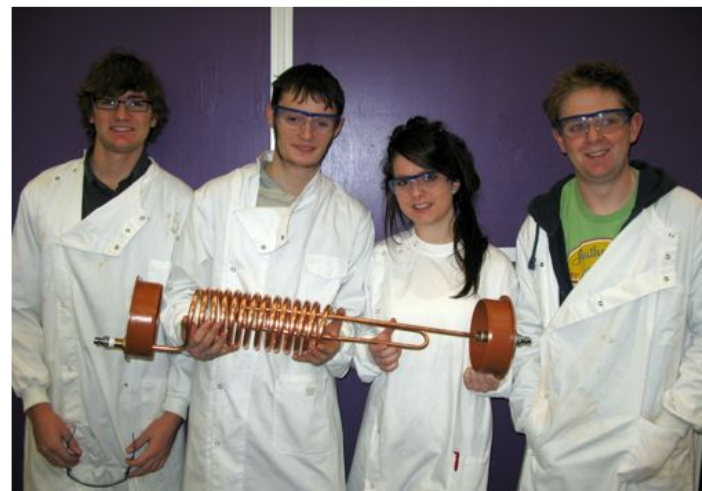
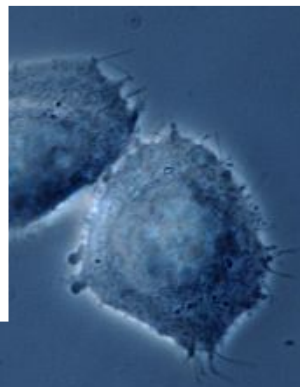
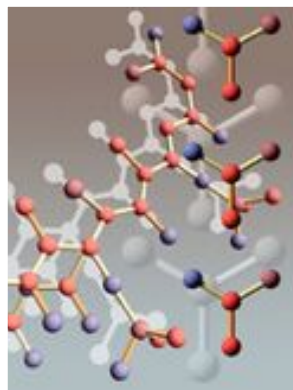
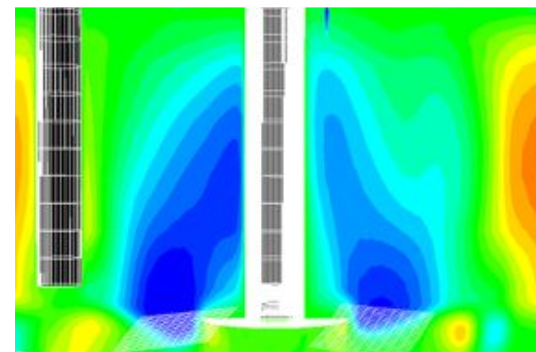


UCD Chemical & Bioprocess Engineering



...bringing science to life

UCD Chemical & Bioprocess Engineering



‘Make your mind up’ time.....

Dr Dermot Malone
dermot.malone@ucd.ie
Dr Patricia Kieran
patricia.kieran@ucd.ie

UCD Chemical & Bioprocess Engineering

- Ireland's oldest & largest Chemical Engineering School
- **BE Chemical & Bioprocess Engineering**
 - 4-year programme
 - accredited at Master level by IChemE
 - 35-45 graduates per annum
 - > 1300 graduates since 1956
- **MEngSc in Biopharma Engineering**
 - Full- & part-time
 - > 75 graduates since 2007
- **MEngSc in Chemical Engineering**
 - non-EU students



Prof Eoin Casey
Head of School



Graduating Class & Staff, 2013

Chemical & Bioprocess Engineering Education

- **Preparation for life-long learning**
 - scientific, mathematical & engineering competencies
 - engineering problem-solving skills
 - effective team work & professional awareness
- **Strong industrial links**
 - Adjunct Professors
 - ▣ Dr David O'Reilly, *formerly* CEO Chevron
 - ▣ Dr Michael Egan, *formerly* Director PM
 - Industrial Internships (>85%)
- **Excellence in Teaching & Learning**
 - ExxonMobil Excellence in Teaching Awards
 - Developing innovative teaching methods

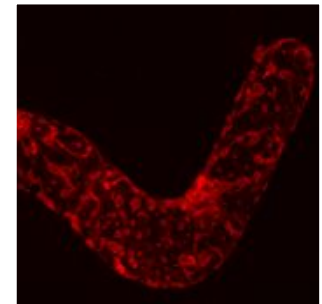
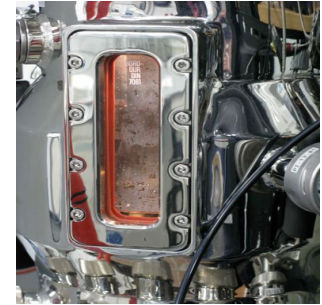


Peer-Assisted Tutorial

Chemical & Bioprocess Engineering Research

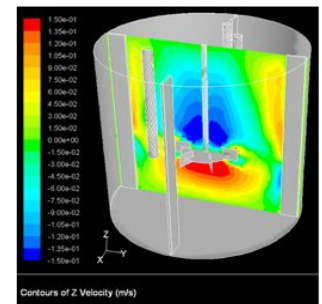
- **Research Strengths**

- Bioprocess Engineering & Multiphase Systems
- Materials Design
- Computational Nanotechnology
- Energy Conversion Systems Engineering
- Pharmaceutical Process Engineering



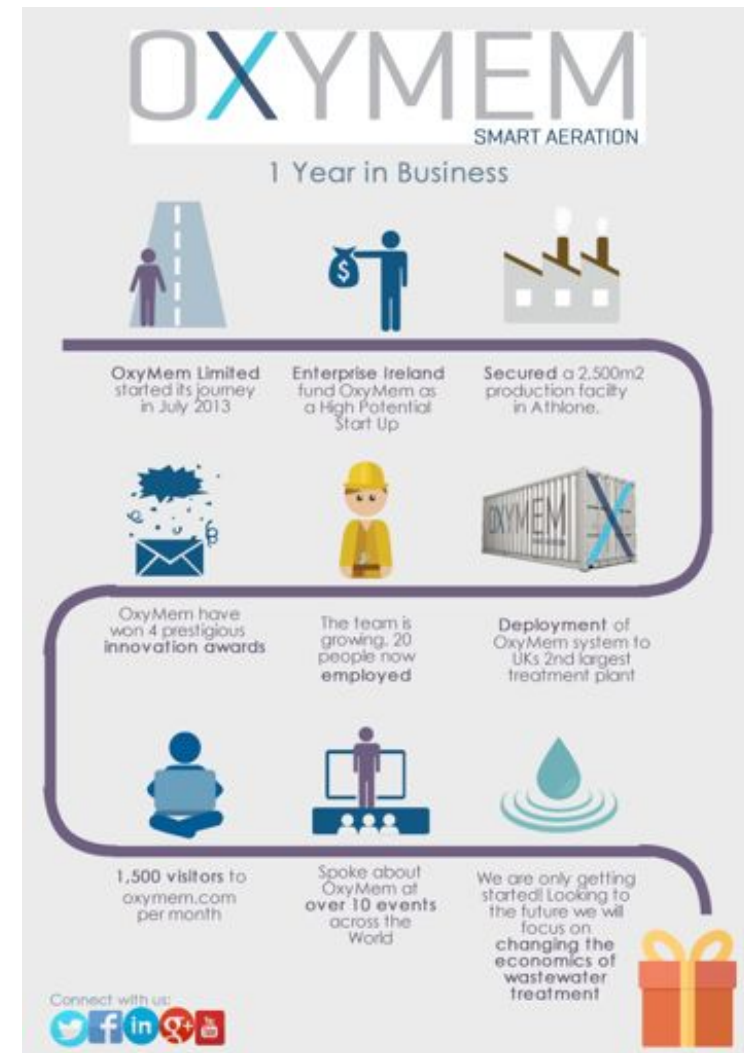
- **Teaching & Research Personnel**

- 10 full-time Academic Staff
- 15 Research Fellows
- 25 PhD students
- 6 Technical Staff



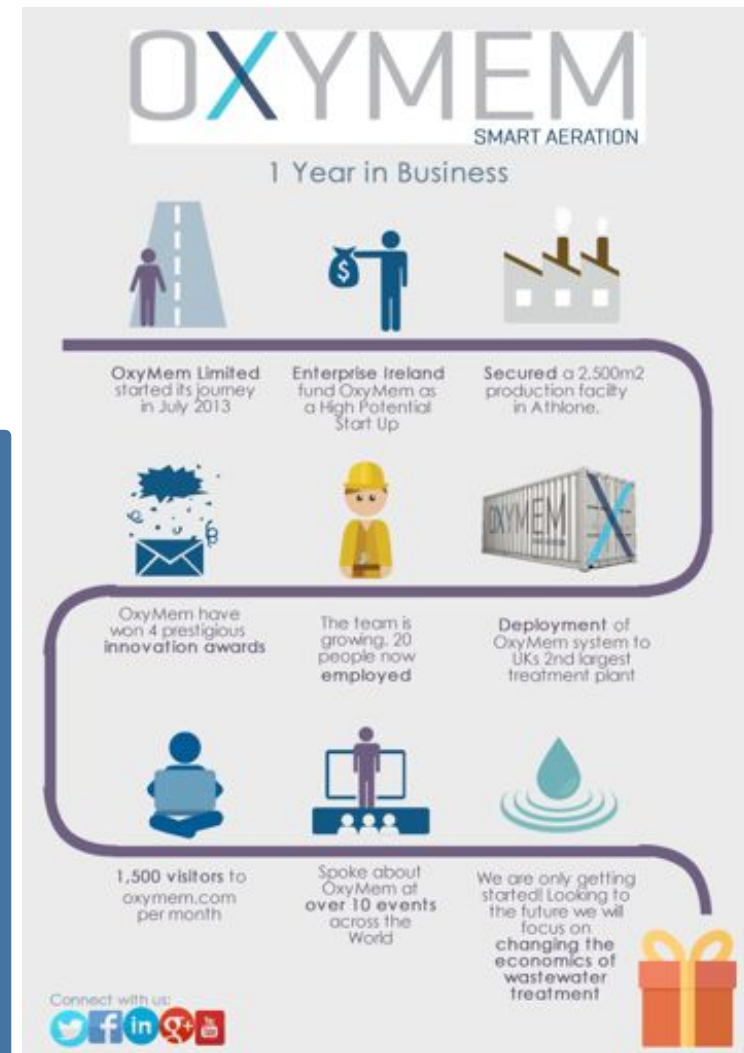
OxyMem

- ❑ Campus company, est. 2013
- ❑ Founders: Prof Eoin Casey & Dr Eoin Syron
- ❑ Solves energy-intensive wastewater treatment with smart aeration



OxyMem

- ❑ Campus company, est. 2013
- ❑ Founders: Prof Eoin Casey & Dr Eoin Syron
- ❑ Solves energy-intensive wastewater treatment with smart aeration



APC: partners in pharmaceutical engineering

- ❑ Campus company, est. Mar 2011
- ❑ Founders: Prof Brian Glennon & Dr Mark Barrett
- ❑ 40 full-time employees
- ❑ Provides proprietary technologies & unique, customised solutions to international pharma industry
- ❑ Clients in Ireland, USA & Europe.



Phase II

Phase III

Manufacture

2nd
Generation

- Route Selection & Design
- Technology-Enabled Platforms

- Process Scale-Up
- Process Optimization

- Process Intensification
- Cost Reductions

UCD Chemical & Bioprocess Engineering

- 4-year (8 semester) degree programme
 - typically 35-45 graduates
 - professionally, internationally accredited:
 - IChemE (MEng level)
 - **Chemical & Bioprocess Engineering?**
 - One curriculum for Stages 2, 3, 4
 - Opportunities to emphasise Chem/Bio through electives
 - strong emphasis on development of
 - **scientific, mathematical & engineering competencies**
 - **Engineering problem-solving skills**
 - **effective team work**
- ⇒ preparation for professional life

Stage 2 Modules

Semester 1

- CHEN20020 Chemical & Bioprocess Engineering Measurement
- CHEN20040 Chemical & Bioprocess Engineering Laboratory 1
- CHEN20030 Chemical Engineering Thermodynamics & Kinetics
- CHEN20050 Biotechnology for Engineers
- MATH20240 Multivariable Calculus for Engineers
- Elective

**co-requisite
modules**

Semester 2

- CHEN20010 Inorganic and Physical Chemistry for Engineers
- CHEM20060 Organic Chemistry for Engineers
- CHEN20060 Transport Phenomena
- CHEN20070 Computers in Chemical & Bioprocess Engineering
- STAT20060 Statistics & Probability for Engineers
- Elective

Stage 2 Laboratory/Project Work

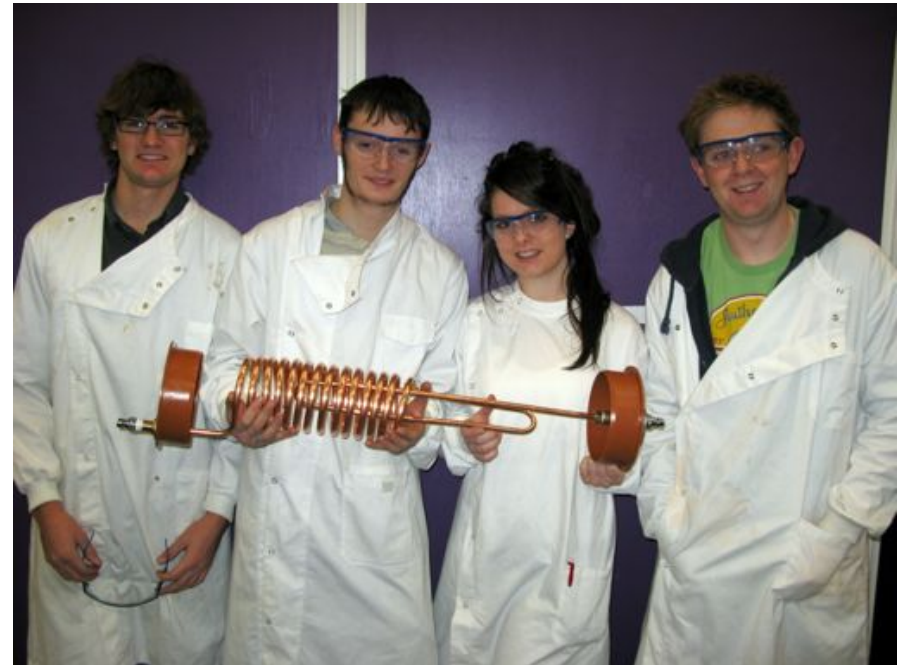
Semester 1

CHEN20040 Chemical & Bioprocess Engineering Laboratory 1

- Engineering & Chemistry experiments
- Computing Sessions
- Group project - Problem-based learning: Design, Construction & Evaluation of a Heat Exchanger

**Members of the winning team
in the PBL HXCR Project 2008-09
with their tubular HXCR**

(L-R) Matthew Perron, Phillip Roche,
Meabh Doyle, James Robinson



Stage 2 Laboratory/Project Work

Semester 1

- **CHEN20050 Biotechnology for Engineers**
 - Group-based poster presentation
- **CHEN20070 Computers in Chemical & Bioprocess Engineering**
 - EXCEL, Matlab, Visio, AutoCAD

CHEN20050 Winning Poster 2007-08
(Cormac Hanley, Sarah Hinchin,
Jason Lott, Stephen O'Brien)

Biotechnology & The Environment

Biotechnological innovations are increasingly producing fresh new solutions to some of the most urgent environmental and ecological challenges faced by society today.

This poster examines four new approaches which address the long-standing issues of **pollution** and **waste** through biotechnology.



1. Crude Oil Bioremediation

Traditional methods for cleaning up oil spills involve excavating, skimming and burning—all proven methods. However, in recent years, bioremediation has become a more environmentally friendly, cost-effective and sustainable option. Bioremediation uses naturally occurring microorganisms and their metabolic activity to break down and remove pollutants from the environment. This poster examines four new approaches which address the long-standing issues of pollution and waste through biotechnology.

HOW IT WORKS

Bioremediation can be performed in a number of ways, depending on the nature of the contamination and the environment. It can be done in situ (within the environment) or ex situ (outside the environment). In situ bioremediation involves the use of naturally occurring microorganisms to break down pollutants. Ex situ bioremediation involves the removal of contaminated material from the environment and its treatment in a controlled environment.

ADVANTAGES AND DISADVANTAGES

The advantages of bioremediation include its low cost, its ability to be used in a wide range of environments, and its ability to be used in conjunction with other remediation techniques. The disadvantages include its slow rate of action, its dependence on the presence of suitable microorganisms, and its potential to produce unwanted by-products.

2. Soil Purification

Contaminated soil can be a problem in many ways, one of which is bioremediation—a biotechnological process. Bioremediation is a technique which involves the use of naturally occurring microorganisms to break down and remove pollutants from the environment. This poster examines four new approaches which address the long-standing issues of pollution and waste through biotechnology.

HOW IT WORKS

There are two methods of bioremediation:

1. In situ bioremediation: This involves the use of naturally occurring microorganisms to break down pollutants within the soil.
2. Ex situ bioremediation: This involves the removal of contaminated soil from the environment and its treatment in a controlled environment.

ADVANTAGES AND DISADVANTAGES

The advantages of bioremediation include its low cost, its ability to be used in a wide range of environments, and its ability to be used in conjunction with other remediation techniques. The disadvantages include its slow rate of action, its dependence on the presence of suitable microorganisms, and its potential to produce unwanted by-products.

3. Biotechnology and radiation

From 1945 to 1960, over 20,000 nuclear weapons were developed by the United States of America. The high rate of nuclear weapons development during this period led to the development of biotechnology. Biotechnology is a technique which involves the use of naturally occurring microorganisms to break down and remove pollutants from the environment. This poster examines four new approaches which address the long-standing issues of pollution and waste through biotechnology.

HOW IT WORKS

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4. Hydrogen from biomass

With much industry and infrastructure dependent on fossil fuels, it is often a long time before new technologies, materials, fuels, etc., are developed. Biotechnology is a technique which involves the use of naturally occurring microorganisms to break down and remove pollutants from the environment. This poster examines four new approaches which address the long-standing issues of pollution and waste through biotechnology.

HOW IT WORKS

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Student Scholarships

Pat McAdam Scholarship in Chemical & Bioprocess Engineering



Martin McAdam
UCD BE (Chem) 1982

CEO Aquamarine Power Ltd



GREEN ENERGY OUT OF THE BLUE

- Established in memory of Pat McAdam, at the request of Mr Martin McAdam, to celebrate and honour the life and work of his late wife, Pat, a much-loved teacher.
- €4,000.00
- to cover Summer Research Internship, Colorado School of Mines

Student Scholarships

Mark Carthy Travel Award in Chemical & Bioprocess Engineering



Mark Carthy

UCD BE (Chem) 1982

Managing Partner
Orion Healthcare
Equity Partners



- Stage 2 & Stage 3 students eligible
- €1000 bursary
- To support travel for personal and/or professional development purposes

Student Scholarships

Abbvie Achievement Award in Chemical & Bioprocess Engineering Practice



- ❑ €1000 bursary
- ❑ Awarded to Stage 3 student receiving the highest accumulated grade
- ❑ Chemical & Bioprocess Engineering Laboratory
- ❑ Chemical & Bioprocess Engineering Design
- ❑ Unit Operations in Chemical & Bioprocess Engineering

Stage 3 Modules

Semester 1

- CHEN30010 Chemical & Bioprocess Reaction Engineering
- CHEN30030 Chemical & Bioprocess Engineering Thermodynamics
- CHEN30050 Chemical & Bioprocess Engineering Laboratory 2
- MEEN30140 Professional Engineering (Finance)
- ACM30030 Multivariable Calculus for Engineers II
- Elective

In-Programme Elective

- CHEN30040 Commercial Pharmaceutical & Bioprocessing Technology

Stage 3 Modules

Semester 2

- CHEN30020 Unit Operations
- CHEN30130 Heat Transfer and Fluid Mechanics
- CHEN30140 Process Instrumentation & Control
- CHEN30150 Chemical & Bioprocess Engineering Design
- CHEN30160 Computational Methods in Chemical & Bioprocess Engineering
- CHEN30120 Applied Chemistry

Stage 3 Laboratory/Project Work

Semester 1

- **CHEN30050 Chemical & Bioprocess Engineering Laboratory 2**
 - Pair-based experimental work
 - Laboratory/pilot-scale equipment
 - Distillation, evaporation, drying....
 - Complements CHEN30020 Unit Ops

Semester 2

- **CHEN30150 Chemical & Bioprocess Engineering Design**
 - Design of a piece of process equipment
 - Factors to consider: purpose, chemical design, material, equipment, safety, cost



Stage 3 Peer-Assisted Tutorials (PAT)

Semester 2

- **CHEN30020 Unit Operations**
 - Group-based tutorials
 - Work on exam-type questions
 - Led by Peer Tutors
 - Stage 4 students
- **CHEN30160 Computational Methods**

Peer Tutors supporting students during 2-hour computing sessions



Stage 3 students, working with their Tutor during a PAT
March 2009

Stage 3 – Industrial Internships

- Stage 3 students strongly encouraged to secure Summer Internships in industry
- Assisted by School
 - Stage 2 Mock Interviews (AbbVie, CPL, UCD EGA)
- Companies which recruited for Summer 2014

APC
DPS Engineering
Eli Lilly
GlaxoSmithKline (4)
Phillips 66

MSD
Pfizer
Roche
Rottapharm
Takeda

BMS

- 9-15 month placements 2014-15

APC
Eli Lilly

Cadbury (3)
Glanbia

FDT
Pfizer

Preparing for the Internships

- **CHEN30040 Commercial Pharmaceutical & Bioprocessing Technology**
 - Lectures on biological & engineering aspects of bioprocessing
 - Professional preparation
 - CV preparation
 - Interview workshop
 - Ethics workshops
 - Technical & Recruitment presentations from companies within the Chemical/(Bio)Pharma/Process sectors
 - Project on a specified biopharmaceutical

Year Abroad?

Spend Stage 3 at another University?

- **Erasmus Programme**

- École Nationale Supérieure in Saint-Étienne, France
- ENSIACET, Toulouse, France
- Technical University of Berlin (TU Berlin) in Germany
- Up to 2 students per annum

- **Recent, Non-EU University Exchange Programmes**

- University of California, Santa Barbara
- University of California, Berkeley
- University of Connecticut
- University of Virginia
- University of Brisbane
- University of Melbourne
- University of Texas, Austin
- University of Boulder, CO
- Villanova

Stage 4 Modules

Semester 1

- CHEN40010 Environmental Engineering
- CHEN40150 Advanced Separation Processes
- CHEN40160 Advanced Heat Transfer & Fluid Mechanics
- CHEN40170 Process Design, Safety & Economics
- CHEN40180 Chemical Engineering Processes
- CHEN40210 Advanced Experimental Design

Preparation for Design & Research Projects

- Literature review linked to Research Project
- Statistical Experimental Methods
- Workshops on Group-Based Problem-Solving

**Preparation for
Design Project**

**Led by
professional
engineer**

Stage 4 Modules

Semester 2

- **CHEN40190 Chemical Engineering Design Project**
15 credits
- **CHEN40200 Chemical Engineering Research Project**
10 credits
- **Elective**

In-Programme Elective

- CHEN40430 'Peer-Assisted Tutoring in Chemical Engineering'



**Stage 4 Peer Tutors
March 2009**

Stage 4 Design Project

‘Capstone’ Design project

- Stage 4 (semester 2; 12-week project)
- 15-credits (\approx 3 ‘normal’ modules; half full semester load)
- Group-based
- Required for IChemE accreditation
- process synthesis, equipment specification & design, safety & loss prevention, economic assessment & environmental impact

.....Design a fermentation plant to produce 100 tonnes per annum of Penicillin G.....

.....Design a plant to produce 50,000 tonnes per annum of electronic-grade N-methyl-2-pyrrolidone (NMP).....

Stage 4 Research Project

- Stage 4 (semester 2; 12-week project)
 - Individually, or in pairs
 - Laboratory-based or PC-based; some industrially-linked
 - Closely linked to School research activities
- Effect of oxygen level on the ex vivo generation of fully mature human red blood cells
 - Assessment of mixing in an aerated stirred tank reactor
 - Nanoparticles for fuel cells
 - Mixing and mass transfer in external loop airlift reactor
 - Thermal conductivity of methane hydrate from equilibrium MD simulation
 - Residence time distributions in continuous stirred tank and plug flow reactors
 - Investigation of Ionic Liquids systems under zero and e/m field conditions
 - Application of probiotic bacteria (*Lactobaccillus casei*) for production of biosurfactants
 - Scale up and economic analysis of a novel bioplastic production process
 - Integrating DynoChem into the ChemE curriculum

Life after graduation.....?

- BE degree
- Accredited by IChemE at Masters level



YES!!!

Life after graduation.....?

Department of Jobs, Enterprise & Innovation 'Highly Skilled Occupations List'

April 10, 2013

All Sectors	Professional Engineers and Technologists	Electrical Engineers; Chemical and Formulation Engineers Analysts (including with Active Pharmaceutical Ingredients background); Design and Development; Network; Validation; Product Development; Planning; Process and Quality Control; Regulation Engineers; Industrial Hygiene Engineers; Telecommunications Validation Engineers; Manufacturing Instrumentation and Control Technicians; Electronics Engineering/Applied Physicists.
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www.djei.ie/labour/workpermits/highlyskilledoccupationslist.htm

Life after graduation.....?

- BE degree
- Accredited by IChemE at Masters level
- **What are the Current Stage 4 students planning?**
 - Offers accepted:
APC, Diageo, Exxon, Glanbia, MSD, Valero, Pfizer (Cork),
PhD research, MSc Programmes
 - Actively recruiting:
Alkermes, Irish Cement, Pfizer (GrangeCastle &
Newbridge)
PhD research in UCD
 - Other options:
Post-graduate courses in Biopharmaceutical
Engineering, Energy, Process Control, Teaching,
Pharmacy, Maths, Business...

What do our graduates have to say?



Justine Forkin
BE 2012

*with Padraig Somers, General
Manager, Helsinn Birex*



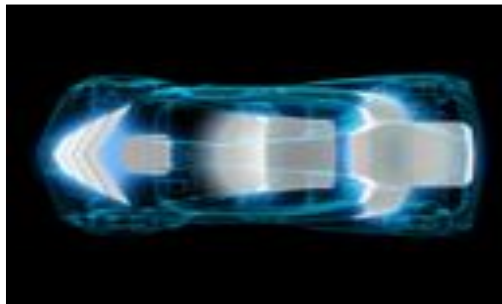
Claire Waddell
BE 2009

*with classmates, Ronan Whelan
(now with AbbVie), Grainne
Phelan (now with VWS)*

Additional Information.....

- **Chemical & Bioprocess Engineering Videos**
[http://www.ucd.ie/eacollege/chembioeng/
undergraduateprogrammes/prospectivestudents/
videowall/](http://www.ucd.ie/eacollege/chembioeng/undergraduateprogrammes/prospectivestudents/videowall/)
- **IChemE 'Why Not Chem Eng?'**
<http://www.whynotchemeng.com>
- **Talk to our staff and students!**

UCD Chemical & Bioprocess Engineering



www.ucd.ie/eacollege/chembioeng/