STEAMxDREAM 生物探索｜iGEM 國際基因工程機器大賽訓練營

STEAMxD iGEM Navigator Program 2025–2026

對象： 國三～高三學生（約 9–12 年級）
 授課方式： 線上/實體課程＋實體實驗室操作
 主辦單位： STEAMxDREAM
 訂位／諮詢專線： 0909-009-985
 官方網站： https://jeff20151.github.io/personal_website/igem/

一、課程與競賽介紹

1. 什麼是 iGEM？

iGEM（International Genetically Engineered Machine）為由 MIT 起源、目前由 iGEM Foundation 主辦的國際合成生物學競賽。
 每年吸引來自全球數十個國家、數百支隊伍參與，包含 Harvard、MIT、Stanford 等世界級名校學生，是目前最具影響力的學生生物科技競賽之一。

iGEM is the Heart ♥ of Synthetic Biology

Over the past 20+ years, iGEM has been central in creating a strong, vibrant and expanding synthetic biology community.

5000+ SynBio Projects

Thousands of synthetic biology projects and proofs of concept have been tested at iGEM, leading to additional research and the launch of hundreds of new companies.

100,000+ iGEMers

Coming from 65+ countries, iGEMers are today's leaders in synthetic biology, pursuing careers in academic research, industry, NGOs and government agencies, and they're creating startups that are pushing the boundaries of what's possible.

Cultivating a Responsible Culture

iGEM's world-class Responsibility Program guides iGEMers in the responsible, safe and secure use of synthetic biology. iGEMers think beyond their lab work, considering biosafety and biosecurity risks, while embodying a culture of responsibility.

84,000+ Biological Parts

Publicly available as an open source, shared resource through iGEM's Registry, over 84,000 biological parts (so far!) have been curated and sequenced for synthetic biology applications.

250+ Startups

While the first iGEM Startup went public in 2021, hundreds of startups have emerged from iGEM. Today, these companies are at the forefront of developing biological solutions to preserve the environment and improve the lives of people worldwide.

2. 什麼是 STEAMxDREAM iGEM 訓練營？

本訓練營專為國三至高三學生設計，從合成生物學基礎概念出發，一路帶領學生：

- 發想與設計屬於自己的 iGEM 專題

- 學習實驗設計與實驗室操作

- 建立數學建模與程式分析能力

- 完成 Human Practices、商業與社會影響分析

- 製作英文網站（wiki）、海報與簡報

- 為參加 iGEM 國際總決賽做好準備

二、適合對象與學習成果

1. 適合誰參加？

- 對生命科學、生醫、藥學、生物科技有興趣的學生

- 喜歡數學、統計、程式設計、AI 或資料科學的學生

- 對品牌企劃、商業模式、永續與 ESG、社會議題有熱情的學生

- 擅長設計、插畫、動畫、網頁或影像創作的學生

2. 完成課程後，你可以獲得：

- 了解合成生物學與基因工程的核心概念

- 具備閱讀學術論文與查找資料的基本能力

- 完整參與一個跨國研究型專題的經驗

- 建立實驗設計、數據分析與建模的初步能力

- 完成一套可放入作品集的英文專題成果（網站＋海報＋簡報）

- 為未來申請海外大學與研究計畫累積具有說服力的實戰資歷

三、課程架構與時程概覽

實際時數可依之後的開課計畫微調，以下為結構模板。

- 課程期間： 2026 年 01 月 ～ 2026 年 10 月（依 iGEM 官方時程調整）

- 授課形式：

    1. 線上課程：理論課程、建模與專題小組討論

    2. 實體課程：實驗室操作、集訓營、模擬答辯

- 主要階段：

    1. 基礎啟蒙與能力建立（約 8-10 週）

    2. 專題發想與實驗／建模設計（約 8-10 週）

    3. 專題執行與 Human Practices（約 10-16 週）

    4. 成果整理、wiki 建置與答辯準備（約 6-8 週）

四、課程模組大綱（中文版）

模組一｜合成生物學與 iGEM 入門

- 了解合成生物學的基本概念與應用範例

- 認識 iGEM 的歷史、規則與評分架構

- 拆解歷屆金牌隊伍的專題與成功關鍵

- 介紹 BioBrick、標準化基因零件與設計思維

模組二｜實驗室安全與基礎技術（Wet Lab 基礎）

- 實驗室安全規範與個人防護

- 移液、無菌操作、培養菌株等基本技術

- DNA 操作與簡單分子生物實驗示範

- 如何整理實驗紀錄與撰寫 lab notebook

模組三｜數學建模與程式入門（**Dry Lab** 基礎）

- 建模在 iGEM 專題中的角色

- 以 Python / R 進行簡單數據處理與視覺化

- 常見動態系統與基因迴路的數學模型概念

- 範例：如何用程式模擬簡單生物系統

模組四｜專題發想與問題定義

- 問題挖掘工作坊：從生活與世界議題中找題目

- 如何閱讀文獻與整理背景資料

- 定義專題目標、研究問題與假說

- 建立初步實驗與建模架構

模組五｜**Human Practices** 與社會影響

- 什麼是 Human Practices？為什麼 iGEM 這麼重視？

- 社會、倫理、政策與利害關係人分析

- 訪談設計與問卷設計基礎

- 將回饋與調查結果回饋到專題設計

模組六｜商業模式與永續策略（**Business & Impact**）

- 從商業角度看合成生物學與創新科技

- 商業模式畫布（Business Model Canvas）入門

- ESG 與永續發展目標（SDGs）與專題連結

- 撰寫簡易商業企畫與 Pitch Deck

模組七｜設計、品牌與數位內容

- 隊伍命名與品牌識別設計（Logo、色彩、風格）

- wiki 網站架構規劃與基本前端概念

- 海報設計原則與視覺資訊呈現

- 影片與社群內容企畫（選配）

模組八｜專題執行與進度管理

- 專題排程與里程碑設計

- 每週進度檢視與問題排除討論

- 實驗與建模結果的整合與迭代修正

- 寫作與整理實驗結果（Figures / Tables / 敘述）

模組九｜英文簡報與 iGEM 答辯練習

- 英文科學簡報結構與說服力

- 問答與臨場反應訓練

- 模擬 iGEM 場景的 full rehearsal

- 如何將 iGEM 經驗整理進 CV、Personal Statement 與作品集

五、指導團隊

- **Jeff｜合成生物學與空間轉錄體學**
  台灣大學 生化科技系、台大生醫電資所碩士（空間轉錄體學）；曾參與 NTU 2024

Graduate iGEM Team 並擔任 2025 年 iGEM 國際競賽評審；興趣含 LLM x 生醫、蛋白質序列分析、空間轉錄體數據。

- **Peggy｜大型語言模型與數學建模**
  台灣大學 電機工程學系、台大電機所博士（研究主題：LLM）；ICML、NeurIPS 第一作者；專長數學建模、機器學習與 AI 生醫應用。

- **Derrick｜臨床醫學與轉譯研究**
  成功大學醫學系、Harvard Medical School 博士後；代表成大參與 iGEM；擅長臨床需求評估、倫理考量與 Human Practices。

- **Vivi｜國際政治、創投與 ESG 商業策略**
  紐約大學國際政治主修；創投與新創教練，擁有多張 ESG / 永續專業證照；專長 business plan、影響力敘事與 Pitch Deck。

- **Will｜Bioinformatics 與資料科學**
  卡內基美隆大學碩士（Bioinformatics）；熟悉 NGS、單細胞、多組學與雲端運算，指導學生建立可重現的分析流程與模型驗證。

- **Jason｜Biomedicine 與轉譯醫學**
  Johns Hopkins University 碩士（Biomedicine）；熟悉國際醫學研究流程與臨床前研究設計，協助學生將研究對齊生醫趨勢與倫理規範。

六、報名資訊與流程

1. 報名資格

- 國三～高三學生

- 具備基本英文閱讀能力（能看簡單英文文章與說明）

- 無需有實驗或程式背景，但需願意投入與團隊合作

2. 費用說明

- 課程與指導費：依最終人數衡量

- 實驗室操作與材料費：依最終人數衡量

- iGEM 官方註冊與報名費：依官方公告

- Grand Jamboree 出國活動費用：依官方公告

3. 報名流程

    1. 線上填寫報名表
       [https://docs.google.com/forms/d/e/1FAIpQLSdMc-UHKOl1L5CWn9YxgD2ZV1ltl8H7ar9HVTCeWqw69UwDFw/viewform?usp=dialog]

    2. 資料審查

    3. 發送錄取通知、課程時程表、預習教材與實驗室報到資訊

4. 聯絡方式

    ● 官方 Line / Email：0909009985

    ● 官方網站：https://jeff20151.github.io/personal_website/igem/

    ● 報名專線：0909-009-985

STEAMxDREAM Bio Exploration | iGEM International Genetically Engineered Machine Competition Training Program

STEAMxD iGEM Navigator Program 2025–2026
 Target Students: Grade 9–12
 Format: Online/ In-Person Courses + In-Person Laboratory Training
 Organizer: STEAMxDREAM
 Contact / Inquiry Line: 0909-009-985
 Official Website: https://jeff20151.github.io/personal_website/igem/

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1. Program & Competition Overview

What is iGEM?

iGEM (International Genetically Engineered Machine) is a global synthetic biology competition originating from MIT and now organized by the iGEM Foundation.
 Each year, hundreds of teams from top universities—such as Harvard, MIT, and Stanford—participate. It is recognized as one of the world's most influential student biotechnology competitions.

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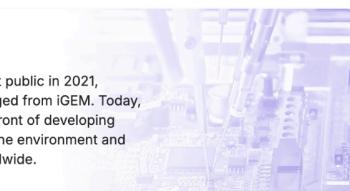
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What is the STEAMxDREAM iGEM Training Program?

This program is designed for students in Grades 9–12. Starting from fundamental concepts in synthetic biology, students will be guided step-by-step to:

• Design their own iGEM project
  • Learn experimental design & hands-on lab techniques
  • Build modeling and computational analysis skills
  • Complete Human Practices, business impact, and societal evaluation
  • Create the required English wiki website, research poster, and presentation
  • Prepare for participation in the iGEM International Grand Jamboree

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2. Target Students & Learning Outcomes

Who is this program for?

• Students interested in biology, biomedical science, biotechnology, or pharmaceuticals
  • Students who enjoy mathematics, statistics, programming, AI, or data science
  • Students passionate about branding, business models, social issues, sustainability, or ESG
  • Students talented in design, illustration, animation, web development, or media creation

After completing the program, you will be able to:

• Understand core concepts in synthetic biology and genetic engineering
  • Gain foundational skills in reading scientific literature and doing background research
  • Experience working on an international, research-oriented team
  • Build skills in experimental design, data analysis, and mathematical modeling
  • Produce a complete project portfolio (English wiki website + poster + presentation)
  • Strengthen your competitiveness for university applications and research programs

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3. Program Structure & Timeline (Overview)

The timeline may be slightly adjusted based on final scheduling and iGEM's official calendar.

• **Program Duration:** January 2026 – October 2026
  • **Format:**
  – *Online*: theory, modeling, team meetings, and project discussions
  – *In-person*: wet-lab practice, bootcamps, and mock presentations
  • **Main Phases:**
  – Foundational learning (8–10 weeks)
  – Project ideation & experiment/model planning (8–10 weeks)
  – Project execution & Human Practices (10–16 weeks)

– Wiki-building, documentation, and presentation preparation (6–8 weeks)

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4. Course Modules – English Version

Module 1 | Introduction to Synthetic Biology & iGEM

- Basic concepts and real-world applications of synthetic biology
- History, rules, and judging criteria of iGEM
- Analysis of past gold-medal projects and their success factors
- Introduction to BioBricks, genetic parts, and design principles

Module 2 | Laboratory Safety & Basic Techniques (Wet Lab Basics)

- Lab safety guidelines and proper PPE use
- Pipetting, aseptic techniques, and microbial handling
- DNA manipulation demos & basic molecular biology workflows
- How to maintain lab notebooks and record experiments

Module 3 | Mathematical Modeling & Programming (Dry Lab Basics)

- Role of modeling in iGEM projects
- Data processing & visualization using Python / R
- Basic concepts of dynamic systems and gene circuit models
- Example: simulating a simple biological system with code

Module 4 | Project Ideation & Problem Definition

- Problem-finding workshop: discovering project ideas from real-world issues
- Literature review and background research
- Defining research goals, questions, and hypotheses
- Drafting initial experiment and modeling frameworks

Module 5 | Human Practices & Social Impact

- What is Human Practices and why iGEM values it
- Social, ethical, policy, and stakeholder analysis
- Introduction to interview and survey design
- Integrating feedback into project improvement

Module 6 | Business Models & Sustainability Strategies

- Understanding synthetic biology from a business perspective
- Introduction to Business Model Canvas
- ESG concepts & Sustainable Development Goals (SDGs)

- Writing a simple business proposal and pitch deck

Module 7 | Design, Branding & Digital Content

- Team naming, branding identity, logo & color system
- Wiki structure planning & basic front-end concepts
- Poster design principles and scientific visualization
- Video and social media content strategy (optional)

Module 8 | Project Execution & Progress Management

- Milestone planning and timeline management
- Weekly check-ins and troubleshooting
- Integrating experiment & modeling results
- Creating high-quality figures, tables, and written summaries

Module 9 | English Presentation & iGEM Defense Training

- Structure and delivery of scientific presentations
- Q&A skills and handling spontaneous questions
- Full simulation of the iGEM presentation environment
- How to include iGEM experience in CVs, personal statements & portfolios

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5. Instructor Team

Jeff

Synthetic Biology & Spatial Transcriptomics
- B.S., Biochemical Science & Technology, National Taiwan University
- M.S., Biomedical Electronics & Bioinformatics, NTU
- Member of NTU 2024 Graduate iGEM Team; iGEM Judge for 2025
- Interests: LLMs × Biomedicine, protein sequence analysis, spatial omics

Peggy

Large Language Models & Mathematical Modeling
- Ph.D., Electrical Engineering, National Taiwan University
- First-author papers at ICML & NeurIPS
- Expertise: machine learning, modeling, AI for biomedical research

Derrick

Clinical Medicine & Translational Research
- M.D., National Cheng Kung University; Postdoc at Harvard Medical School
- Former NCKU iGEM team member
- Expertise: clinical needs assessment, ethics, Human Practices

Vivi

International Relations, Venture Capital & ESG
• B.A., International Politics, New York University
• VC experience and startup coach; multiple ESG certifications
• Expertise: business plans, sustainability, impact storytelling, pitch decks

Will

Bioinformatics & Data Science
• M.S., Bioinformatics, Carnegie Mellon University
• Expertise in NGS, single-cell, multi-omics, cloud workflows & reproducibility

Jason

Biomedicine & Translational Science
• M.S., Biomedicine, Johns Hopkins University
• Expertise in research design and biomedical ethics

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6. Registration Information

Eligibility

• Students in Grades 9–12
• Basic English reading ability
• No prior wet lab or programming experience required—only motivation and teamwork

Fees

• Course & coaching fees: based on final enrollment
• Laboratory materials & equipment: based on final enrollment
• iGEM Registration Fee: according to official announcements
• Grand Jamboree travel/attendance fees: according to official announcements

Registration Process

1. Complete the online registration form[https://docs.google.com/forms/d/e/1FAIpQLSdMc-UHKOl1L5CWn9YxgD2ZV1ltl8H7ar9HVTCeWqw69UwDFw/viewform?usp=dialog]

2. Document review

3. Complete payment

4. Receive acceptance notice, schedule, pre-class materials, and lab onboarding info

Contact

- Line / Email: 0909009985
- Official Website: https://jeff20151.github.io/personal_website/igem/
- Inquiry Hotline: 0909-009-985