Engaging (and teaching) the Internet Generation

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Chemical & Biomolecular Engineering

ENGRD 2190:
Mass and Energy Balances

Faculty Innovation in Teaching grant:

Balancing Mass, Energy, and Student Interest

(In collaboration with Kathryn Dimiduk, Director TEI)

Project Goals:

Expand focus from industrial chemical processes to current topics in biotechnology, energy, & environment

Embrace new teaching technologies to:
- engage students
- support student's learning
- promote interaction in the classroom
- encourage connections to the major

Added Technology

The Wacom Tablet
- i-clicker polling
- Computer animations

Group projects include
- Excel simulations
- Video-tour of AEW Cayuga power plant
- On-line tutorials & peer evaluation surveys

Wacom tablet demonstration

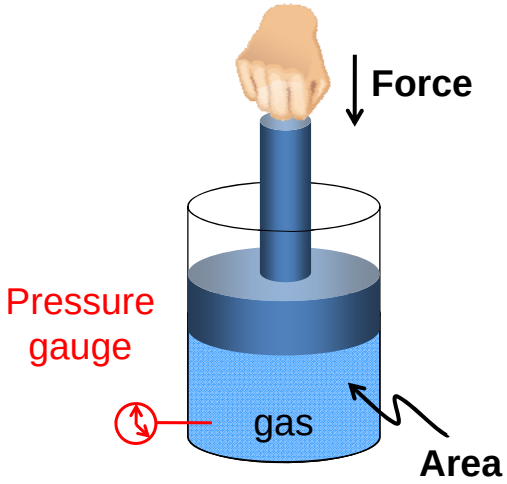
Pressure measurements

Gauge reads ZERO at atmospheric pressure

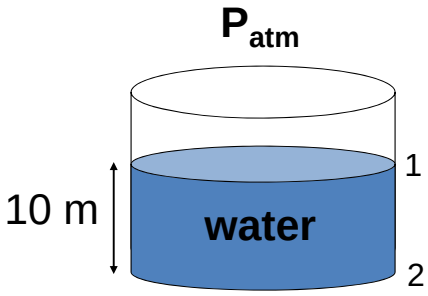
P =

Absolute pressure

P_{abs} =



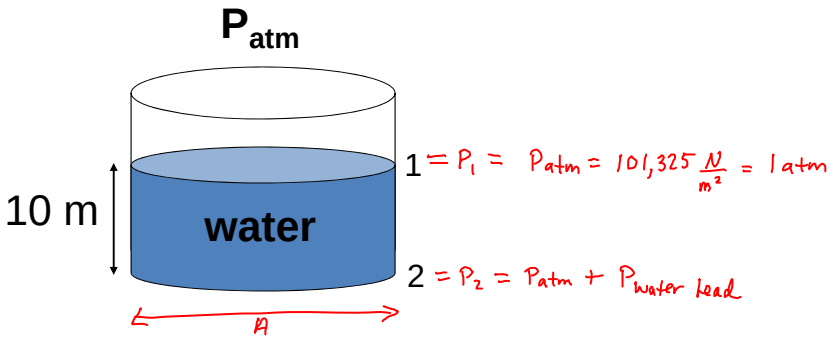
What else is applying a force to the piston?



i-clicker question:

What is the most specific and true comparison of the pressure at 1 and 2?

A. The same
B. $P_1 > P_2$
C. $P_1 = 2\ P_2$
D. $P_1 < P_2$
E. $P_1 = 0.5\ P_2$



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$P_w = \frac{F}{A} = \frac{mg}{A} = \frac{V\rho g}{A} = \frac{Ah\rho g}{A} = \rho g h$

$P_w = \left(1000 \frac{kg}{m^3}\right)\left(9.8 \frac{m}{s^2}\right)(10 m) = 98{,}000\ N/m^2$

$P_2 = 101{,}325 + 98000 = \sim 200{,}000\ N/m^2$

Other Advantages of Wacom

Paces lecture appropriately

Can include diagrams, pictures, tables, & charts for easy markup, saving time in lecture for teaching

Videos and animations can be included – it's dynamic!

Captures entire annotated lecture for later online review

It's very easy to use *and fun*!

Student Feedback

Selected comments:

- *Later posting of the lecture was extremely helpful to review concepts that one perhaps did not understand earlier and did not write good enough notes about.*

- *The on screen markup made it less boring and more interactive.*

- *The clickers definitely helped make sure you were paying attention and attending class. Having the lecture slides posted online was extremely helpful when preparing for exams and filling in notes you missed during class if the topic was covered too fast.*

New Biotechnology Team Project

Project Goals:

Apply course concepts and skills to a current research area and at a new scale

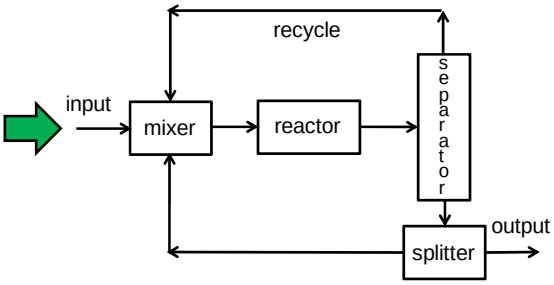
Continue to build teamwork skills

Engage students in higher level thinking and analysis skills

"Classical" chemical engineering language and fundamental skills

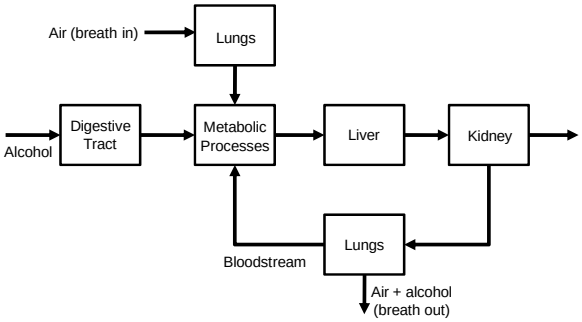
Industrial chemical plant

Corresponding flowsheet



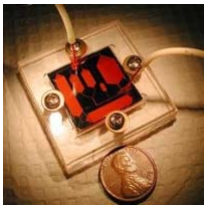
Fundamental skills applied to new systems

The human body



"Body-on-a-chip"

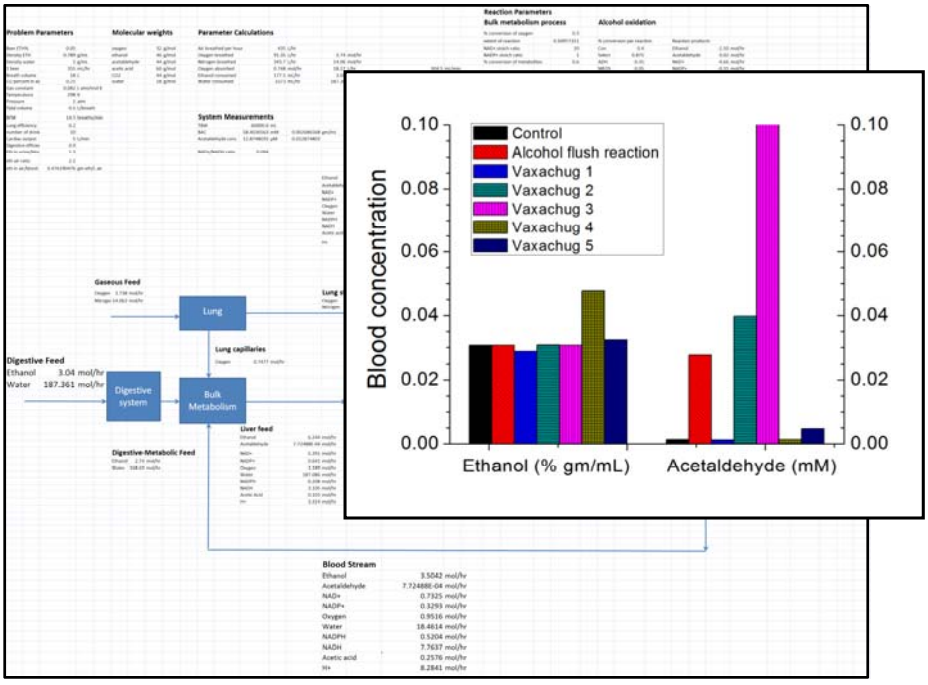
Biotechnology
Pharmacology
Human health
Scaling down



Shuler Group Research

“Consulting” for a Pharmaceutical Company

- Design simulation model
  - Develop mass balance model for human body
  - Incorporate metabolism reactions for ethanol
  - Create excel spreadsheet simulation
- Test Model
  - Run control cases
  - Explore genetic mutation that alters metabolism
- Extend and Apply
  - Test new alcoholism drug formulations based on mutation
  - Scale down model to chip size
- Analyze
  - Report on drug efficacy, make recommendations



Dissemination

2 education journal articles:
- Proceedings of the ASEE (accepted)
- Chemical Engineering Education (in review)

National ASEE conference presentation in June
(TA Allen Yang)

In discussions for a chapter in Felder & Rosseau's *Elementary Principles of Chemical Processes*, the premier textbook for this course.

Invitation to NSF workshop on determining best practices in Assessment and Dissemination of Teaching Innovations
(Kathryn Dimiduk)