Cathal Garvey

Synthetic Biologist, Science Communicator

contact

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research

Lean Biotech R&D
Science Communication
Computational Biology
Synthetic Biology
Precision Gene Therapy

programming

Python, Lua, Coffeescript,
Javascript, CSS3 & HTML5,
Mozilla Rust, Haxe, Java,
Cobra (CLI), Haskell,
ANSI C

interests

Synthetic Biology, Biotech,
Bioinformatics,
Programming, Gene
Therapy, Cancer, Ageing,
Cryptography, Data
Analysis & Visualisation,
Open Science,
Permaculture, Cycling,
Writing, Hiking, Linux &
FLOSS

Formal Education

2003–2007 **Bachelor of Science, Genetics** NUI-Cork / University College Cork
Focus on Medical Genetics, Bioethics, Virology & Plant Science. Penultimate year project on plant immune response and soil potentiation of plant disease resistance. Final year project on murine pregnancy-specific glycoproteins & PCR recovery of same. Graduated 2H1 with consistent honours.

Professional Experience

2012–2014 **Glowbiotics Ltd** Cork, Ireland
Founder, Chief Executive Officer
Two years in a venture-funded startup pioneering lean biotechnology and computational DNA design for synthetic biology. Wrote a number of in-house DNA design tools, designed and used in-house hardware designs to reduce costs and accelerate research. Collated and compiled protocols and SOPs based on deep literature research that saved time and money while remaining efficient and reliable. Conceived and designed a series of ambitious DNA-based products with many novel and positive results.

2014 **Open Innovation Partners Ltd** Cork, Ireland
Contract Software Engineer
Contracted to produce a business intelligence & data-visualisation platform for co-authorship data via the NCBI EUtils API in order to perform due diligence consultations and to discover and assess potential future academic collaborators. Given a name or a MeSH heading, a connectivity graph with visual indicators of academic impact could be produced and interactively explored. Also offered incidental support in data recovery, analysis & databasing.

2013–2014 **Science Gallery** Trinity College, Dublin, Ireland
Exhibit Curator
Co-curated a flagship exhibit exploring the future and cultural role of Synthetic Biology. Assisted in selecting, coaching and properly exhibiting pieces exploring democratisation of science, speculative med-tech design, trans-humanism and radical or guerilla bioremediation. Provided a number of workshops and residencies on synthetic biology & genetics.

2007–2010 **Cork Cancer Research Centre** Cork, Ireland
Research Assistant
DNA design, cloning & artificial gene synthesis for gene therapy vectors. PCR optimisation vector insert recovery using stepdown and solvated PCR. Academic review support for projects related to targeted, integrative gene therapy. Received training in mammalian cell culture, laboratory animal welfare & handling. Received, processed & stored a number of primary human tissue samples for research use. Conducted gene therapy trials on in-vitro mammalian cell cultures. Maintained diverse mammalian cell culture stocks in nitrogen and in constant passage.

Memberships

2014	**Secretary**	Cork Biomakerspace

(In progress) Founding, locating and outfitting a biolab suitable for community, outreach, educational and start-up use in Cork City Centre with support from local industry, academia and state bodies.

2012–2014	**Leonardo**	Science Gallery "Leonardo" Group, Trinity College Dublin

Serving as member of Leonardo think-tank, providing support and creative input on present and future exhibits, knowledge and input to events, membership on various panels and suggestions for collaborations and future exhibit curators.

2009-2014	**Founder**	Nexus Cork Makerspace

Founded a successful information technology club which has held stable residence in a central location and which has hosted a variety of technology related events.

2011	**Delegate**	DIYbio.org Bioethics Congress

Participated in creating a widely accepted, terse yet expressive code of conduct for independent researchers and amateur biotechnologists.

Software

2012	**PySplicer**	Github

Wrote a cutting edge CDS optimisation suite, PySplicer, which implements current research in codon and coding sequence optimisation, surpassing all other freely available tools. Used in-house to design fluorescent protein expression constructs successfully, with exceptional expression levels.

2013	**DNcode**	Github

Wrote a compression function for nucleotide sequences which could rapidly & losslessly compress DNA or RNA sequences to one quarter of their original storage size, at a scalar rate that could easily be implemented at database level without significant performance loss. Applications for bioinformatic servers or for archival use on growing bodies of medical sequence data.

2013	**Litmoria**	Private / Proprietary

Wrote a search-engine and data-visualisation framework for academic data, graphing co-authorship connectivity, authorship volume, last-author frequency, & degree-of-separation for data from NCBI Pubmed. The engine allows arbitrary search patterns by author name or by keyword, and has been instrumental to the client in evaluating potential academic partners, as well as seeking unaffiliated yet academically well-placed partners for due-diligence prior to investment or partnerships.

Hardware

2009   **Dremelfuge** Github

Having a need of a centrifuge for work in my own lab, and perceiving a general need for a low-cost, high-speed microcentrifuge for medical applications in deprived areas, I designed a 3D-printable rotor for common rotary multitools which could be fabricated for approximately €1 and which could easily accomplish routine medical and laboratory centrifugation. The designs were made available generally, and have been exceptionally well received.

2011   **PID Water Bath Controller** Private Implementation

Needing a water-bath and scandalised by the prices quoted for such a simple piece of equipment, I designed a microcontroller-driven feedback system and AC power controller which could be used with domestic equipment (to wit, a kettle) to provide a water bath solution for general use. Upgrade to an edge-immersion, fan-agitated system was partially implemented but was found to be unnecessary.

2012   **OpenPyCR** Github

For reasons of cost-effectiveness and ease of customisation, I made use of an OpenPCR thermal cycler for polymerase chain reaction and other enzymatic or cell reactions requiring precise timing and temperature control. However, the software provided was poorly customisable and required software I was unwilling to install for security reasons, so I re-implemented the hardware control software from first principals, and extended it to allow a terse and human-readable specification of program flow in plain text.

Biotech

2010   **IndieBB (1)** Glowbiotics

Identifying a market need for a robust & modern-standards compliant plasmid vector for *B.subtilis*, I designed a vector entirely manually which would enable antibiotic-free selection & maintenance and which provided "biobrick" compatible cloning sites. The selection scheme, which relied upon sugar to transiently complement lab strains' inability to differentiate into swarming cells, worked as intended but the plasmid vector itself proved unstable; I would later learn that the CDS optimisation systems I was using were just becoming deprecated with new research, leading to the authorship of *PySplicer*, above.

2012-2013   **Fluorenzymes** Glowbiotics

Desiring to produce and market a "ferment your own" enzyme product which would permit arbitrary enzyme fermentation and purification in usefully pure form, I designed a novel chromatographic solution and tested it with transgenic fluorescent proteins. Wild-Type GFP was optimised for expression in *E.coli* using in-house software *PySplicer* and was fused to a likewise optimised CDS coding for an agarose-binding protein domain, to provide an agar or agarose-based chromatographic separation and purification method. While proper function of PySplicer was successfully demonstrated by vivid, eGFP-like fluorescence (a remarkable achievement for wild-type GFP), and while successful export of some protein to *E.coli* periplasm was achieved using a fusion export system, the agarose-binding protien proved unamenable to protein fusion and did not function as a chromatographic fusion tag after several rounds of prototyping and expert consultation.

2014   **IndieBB (2)** Glowbiotics

Returning to the need for a generalised, modern vector for biotechnology that obviated the need to rely on antibiotics for selection and maintenance, I designed a concept vector that would enable antibiotic-free selection in *E.coli* using Colicin-V mediated allelopathic selection. Planned further experiments upon the vector would have attempted to replace the sizeable transport cassettes of the Colicin V operon with low-cytotoxicity periplasmic disruption proteins, which could potentially have yielded allelopathic selection with a lower DNA footprint than extant optimised AmpR cassettes. Regrettably, funding was not raised for this project, though it is instead being implemented as an iGEM project by a New York biotechnology lab.

Communication Events

2014   **Stem Cells, Biohacking, GM & the future of humans**   Pint of Science, Dublin
Participated in a Panel Discussion on Biotechnology, Agriculture, Bioethics & Human Enhancement with positive responses from a mixed-background audience.

2013   **Bringing Biotechnology Into the Home**   TEDx Dublin 2013
Presented a vision for ubiquitous synthetic biology as a facet of a future everyday life at an event attended by thousands and viewed and favoured by over ten thousand more since.

2012   **Enter Bio-Hacking**   PICNIC Conference, Amsterdam
Introduced the rapidly changing field of "do-it-yourself" biotechnology at a technology and design conference in a prominent waterfront theatre in Amsterdam.

Media Appearances

2012   **Doing Biotech in my Bedroom**   MIT Technology Review
Coverage of a lab I established in a domestic setting and my work in enabling low-cost synthetic biology. (NB: There was never a bed in the lab)

2012   **For Bio-hackers, Lab Work Often Begins at Home**   New York Times
Headed a story on DIY-biotechnology with reference to my work designing low-cost tools and methods.

2013   **Biohackers - Les Bricoleurs d'ADN**   Le Monde (Online)
Presented alongside other leading figures in Lean Biotech in an interactive online format which encouraged viewers to "ask" questions and receive pre-recorded responses. Initially available to the public, but since paywalled.