

Chemical Engineering

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Vibes and Waves in Action

NSF Award #0841392

Honors Physics – Lowell High School

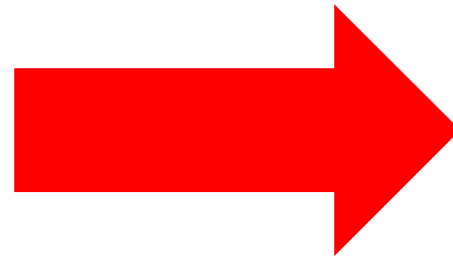
September 8, 2010

What is Engineering?

Math

Science

- Physics
- Chemistry
- Biology



Invent

Design

Build

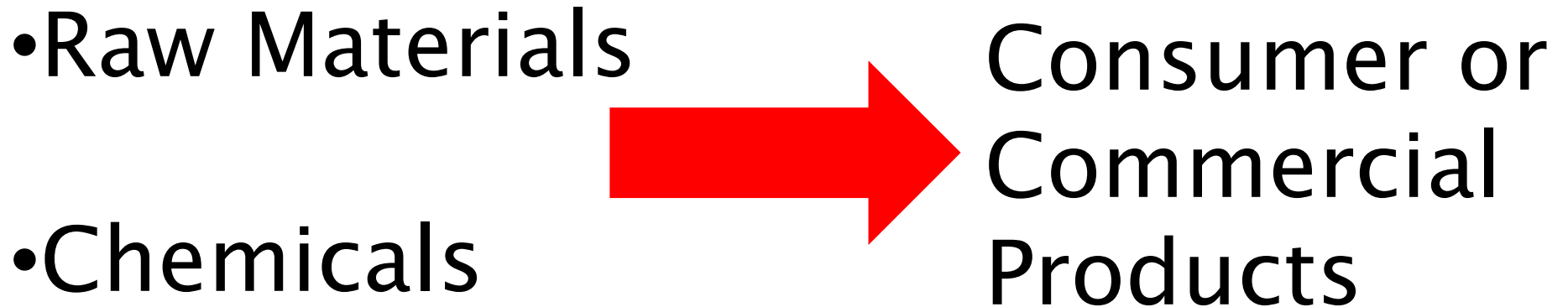
www.discoverengineering.org

Engineering Disciplines

- ▶ Mechanical
- ▶ Electrical
- ▶ Civil
- ▶ Chemical
- ▶ Aerospace
- ▶ Plastics
- ▶ Computer
- ▶ Environmental
- ▶ Biomedical



What is Chemical Engineering?

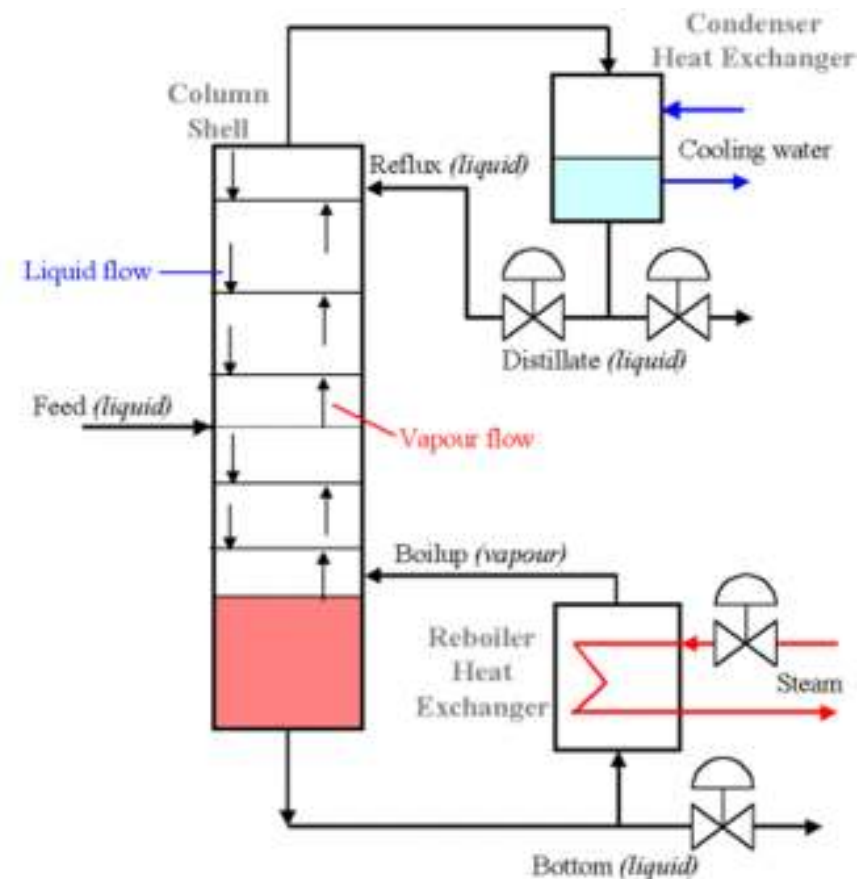


Universal Engineer



What makes us different?

- ▶ All Engineers employ math, physics, and engineering skills
- ▶ Chemistry!
 - Chemical Reaction Engineering
 - Separations



Chemical Engineering

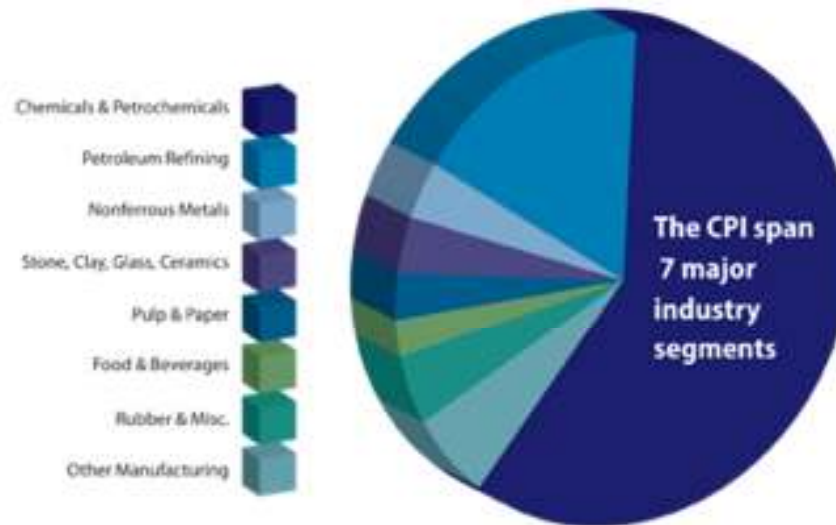
- ▶ Applying chemistry, math, physics, and life sciences to solve a variety of problems
- ▶ Address the problem of “scale-up”
 - Lab Scale to Manufacturing Scale



Chemical Process Industries (CPI)

Finished Products

Our readers produce a myriad of finished products, spanning 7 major industry segments



Market segments comprising the chemical and petrochemicals industries include:

Inorganic Chemicals
Plastics Materials and Synthetic Resins
Pharmaceuticals
Soaps and Detergents

Paints and Allied Products
Organic Chemicals
Fertilizers and Agrichemicals
Adhesives and Sealants

* Publisher owned data

The CPI includes all industry segments that:

- 1 Take raw materials such as minerals, petroleum or even air
- 2 Apply chemical, thermal, or mechanical processes to them, such as oxidation, polymerization, distillation or filtration
- 3 And produce end products such as plastics, paper, paint, pharmaceuticals, soap, gasoline or fertilizers for commercial or consumer use

**What is the difference
between a chemical
engineer and a chemist?**



Chemist Vs. Chem. Eng.

- ▶ Chemists discover new products, chemicals, or invention
- ▶ Chemical engineers bring these new ideas to the manufacturing level
- ▶ Chemists → Chem. Eng. → People



Scale-Up

- ▶ Simple Chemical Reaction – Soap
 - Produce a little bar of soap in the lab or at home

Is it practical for a company to make soap at this small scale?

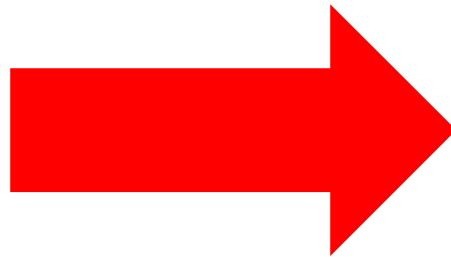


Scale-Up

This is where chemical engineering comes into play



200 mL



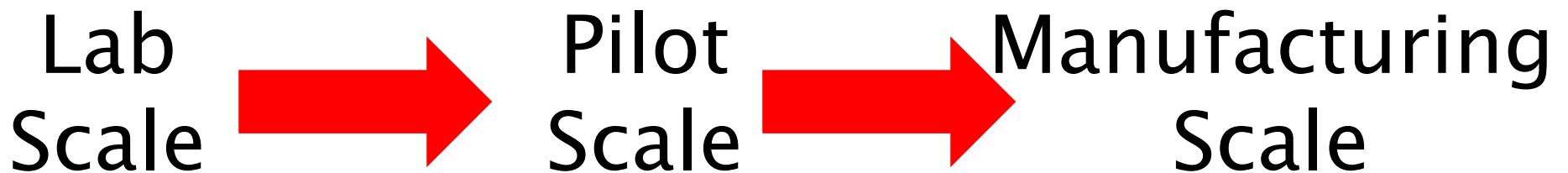
1,000 L

**What sort of challenges do
you think chemical
engineers deal with when
designing a process?**



Problem/Issues

- ▶ Scale – Up
 - Reaction kinetics, temperatures, pressures, size, transportation



Problem/Issues

- ▶ Economics – \$\$\$
- ▶ Safety
 - Workers, Environmental, etc..
- ▶ Regulations
 - Federal, State, & Local Government



**Where do you think the
physics comes in?**



Classical Physics

Dealing with physics at the macroscopic level (bulk level)

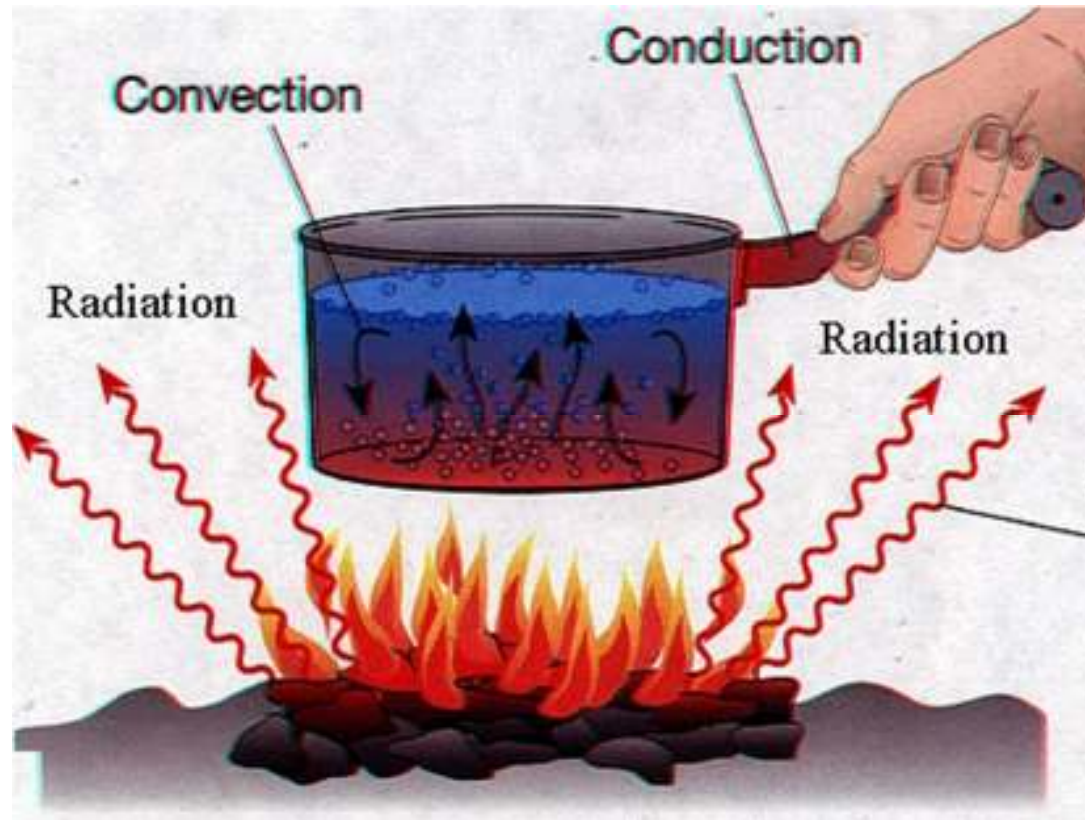
Chemical Engineers:

- ▶ Heat Transfer
- ▶ Fluid Mechanics
- ▶ Mass Transfer



Heat Transfer

Transfer of thermal energy



http://www.studentsoftheworld.info/sites/science/img/31368_ccr.jpg

Fluid Mechanics

Study of fluids

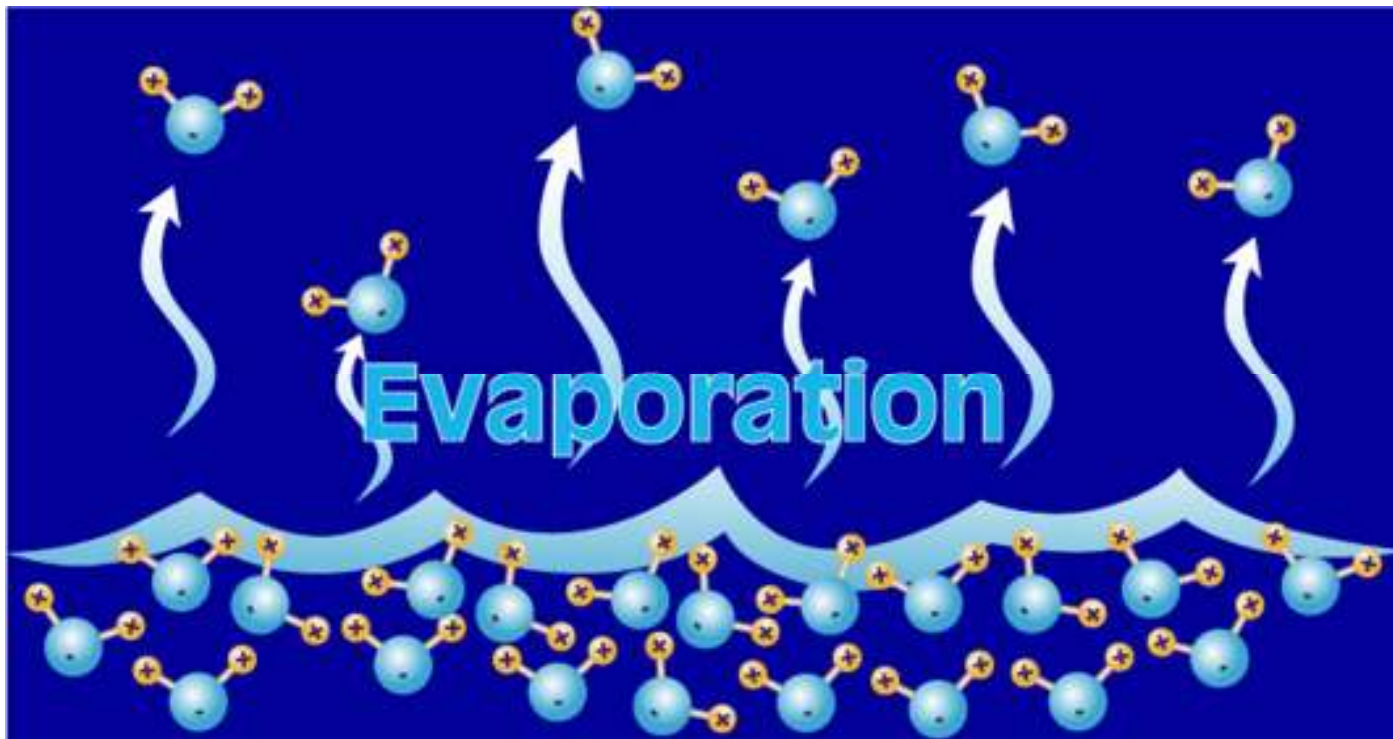
- Dynamic– Motion
- Static –At rest



<http://www.google.com/imgres?imgurl=http://i152.photobucket.com/albums/s177/kurtks/fluids-1.jpg&imgrefurl=http://>

Mass Transfer

Movement of mass



Quantum Physics

- ▶ Physics at the atomic level
 - Atomic Forces
 - Van der Waals
 - Hydrogen Forces
 - Reaction Kinetics
 - Physical Chemistry/Thermodynamics
- ▶ Nanotechnology



Summary

How do chemical engineers impact your everyday lives?

