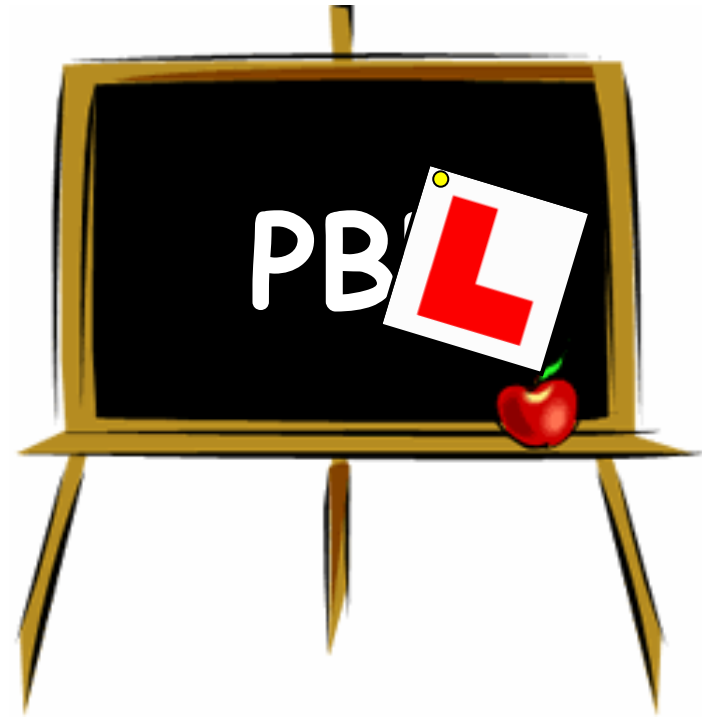
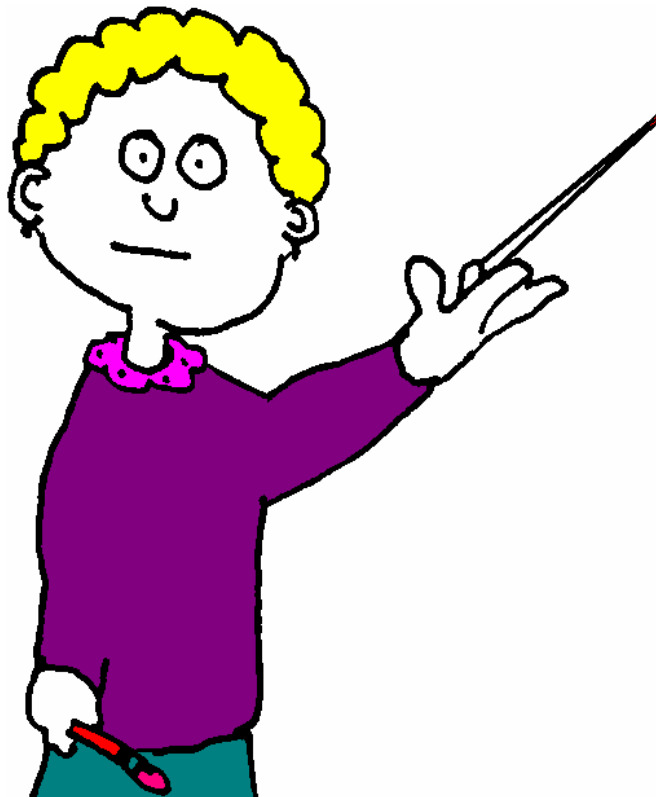




Introducing PBL to the Chemical Engineering Curriculum: Design, Construction & Evaluation of a Heat Exchanger

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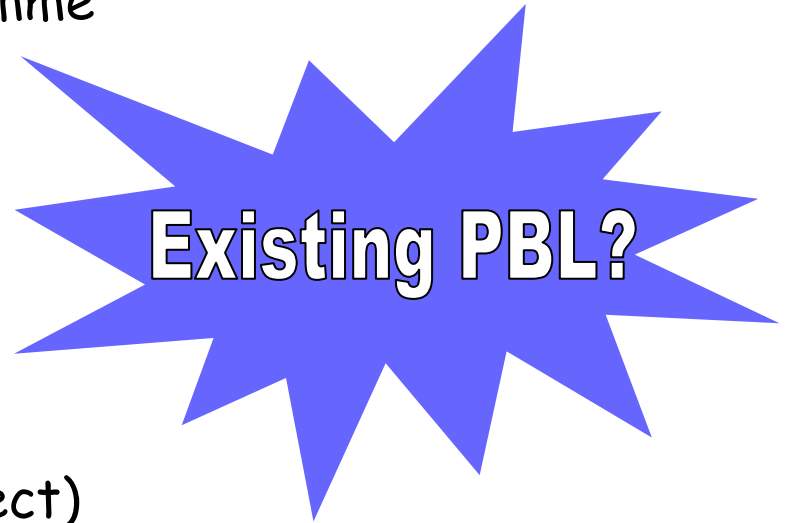
Chemical Engineering at UCD

- 4-year (8 semester) degree programme
- typically 35-40 graduates
- accredited
 - Engineers Ireland
 - IChemE (MEng level)

'Capstone' Design project

- Stage 4 (semester 8; 12-week project)
- 15-credits (*i.e.* \cong 3 'normal' modules; half of a full semester load)
- process synthesis, equipment specification & design, safety & loss prevention, economic assessment & environmental impact

.....Design a fermentation plant to produce 100 tonnes per annum of USP K Penicillin G.....
.....Design a plant to produce 50,000 tonnes per annum of electronic-grade N-methyl-2-pyrrolidone





Introducing PBL to Stage 2 Chemical & Bioprocess Engineering

FRAMEWORK

CHEN20020

Chemical & Bioprocess Engineering Measurement

- 5-credit compulsory lecture-based module
- 3 contact hours per week

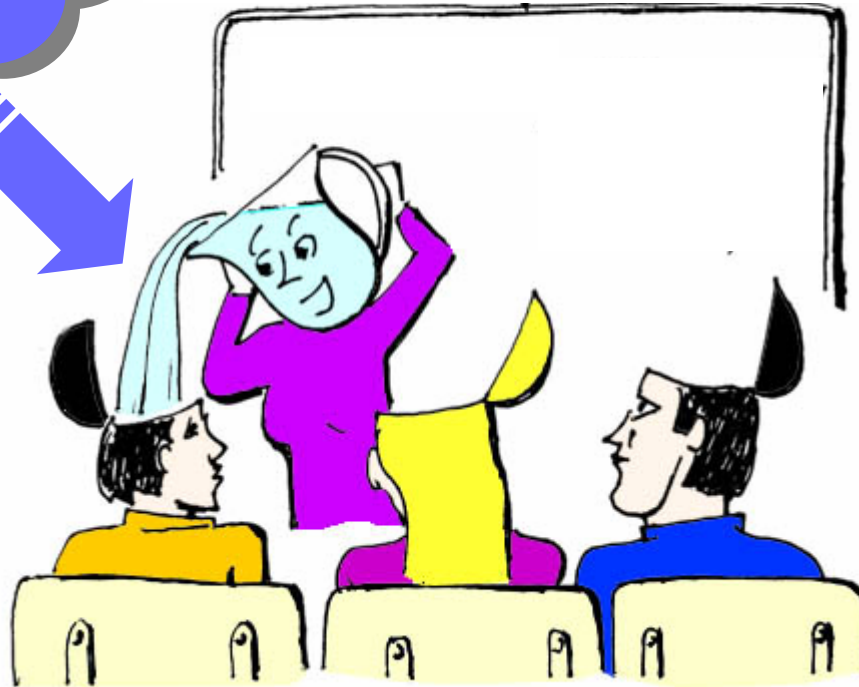
CHEN20040

Chemical & Bioprocess Engineering Laboratory I

- 5-credit compulsory laboratory-based module
- 12 3-hour sessions per semester
- traditional Chemical Engineering experiments, data analysis, report writing: heat transfer, mass transfer, fluid flow, rheology, pumps....

Moving from....

what I know you
need to know



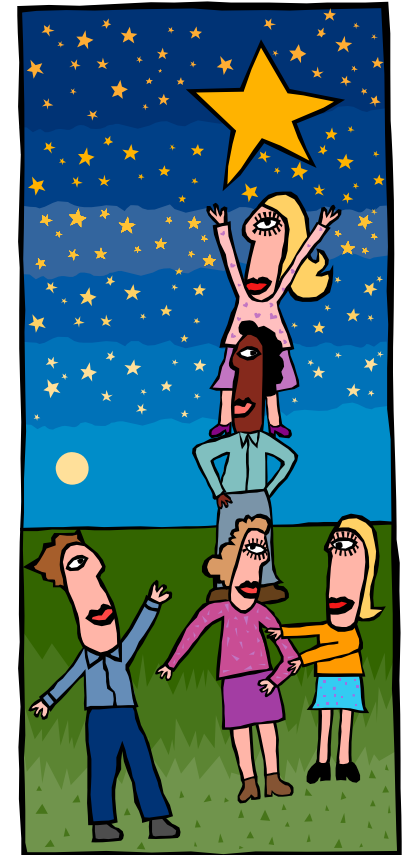
which involves a lot of this....



'What's the opposite of "Eureka"?'

...to...

- (relatively!) open-ended, group-based activity
- allowing students to gain confidence in practical engineering work, in a 'safe' environment
- unconstrained by 'cookbook' instructions
- facilitate the development of
 - self-directed learning
 - group interaction
 - independent-thinking
 - technical communication skills





PBL Project

- Original project developed and implemented at University of Minnesota Duluth¹
- Similar exercise implemented at Dublin City University, 2007²

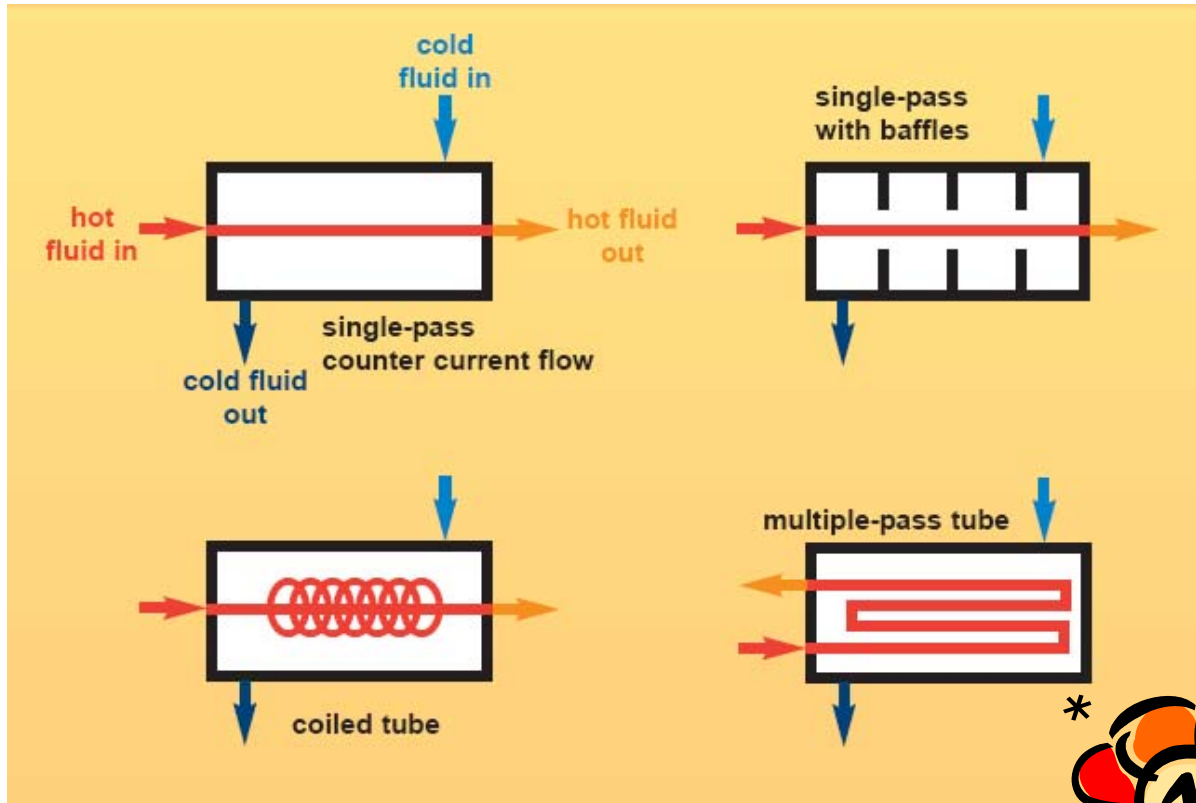
"...Design, construct and evaluate a compact (maximum dimension: 0.6 m) heat exchanger which uses warm water ($T = 60^{\circ}\text{C}$), at flowrates of up to 5 L/min, to heat a stream of cold water ($T \sim 15^{\circ}\text{C}$; flowrates of up to 5 L/min)."

Wavin piping and copper piping and appropriate fittings are available, in a range of specified sizes

¹Davis RA (2005) *Chemical Engineering Education* 39(1):38-41

²Freeland B, Tobin JA, Foley G (2007) *International Symposium for Engineering Education*, DCU

Some possible HXCR configurations



$$\text{Efficiency} : \frac{Q}{\Delta T_{Lm} C}$$



Proposed Implementation

Week	1	2	3	4	5	6	7	8	9	10	11	12
Lecture Module	Problem statement & group allocation	Brainstorming 1 (1 hr)		Brainstorming 2 (1 hr)								
Student directed activity	Research	R&D	R&D	R&D								
Lab Module	Excel Intro	Visio Intro	Safety & Training					Build 4 teams each week	&	Test 6 hours per team		
Hand-ups						Design Report				Final Report	Final Report	Final Report



Challenges!

- Practicalities of integrating initiative within confines of the existing curriculum/timetable
- Encouraging (and allowing!) students to take responsibility for learning
- Facilitating effective group activity - and assessing it
- Assessing the effectiveness of this initiative
 - Student feedback?
 - Student performance in related material?
- What might we lose???
- Identifying a new PBL-based experiment for 2009!



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