What is ChBE?

Wednesday, February 10, 2016

What is Chemical Engineering?

Chemical engineering is about processes.

(Process flows are a basic concept in chemical engineering.)

Chemical engineers decompose complex processes into more simple components called “unit operations” in order to analyze and design processes.

Unit Operations of Chemical Engineering

Unit operations can be divided into three major classifications:

1) Reactions and Transformations

2) Separations — Things mix spontaneously, separation is the unmixing process

Equilibrium:
Separation based on thermodynamic partitioning of different components between phases.

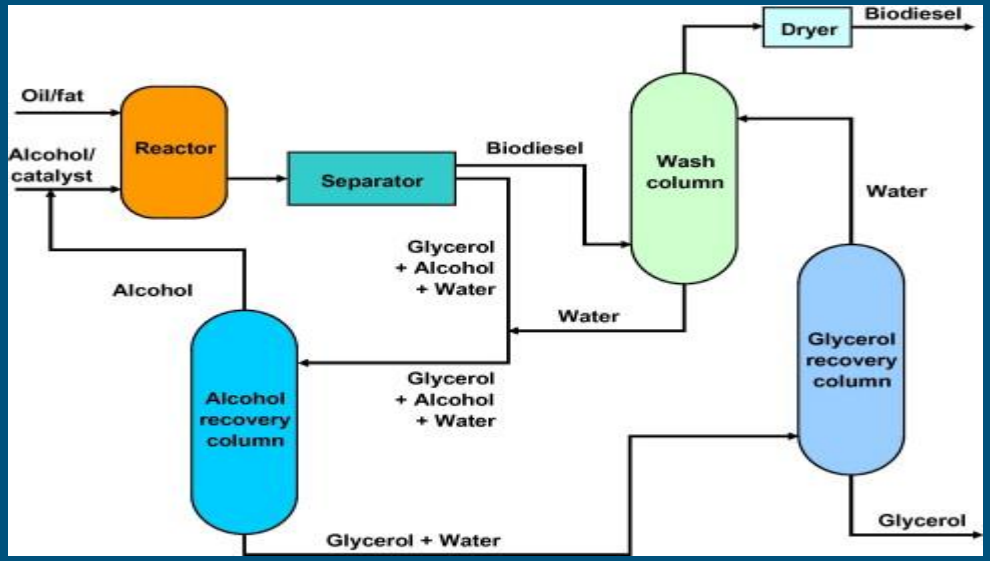
Examples: distillation, extraction, gas absorption

Rate-based:
Separation based on differences in transport rates of different components between phases.

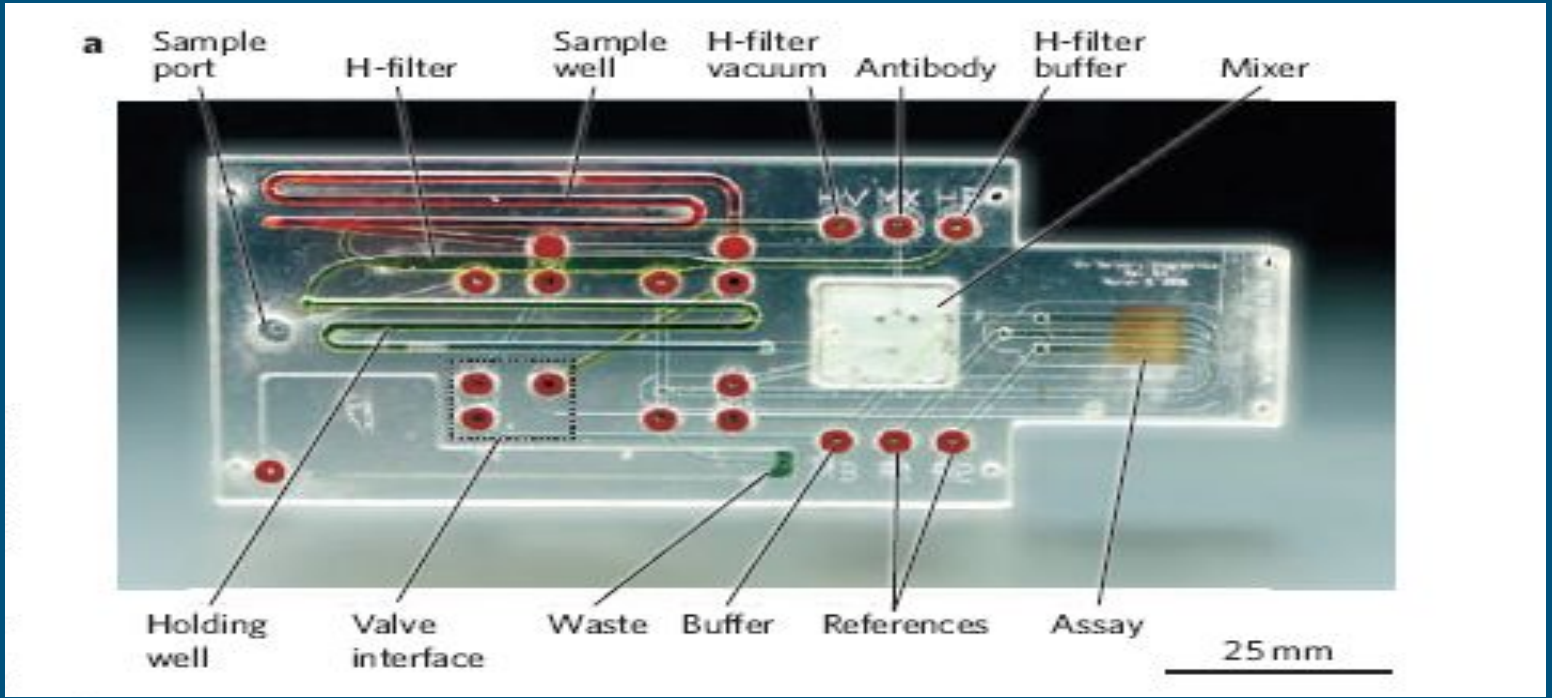
Examples: chromatography, membrane separations (Reverse Osmosis)

3) Support Networks pipes, heat exchangers, pumps, storage vessels

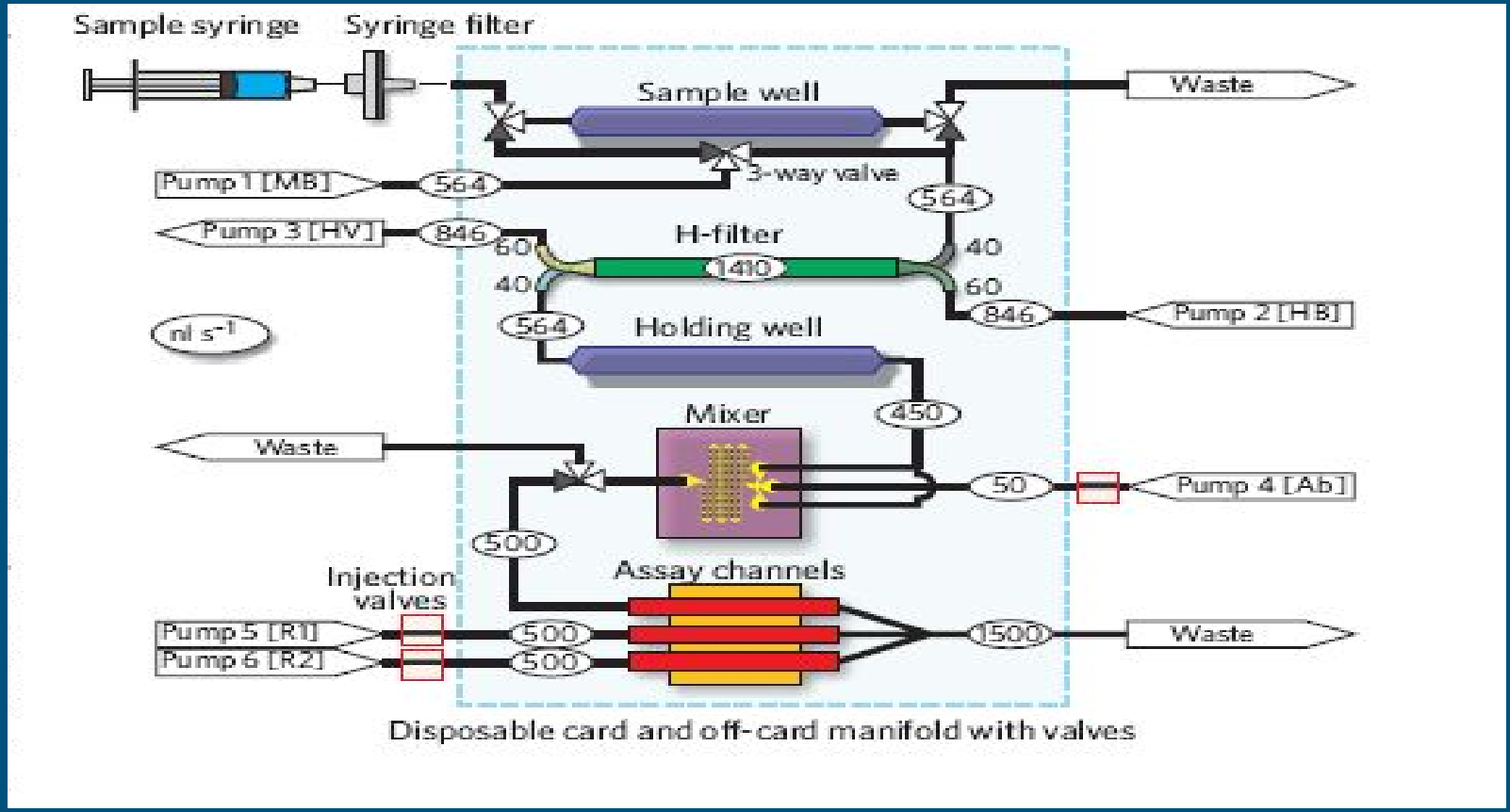
Greatest ChemE Challenges



Greatest ChemE Challenges: Bioengineering



Microfluid Medical Diagnostics



Chemical and Biomolecular Engineering Curriculum

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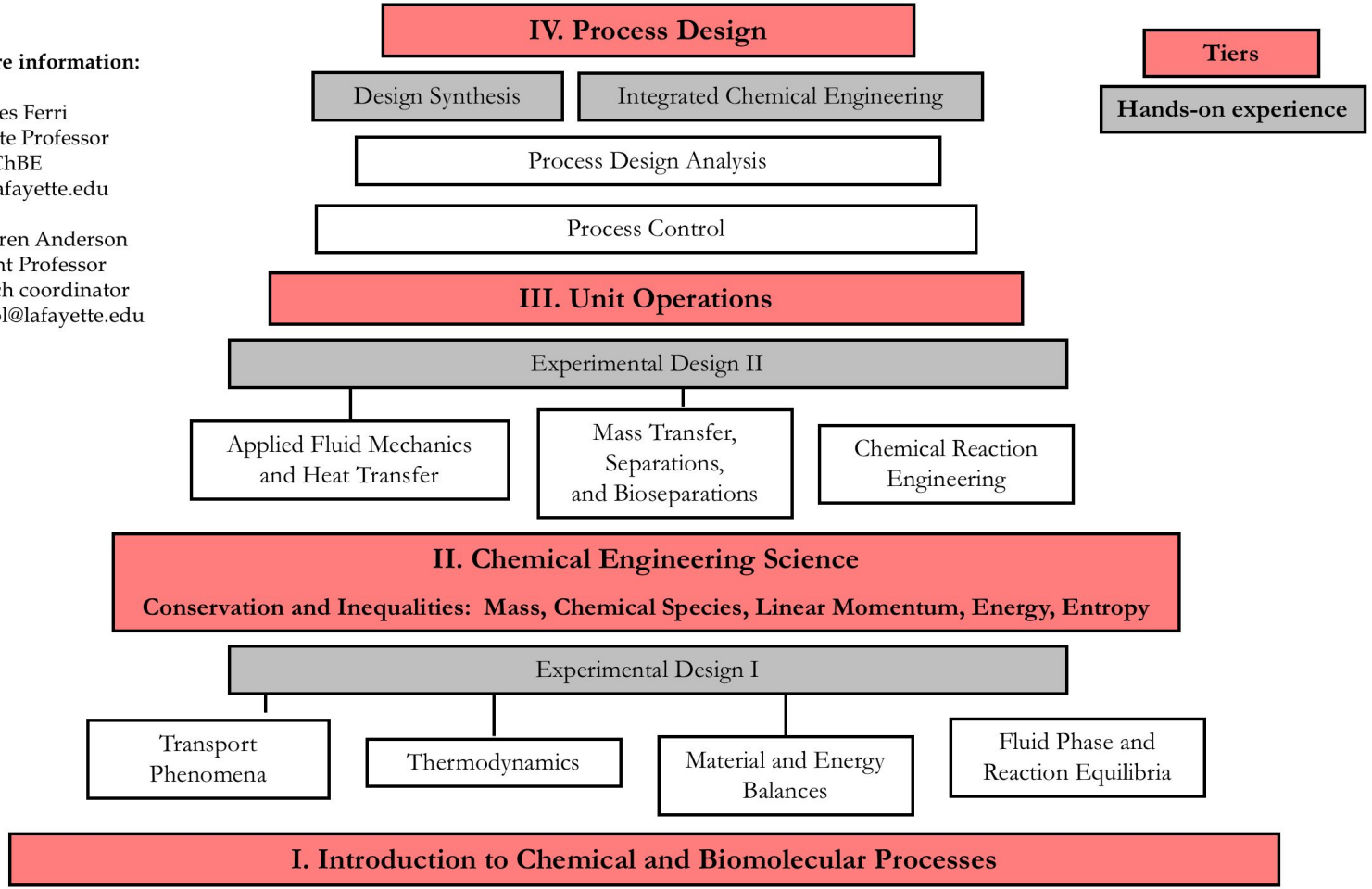
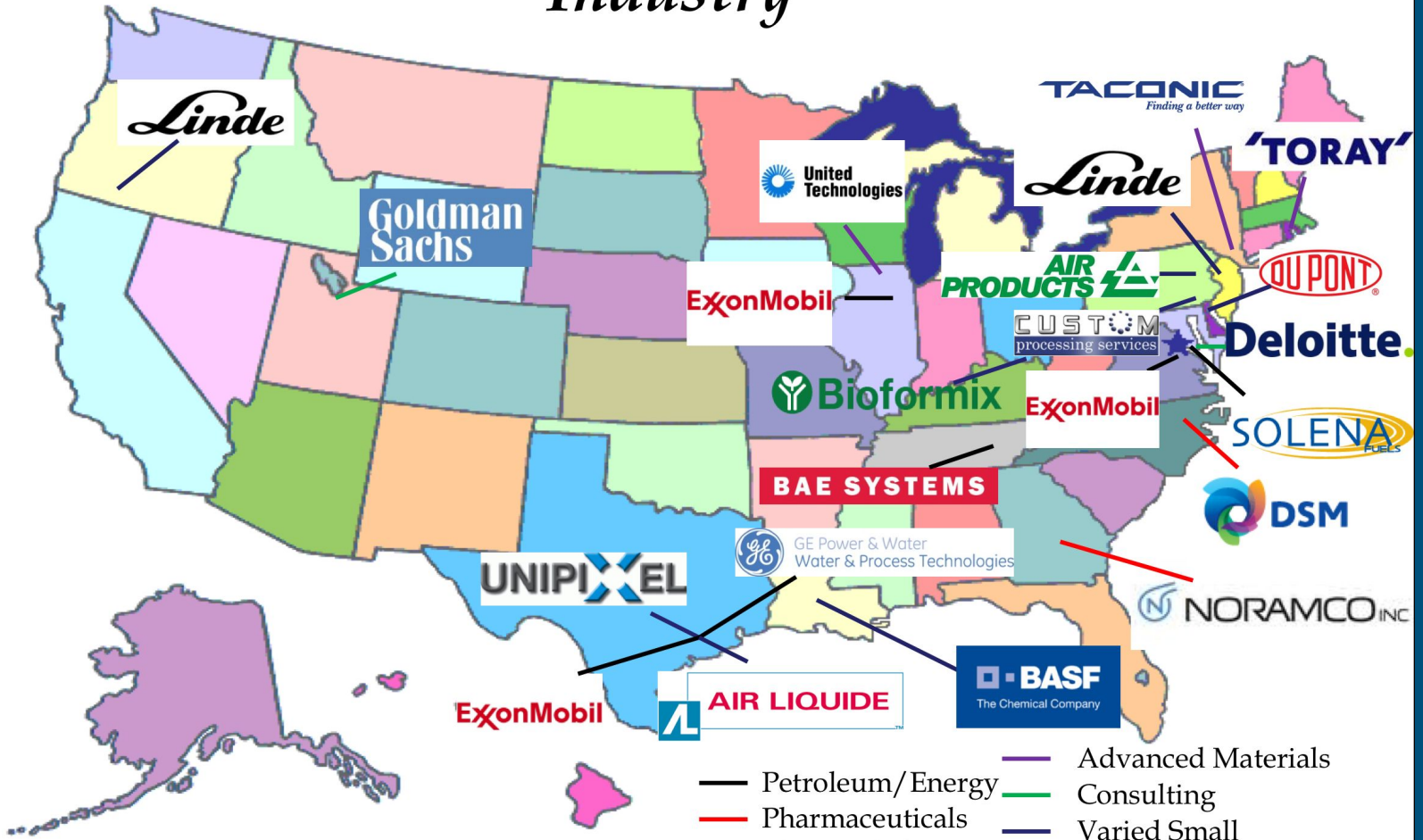


Industry


Linde
Goldman Sachs
United Technologies
ExxonMobil
TACONIC
Finding a better way
Linde
'TORAY'
AIR PRODUCTS
DUPONT
CUSTOM processing services
Deloitte.
Bioformix
ExxonMobil
SOLENA FUELS
BAE SYSTEMS
DSM
GE Power & Water
Water & Process Technologies
UNIPIXEL
NORAMCO INC
BASF
The Chemical Company
ExxonMobil
AIR LIQUIDE
Petroleum/Energy
Pharmaceuticals
Chemicals/Gases
Advanced Materials
Consulting
Varied Small Companies/ Startups

Petrochemical

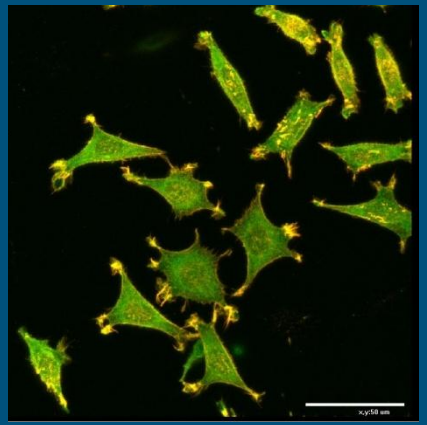
- Petroleum-based manufacturing
- Gasoline, oils, etc.

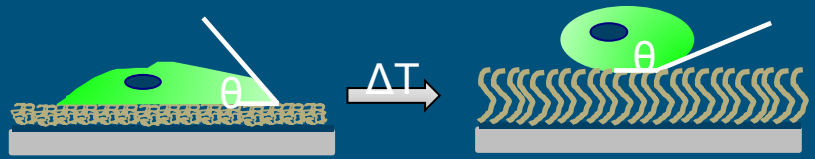
Chemicals

- Commodity
- Specialty
- Agricultural
- Polymers
- Paints and pigments

Molecular Bioengineering

Molecular Bioengineering exists at the interface between engineering and molecular biology (cells and molecules) and focuses on both understanding and engineering complex living systems for applications ranging from drug delivery and tissue engineering to biological synthesis of alternative fuels.





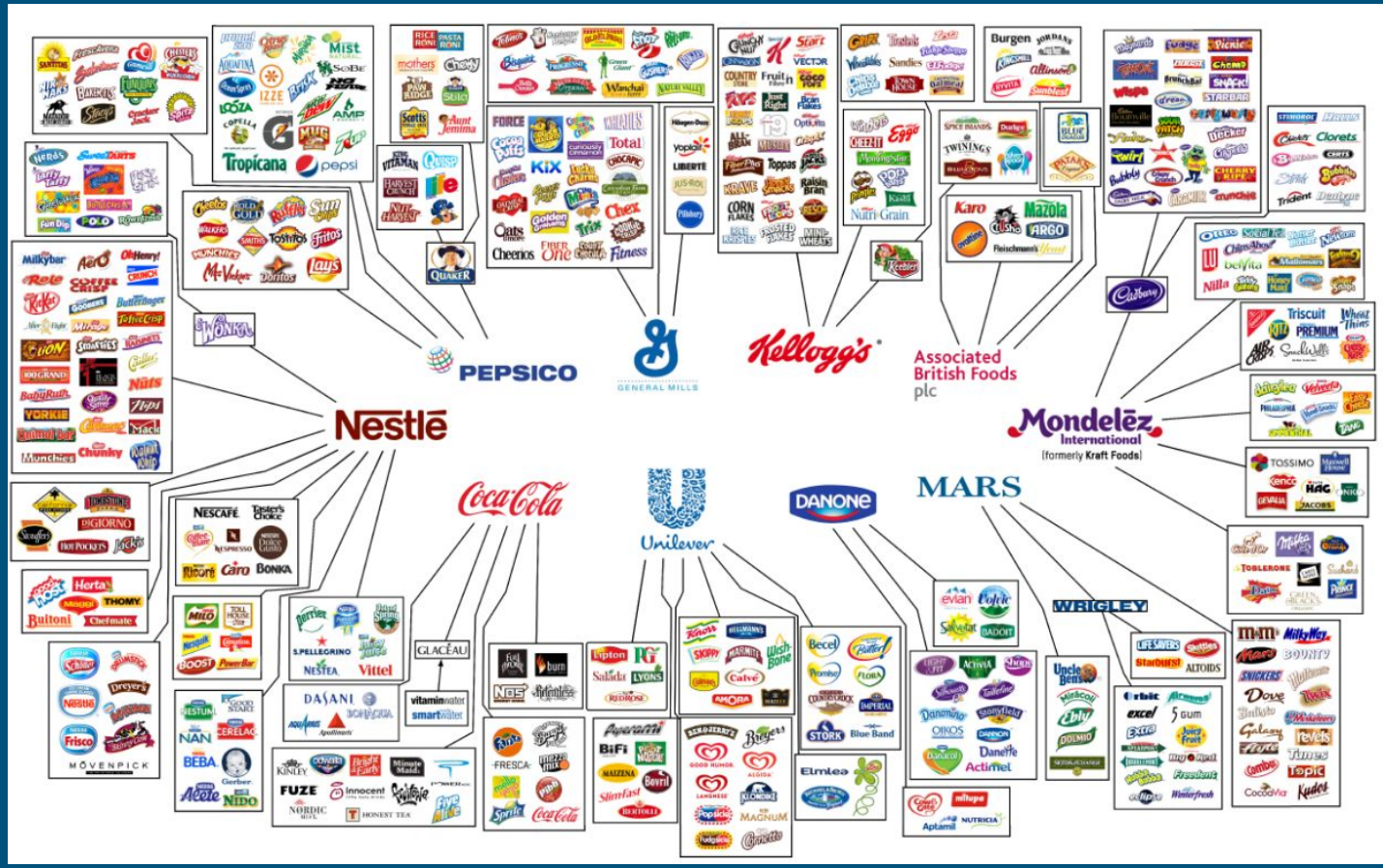
Co-localization of focal adhesion complexes in fibroblasts cultured on thermoresponsive polymer brushes.

Pharmaceutical/Biotechnology

- Drug discovery
- Manufacturing scale-up
- Solid, liquid, vapor dosage
- Testing
- Medical devices
- Drug delivery

Food

- Beverages
- Dairy
- Sugars, oils
- Cereals, grains
- Candy, snacks



Energy and the Environment

While chemical engineers are trained to deal with all aspects of environmental issues, their main focus has been in air pollution control, solid waste management, and hazardous waste management. In response to the growing demand for energy and adverse environmental impacts of fossil fuels, chemical engineers have been active in search for new fuel sources including conversion of waste materials (plastics, cellulosic compounds, etc.) and production of diesel fuel from algae.

Alternative Energy Production from Sustainable Sources

Environmental

- Biofuels
- Fuel cells
- Combat pollution
- Catalysis
- Cleaner Fuel
- Recycling processes
- Green manufacturing

ERG

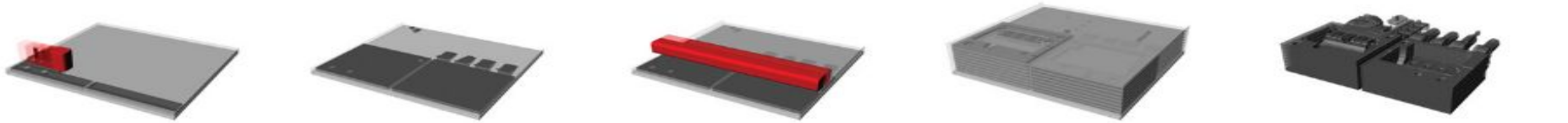
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA

Materials & Interfaces

A fundamental understanding of the physical and chemical properties of interfaces in natural and engineered materials is of paramount importance and finds engineering significance in fields as diverse as drug delivery, water treatment, semiconductor processing, biology, and nanotechnology.

"Binder Optimization for Materials Additive Manufacturing"
- sponsored by The ExOne Company.



1. Print	2. New layer	3. Spread	4. Repeat	5. Finishing
Selectively dispense binder using inkjet printing technology	The build platform is lowered by a set increment.	Spreads a new layer of powdered metal.	Repeat Steps 1-3, until the part is built.	Unbound metal is removed. Metal parts are thermally processsed.

Micro-and Nano Fabrication

Chemical engineers are also increasingly applying their fundamental knowledge of chemistry, physics, and math to “scale-down” processes, thereby allowing for a reduction in material and spatial requirements while providing for more controlled operating conditions. This scale-down gives rise to the need to fabricate systems that span length scales that can be on the order of microns to nanometers.

“Shell Encapsulation and Membrane Formation in Microfluidic Devices”

Electronics

- Semiconductor manufacturing
- Sensors
- Computers
- Home electronics

Consumer Products

- Hygiene
- Cosmetics
- Soaps/Detergents

Pulp and Paper

- Harvesting/Processing
- Paper
- Containers
- Paper products (tissue, towels)
- Recycling processes

Catalyst

Today's Paper.

Government/Military

- Policy Development
- Patent Law
- Armament Research
- Forensic Engineering

GENERAL DYNAMICS
Mission Systems

Academia

...and more!