

CHBE 100

CHEMICAL AND BIOMOLECULAR ENGINEERING

UNDERGRADUATE

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Overview

Our department offers two undergraduate degrees: the Bachelor of Science in Chemical Engineering (BSCHE) and Bachelor of Arts (BA) degree. The program leading to the BSCHE degree is accredited by the Accreditation Board for Engineering and Technology (ABET) under the EC2000 criteria.



In today's rapidly changing business climate, industrial sectors from petrochemicals to biotechnology and semiconductor manufacturing offer a wide variety of employment opportunities to our graduates. As a result, chemical engineering graduates may get involved with (among others):

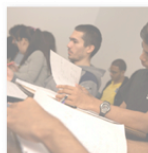
- the development of new processes and products for the chemical industry;
- exploration, production, and refining of oil and natural gas;
- design and optimization of fabrication facilities for semiconductors or magnetic storage devices;
- production of advanced materials - from plastics and fibers to catalysts and biomaterials;
- design of water and air pollution control devices;
- production of pharmaceuticals and biologic devices used for medical applications.

While industry employs the majority of chemical engineering students receiving a bachelor's degree, a large fraction of our graduates continue their education in:

<http://chbe.rice.edu/Content.aspx?id=33>

Our Curriculum

What opens all these career options to our graduates is a broad education that encompasses both fundamentals and applications to give students a sound scientific and technical grounding for further development in a variety of professional environments.



Questions

- What is engineering?
- What is chemical & biomolecular engineering?
- Where do our graduates work?
- How do I prepare for an engineering career?
- Will I find a job when I graduate?

What is engineering?

What is engineering?

The words *engine* and *ingenious* come from the same latin root:

ingenerare

which means

“to create”

Engineers are creators!

First Use

- Around 200 AD: Tertullian describes a Roman attack on the Carthaginians using a battering ram that he calls an “**ingenium**,” an ingenious invention.

Note: battering rams were introduced much earlier:

- 9th century BC by the Assyrians,
- 5th century BC by the Greeks.
- 1200 AD: **Ingeniators** are the people responsible for developing ingenious engines of war (battering rams, floating bridges, catapults, etc.)

Definition

- **engineer**: one who contrives, designs or invents; an author, designer (const. of); also absol. an inventor, a plotter, a layer of snares.
- **contrive**: I. trans. to invent, devise, excogitate with ingenuity and cleverness (any plan or purpose).

Oxford Dictionary

What is engineering?

- The function of a scientist is to know, while that of an engineer is to do.
- A scientist adds to the store of verified, systematized knowledge of the physical world; the engineer brings the knowledge to bear on practical problems.

Encyclopaedia Britannica

But, how does the engineer achieve that?

What is engineering?

- Engineering is based principally on physics, chemistry, and mathematics and their extensions into materials science, solid and fluid mechanics, thermodynamics, transport and rate processes, and systems analysis.

Encyclopaedia Britannica

- *In the second half of the 20th century, biology has emerged as an equally important enabling science for engineering (particularly chemical engineering).*

What is engineering?

- Unlike scientists, engineers are usually not free to select the problems on which they work; they must solve problems as they arise, and these solutions must satisfy conflicting requirements.
- Usually efficiency costs money, safety adds to complexity, increased performance may increase cost, weight etc.

Encyclopaedia Britannica

What is engineering?

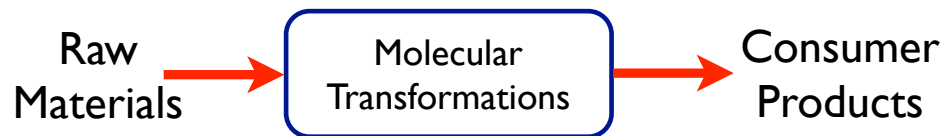
- The engineering solution is an optimal solution, the end result that, taking many factors into account, is most desirable. It may be the most efficient or reliable solution within certain cost or weight limits, the simplest that may satisfy certain safety requirement.
- In many engineering problems, the social costs are significant.

Encyclopaedia Britannica

What is chemical engineering?

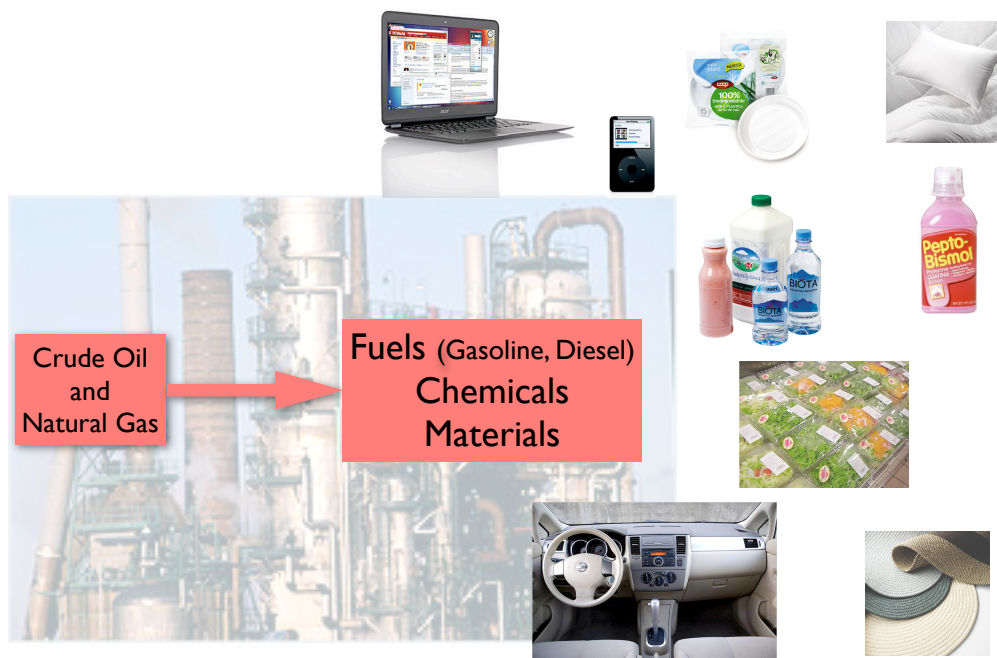
What is chemical engineering?

Chemical engineering is a discipline focused on the quantitative description, modeling, and optimization of processes that involve **complex molecular transformations**.



Chemical engineers are **molecular engineers**!

What is chemical engineering?

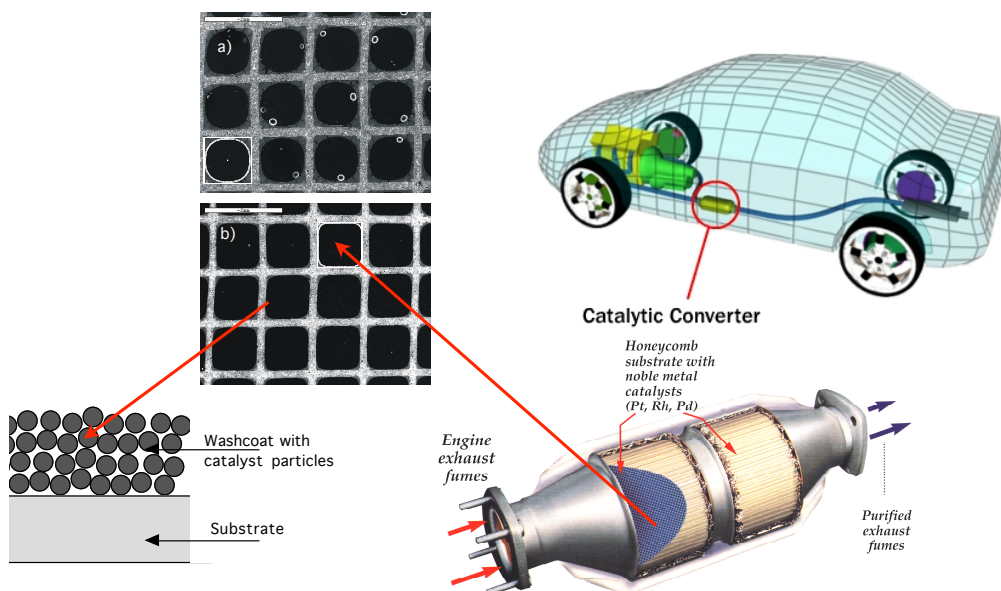


What is chemical engineering?

Chemical engineers

- Develop and run the processes that
 - provide the energy our economy needs and
 - manufacture the consumer products and medicines we depend on;
- Manage natural resources;
- Protect the environment (air/water pollution).

Automotive Catalytic Converter



What is chemical engineering?

- Chemical engineers have a long and rich history of major contributions to the technological infrastructure of the U.S.
- Success came from a deep knowledge of basic sciences (math, chemistry, physics and, now, biology) and ability to
 - tailor manufacturing technology to the requirements of their products, and
 - integrate product design with process design.

Forces of Change

- Revolutionary advances in molecular biology and nanoscale science offer exciting new avenues for chemical processing.
- Economic and social forces are driving a transition towards more **sustainable** and production methods that are **friendly to our environment**.

Top 10 Problems in 21st Century

1. Energy
2. Water
3. Food
4. Environment
5. Poverty
6. Terrorism & War
7. Disease
8. Education
9. Democracy
10. Population

* List compiled by Richard E. Smalley, 1996 Nobel Laureate

Grand Challenges for Chemical Engineering

- “Beyond the Molecular Frontier: Challenges for Chemistry and Chemical Engineering”

Report published by the National Academies of Sciences and Engineering (2003)

Grand Challenges for Chemical Engineering

- Develop new ways for **energy** generation, storage and transportation to pave the way for a truly **sustainable** future.
- Synthesize and manufacture new **materials** with high-yield, low-energy consumption and benign environmental effects.
- Understand the **chemistry of living systems** in detail.

Future of Chemical Engineering

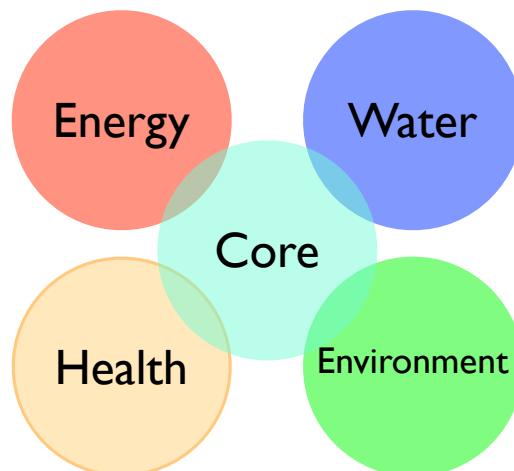
Unique qualifications of chemical engineers:

- Mastery of **basic sciences** (math, chemistry, physics, and biology)
- **System-based** approaches to problem solving (product and process design)
- Ability to **scale up** processes (bench to large scale)

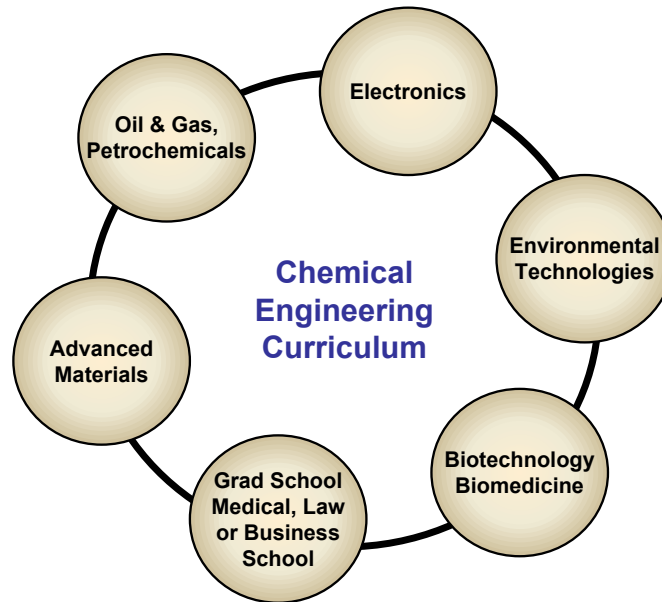
Future of Chemical Engineering

- Chemical and biomolecular engineers will play leading roles in the design and development of the next generation of
 - energy systems,
 - advanced materials,
 - biological products, and
 - medical therapeutics.

Future of Chemical Engineering



Career Options



Our Department's Mission

- Conduct world-class basic and applied research in the following areas:
 - Nanomaterials and complex fluids;
 - Biosystems engineering;
 - Energy systems and sustainability,
- Maintain outstanding educational programs