Richard J. BARKER, *Curriculum vitae*

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Cofounder of the Collaborative Science Environment (CoSE): The CoSE benefit corporation has built random position machines (RPM) for the NASA microgravity research facilities and research groups.

Cofound of AstroBotany.com: The AstroBotany corporation seeks to share protocols and inspire citizen scientists with fun fashion and educational assistance such as photography calibration makers.

Education

2023-2024: NASA Transform to Open Science (TOPS) training course and curriculum.
2022-2023: NASA Cyber security training course
2021-2022: Software and data carpentry course.
2007-2011: Plant Science Ph.D. University of Nottingham, supported by the Rothamsted Research Laws Trust Agricultural Scholarship, UK.
2003-2007: 1st class Plant Science degree with Honors at the University of Nottingham, UK.

Work Experience

2023-2024: Project Scientist at NASA Genelab and Open Science Data Repository (OSDR) contract Programmer with the Blue Marble Space Institute of Science (BMSIS), USA.
2022-2023 Chief Data Scientist Oncology Consultant at Yuri Gravity, Germany, EU.
2015-2023: Scientist at the Gilroy lab in the UW-Madison Botany Department. During the 2018-19 season, the BigTen football network made a 1 minute video summary summarizing our research for the halftime display. “Wisconsin is putting down roots in space: LiveBIG 2018-19”, USA.
2014-2015: Postdoctoral research associate, in the Department of Botany (Gilroy Lab), at the University of Wisconsin-Madison, USA.
2012-2014: Postdoctoral research associate in the Department of Genetics (Masson lab), at the University of Wisconsin-Madison, USA.
2007-2011: Rothamsted Research, Genetic engineer in the Plant Hormone Group (Hedden Lab), UK.
2006-2007: John Innes Centre, Molecular Laboratory assistant in the Cambridge lab (Bevan Lab), UK.
2002-2005: John Innes Centre, Greenhouse assistant for the Cambridge lab (Bevan Lab), UK.

Entrepreneurial Awards and Honors

2021: Graduated from the NASA Star course

2020: Completed the American Family Insurance Social Impact educational accelerator program.

2019: Winner of the American Society for Gravitational and Space Research (ASGSR) Thora Halstead Young Investigator Award.

2018: Winner of the UW-Madison undergraduate mentoring award.

2015: Director of “FlashLapse” team that won Wisconsin Institute of Discovery (WARF) StartUp weekend.

2010: Second in the national finalist for BBSRC Biotec business entrepreneurial contest, Oxford, UK.

2008-2009: Science, Technology, Engineering and Mathematics (STEM) ambassador, Norwich, UK.

2007-2008: Best science communication student award from Rothamsted Research, Harpenden, UK.

2006-2007: The University of Nottingham Award for a distinguished research project in plant science, Sutton Bonington Biotechnology Campus, UK.

2005-2006: The University of Nottingham Kenneth Whymes Memorial Prize for Distinction in Plant Science, Nottingham, UK.

Representative of the American Academy of Science

- Co-author on multiple white papers to the American Academy of Science as part of the 2021 NASA decadal review entitled
    - “Ground and flight based plant microbial interaction research and related space crop production applications” in collaboration with the University of Florida.
    - “Research Campaign - Artificial Intelligence for Autonomous Space Plant Production” with NASA Kennedy Space Center agronomy research group.
    - “Machine Learning, Artificial Intelligence and Data Modeling for the Next Decade of Space Biology Research and Astronaut Health Support” in collaboration with the NASA GeneLab and Life Science Data Archiving (LSDA) team.
    - “FlagShip facility: PRECISE - PRoton Environmentally Controlled Investigations for Space Explorers” with the NASA Ames GeneLab and radiation biology groups.
    - “Open science for the next decade of life and physical sciences research for deep space exploration” in collaboration with NASA Open Science Data Archive.
- May 2017 - Continuation of the 5th CAS-NAS forum. This was organized by the Bureau of International Cooperation and the National Space Science Center.
- December 2016 - Invited speaker at the 5th CAS-NAS Forum for New Leaders in Space Science in Beijing, China. This program was aimed at promoting collaboration between Astro-biology researchers around the world.

Teaching Experience

2024: Visiting lecturer on the NASA STAR course and GeneLab for Highschool research group mentor.

2022-2024: Guest lecturer for the Kennedy Space Center Space crop production team's "Virtual Lunch, Learn and Discuss" series in collaboration with Dr. Gioia Massa's research and the "Students Planting Research of Use To Space" or "SPROUTS" interns.

2022-2023: Visiting lecturer at the International Space University teaching the application of practical bioinformatic mining methods for analyzing astronaut multi-omics data for the practical application and the development strategies for future risk mitigation.

2020-2021: Virtual mentor to an international cohort of high school teachers who are part of the Magnitude.io aerospace education program.

2021: Cofounder of AstroBotany International Research program in collaboration with international schools in Japan and England (astrobotany.com).

2020-2021: Due to COVID we co-created the virtual PEOPLE program and included virtual presentations from the Kennedy Space Centers Space Chile Challenge team for the students.

2017-2020: Developed the UW-Madison AstroBotanical Engineering project-based research course.

2018: UW-Madison undergraduate mentoring award for outstanding service as a research mentor.

2018-present: Guest lecturer at Carthage College as part of the Wisconsin Space Grant Consortium (WSGC) space biology course.

2016-2023: Guest lecturer in UW-Madison plant physiology and plant genetics courses.

2016-2023: Mentored high school students as part of the UW-Madison PEOPLE program.

2015-2020: Developed a custom AstroBotany curriculum to train high school teachers at the Promega Biopharmaceutical Training Institute (BTCI).

2015-2020: Mentored high school students as part of the Madison West High School rocketry program

2015: UW-Madison DELTA teaching program using the "RNAseq for the next-generation lesson plan".

2014: Cold Spring Harbor DNA learning centers RNAseq for the next-generation lecturer training course.

2014-2015: Guest lecturer in UW-Madison genetic department introductory genetics course.

2014: Developed a custom curriculum as part of the Cold Spring Harbor RNAseq for the next-generation training course.

International AstroBotany Outreach Tour 2018: United Kingdom (UK) "Plant BRICs in Space"

- The UK outreach tour started at the UK Natural History Museum London with a public engagement talk entitled "Plants in Orbit" to a public audience.
- Invited departmental talk at The University of Nottingham's "Centre for Plant Integrative Biology" (CPIB), entitled "Analysis of the transcriptomes of 4 ecotypes of Arabidopsis grown on the international space station during the APEX05 mission".
- Invited to give a talk entitled "Analysis of the transcriptomes of 4 ecotypes of Arabidopsis grown on the international space station" at the Rothamsted Research Applied Agronomy symposium.
- Invited for a private meeting with Sir David Baulcombe FRS head of Cambridge Plant Science Department to discuss the "Analysis of the transcriptomes of 4 ecotypes of Arabidopsis grown on the international space station" and analysis of microRNA's involved in gravity sensing.

Most relevant Publications

- Shahbazi, Rutter, and Barker (2024). Transcriptional response of Arabidopsis thaliana's root-tip to spaceflight. Plant Mol Biol.
- Anjali Gupta, Richard Barker, Pedro Madrigal, Nailil Husna, Daniela Bezdan, Masafumi Muratani, Saswati Das, Henry Cope, Cassandra Juran, Raul Herranz, Manuel A. Fernandez-Rojo, Nathaniel Szewczyk* and Stefania Giacomello*. (2024) Emerging Trends in Space Omics. Nature methods.
- Camera et al., (2024) “Aging and putative frailty biomarkers are altered by spaceflight”. Nature scientific reports.
- Gonzalez., et al., (2024). Spaceflight alters host-gut microbiota interactions. *Cell Host & Microbe*..
- Barker *et al.*, (2023). The Matrix: Meta-analysis of the space flight and microgravity response on Arabidopsis plant transcriptome.
- Lombardino, Bijlani, Singh, Wood, Barker, Gilroy, Wang and Venkateswaran. (2022). Genomic characterization of potential plant growth-promoting features of *Shingomonas* strains isolated from the International Space Station. Microbiology Spectrum.
- Fitzgerald, Vens, Miller, Barker, Westphall, Lombardino, Miao, Swanson and Gilroy (2022). Using the Automated Botanical Contact Device (ABCD) to deliver reproducible, intermittent touch stimulation to plants. Methods in Molecular Biology.
- Barker, Johns, Trane and Simon Gilroy (2021). Analysis of Plant Root Gravitropism. *Methods in Molecular Biology.* Springer.
- Barker, Fernandez Garcia, Powers, Vaughan, Bennett, Phillips, Thomas and Hedden (2021). Mapping sites of gibberellin biosynthesis in the Arabidopsis root tip. New Phytol.
- Sanders et al. (2021). Beyond low earth orbit: biological research, artificial intelligence and self-driving labs. arXiv preprint arXiv:2112.12582
- Scott et al. (2021). Beyond low earth orbit: biomonitoring, artificial intelligence, and precision space health. arXiv preprint arXiv:2112.12554
- Barker, Costes, Miller, Gebre, Lombardino and Gilroy (2021). Rad-Bio-App: a discovery environment for biologists to explore spaceflight-related radiation exposures. Microgravity Nature Publishing Group. npj Microgravity.
- Barker, Johns, Trane and Simon Gilroy (2021). Analysis of Plant Root Gravitropism. Methods in molecular biology. Springer, New York, NY, USA.
- Overbey et al. (2021). NASA GeneLab RNA-seq consensus pipeline: standardized processing of short-read RNA-seq data. Iscience.
- Neelam, Richardson, Barker, Udave, Gilroy, Cameron, Levine and Zhang (2020). Changes in nuclear shape and gene expression in response to simulated microgravity are LINC complex-dependent. Molecular biology and space medicine.
- Barker, Lombardino, Rassmusen, and Gilroy (2020). TOAST: A discovery environment to explore multiple plant biology spaceflight experiments. Frontiers in Plant Science.
- Rutter, Barker *et al*., (2020). A New Era for Space Life Science: International Standards for Space Omics Processing. Patterns. Cell pres.
- Afshinnekoo *el al*., (2020) Fundamental Biological Features of Spaceflight: Advancing the Field to Enable Deep-Space Exploration. Cell.

- Choi, Barker, Kim, Swanson and Gilroy (2019). Variation in the transcriptome of different ecotypes of Arabidopsis thaliana reveals signatures of oxidative stress in plant responses to spaceflight. American Journal of Botany.
- Lien, Barker, Ye, *et al. (*2019). A low-cost and open-source platform for automated imaging. Plant Methods.
- Barker and Gilroy (2017). Life in space isn't easy, even if you're green. Review article. Biochemist 39:6.
- Barker, Cox, Silber, Sangari, Assadi and Masson (2015). Assessing gravitropism in Arabidopsis thaliana, in Environmental Responses in Plants. Methods in Molecular Biology, Springer, NY.
- Swanson, Barker, Ye, and Gilroy (2015). Evaluating Mechano-Transduction and Touch Responses in Plant Roots, in Plant Gravitropism (ed Elison Blancaflor), Methods in Molecular Biology, Springer, NY.
- Barker, Cox, Mackie and Masson (2013). Vacuum Seed Sowing Manifold: a novel device for high-throughput sowing of Arabidopsis seeds. Plant Methods.

Journal Reviewer

- Peer reviewer: Frontiers in Plant Science
- Peer reviewer: Heliyon
- Peer reviewer: ASGSR journal (2022)
- Peer reviewer: Nature Communications (2022)
- Peer reviewer: iScience (2022)
- Peer reviewer: Patterns (2022)
- Peer reviewer: Life Science in Space Research (2021)
- Peer reviewer: Nature Publishing Group Microgravity (2020)
- Peer reviewer: Frontiers in Plant Biology (2019)
- Peer reviewer: Astrobiology (2018)
- Peer reviewer: Plant methods (2017)
- Student research judge: Growing Beyond Earth program (2020--present)
- Student poster judge at ASGSR from (2015-present)

Committee and Focus Groups

- Organizing team for the NASA GeneLab Analysis Working Group's ASGSR public and private workshops for the ASGSR conference 2021.
- Chair of the NASA GeneLab Plant Analysis working group (2018-present).
- Member of the NASA GeneLab Microbe Analysis working group (2018-present)
- Member of the NASA GeneLab Multi-omics Analysis working group (2018-present)
- Member of the GeneLab RNAseq focus group at the GeneLab steering committee meeting at the Kennedy Space Center, 2016.
- Presentation entitled "GeneLab RNAseq analysis on the DNA subway green line" to the GeneLab Steering Committee at the NASA Johnson Space Centre in Houston, in 2015.

Grant review panel

- NSF Panel reviewer for the Prototype Open Knowledge Network (Proto-OKN) solicitation (spring - 2023).
- Review panel Transform to Open Science (TOPS) solicitation (2023), ROSES-23 Amendment 5: F.15 "High Priority Open-Source Science" (summer - 2023)

Invited Conference Presentations

- Invited Speaker at ELGRA with a talk entitled: "Insights from analysis of shoots from TICTOC (Targeting Improved Cotton Through Orbital Cultivation) stress resistance in vacuolar pyrophosphatase over-expressing cotton (*Gossypium hirsutum*) grown on the ISS" (2024).
- Invited Speaker at ASGSR with a talk entitled: "The GeneLab Buffet: Insights from machine learning and knowledge graphs" (2023).
- Invited Speaker at ASGSR with a talk entitled: " Insights from analysis of roots from TICTOC TICTOC (Targeting Improved Cotton Through Orbital Cultivation). stress resistance in vacuolar pyrophosphatase over-expressing cotton (*Gossypium hirsutum*) grown on the ISS" (2022).
- Invited speaker for the American Society of Plant Biology “Plants for Space” symposium with a talk entitled: “APEX5: Analysis of WT and Ca2+ Transporter Mutants Grown on the International Space Station. Plants for space symposium” (2021).
- “Open science, discoveries enabled by NASA GeneLab’s FAIR principles” was the title of the talk I was invited to present on behalf of the GeneLab program (2021).
- Panel member alongside NASA space biology at the American Society of Gravitational Space Research Conference (2021).
- Speaker for NASA GeneLab Plant Analysis Working group for talk entitled: “Lessons learnt from the meta-analysis of the first 15 Arabidopsis space flight transcriptomes” (2021).
- Speaker at the NIH/NASA/NCATS interagency Mitochondria meeting entitled: Mitochondrial Dysfunction as a Universal Driver for Increased Health Risks: from COVID to COSMOS (2021).
- Speaker at the ISS RnD conference with a talk entitled: “APEX5, the reduction of ROS signaling in space” (2019), Co, USA.
- Presented a talk entitled “APEX-05: Calcium Signaling in Space”, UK (2018) at the American Society for Gravitational and Space Research (ASGSR) conference, MD, USA.
- Presented a talk entitled “Calcium Waves in Arabidopsis” at the Plant Calcium Signaling Conference, John Innes Centre, UK (2017).
- Presented a talk entitled “An interactive relational database designed to analyze the botanical data within the NASA GeneLab data store” at the Plant Cell Dynamics conference, St Louis (2016).
- Presented a talk entitled “Analysis of the transcriptomes of 4 ecotypes of Arabidopsis grown on the international space station” and poster Judge at the American Society for Gravitational and Space Research (ASGSR) conference, Washington DC, USA (2015).
- Presented a talk at the Plant and Animal Genome (PAG) conference, San Diego, USA (2013).
- Presented a poster at the IPGSA Plant Hormone Conference, Tarragona, Spain (2010).
- Presented a poster at the International Conference on Arabidopsis, Edinburgh, UK (2009).
- Presented a poster at the Journal of Experimental Botany’s GARNet conference, Nottingham, UK (2009).

Grants

- Co-investigator (CoI) on the successful Gilroy Lab application to the NASA Research Announcement (NRA) Effects of Spaceflight on plant microbe interactions; TASTIE: Tomato and Space Trichoderma In E (TASTIE). Role: CoI - NASA; 2021-2024; ~$750,000
- CoI on the successful Gilroy Lab application to the NASA Research Announcement (NRA) “GeneLab Innovation Awards for Translational Systems Biology and Informatics Research Using the GeneLab Data System.” MANGO Role: CoI - NASA- JPL (2018-2021); ~$110,000.
- Co-investigator on the successful Gilroy Lab application to the NASA Research Announcement (NRA) “GeneLab Innovation Awards for Translational Systems Biology and Informatics Research Using the GeneLab Data System.” TOAST CROSS KINGDOM. Role: CoI - NASA; GeneLab: Revealing Spaceflight- and Gravity-Response Networks in Plants; 2016-2019; ~$250,000.
- Co-investigator on the successful Gilroy Lab application to the NASA Research Announcement (NRA) NNH16ZTT001N-GL: “Appendix A: GeneLab Innovation Awards or Translational Systems Biology and Informatics Research Using the GeneLab Data System.” With the proposal entitled “Genelab: Revealing Spaceflight- and Gravity-Response Networks in Plants”. Role: CoI – NASA; GeneLab: Extending the Reach of the GeneLab Data System Across Kingdoms; 2018-2021; ~$300,000.
- Supported and provided the data for Prof Patrick Mason’s application to NASA Research Announcement (NRA) NNH14ZTT001N “Spaceflight Research Opportunities in Space Biology.” In which our proposal entitled “Using Brachypodium distachyon to investigate monocot plant adaptation to spaceflight” was accepted. Role: CoI – NASA; APEX06 assessment of Brachypodium for growth on the ISS; 2017-2019; ~$300,000.
- Supported and provided the data for Prof Simon Gilroy application to the successful NSF grant proposal to look at the interactions and overlaps between the mechanical and pathogen response pathways ~$400,000.
- Wisconsin Space Grant Consortium (WSGC) innovation award for a collaboration between the UW-Madison Gear Learning and the Boys and Girls Club of Dane County to develop AstroBotany educational computer games (2018) ~$40,000.
- Mentored multiple (on average 1 per year) undergraduate and postgraduate students through the processes of WSGC scholarships (2015-2021).

References are available on request from a range of perspectives.

Most recent employer NASA Open Science Repository: 2022-2024
Dr Sylvain Costes
Affiliation: NASA Space Biosciences Research Branch
Cell phone no: (650) 604-5343
Email: Sylvain.V.Costes@nasa.gov

Space Biology NASA Research Mentor: 2014-2023
Professor Simon Gilroy
Dept. Botany, Madison, WI,
Office phone no: (608) 262-4009
Email: sgilroy@wisc.edu

Astrobotany Post Graduate Student Mentee: 2021-2023
Major Lucia White, MSc in Botany
Dept. of Biology, US Air Force Academy, CO 80840
Cell phone no: 304 914 6231
Email: Lucia.white@afacademy.af.edu

Research biomedical device collaborator: 2013-present
Dr Ben Cox
Manager of Intellectual Property and Technology Development at the University of Chicago
Cell phone no: (608) 469-4846
Email: blcox@uchicago.edu

Plant Space Biology Research Collaborator: 2013-present
Dr Christina M. Johnson
Collaborative Science Environment Consultant.
Cell phone no: (805) 300-0468
Email: botanynerd@gmail.com

Post-Doctoral NSF gravitropism research associate: 2012-2014
Professor Patrick Masson
Dept. Genetics, Madison, WI,
Office phone no: (608) 262 2312
Email: phmasson@wisc.edu

PhD Supervisor and plant hormone research mentor: 2007- 2012
Professor Peter Hedden
Dept. Plant Science, Rothamsted Research, Harpenden
Office phone no: 01582 763133 ext 2133
Email: peter.hedden@bbsrc.ac.uk