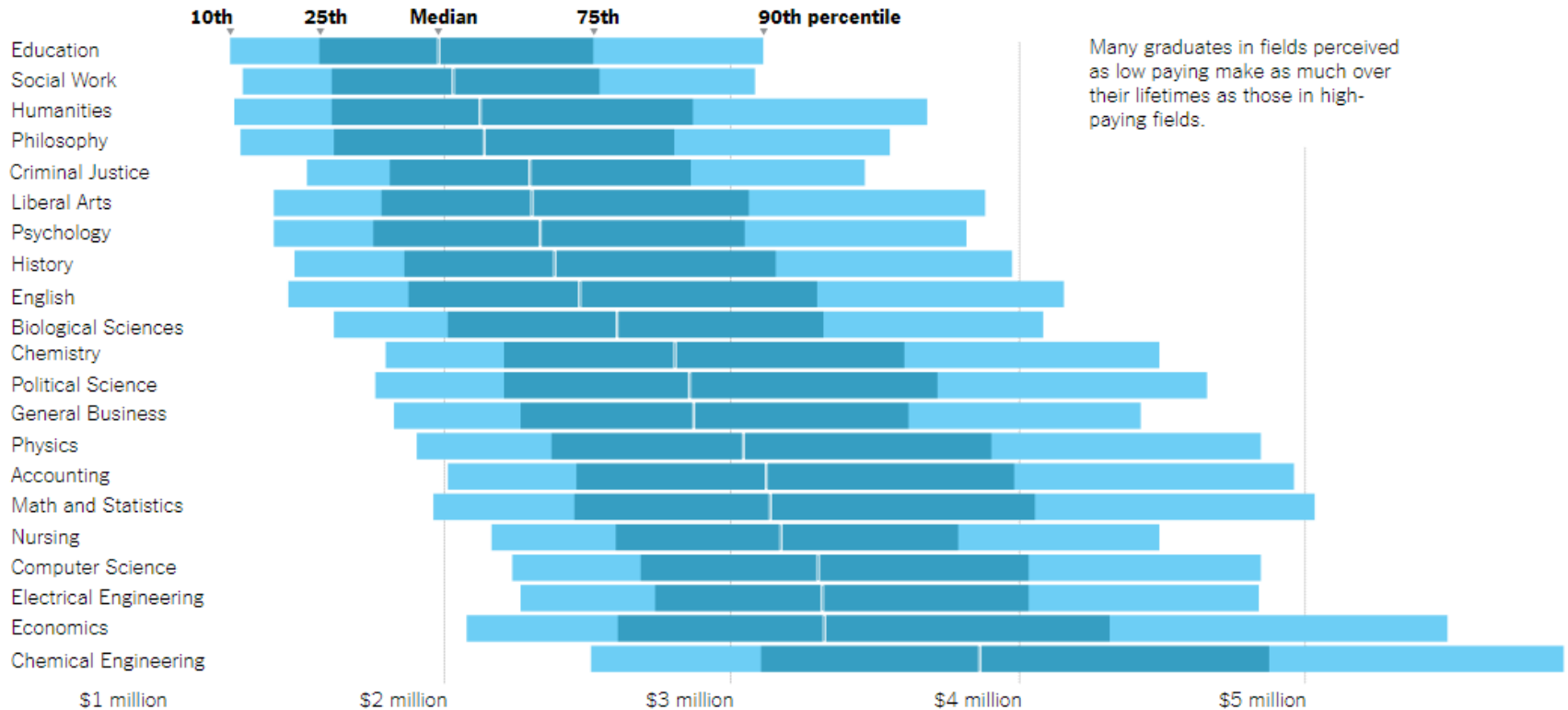
## A Chemical Engineer works with these questions:

- Which raw chemicals should we use to make a chemical process economically viable and environmentally responsible?
- How can we efficiently and safely produce required quantities (for example: 100,000 tons/year) of our product(s)?
- What processing steps (reactors, heat exchangers, pumps, separators) are needed?



# Projected career earnings

Projected career earnings for college graduates in the ...



"The Lifetime Earnings Premia of Different Majors," 2014 (updated: 2017), by Douglas A. Webber

Jeffrey J. Selingo, [Six Myths About Choosing a College Major](#), New York Times, Nov. 2017

# Questions!

- Prof Amarjeet Bassi
- [abassi@uwo.ca](mailto:abassi@uwo.ca)
- Please email for an individual or group meeting (in person or Zoom) to learn more.

Thank you for your time and interest.