

# MICROBIOLOGY

at University College Cork

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**ecogase** **UCC** **APC**

### Contrasting effects of fat source & energy source on gut microbial compositions in the development of obesity

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**Introduction**  
Over the past few decades, dramatic changes have taken place in the feeding habits and dietary patterns of people all over the world. Coupled with these changes, are increases in diseases related to The Metabolic Syndrome such as obesity, type-2 diabetes, hypertension and cardiovascular disease. Recent studies have demonstrated altered gut microbial compositions in response to dietary shifts and obesity (Murphy et al., Gut 2010;59:1635-1642). In this study we aimed to look at the effect specific components of fat (saturated, monounsaturated, polyunsaturated) and a high sucrose diet would have on gut microbial composition and to further elucidate the role they might play in the development of obesity.

**Materials & Methods**  
Week 0 - Trial Begins n=20/group  
16 weeks dietary feeding Week 16 - Trial Finishes

**Dietary Groups:**  
Group A: Low fat (LF) Control (12% kcal from fat, mixed fatty acid sources, low sucrose)  
Group B: High Fat (HF) Palm Oil (45% kcal from fat, 22.5% Palm Oil)  
Group C: HF Olive Oil (45% kcal from fat, 22.5% Olive Oil)  
Group D: HF Safflower Oil (45% kcal from fat, 22.5% Safflower Oil)  
Group E: HF Flaxseed/Fish Oil (45% kcal from fat, 11.25% Flaxseed Oil, 11.25% Fish Oil)  
Group F: LF-High Sucrose (22% kcal from fat, mixed fatty acid sources, high sucrose)

**End-point Analysis:**  
Bodyweights & food intake measured every week, Glucose Tolerance Test performed on Week 14, body compositional analysis, plasma variables measured, liver triglyceride levels measured, gene expression in the liver, fatty acid analysis of the liver, epididymal adipose tissue & brain, short chain fatty acid analysis of anal content & pyrosequencing of DNA extracted from the fecal content.

**Results**

**Figure 1:** Bodyweight gain per week. Line graph showing bodyweight gain (kg) over 16 weeks for six groups. Group B (High Fat Palm Oil) shows the highest gain, followed by Group C (High Fat Olive Oil). Groups A, D, E, and F show lower gains.

**Figure 2:** Phylum level distributions. Bar chart showing the relative abundance of different bacterial phyla in the gut microbiota of the six groups. There are significant differences between groups, particularly in the Bacteroidetes and Firmicutes phyla.

**Figure 3:** Fat source & energy source show many significant differences between groups at the family level. Bar chart showing the relative abundance of different bacterial families. Significant differences are observed between groups, particularly in the Lachnospiraceae and Bacteroidaceae families.

**Figure 4:** Significant differences at the genus level further highlight the impact of fat type & energy source on the gut microbiota. Bar chart showing the relative abundance of different bacterial genera. Significant differences are observed between groups, particularly in the Lachnospiraceae and Bacteroidaceae genera.

**Figure 5:** PCoA Plot shows that mice cluster into distinct groups based on fat source. Scatter plot showing the first two principal components of the microbial community composition. The groups cluster into distinct groups based on their fat source.

**Figure 6:** Supplementation of LF with Palm Oil increases LPS whereas the other fats did not. Bar chart showing the levels of lipopolysaccharide (LPS) in the gut microbiota of the six groups. Group B (High Fat Palm Oil) shows significantly higher levels of LPS compared to the other groups.

**Conclusions**  
Supplementation of a HF diet with different sources of fat clearly alter gut microbial populations. •Supplementation of a HF diet with Palm Oil leads to increases in bodyweight gain & SCFA production. This fat source is also associated with a decrease in Bacteroidetes in the gut microbiota. •Dietary supplementation with Palm Oil leads to increases in Lachnospiraceae at the family level. •Dietary supplementation with Olive Oil leads to an increase in Bacteroidaceae at the family level. •Bacteroidetes at the phylum level is associated with an increase in Bacteroidaceae at the family level. •Supplementation with Flaxseed/Fish Oil, as a rich source of omega-3 polyunsaturated fat, is associated with an increase in Bacteroidetes at the phylum level. •Supplementation with Safflower Oil, as a rich source of omega-6 polyunsaturated fat, is associated with an increase in Bacteroidetes at the phylum level. •Supplementation with LF-High Sucrose leads to increases in bodyweight gain & SCFA production. This fat source is also associated with a decrease in Bacteroidetes in the gut microbiota. •The textual assistance in research centre funded by Science Foundation Ireland (SFI) and the authors & their work were supported by EC FP7 grant.



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Postgraduate Poster Day



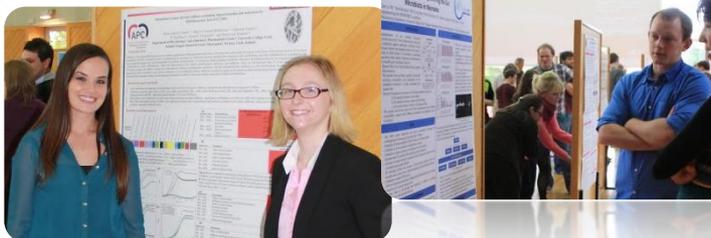
## Showtime!

As part of their annual review process, Microbiology postgraduate students presented their work in poster format at the department "Postgraduate Poster Day".



The Microbiology "Postgraduate Poster Day" took place on Wednesday 19 September 2012 in the main hall of Áras na Mac Leinn, UCC, from 2.30pm- 4.30 pm. This was the inaugural running of what is planned to be an annual event. Thirty five postgraduate students between years 1 and 4 of their research programme prepared and presented posters of their work. The poster session was open to all members of the department and was very well attended by other postgrads, post-doctoral researchers and academic staff. It was a great chance to see a cross section of the research going on in the Department and provided a tremendous "birds-eye" view of the diversity of research themes in Microbiology.

In addition, this session formed part of the annual review that all postgraduate students complete, where a dedicated thesis committee review their progress and offer advice and suggestions. Each thesis committee visited posters to discuss the work with the student. Later that evening, an informal debriefing took place in the Franciscan Well, where the Microbiology Department hosted a BBQ for all staff and postgraduate students.



Cover picture: Dr John Morrissey, Microbiology Department Graduate Studies Committee Chair, and Ms Elaine Patterson, PhD Student.  
Top: Prof Ger Fitzgerald, Head of Microbiology Department, and Lorraine Draper, PhD Student. Above: Group attending the event.

Above: Kerry O'Connell and Muireann Egan, PhD Students; Cian Hill, PhD Student and Dr Marlies Mooij, Postdoctoral researcher at BIOMERIT Research Centre, Microbiology Department.

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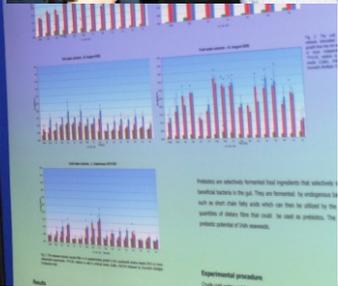
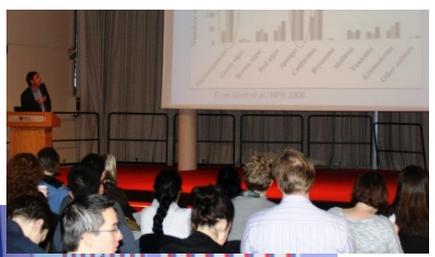


## Something in the water

### UCC hosts the Marine Microbiology & Biotechnology Conference

The Society for General Microbiology (Irish Division) held a joint SGM/FEMS "Marine Microbiology and Biotechnology" conference in University College Cork from 14-16 November 2012. The meeting brought together international experts from three key marine biotechnology research themes; biodiscovery, biodiversity and bioremediation, in which microbiology is a core contributory discipline. UCC Organising Committee Members:

Dr Niall O' Leary (Chair),  
Prof Alan Dobson,  
Prof Fergal O' Gara and  
Dr John Morrissey.



Pictured above: (Top) Prof Alan Dobson Microbiology, UCC, delivers a talk on marine derived bio-actives. Members of the 140 delegates at the poster viewing reception.

### UCC Microbiology postgraduates take first prizes in the best oral and the best poster competitions.

Congratulations to *Robert Phelan (oral)* and *Ronan McCarthy (poster)*. Robert will go on to represent the Irish Division in the SGM annual *Sir Howard Dalton Young Microbiologist of the Year Competition* in Sussex next Autumn. Judging panel consisted of: Prof Ian Henderson, SGM Council UK and Dr Kevin Kavanagh, Chair of SGM Irish Division.

***"The conference achieved a record attendance for an SGM Irish division event, attracting 140 delegates from over 20 countries; highlighting marine microbiology and biotechnology as a promising area for future growth and research commercialisation opportunities"***



Dr Niall O' Leary,  
Microbiology, UCC,  
SGM Irish Division  
Committee & Local  
Organiser (pictured left).

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## Plain sailing

PhD student Robert Phelan has published 2 papers, submitted a third and been around the world in 80 days!

Since beginning his PhD Thesis '*Biotechnological potential of sporeformers from coastal and deep sea marine sponges*' in October 2009, Robert has spent 10 days at sea, over 2 months in Texas and 3 days at the University of Tromso, Norway. In April 2010, Robert boarded the Celtic Explorer, Marine Institute Research Vessel at Killybegs to collect samples of deep sea marine sponges. The ship travelled 300 nautical miles off the NW coast of Ireland to the Rockall Trough and Porcupine Bank. A remote operated vehicle (ROV) was used to dive to depths of 3000 M below sea level, to pick up and store samples of interest and provided a live feed to crew and students on-board the ship. Marine sponge bacteria are emerging as an important source for novel bioactive molecules. Sporeformers are frequently isolated from marine sponges, but their properties and metabolites remain poorly understood. Robert's PhD research project is focused on the characterization of the sporeforming population associated with marine sponges isolated from Irish waters and in unravelling their biotechnological and biopharmaceutical potential. In March 2012, Robert went to work at a centre of excellence for bioinformatics at the Human Genome Sequencing Centre, Baylor College of Medicine, Texas, USA. The aim of his trip was to take part in sequence analysis and to learn the bioinformatics skills required to fully exploit the information contained in three marine sponge *B. subtilis* genomes (sequenced at the centre) which may represent a marine specific group. He also hopes to identify marine specific signatures, novel enzymes and antimicrobials produced by these isolates. In February 2013, Robert attended the BIOPROSP\_13 International Conference on Marine Bioprospecting at the University of Tromso, Norway. He gave a short oral and poster presentation on his PhD research project and spent time networking with experts in the marine biodiscovery field to get an insight into other areas of research being carried out around the world.

Robert's PhD is supervised by Prof Fergal O'Gara, Dr Teresa Barbosa & Dr John Morrissey. His project is part of the Microbiology Department / Biomerit Research Centre / Environmental Research Institute Marine Biodiscovery Programme led by Prof Alan Dobson, Prof Fergal O'Gara and Dr John Morrissey and is funded by the Beaufort Marine Biodiscovery programme.

Pictured from top: Robert aboard the Celtic Explorer; with Dr Burkhardt Flemer, Microbiology, UCC, preparing to board; Robert at the BIOPROSP\_13 Conference (picture courtesy of BIOPROSP <http://mabit.no/bioprosop>); the ROV collecting samples from the Celtic Explorer; the HiSeq 2000 at Baylor College of Medicine, Texas.



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## Lost in Transition

Microbiology is a popular choice for Transition Year and work experience students.

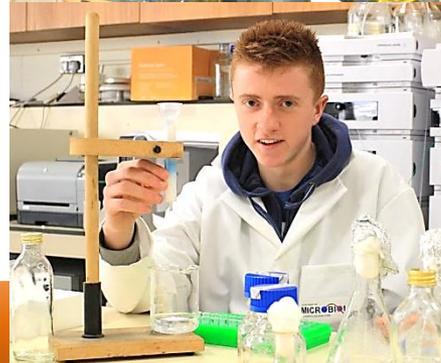
Each year over 20 students come to the Microbiology department on work experience. Most come for a full week, from second level schools and colleges as part of their Transition Year (TY). Other students studying in VEC Adult and Community Education Colleges e.g. Coláiste Stiofáin Naofa and St Johns Central College in Cork, attend on a more regular basis throughout the academic year in order to complete the work experience module of their course. Students come mainly from the Munster area but students from Dublin, Galway and other counties have also spent time in the department on work experience. Most students come for one week and occasionally 2 weeks. They learn many of the basic aspects of microbiology from preparation of laboratory media, sterilisation, inoculation of plates and identification of microorganisms. They also sit in on lectures and laboratory practical classes which give them a taste for university life. Usually TY/Work experience students work with Carmel Shortiss in the department but others work with postgraduate students, research staff or technical staff in the department. Some years the work experience programme is fully booked out by July before the academic year starts!

***“Work experience in Microbiology really opened my eyes as to how science subjects are thought at a college level. The staff were extremely kind and always explained things to me. “***

*Aimee Phelan, TY,  
Colaiste an Phiarsaigh Glanmire.*

*Pictured (top): Julie Scanlon,  
Coláiste Stiofáin Naofa , Applied  
Biology, Food Health and  
Nutrition Programme;  
(middle l-r) Kate Fleming,  
Midleton College, Grace  
Heffernan, Ballincollig  
Community School and Ms  
Carmel Shortiss, Microbiology,  
UCC;*

*(right) Billy Mulcahy, Kinsale  
Community School*



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## Prizes and Awards

PhD student Kate Twomey (right) was awarded best research poster prize at the 13th Irish National Cystic Fibrosis Conference held in Killarney from 31 January to 1 February 2013.



Kate is a final year PhD student in the Department of Microbiology under the supervision of Dr Robert Ryan. Her thesis examines the polymicrobial nature of cystic fibrosis airway infection and the role it plays in influencing bacterial virulence and response to antibiotic therapy. This project builds on strong collaborative links with Dr Barry Plant's clinical group at the adult cystic fibrosis centre based in Cork University Hospital.



**Leadership Award presented to Professor Gerald Fitzgerald at the University Staff Recognition Awards Programme 2012.**

Professor Gerald Fitzgerald (left) is Head of the Department of Microbiology, Deputy Director of the Alimentary Pharmabiotic Centre, served as Inaugural Director of Food for Health Ireland and is Director of the BioTransfer Unit. He has published over 300 papers on his research and was awarded a DSc in 2006. He received the Elie Metchnikoff Prize in Microbiology in 2010.

Professor Fitzgerald was recognised for his outstanding leadership in all aspects of University life, including Research, Teaching and Administration. He has had an enormous influence on countless undergraduate and postgraduate students who have passed through the Microbiology Department, he has mentored fellow academics, fostered key alliances with Medicine and with Teagasc, has been involved in research grants and Centres worth over €150 million, while maintaining his own productive research career.

**The Microbiology Department is delighted that UCC has seen fit to honour Professor Fitzgerald – congratulations Ger!**

***“The successful nominees inspired their colleagues and students due to their commitment, innovation and inspirational achievement.”***

*Dr Áine Ryall, Chair,  
University Staff Recognition Awards  
Selection Committee*

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## Prizes and Awards

Early Stage Researcher of the Year award presented to Microbiology Lecturer Dr Marcus Claesson at the inaugural UCC Research Awards.

Six individual researcher awards and one research team award were made at the ceremony, which was held in UCC's Glucksman Gallery on Monday 19 November 2012. The Award ceremony was sponsored by Gilead Sciences, Ireland.

Marcus' research interests are in metagenomics and metatranscriptomics of the human gut and in bioinformatics methods development. Prior to his appointment as Lecturer in Microbiology, Marcus worked in a postdoctoral position in Dr Paul O'Toole's lab where he led the bioinformatics platform for the ELDERMET project. Marcus' IRIS profile can be viewed at: <http://research.ucc.ie/profiles/D010/mclaesson/Home>

For more information on Research at UCC and the UCC Research Awards, visit: <http://www.ucc.ie/research/rio/overview10.html>



*Pictured above: Prof Gerald Fitzgerald and Kieran James.*

### Kieran James wins SGM Prize

The Society for General Microbiology (SGM) offers prizes for undergraduate students who are studying Microbiology in the UK and the Republic of Ireland. At UCC the prize is given to the Microbiology student who achieves the highest aggregate mark at the Third Science Examination at the first attempt. A cash prize and one year's free membership of the Society was presented to Kieran James at the departmental seminar on 6 December 2012.



*Pictured above: Dr Michael Murphy, President of UCC and Dr Marcus Claesson.*

***“An active research landscape across the university sector is critically important in sustaining Ireland’s workforce of talented doctoral and postdoctoral professionals. UCC, as a national research leader, plays a key role in this”.***

*Ms Julie O’Neill,  
Vice President and General Manager  
at Gilead Sciences.*

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## International Highlights

### Professor Colin Hill appointed President of the International Scientific Association for Probiotics and Prebiotics (ISAPP).



ISAPP is an association of academic and industrial scientists who have a common interest in generating high quality scientific information for the probiotic and prebiotic fields. The organization hopes to raise the scientific credibility of the field by working with experts and conducting meetings on high quality research. Providing an objective, science-based voice benefits the end users of these products by helping them make informed choices. ISAPP is the only scientific organization dedicated specifically to probiotics and prebiotics, bringing together scientists from all pertinent disciplines, including food science, microbiology, immunology, biochemistry, nutrition and medicine. Industry involvement and support is considered important, but no industry group or commercial entity dictates the activities or opinions of ISAPP.

Professor Colin Hill holds the Chair of Microbial Food Safety in the Microbiology Department, UCC and is a Principal Investigator at the APC and the Food for Health Ireland research centre. His research interests include the molecular biology of food pathogens and the development of antimicrobial peptides for use in foods and medicine. He has published over 300 papers on his research and was awarded a DSc in 2005. He is a Member of the Royal Irish Academy since 2009, received the Elie Metchnikoff Prize in Microbiology, 2010 and was elected to American Academy of Microbiology, 2010. He has also served on the Scientific Committee of the Food Safety Authority of Ireland (1999-2010).

In October 2012 the 10th meeting of ISAPP was held in UCC with 200 scientists from industry and academia all around the world (Europe, North & South America, Australia & New Zealand) in attendance. UCC was chosen as the location for the meeting as it, together with Teagasc, Moorepark, is the site of the Alimentary Pharmabiotic Centre. The APC is one of the most prominent global research centres devoted to gastrointestinal microbiology and one of the leaders in the fields of probiotic and prebiotic research.

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## International Highlights

### Scientific links between Microbiology, UCC and China

During her PhD, Shi-qi An worked in the laboratory of Dr Max Dow in UCC, funded by the SFI International Research Partnership. Shi-qi An's research, the aim of which was to study the virulence-related regulators HpaR1 and RpfG in the plant pathogen *Xanthomonas campestris*, was performed under the joint supervision of Dr Max Dow at Department of Microbiology, UCC and Prof. Ji-liang Tang at College of Life Sciences, Guangxi University. This project is part of a long standing joint programme aimed at understanding the role cell-to-cell signalling plays in virulence in plant pathogenic bacteria belonging to the genera *Xanthomonas*. Shi-qi An successfully defended her PhD thesis in Guangxi University, Nanning, China on 3 December, 2012.

Pictured (L-R): Prof Wei Jiang; Prof Bin Liu (Member of the PhD committee); Prof Ji-guang Wei (Member of the PhD committee); Shi-qi An (PhD candidate); Dr Robert Ryan (Department of Microbiology, UCC); Dr Delphine Caly (Department of Microbiology, UCC); Prof Xiao-hui Fan (Chairman of the PhD committee); Prof Jia-xun Feng (Dean of the College of Life Sciences); Xiao-lin Chen (PhD candidate); Prof You-zhi Li (Member of the PhD committee and Dean of Graduate Studies); Wei Liu (PhD candidate); Prof Yong-qiang He (Vice-dean of the College of Life Sciences).



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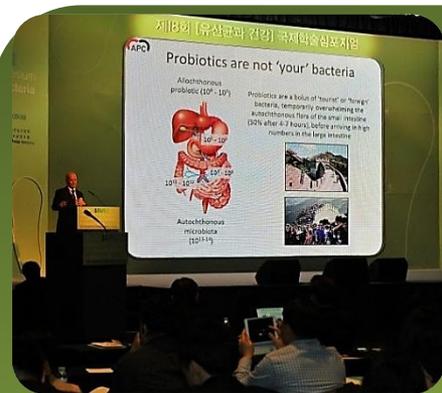
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### Keynote Lecture in Seoul, Korea

Professor Colin Hill was invited to give a keynote lecture at the 18<sup>th</sup> International Symposium on Lactic Acid Bacteria & Human Health - Lactic Acid Bacteria & Intestinal Microbiota, in Seoul, Korea, on 13 March 2013. The symposium, organized by the Korean Society of Health and Lactic Acid Bacteria and held by the Korea Public Health Association (KPHA), was sponsored by R&BD Centre, Korea Yakult Co., LTD.



Pictured (above): Prof Colin Hill at the International Symposium on Lactic Acid Bacteria & Human Health in Seoul, Korea, (right) at Temple and (far right) with group at Korea Yakult R&D Centre.



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## International Highlights

### Microbiology UCC researchers present their work at the prestigious Gordon Research Conference.

Post-doctoral researcher Dr Des Field, Research Assistant Karen Daly and PhD students Lorraine Draper, Alan Marsh (Microbiology UCC and Teagasc) and Alicia Campion all presented their work in poster format at the Gordon Research Conference on 'Antimicrobial Peptides: Discovery, Function and Application', in California USA. This conference held from 24 February – 1 March, 2013 in Ventura California focussed on the most recent discoveries in antimicrobial peptide (AMP) research, including structure and function analysis, expression and regulation, antimicrobial actions and mechanisms, microbial resistance strategies, health and disease-related immunomodulatory functions, and development of AMPs as therapeutics. The UCC/Teagasc team presented posters covering a wide-range of research on the lantibiotic class of antimicrobial peptides including bioengineered nisins, lantibiotic immunity and the use of genome-mining in the discovery of novel lantibiotics.

*Pictured above: Lorraine Draper, Alan Marsh, Des Field, Alicia Campion and Karen Daly taking time out to visit the sights after the conference.*



### Group from Microbiology, UCC attended The Society for General Microbiology's Annual Spring Conference.

The Conference was held in the Manchester Central Convention Centre from 25-28 March 2013. A number of Microbiology staff gave Major Lectures including: Prof Paul O' Toole: Hot Topics Lecture 'Human Microbiome: overdue recognition for our fellow travellers'; Dr Robert Ryan: Fleming Prize Lecture 'Cyclic di-GMP signaling and the regulation of bacterial virulence'; Invited Plenary talks: Dr John Morrissey 'Investigations on the *Pseudomonas fluorescens* anti-fungal metabolite 2,4 diacetylphloroglucinol' and Dr David Clarke 'The regulation of symbiosis in *Photorhabdus*'; Invited talks: Dr Jonathan Kennedy 'Genomic mining of bioactive marine sponge *Streptomyces* strains SM2 and SM8 uncovers novel cryptic clusters with antimicrobial activity' and PhD student Kate Twomey 'Transcriptome and small molecule profiling reveals the influence of bacterial community structure on the available metabolites of the cystic fibrosis airway'. There were also 12 posters presented by Microbiology postgrads and post-docs. Dr John Morrissey and Dr David Clarke also acted as Session Chairs for 'Bacteria and fungi in communities' and 'The metabolic interface between pathogen and host' respectively.



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## Graduations

A total of 9 PhD students and 2 MSc Research students graduated over the Autumn and Spring graduations.



Above: Autumn 2012 Conferring Ceremony  
Photo L-R: Eoin Barrett PhD, Karen O'Donovan PhD and Lea Lango-Scholey PhD. Also graduating were: Neasa Wallace MSc; Sarah Norberg PhD and Aditya Upadrasta PhD.



Above: 2102 BSc Microbiology Class on their Graduation day.



Above: Spring 2013 Conferring Ceremony  
Photo L-R: Adam O'Driscoll PhD, Bill Ryan PhD, Iwona Kozak MSc, Danielle Troppens PhD and Jana Haase PhD.

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## Lighter Notes

### Franciscan Well Barbeque

When all the posters had been put away after the Microbiology Postgraduate Poster Day on 19 September 2012, the department hosted a barbeque get-together in the Franciscan Well to celebrate the event. A good evening was had by all and a well-deserved treat.

*Pictures above from the Microbiology BBQ in the Franciscan Well.*



## Micro Families

### New Arrival in the Microbiology family.

Konstantina Arlene (Arlie) Konstantinidou (right with her mum, Nina) was born to delighted parents Nina and Stratos on 28 October 2012 weighing 8 lb 13 oz.  
*(Mum Nina was conferred with her MSc Bioinformatics in February 2013, and is currently studying for her PhD in Molecular Cell Biology with John Morrissey)*



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