Welcome Early Admits (and maybe Class of 2020)!

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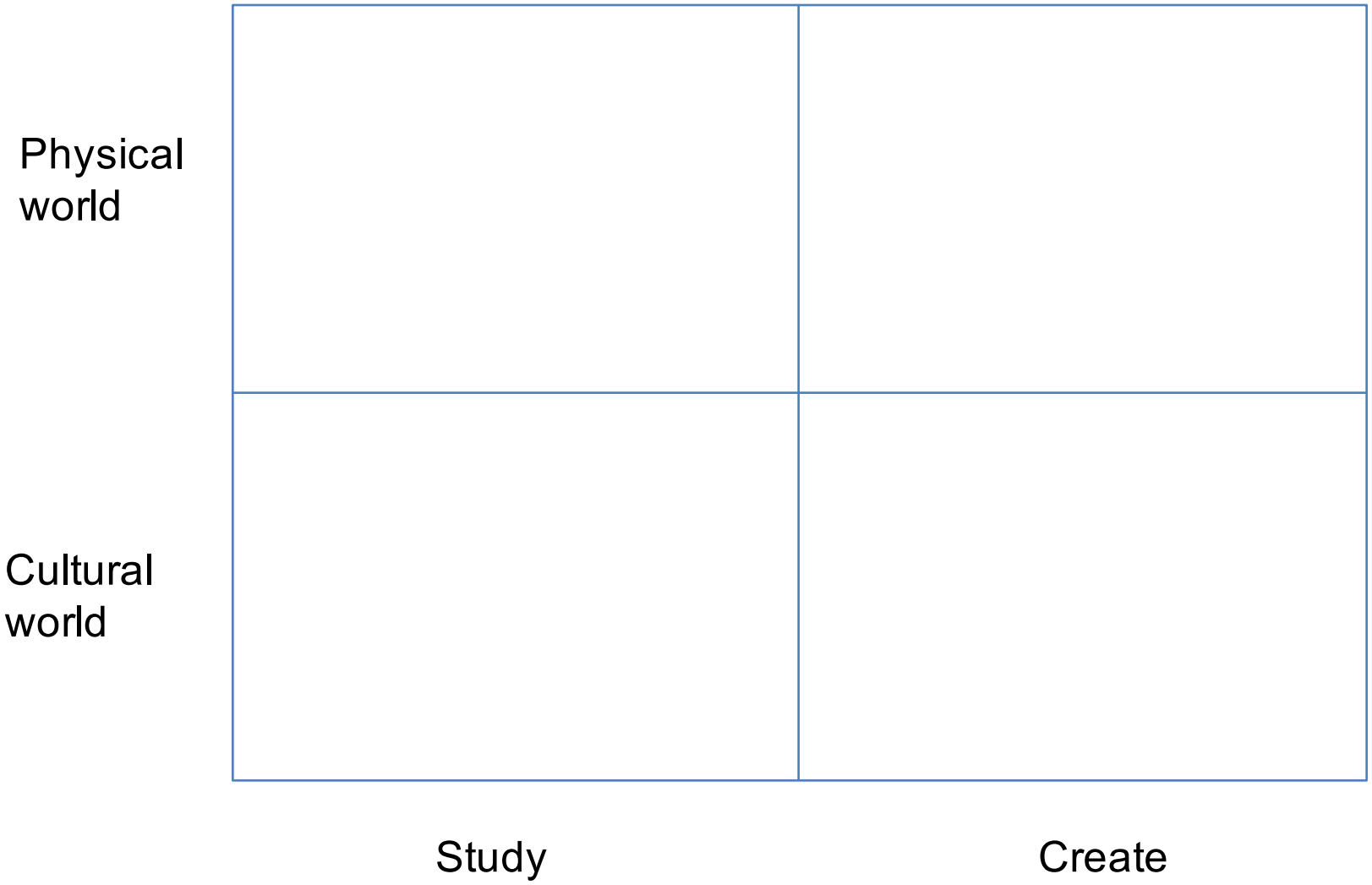
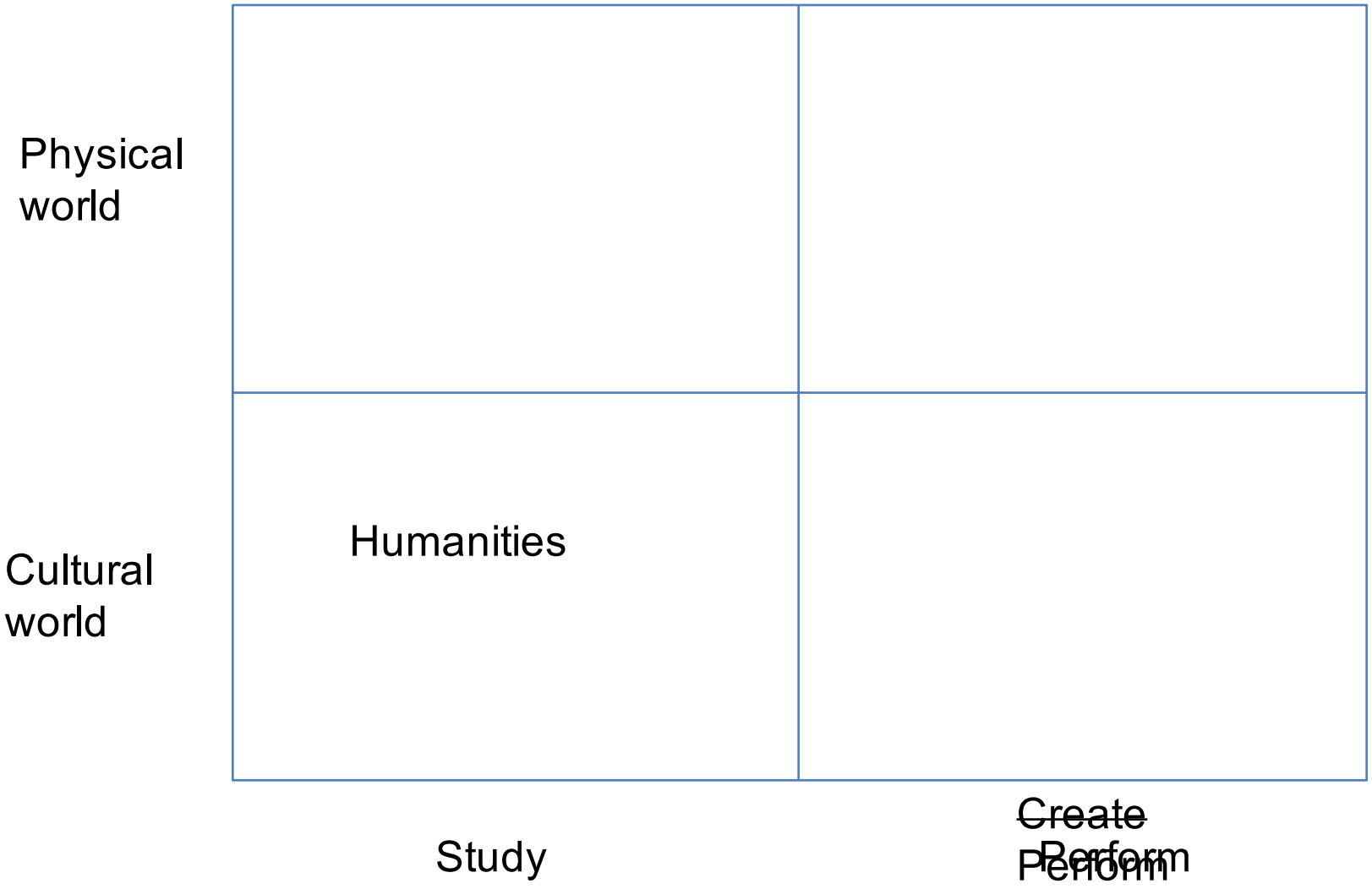
Edited version of a talk that originated with Professor Edward J. Maginn
Pdf is available at:
http://chemeprof.com/teaching.html

Is chemical and biomolecular engineering right for me?



Is chemical and biomolecular engineering right for me?



Is chemical and biomolecular engineering right for me?

	Study	Perform
Physical world		
Cultural world	Humanities	Arts

Is chemical and biomolecular engineering right for me?

	Study	Perform
Physical world	Science	
Cultural world	Humanities	Arts

Is chemical and biomolecular engineering right for me?

	Study	Perform
Physical world	Science	Engineering Ubiquitous use of mathematics because we need to predict behavior before we build it!
Cultural world	Humanities	Arts

What is chemical engineering?

- **Originated with a desire to transform raw materials into useful products through chemical reactions.**
- **The reactions were discovered by chemists starting in the 1600's and by the end of the 1800's, there was a need to produce large quantities of an ever increasing number of materials.**
- **The "scale-up" of a laboratory reaction (~grams) to a profitable commercial process 10^6 grams) is usually not a matter of just making bigger laboratory equipment (flasks, beaker and Bunsen burners).**
  - "Know-how" was generalized with scientific understanding and mathematical analysis, then was translated into a formal curriculum
- **"Biomolecular" was added in (about) 2000 to reflect the growing importance of molecular biology as a fundamental component**

Then

Series I. Number IV.

BULLETIN

OF THE

University of Notre Dame

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UNIVERSITY PRESS

APRIL, 1906

Entered at the Postoffice, Notre Dame, Indiana, as second class matter, July 17, 1905.

STUDIES PRESCRIBED FOR THE DEGREE OF CHEMICAL ENGINEER.

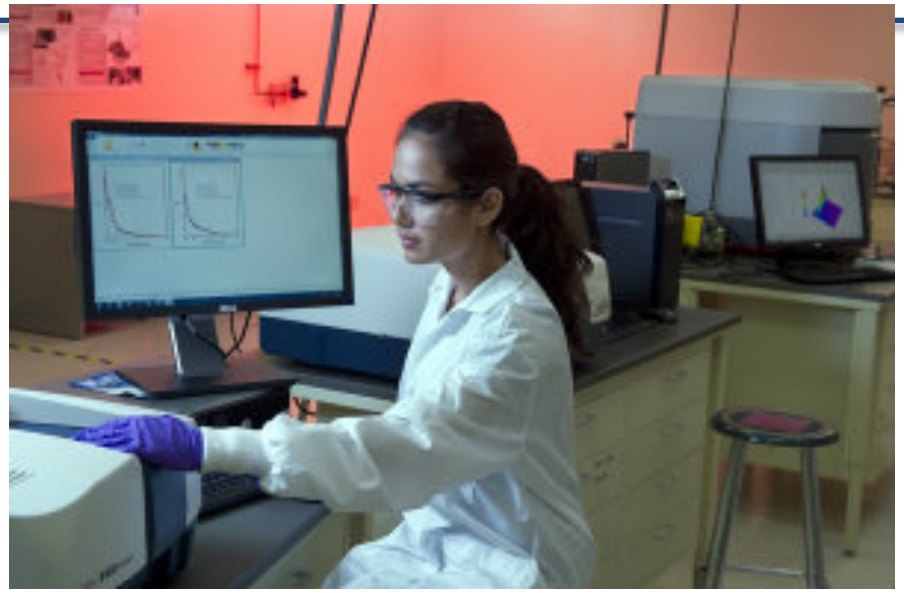
FRESHMAN YEAR.

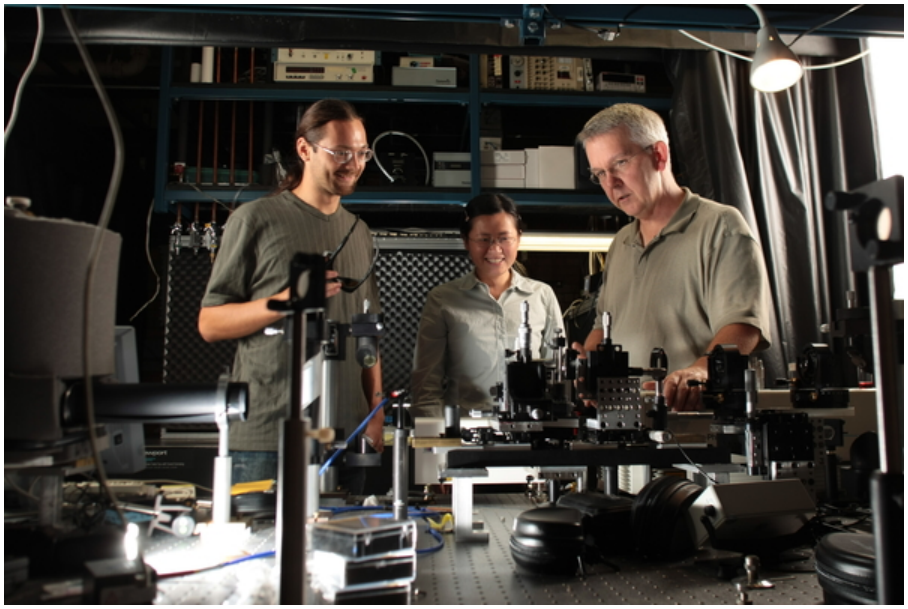
SUBJECTS First Term	Hours a week	See for Description	SUBJECTS Second Term	Hours a week	See for Description
			Steam Boilers	3	161 IV

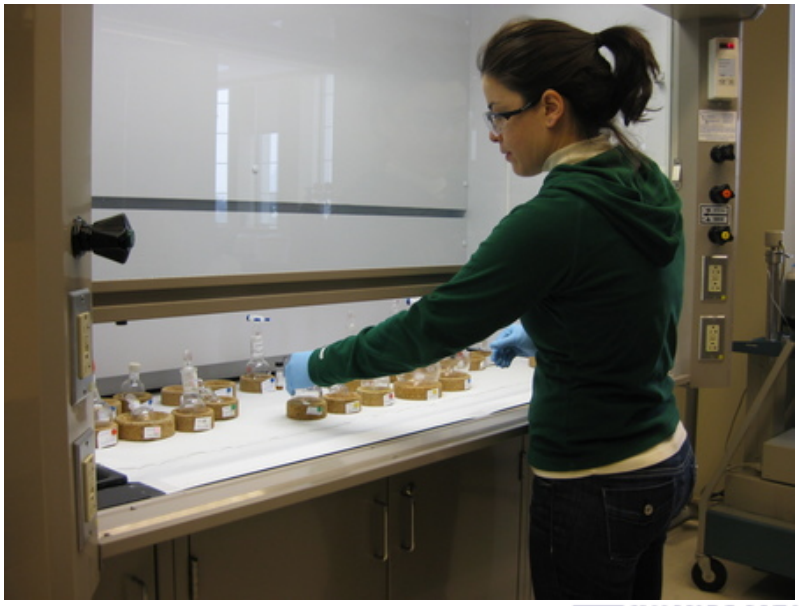
SENIOR YEAR.

Chemistry	6	123	IX	Chemistry	7	123	IX
Chemistry	3	125	XIII	Chemistry	4	124	XI
Chemistry	5	125	XIV	Chemistry	5	125	XIV
Thermodynam.	3	160	I	Thermodynam.	3	160	I
Mech'l. Lab.	3	163	VIII	Thesis			

Now





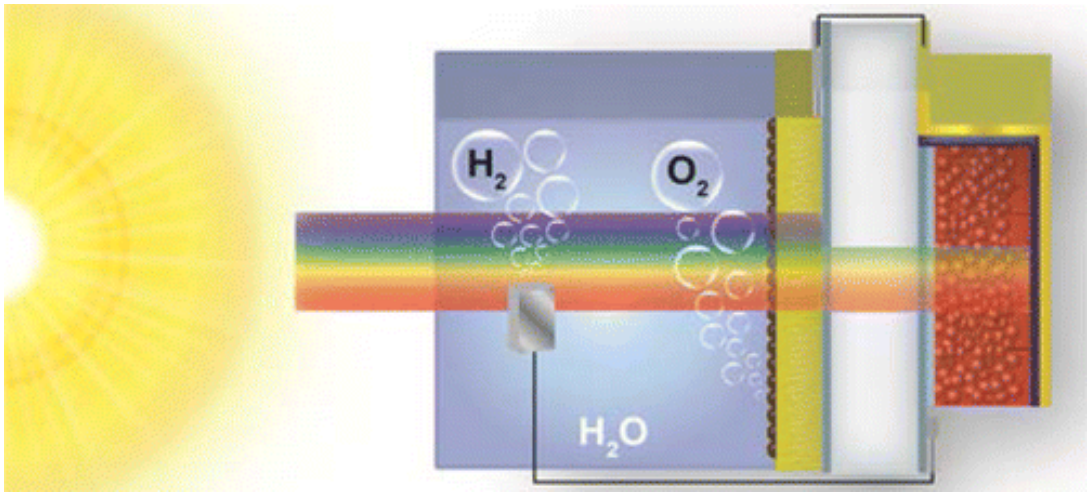


Key Areas of CBE

- **Energy**
  - production and utilization; conventional and new sources

Image from Omni Petroleum

Fossil fuel production



Lead-halide perovskite material for photolytic solar fuel production.
- Prof. Prashant Kamat, *J. Am. Chem. Soc.*, **2015**, *137* (2), pp 974–981

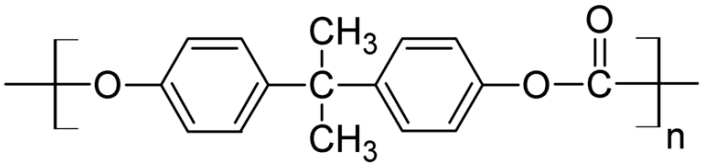
Key Areas of CBE

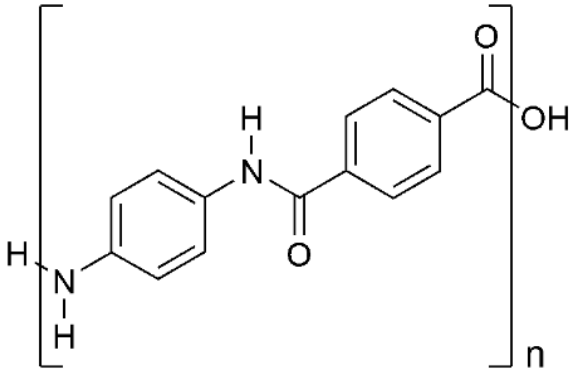
- **Separations**
  - Clean water, purification of products

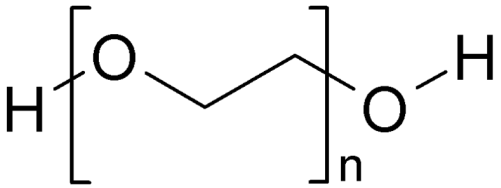
Perth desalination plant: 130 M liters/day

Key Areas of CBE

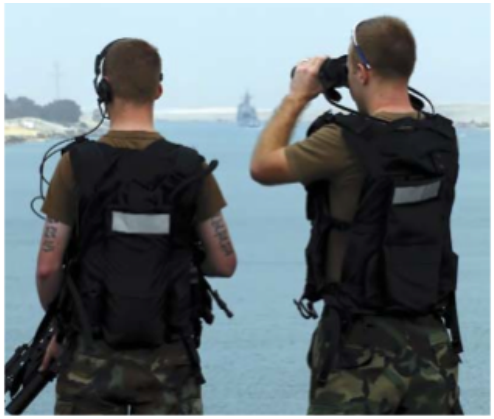
- **Materials**
  - Polymers, catalysts, "soft" matter, "hard" matter, microelectronics

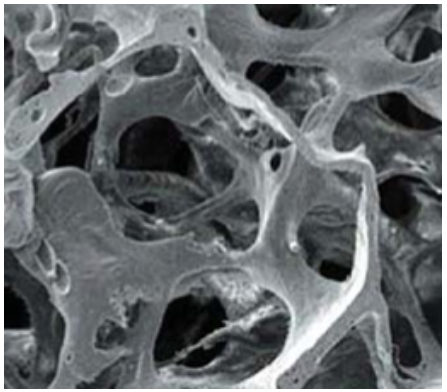




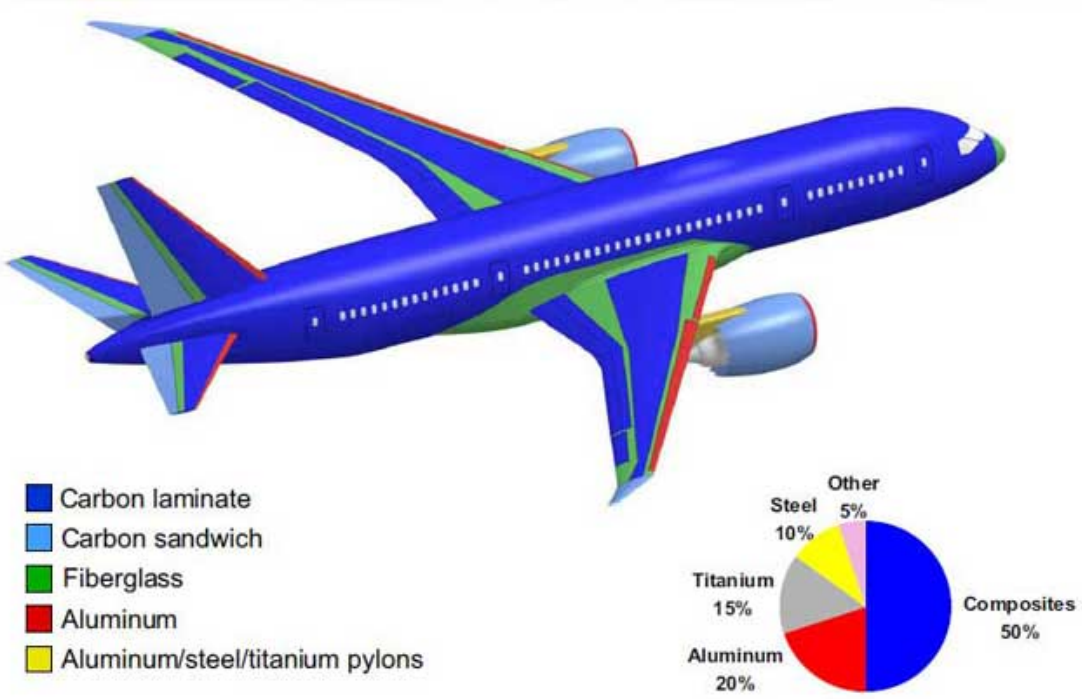


Key Challenge: Forget drones… why does Amazon need 2 corrigated cardboard boxes for every item!





Materials: Aerospace engineering?



Boeing Dreamliner
Fuel use approximately
¼ of original Boeing
Jetliner

Materials: Electrical engineering?

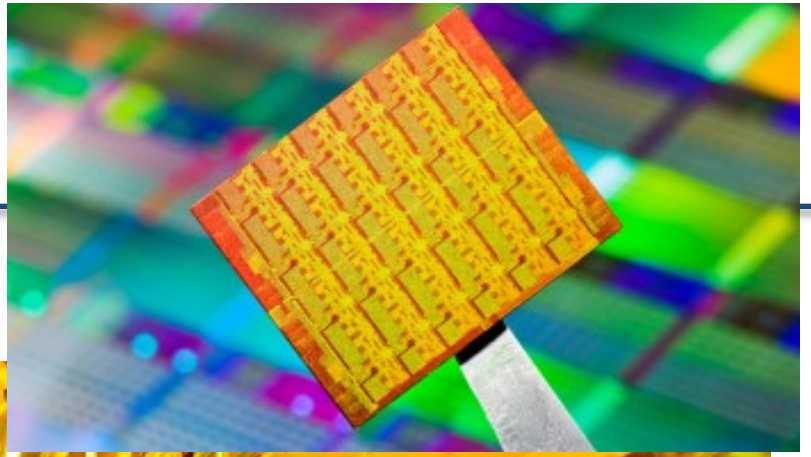


Image courtesy of Intel

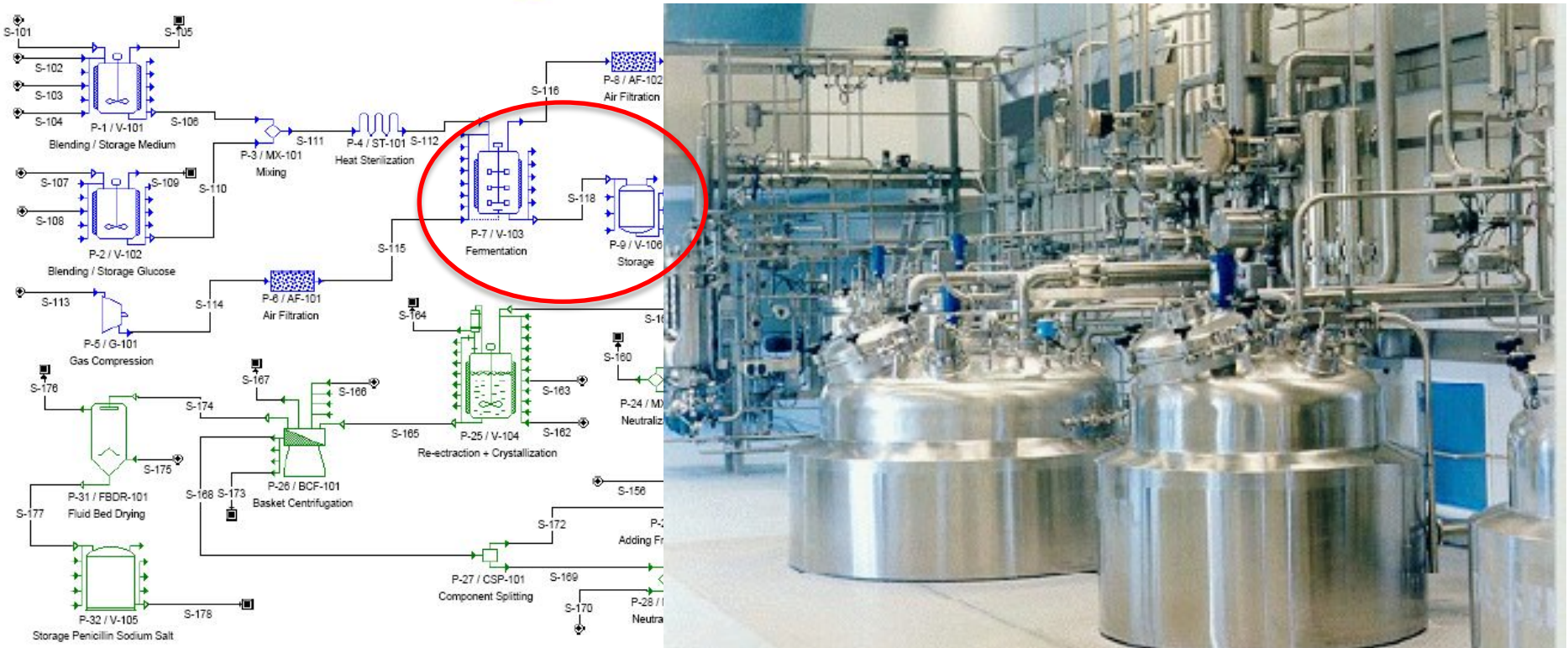
First jobs of recent grads

- Accenture, Epic (IT / business consulting)
- Bayer, Merck, Lilly, Abbott (pharmaceuticals)
- Procter and Gamble (brand mgmt)
- UOP (process engineering)
- TRW (satellite systems)
- Merrill Lynch (investment banking)
- GE (aircraft engines division)
- Loyola (law school)
- Air Products (Career Development Program)
- I.U (medical school)
- Military (medical service corps, flight school)
- MIT, Stanford, UCSB, Minnesota (graduate school in chemical engineering)
- BP, Marathon, Exxon (Oil industry)

Key Areas of CBE

- **Biomolecular engineering**
  - Pharmaceutical production, tissue engineering, drug delivery, biomaterials

Process Flow Diagram: Penicillin



What do CBE graduates do?

- **VP Consumer Food Sales, General Mills**
- **Air Products (2 years)**
- **Harvard MBA (1990)**
- **Manages ~ 250 people in division with $2 billion in revenue**

Shawn O'Grady '86

What do CBE graduates do?

- **Manager, Global Employee Benefits, Air Products and Chemicals**
- **18 years at APCI: product manager, university relations, new product commercialization, product marketing**
- **MBA, Lehigh (1998)**

Melanie Sanchez-Jones ‘89

What do CBE graduates do?

- **Professor of Law, Vanderbilt University**
- **Harvard Law (#1 in class)**
- **Clerk for Supreme Court Justice Anthony Scalia**
- **Formerly worked for a private firm in D.C.**
- **Special Counsel for Supreme Court nominations for a US senator**

Brian Fitzpatrick'97

What do CBE graduates do?

- **Scientist at Salk Institute working on therapeutics for Alzheimer's disease and diabetes**
- **ND valedictorian**
- **Two years in ACE program, then two years at Merck**
- **PhD Stanford Chemical Engineering**

Jennifer Ehren '99

What do CBE graduates do?

- **Global Operations Leadership Development (GOLD) program, Johnson & Johnson**
  - Manufacturing engineering (Ortho Clinical Diagnostics, Rochester, NY)
  - Quality engineer, Ethicon Endo-Surgery (Juarez, Mexico)
  - Source buyer (J&J headquarters, New York)
  - Quality Systems Senior Manager, Ethicon Endo-Surgery (Cincinnati)
- **MBA, Xavier University**
- **ND crew team**

Pamela Jefson ‘06

What do CBE graduates do?

- **Engineer with Owens-Corning, Columbus, OH**
- **PhD in chemical engineering, 2013 University of Texas**
- **Fulbright Scholar**
- **Internships with GE, Pepsico, Lyondell and DuPont**
- **Active in AIChE, SWE, NSBE**

Richelle Thomas ‘08

Chris Hensler ‘13

- **Rotational Engineering program, Lummus Technology, Houston, TX**
  - First assignment: Randall Gas business
- **CBE graduation speaker; active in Tau Beta Pi, AIChE, Joint Engineering Council…**
- **Process Engineering Intern, Carnegie Strategic Design Engineers, LLC (Pittsburgh)**
- **Study Abroad, Universidad Politecnica da Valencia, Spain**

What do CBE graduates do?

- **Senior Associate Scientist, Amgen, Cambridge, MA doing downstream process development**
- **Previously worked for Biogen on protein production**
- **As an undergrad, held internships with Pfizer, GE**

Carson Tran ‘09

What do chemical engineers learn about to become one?

- **Fundamental Science,**
  - Mathematics, Chemistry, Physics, Biology
- **Engineering science topics:**
  - Chemical Thermodynamics
  - Transport Phenomena
- **Integration of these in courses such as**
  - Reaction Engineering, Separation Processes and Process Design

Our Curriculum

Dept. of Chemical and Biomolecular Engineering

Standard Curriculum

	Fall		Spring	
Freshman	MATH 10550, Calculus 1	4	MATH 10560, Calculus 2	4
	CHEM 10171/11171 Intro to Chem	4	CHEM 10122 Gen Chem	3
	EG 10111, Intro to Eng	3	EG 10112, Intro to Eng	3
	Arts & Letters 1	3	PHYS 10310, General Physics 1	4
	University Seminar/A&L 2	3	University Seminar/A&L 3	3
		17		17
Sophomore	MATH 20550, Calculus 3	3.5	MATH 20580, Linear ODEs	3.5
	CHEM 10172/11172, Organic 1 +lab	4	CHEM 20273, Organic 2	3
	CBE 20255, Intro to Chem Eng	3	CBE 20260, Thermodynamics 1	3
	PHYS 10320, Gen Physics 2	4	CBE 20258, Computer Methods	3
	A&L 4	3	A&L 5	3
		17.5	*CBE 20290, Career Choices Eng	*1
				15.5 /*16.5
Junior	MATH 30650, Differential Eq	3	CHEM 30324, Pchem	3
	CHEM 30333/31333 Achem & Lab	4	CBE 30338, Chem Proc Control	3
	CBE 30355 Transport 1		CBE 30356, Transport 2	3
	or CBE 30357 Biotransport	3	CBE 31358, Chem Eng Lab 1	3
	CBE 30367, Thermo 2	3	A&L 6	3
	CBE 30361, Materials	3		15
		16		
Senior	CBE 40443, Separations	3	CBE 40448, Process Design	3
	CBE 40445, Reaction Engineering	3	CBE Elective	3
	CBE 41459, Chem Eng Lab 2	3	Tech Elective	3
	CBE Elective	3	Advance Science Elective	3
	A&L 7	3	A&L8	3
		15		15
Total		128 credits	*Strongly recommended	

Curriculum

- **We have example class schedule plans for you**
- **Several "tracks"**
  - Regular
  - Accelerated (AP credit in math, physics, chemistry)
  - Pre-med
- **Concentrations in CBE**
  - Biomolecular
  - Materials
  - Energy

Study abroad

- **Semester abroad**
  - Normally fall semester junior year
    - **Perth (Western Australia)**
    - **Dublin (University College Dublin)**
    - **Santiago (Pontifical University of Chile –Spanish language)**
  - Others possible: engineering.nd.edu/academics/studyabroad
- **Summer programs**
  - London, Rome, Alcoy (Spain)
  - CBE-specific program: Imperial College London

Summer Abroad CBE

- **Program at Imperial College just for CBE students**
- **July-August**
- **Targeted at rising juniors**
- **CBE Lab I (CBE 31358) and CBE 44360 (elective, plant operations)**

2015 Imperial class

Imperial College program

Classes at Imperial, taught by Imperial and ND faculty

Live in Lee Abbey, a nearby student guest house

London CBE – Classroom and location

Many opportunities to get involved

- **Notre Dame American Institute of Chemical Engineers (AIChE) student chapter**
- **Joint Engineering Council**
- **Society of Women Engineers**
- **ND National Society of Black Engineers**
- **ND Hispanic Engineers and Scientists**
- **Many service activities outside of engineering:** http://gsu.nd.edu/student-resources/communityresources/external-affairs-community-service-opportunities/

AIChE student chapter "ChemE Car"

Why Choose Chemical Engineering at Notre Dame?

- **"Secret" to an effective undergraduate program**
- **Talented Faculty**
  - ND has many leaders in their fields of research, including two members of the National Academy of Engineering
- **Talented Students**
  - Like you!
    - **Strong by any measure.**
- **Both groups committed to the "enterprise"**
  - The faculty are at Notre Dame because it is an excellent academic environment and because we want to teach the undergraduate students!
  - The students are willing to balance the extra-academic activities and distractions with their desire to be successful students

So: They work hard!

Important point

- **Notre Dame is a not a "generic" University and would not be mistaken for**
  - Big-Ten or other major Public University,
  - Princeton, Duke or Vanderbilt, or Georgia Tech or MIT
  - Nor even Georgetown, Boston College or Villanova
- **Choose Notre Dame because it is the right (overall) fit for you!**
  - If you come to be a chemical engineer, you are coming to a top program

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		17		17
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