



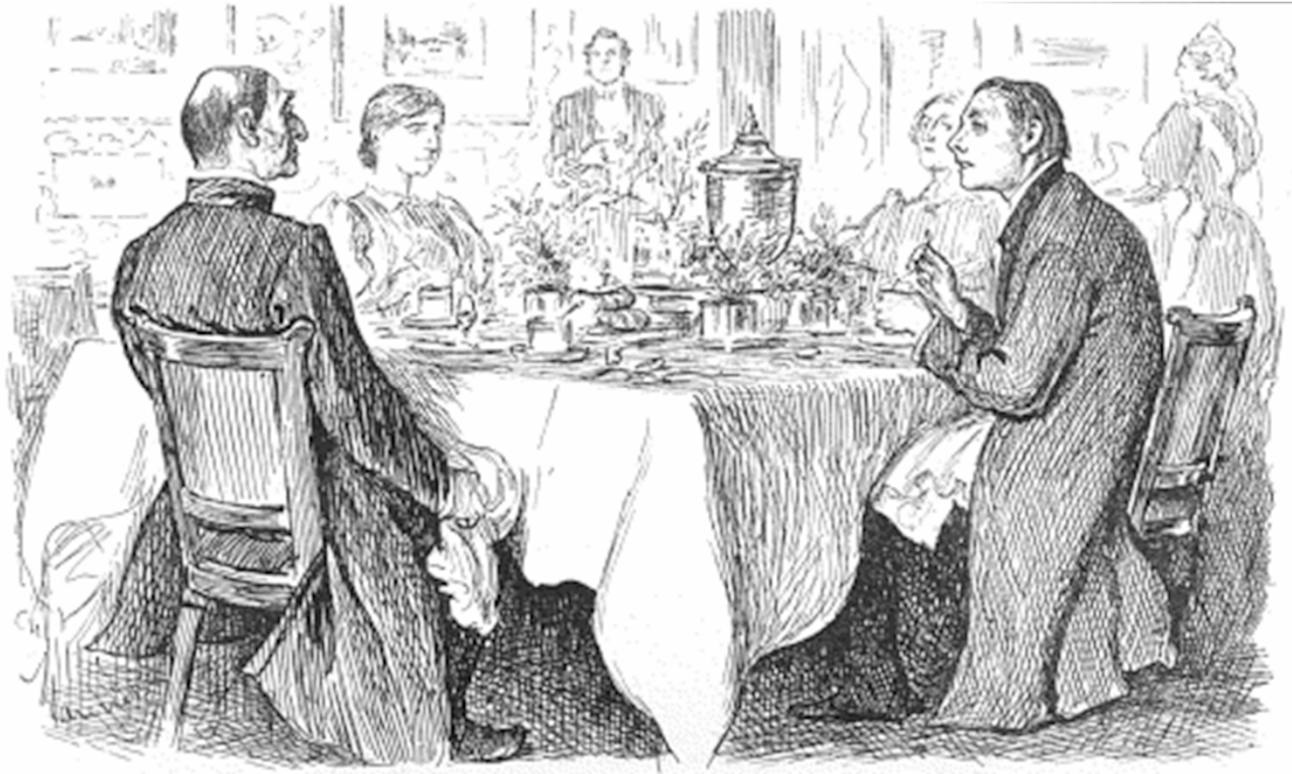
Queen's University  
Belfast

John W. McGrath

School of Biological Sciences and  
QUESTOR Centre



# Microbiology: A Curate's Egg



Bishop: "I'm afraid you've got a bad egg, Mr Jones";  
Curate: "Oh, no, my Lord, I assure you that parts of it are excellent!"  
George du Maurier, *Punch*, 1895.

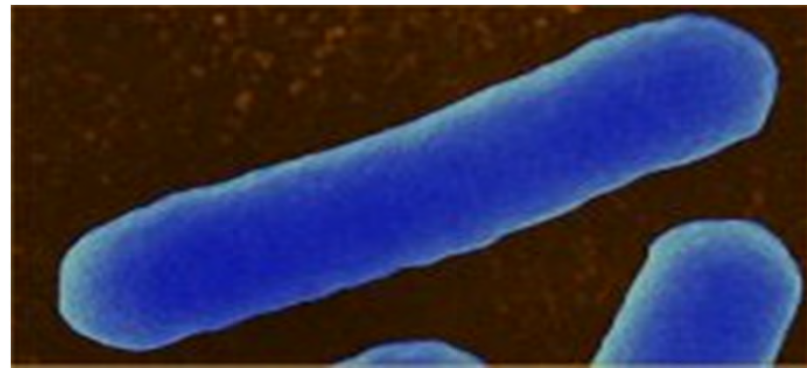
# Microorganisms and Disease





# Microorganisms and the Environment

- Microorganisms essential for nutrient cycling
  - Carbon, Nitrogen and Phosphorus



# Environmental Microbiology



Michael T. Madigan



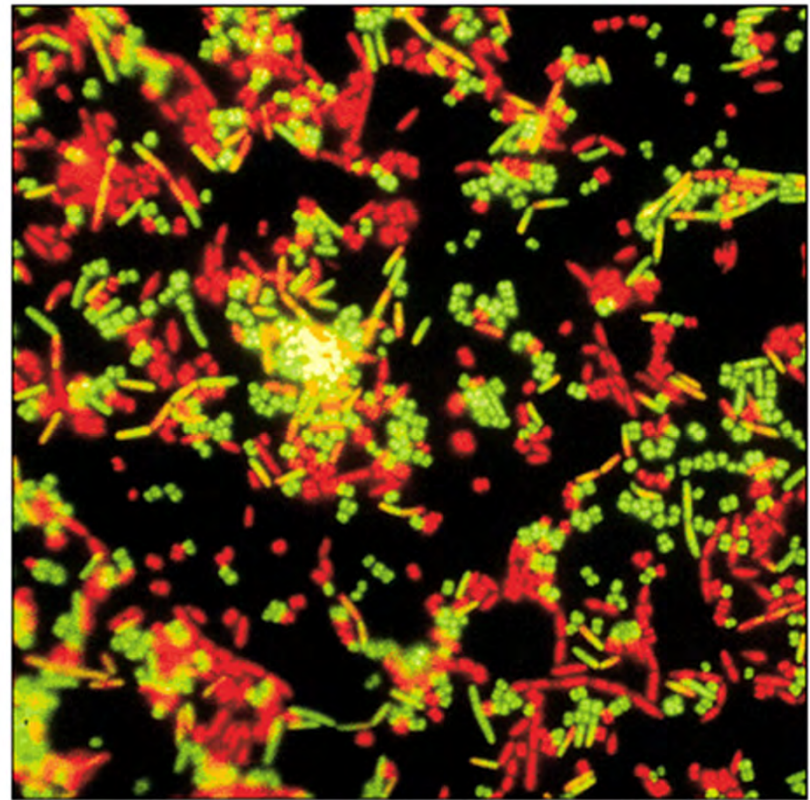
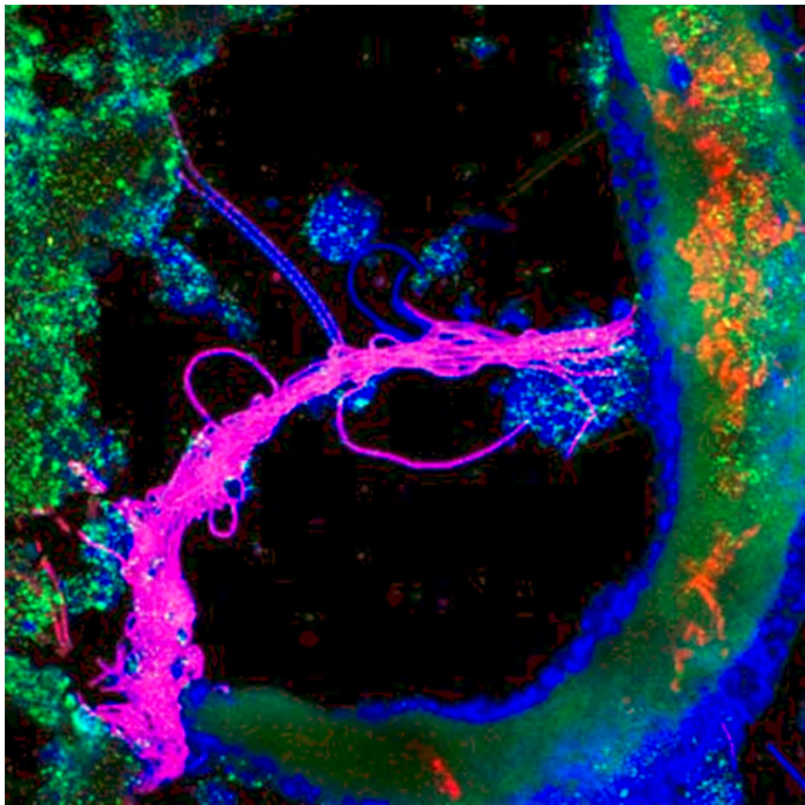
D. Brock





# The Unknown Microbial World

- So far only 5,000 or so bacteria characterised



# Environmental Microbiology in Ireland

- Environmental microbiology is practised throughout Higher Education Sector



**Anti-Fouling Strategies - Biodegradation of fats, oils and greases: DCU**  
**Clean-up of contaminated sites: UCD**

# **Environmental Microbiology in Ireland**

- **Research seeks to tackle such problems as:**
  - **Energy generation**
  - **Environmental protection**
  - **Climate change**
  - **Sustainability through material recovery**
  - **Marine microbiology**





# **Energy: Anaerobic digestion**

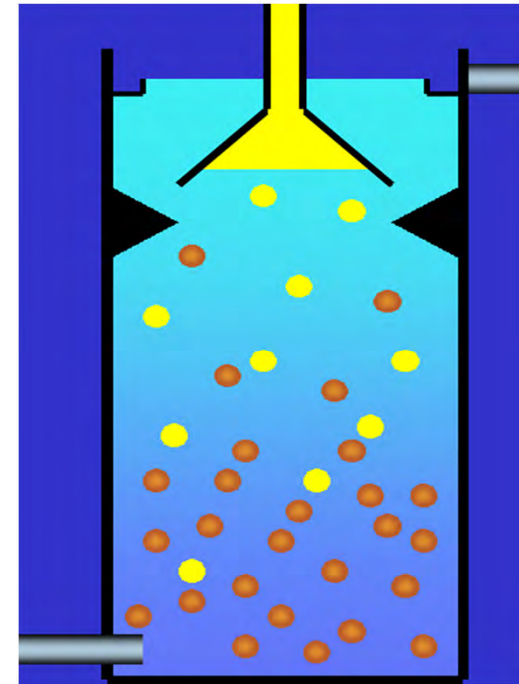
## **Vincent O'Flaherty – NUI Galway**

- **Market for energy from waste: €3 billion p.a. 2025**
- **All the potential waste utilized generate energy equivalent to approximately 3 million barrels of oil annually**
- **Save between 0.22 and 0.35 million tonnes of CO<sub>2</sub>**

# Key Themes

- **Bioenergy from cold, dilute wastewaters (domestic sewage) - commercialisation**
- **2<sup>nd</sup> generation biofuels: meadow grass; organic wastes; municipal solid waste**
- **Multi-disciplinary: microbiologists, engineers, policy makers, regulators**

# Biologically Mediated Sustainable Energy Generation



Department of Communications, Energy and Natural Resources  
Roinn Cumarsáide, Fuinnimh agus Acmhainní Nádurtha

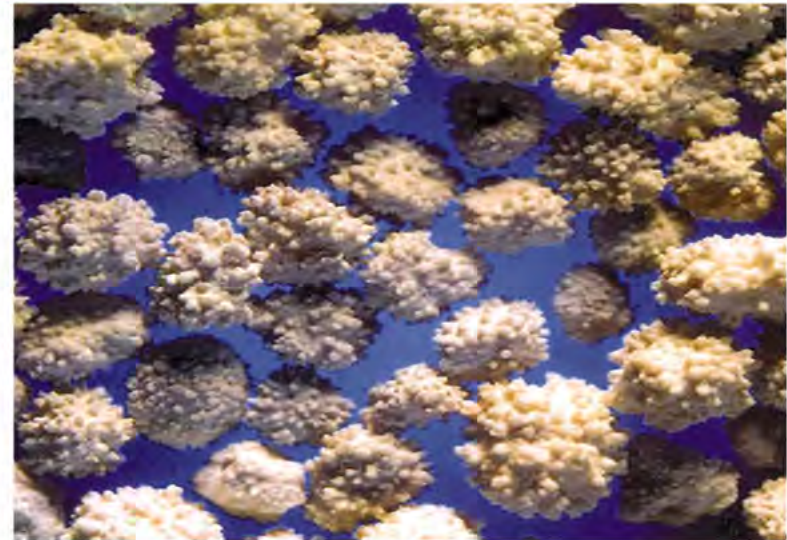




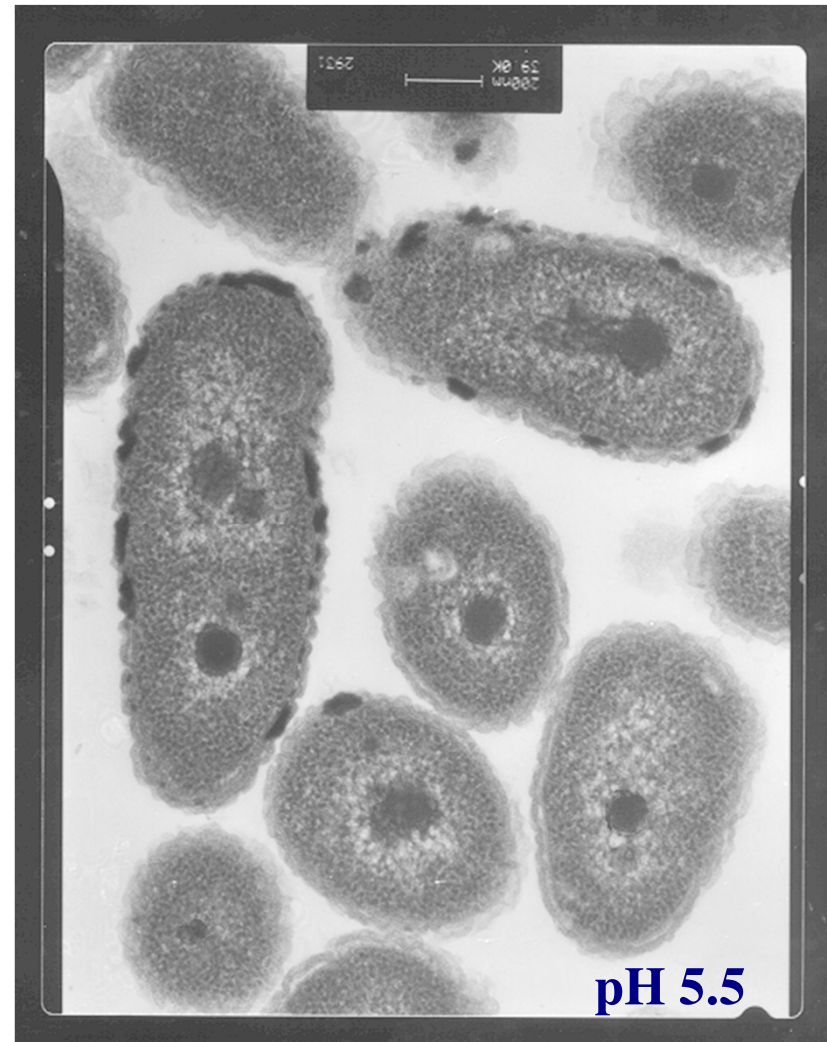
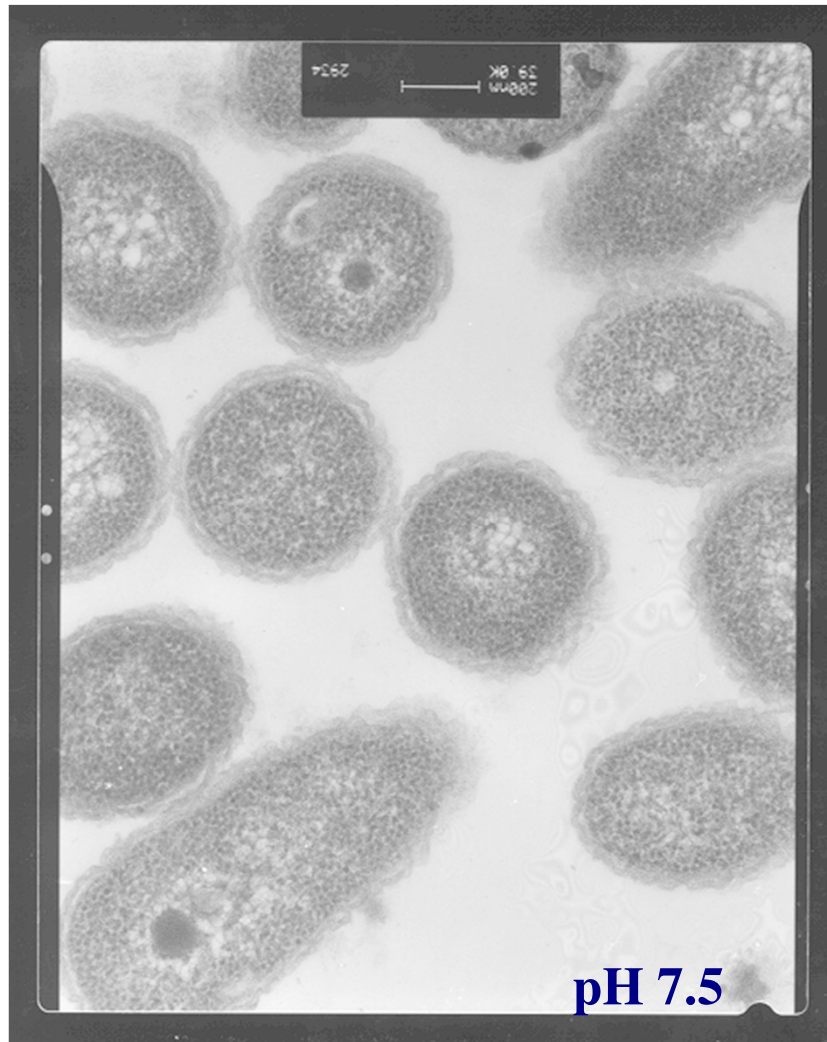
# Environmental Protection: Eutrophication

## John McGrath - QUB

- Eutrophication biggest global threat to good water quality
- Caused by discharge of phosphorus
- Lough Neagh / Erne highly eutrophic
- Of 238 EPA monitored lakes, 86 currently do not comply with phosphorus targets



# *Burkholderia cepacia* AM19





# Pilot Plant



Environmental Protection Agency

northern ireland  
water



QUESTOR  
CENTRE



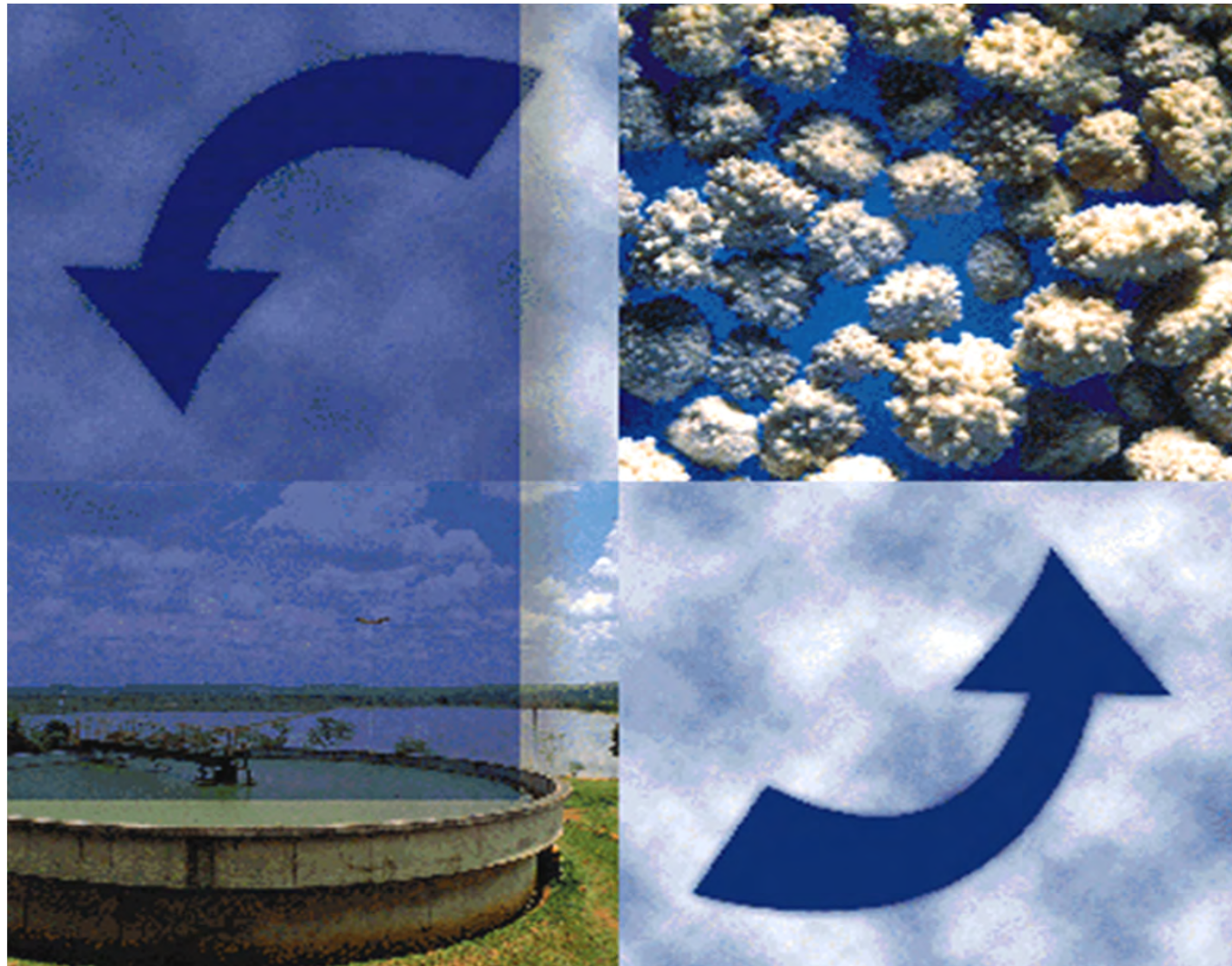


# Full Scale Trial





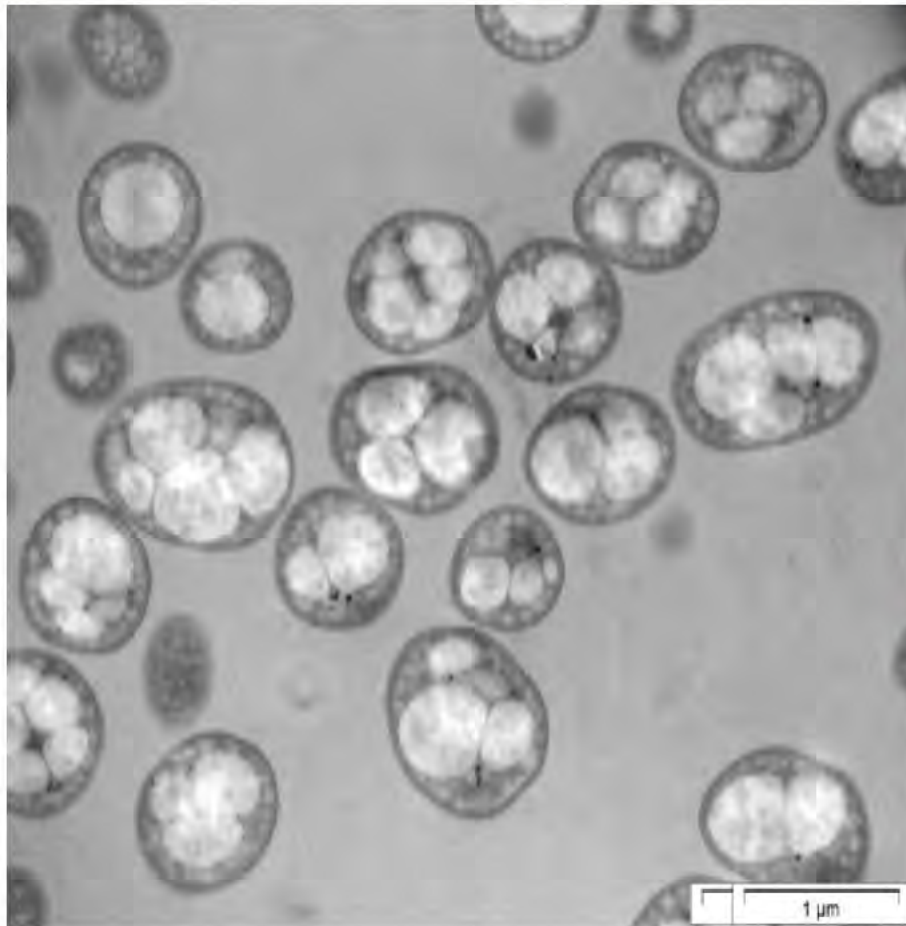
# Phosphorus Recovery





# Sustainability: Bioplastic

## Kevin O'Connor - UCD

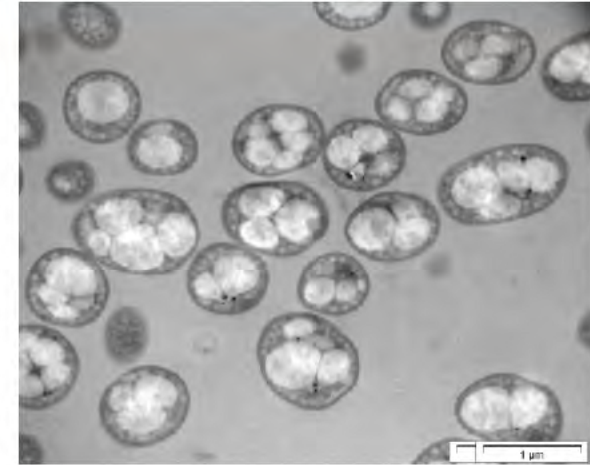


- Ireland >300,000 tonnes plastic waste generated annually
- 80% landfill
- Biodegradable plastics are part of the solution.
- Can be manufactured from waste and from renewable non food resources.





# Bioplastic Production



**Packaging & Biomedicine**

# Collaboration: Superior Waste Treatment



**Energy - Waste treatment – Recovery**



University College Cork  
Coláiste na hOllscoile Corcaigh

# Marine Microbiology

Alan Dobson/Fergal O'Gara - UCC  
John McGrath - QUB

- Ireland has 220 million acres of sea (17 million acres land)
- Microorganisms constitute more than 90% of the living biomass in the oceans.
- Microbial activity produces half of the Earth's oxygen
- The marine environment is an increasingly important source of new enzymes, antibiotics, drug compounds
- Metagenomics to screen for these.





University College Cork  
Coláiste na hOllscoile Corcaigh

# Marine Biodiscovery



Queen's University  
Belfast

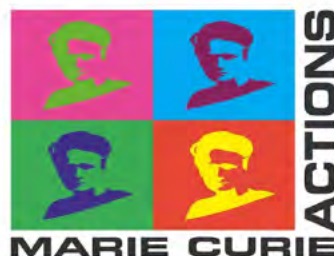


'Omics



Identification of:

- Novel genes and enzymes
- Drugs and drug precursors.



# Summary

- **Microbial enzymes and microbial processes are critical for next generation of sustainable technologies.**
  - **Biomass to biofuel**
  - **Waste treatment**
  - **Waste to value added products (phosphorus / plastic)**
  - **Producing the next generation of antibiotics / cytotoxics**



# Summary

- **Investment in Ireland's (North - South) R and D base, and the provision of microbiology degree courses, will underpin competitiveness in this area.**
  - **Job creation**
  - **Economic growth**