

Annual Report on Chemical Education in the Republic of Ireland 2018-2019

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SUMMARY

The most significant development in the last year has been the completion of the first full cycle of the new Junior Certificate Science course and this being examined for first time. The new course is shorter than the previous one, and includes coursework, and inquiry-based foci in addition to a terminal examination. The course aims to strike a balance between traditional learning of science and incorporating argumentation and scientific literacy. There have been mixed responses from teachers and pupils to the new course, with some teacher unions believing that the course does not adequately prepare students for Leaving Certificate Physics and Chemistry. Others welcomed the ‘topical’ and relevant nature of the examination paper, with references to climate change, depletion of iridium for mobile phone use, and research on the gut microbiome and stress-related disorders.

The other significant development in Chemical Education in Ireland was the decision to cancel the practical component of the revised Leaving Certificate programme. Main reasons cited for this decision were cost and logistical problems such as difficulty in recruiting examiners, the need to bring all school science laboratories up to similar standards, and fitting practical examinations into a crowded timetable for examination students. The Leaving Certificate Chemistry syllabus is currently being reconsidered.

POLICY DEVELOPMENTS

From September 2018, the first students will begin studying the **Leaving Certificate Computer Science and Physical Education** courses. Both subjects are being introduced to an initial group of schools, before both are rolled out nationally in 2020 to all schools who wish to teach them. The impact of these new subjects on update of other subjects at Leaving Certificate level will be interesting to monitor.

In October 2018, Science Foundation Ireland (SFI) and the Department of Education and Skills (DES) launched a study asking businesses across the country to **assess their science, technology, engineering and maths (STEM) engagement with schools**. This study is part of the STEM Education Implementation Plan launched in 2017 and aims to identify and encourage robust and sustainable partnerships between schools, business and industry, public sector bodies, research organisations, further and higher-level institutions, and the Arts.

In March 2019, (<https://www.education.ie/en/Publications/Corporate-Reports/Strategy-Statement/action-plan-for-education-2019.pdf>) CUMASÚ Empowering through learning - Action Plan for Education 2019 was launched. Actions planned during 2019 include:

- **Progressing implementation of the STEM Education Policy Statement 2017- 2026** and the Implementation Plan 2017-2019, including developing a work plan to increase the numbers of women participating in STEM through:
 - Develop a work plan as part of a coordinated response to increase the numbers of **females participating in STEM**, including the establishment of a females in STEM subgroup
 - Develop a work plan in relation to the **integration of Arts** education into all STEM learning experiences
 - Develop a **framework in relation to STEM partnerships** between Business/Industry and Schools to include an agreed set of mutually beneficial guidelines in relation to engagement
 - Implement a **STEM advertising campaign** aimed at learners, teachers, school leaders and parents in order to increase participation levels in STEM subjects

The Action Plan also highlighted the action to commence a **review of the draft Leaving Certificate subject specifications** for Biology, Chemistry and Physics, including a new coursework assessment component

New University – in January 2019, the 4th University in Dublin (TU Dublin), was launched, combining DIT, IT Blanchardstown and IT Tallaght. TU Dublin, Ireland’s first Technological University, where ‘career-focused students, dedicated staff and academic excellence in science, the arts, business, engineering and technology converge to create the leaders of tomorrow’.

Ranking of Irish Universities has changed little over the year with the QS university rankings showing little sign of reversing their decade-long decline. (Table 1). Challenges of larger class groups are now critical factors in the Irish university sector. However, it should be said that a small country like Ireland does well to have 5 universities in the top 500 and both DCU and UL rank within the top 100 under 50 years old.

Table 1: QS ranking of Irish Universities (2018 - 2020)

HEI	2018	2019	2020
TCD	88	104	108
UCD	168	193	185
NUIG	243	260	259
UCC	283	338	310
DCU	391	422	422
UL	501-550	511-520	521-530
NUIM	701-750	701-750	701-750

STEM Research in Irish universities is in a healthy state due to the funding from Science Foundation Ireland (SFI) as well as funding from the EU. (www.sfi.ie) Minister for Training, Skills, Innovation, Research and Development announced a national investment of €3.6 million through SFI Discover Programme, to fund projects dedicated to educating and engaging the

public in science, technology, engineering and maths (STEM). Through its SFI Discover Programme, it aims to develop a highly- engaged and scientifically-informed public. 41 diverse initiatives are supported by this year's programme with continuation funding for a further 11 projects. Some STEM initiatives that were funded in 2019 (and specifically targeted towards engaging girls and women in STEM, highlighted in Chemistry in Action) were:

SOPHia: Science Outreach to Promote Physics to Female Students (UL) - a project that aims to encourage female students to take up physics as a Leaving Certificate Subject.

- **STEMChAT – Women as catalysts for change in STEM education (UL)** – looks at the recruitment of female undergraduate STEM Champions and industry mentors who will facilitate informal workshops with school students and parents, predominantly in disadvantaged areas.
- **Strength in Science (NUIG)** – The development of cross-curricular resources for science and PE teachers that are linked with the Biology, Physics and PE curricula that will increase girls' interest in both learning science and participating in exercise
- **Engaging Girls in CS - Code Plus (TCD)** – Female-only coding workshops facilitating a cohort of female speakers working in computing, to deliver career talks in girls' schools. Tech companies will host visits for teenage females.
- **Girls in DEIS Schools: Changing Attitudes /Impacting Futures in STEM (UCD)** - Students will engage with STEM by exploring the lives and impact of several female STEM pioneers, both historical and contemporary.
- **Let's talk about STEM: supports for girls' early science engagement (DCU)** - Parents and educators will participate in workshops to consider evidence on the role of language in differentially motivating girls' and boys' interest in and persistence with scientific learning

Female-only STEM Professors initiatives - In Nov. 2018 Minister of State for Higher Education, Mary Mitchell O'Connor, announced the Government's intention to create up to 45 new posts to boost women's representation in senior academic positions. In Irish universities, 50% of lecturers are women but only 24% of professors are women. This initiative, whose details are still to be worked out, aims to redress the balance and break the glass ceiling. The percentage of women in higher academic posts varies between institutions and between disciplines.

CURRICULUM DEVELOPMENTS

The new junior science course has been examined for the first time in in June 2019. The new course is shorter than the previous one (200 versus 240 hours) and includes an element of coursework and an emphasis on inquiry-based learning.

Specifications for the new Leaving Certificate science courses in Biology, Chemistry and Physics proposed the inclusion of a practical based assessment, assessing elements of the specification that were not possible to assess in the written paper. However following a pilot project run by the State Examinations Commission in 2018 and also a change in the Minister of Education and Skills, in Dec 2018 the Minister of Education announced that the practical

exams in the new LC science subjects (biology, chemistry, and physics) as proposed by the NCCA, would be shelved due to cost and logistical problems. *“Instead, he has asked the curriculum advisory body to explore the option of a coursework assessment - such as a project - in biology, chemistry and physics, similar to what happens in some other subjects. Students would complete the coursework during the school year, under the guidance of teachers, and it would be marked by an examiner appointed by the State Examinations Commission (SEC).*

The NCCA, the body responsible for curriculum and assessment, examining the feasibility of integrating a coursework assessment component into the Leaving Certificate Chemistry / Physics / Biology specification. NCCA has also been requested to review the specification in light of the time that has passed since its development, including recent developments associated with the introduction of the new *Framework for Junior Cycle (DES, 2015)*, such as the implementation of the new specification for Junior Cycle Science. This group will hopefully generate a new specification for 2020!

OUTREACH AND INFORMAL LEARNING

Major national science events for school included:

- **BT YoungScientist & Technology Exhibition** in January 2019 - 3,773 students from 374 schools across the island of Ireland competed
- **Scifest** has again expanded this year, with 86 schools running SciFest@School Fairs 2018/19 and Regional events at 16 centres around the country. Winners from the Regional events then participate in the National Final.

Ireland has continued to participate in the **Science Olympiad** events with success:

- At IJSO (International Junior Science Olympiad) in December 2019, Borswana, where Ireland secured two Bronze medals
- At EUSO (European Union Science Olympiad) in Portugal in May, where Ireland teams secured a Gold medal and Silver medal; this was the best ever performance by an Irish team at EUSO.
- At IChO (International Chemistry Olympiad) in Czech Republic and Slovakia in July 2018. Ireland team travelling to IChO in Paris July 2019.
- The Irish Science Teachers Association Senior Science Quiz took place in the Tercentenary Hall in Trinity Biomedical Sciences Institute on Saturday November 24, 2018. Fifty teams of Leaving Certificate students representing 20 counties across Ireland participated. Almost 1100 Leaving Certificate students took part in the Regional Finals held during Science Week and the top 150 LC students were invited to the BioPharmaChemical Ireland sponsored National Final.

Every year in Ireland Science Week and Chemistry Week just so happen to fall back to back, which gives our Irish RSC members plenty of opportunities to promote the chemical sciences.

This year was no exception with dozens of Irish RSC members organising and collaborating on events nationwide to showcase chemistry to school students and the general public.

Careers in Chemistry: This annual event is run by our Irish Education Coordinator, John O'Donoghue, in partnership with the School of Chemistry at Trinity College Dublin. This year the event showcased the diversity of chemistry careers with frank and honest discussions from experienced chemists. Nearly 400 senior secondary school students spent their day with an eclectic array of chemists – including a politician and sports star – as well as researchers and industry professionals.

EDUCATIONAL STATISTICS

Chemistry continues to hold its position as the second most popular LC science subject (Figure 1), taken by approx. **17%** of students although Biology attracts almost 63% of all students taking Leaving Certificate. Physics and Agricultural Science have similar uptakes of 14.1% and 14.5% respectively. The gender split in each of the science subjects is interesting with **Chemistry** tending towards equal participation - (**55.5% Female**), Biology (60.1% Female), Agricultural Science (40.5% Female) and Physics (27.5% Female). In comparison to 2017, 2018 showed a slight increase in female participation (0.5% chemistry and 1% in Physics)

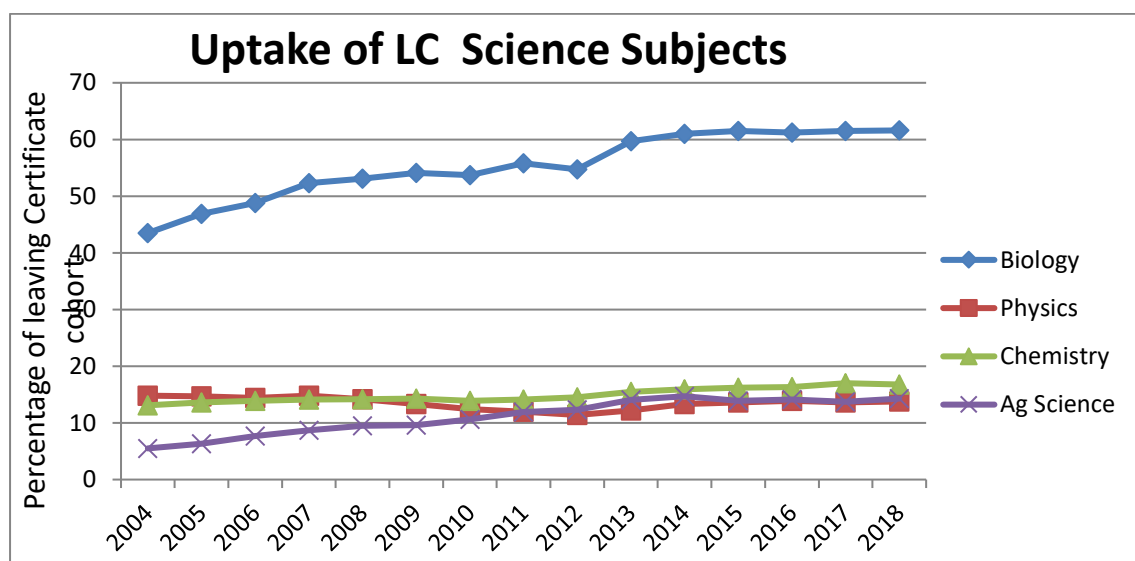


Figure 1: Leaving Certificate science uptake 2004-2018

It will be interesting to monitor the uptake of these subjects with the introduction of Computer Science as a Leaving Certificate subject from September 2018.

COURSES AND WORKSHOPS

Irish chemistry teachers are well provided with conferences, courses and workshops, and these are listed below, including those provided by the Professional Development Service for Teachers (PDST), which provides induction courses for new teachers and CPD workshops. There are additional courses, seminars and conferences for those involved in chemistry education in Higher Education also.

- Chem-Ed Ireland, Dublin, Oct. 2018 (annual)
- BASF Teacher's Workshop, Cork, June 2018 (annual)
- Boyle Summer School Lismore, Waterford, June 2018 (annual)
- Chemistry Demonstration Workshop, Limerick, July 2018 (annual)
- ISTA Annual Conference, Dublin, April 2018 (annual)
- Irish Variety in Chemistry Education, Dublin, April 2018
- SMEC 2018, Dublin, June 2018 (biannual)
- Methods for Research in Science Education (MORSE), Dublin, November 2018
- Irish Universities Chemistry Colloquium, Belfast, 2018
- 43rd Institute of Chemistry Ireland Congress, Athlone, May 2018

AWARDS

Institute of Chemistry of Ireland Awards

The ICI Boyle Higgins Gold Medal and Lecture Award (2018) was awarded to **Professor John M. Kelly**, TCD, whose lecture was entitled *Giga-seconds Exciting Chemistry – Time and the Photochemist*. **This award is made for an outstanding and internationally recognised research contribution to the advancement of chemistry by a chemist of any nationality working in Ireland or by a chemist who is an Irish citizen working overseas.**

The ICI Boyle Higgins Gold Medal and Lecture Award (2019) was awarded to **Professor Suresh Pillai**, IT Sligo, whose lecture was entitled '*Materials in the Nanoscale; From the Laboratory to Industries*'.

The ICI Annual Award for Chemistry (Eva Philbin Lecture Series) (2018) was awarded to **Professor Anita Maguire**, SSPC, UCC, whose lecture title was '*Using Hazardous Reagents Safely – Go with the flow!*' This award is made to an Irish or international chemist of repute who will present lectures on their field of work, across the country that are open to the general public as the purpose of the award is to promote the benefits of chemistry to the widest audience.

The ICI Postgraduate Award (2018) was awarded to **Ms Adele Gabba**, working under the supervision of Professor Paul Murphy (NUIG). She will give her award lecture at the forthcoming 71st Irish Universities Chemistry Research Colloquium, June 2019. This award is for a registered PhD student in any Chemistry discipline working in an Irish Higher Education Institution who has demonstrated excellence in research through publications and a commitment to supporting and promoting Chemistry within their University.

SFI Outstanding Contribution to STEM Communication

SFI awards to recognise an outstanding contribution to the popularisation of science, and recognises an individual who raises public awareness of the value of science to human progress, were awarded to:

Dr Niamh Shaw, Blackrock Castle Observatory and Cork Institute of Technology – an Irish engineer, scientist and performer. She presents the human story of science, creating theatre shows, public events and contributions to media with this focus.

Dr John O'Donoghue, RSC Chemistry Education Coordinator at the School of Chemistry, Trinity College Dublin – where he develops and empowers third level students to engage with schools and the general public. His Spectroscopy in a Suitcase programme has visited schools in every county, showing the real-world applications of chemistry, and his career events have provided students with dozens of valuable science role models.

RSC Awards

Dr Barry Ryan, Irish Chemistry Lecturer in TU Dublin was awarded the RSC's Higher Education Teaching Award;

Chemical Sciences Technical Team at Dublin City university was awarded the RSC Higher Education Technical Excellence Award;

Dr Michael Seery, formerly of TU Dublin (DIT), now of University of Edinburgh, was awarded the RSC's Inspirational Member Award.

PUBLICATIONS

Chemistry in Action! magazine, started in May 1980, has gone to two issues a year (down from three) and mainly electronic publication from issue 110 due to postage costs and this makes it more widely available. In addition, a new website with current and back issues has been launched (www.cheminaction.com).

Irish Chemical News, the journal of the Institute of Chemistry of Ireland, is now produced electronically (<http://www.chemistryireland.org/html/ichemnews.html>).

SCIENCE magazine is the journal of the Irish Science Teachers Association (ISTA). A new series on Pioneers of Science by Dr Peter Childs was started in 2017.

ESERA proceedings published (available at <https://www.esera.org/publications/esera-conference-proceedings>). (Finlayson, O.E., McLoughlin, E., Erduran, S., & Childs, P.E. (Eds.) (2018). Electronic proceedings of the ESERA 2017 Conference. Research, Practice and Collaboration in Science Education. Dublin, Ireland: Dublin City University. ISBN 978-1-873769-84-3).

Book of ESERA 2017 selected papers will be available during summer 2019.

CHEMICAL INDUSTRY AND CAREERS

Good news for chemistry and for chemistry graduates.

The Irish trade figures for 2018 were very good and the economy is showing strong growth, led by the chemicals and pharmaceuticals sector (<https://www.cso.ie/en/statistics/externalt>

rade/goodsexportsandimports/). Of the total of €140,835 million exports, €86,100 million were chemicals, 61.1%. The net trade balance in chemicals was €66,280 million. The chemicals export figure has grown from €66,385 million to €86,100 million since 2016 alone, a rise of 29.7%.

Chemicals, referred to here as the pharmaceutical sector, plays a pivotal role in the Irish economy. It accounts for over 60% of goods exported from the country. It employs more than 30,000 people, and supports a further 26,000 indirect jobs. More than half of the workforce are university graduates. In Ireland the industry is dominated by pharmaceutical companies engaged in either Active Pharmaceutical Ingredient (API) manufacture or/and also dosage form manufacture. As a centre for manufacturing biopharmaceuticals, Ireland is second only to the United States. Recent investments amount to just under €4 billion – the majority from US-based companies including Bristol Myers Squibb, Alexion, Regeneron and Eli Lilly. (<https://www.chemlandscape.cefic.org/country/ireland/>). In recognition of this Science Foundation Ireland re-funded SSPC, the SFI research centre for pharmaceutical manufacturing for a further 6-year term. The SSPC is hosted by the University of Limerick, in partnership with UCC, NUIG, UCD, DCU, TCD, RCSI, MU and WIT, and is a truly national centre. SSPC actively engages with pharmaceutical and biopharmaceutical companies both in Ireland and globally, and has an active Education and Public Engagement team working with teachers, parents and pupils to promote and engage in chemistry.

(reproduced from report in Chemistry in Action 113, Spring 2019)

CONCLUSION

Overall chemistry remains in a healthy state at school with uptake continuing close to 17%, and the demand for third level courses continues. The chemical, pharmaceutical and biopharmaceutical industry continues to thrive in Ireland, and overall other STEM related industries continue to create employment to the extent that sourcing sufficient numbers of graduates can be problematic.

The recognition of the need for diversity in STEM continues to grow, with the government funded initiatives aiming to support this throughout the pipeline, from school to professorial level in Higher Education.

The new Leaving Certificate (LC) Chemistry course (along with Physics and Biology courses) was due to start in 2019, but has not met this deadline, although it was intended that they would follow on from the new junior science course. A report on the pilot of the new practical assessment for these LC science courses has been published, indicating broadly positive results, but the decision not to pursue practical assessment was made due to potential for mounting costs and significant logistical issues. .