



Reading Botany 2019 Symposium

THE BIG BOTANY CHALLENGE!

Promoting passion for plants in our schools

Friday 8th November 09:30-16:30
Meadow Suite, University of Reading

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Reading Botany 2019 Symposium

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Promoting passion for plants in our schools

Symposium Lead: Dr Jonathan Mitchley
Booklet designer: Laura Bennetto

THE BIG BOTANY CHALLENGE!

Programme

09:30 **Welcome: Jonathan Mitchley**

09:35-10:05 **Symposium Keynotes** (Chair: Jonathan Mitchley)

Steve Blackmore (Botanic Gardens Conservation International):
The plight of British botany: international perspectives
Julie Hawkins (University of Reading):
The plant pipeline: teaching challenges

10:10-11:00 **Session 1: Fascinating plants and their stories**
(Chair: Jonathan Mitchley)

Frank Mayle (University of Reading): Plants from the Amazon –
a multitude of everyday uses
Robbie Blackhall-Miles (Fossil Plants): Some weird fern relatives
and the great carbon challenge!
Nigel Chaffey (#Plants R Us): Teaching botany by stealth...
Chris Thorogood (Oxford Botanic Garden): The evolution of new
species of “killer plant”!

11:00-11:25 **Coffee break and poster session**

11:25-12:00 **Session 2: Connecting young people with career opportunities**
(Chairs: Angela Hall and Simon Mortimer)

Celia Knight MBE (Celia Knight Consulting): Building the plant
health profession
Tamjid Mujtaba (University College London) - Science capital and
raising awareness, motivation and aspirations for science careers

12:00-13:15 **Session 3: Making the best of plants in the secondary curriculum**
(Chairs: Angela Hall & John Warren)

Hannah Cheek (Pearson Edexcel): Does assessment contribute to the
lack of emphasis on plants in the curriculum?
Ann Scott (University of York): How can context-led A level teaching
raise the profile of plant biology?
Dan Jenkins (Science & Plants for Schools): Just because plants
are amazing ... (What can research tell us about good botany teaching
and learning?)
Marcus Grace (University of Southampton): What role should plant
science play in citizenship science?

13:15-14:15 **Lunch break including poster session and audience feedback activities**

14:15-15:25 **Session 4: What makes a great plant resource to inspire teachers
& school students?** (Chairs: J P Flavell & Sue Townsend)

Science & Plants for Schools (SAPS): Transport in plants
John-Paul Flavell (Kingston Grammar School): Using and making keys
Sue Townsend (Field Studies Council): Familiarity leads to
understanding: botanical terms exercise
Zephaniah Lindo (RHS Campaign for School Gardening):
Showcasing training and resources for secondary teachers
Alastair Culham (University of Reading): Cool Plants for
Hot Classrooms
Aaron Mills & John-Paul Flavell (Andover College & Kingston Grammar
School): Views from current biology teachers

15:25-16:30 **Session 5: Practical outputs and next steps for making secondary
education a better place for discovering the joy of plants**
(Chairs: Sue Townsend & Jonathan Mitchley)

16:30 **End**



POSTER DISPLAYS

1. Celia Knight MBE: Building the Plant Health Profession

With increasing concerns about plant biosecurity and continued demands for rewarding career prospects, now is an opportunity to build the plant health profession. We understand the range of careers in the healthcare sector for medically-related jobs; why don't we think professionally about plant healthcare in the same way? Clear presentation of training and professional recognition in plant health appeals to students interested in biology and complements recruitment efforts from established professions such as agriculture, horticulture and forestry to build the skills base. We present work on two schemes administered by The Royal Society of Biology to increase opportunities in plant health:

- 1) Plant Health Undergraduate Studentships; in its third year, a competitive scheme for research addressing Defra's priorities has funded nine studentships¹
- 2) Plant Health Professional Register; in its fourth year this scheme recognises plant health competencies in the workforce²

¹<https://www.rsb.org.uk/get-involved/grants/plant-health-ug-studentships>

²<https://www.rsb.org.uk/careers-and-cpd/registers/plant-health-register>

2. Alison Foster: The SClence Garden at SCI - the importance of horticulture and plant science for a sustainable future

The Society of Chemical Industry (SCI) was founded in 1881 by a group of scientists, inventors and entrepreneurs. It is a multi-disciplinary and inter-disciplinary society aiming to bring science into industry. The SCI Horticulture Group was founded just eleven years ago, but has established itself as a forum for those working across the horticulture industry and aims to bring people working within academia together with those working in more commercial and production environments. The Horticulture Group started to create a SClence Garden at SCI Headquarters in central London just over two years ago. This garden is now available as an interactive resource to showcase the importance of plants for a sustainable future across a wide range of industries including food, fine chemicals, agri-science and horticulture. We would like to discuss how best to use this resource to support secondary education.

3. Sebastian Eves-van den Akker: The David Miller Award to kick-start a career in plant sciences

The David Miller Award, founded in 2010 in memory of David Miller MBE, is designed to give young plant scientists or horticulturists the opportunity of overseas travel in connection with their horticultural careers. The Award has tremendous reach, with awardees travelling across the world to further their studies. Many awardees are further recognised in their respective communities and go on to populate various academic and industrial research institutions around the UK and further afield. More recently, we have established a network of past alumni to provide an opportunity for contact and identification of areas of synergy. The David Miller Award is therefore a tremendous way to kick-start a career in plant sciences.

4. Joanna Wood: A cornucopia of career opportunities

There are so many career opportunities within the fresh produce industry. Taking the example of my own 45 year career it is possible to become involved in many parts of the food chain, research, advisory extension work, produce procurement, quality assurance, public relations, journalism and knowledge transfer.

5. Tony Girard: Where plants meet business

Plants are vital for life. Harnessing their attributes gives us the benefits we all enjoy, Food, Medicines,

Heath, Landscapes, Timber and Energy from Fuel. Horticulture and Agriculture are terms used to signal the business of producing crops and enhancing the benefits from plants. The poster helps to demonstrate to Teachers and Careers Advisors, the vast array of opportunity that 'the business of plants' offers and in turn to encourage Students to include plants in their possible future careers, which often include the added attraction of travel to different parts of the world.

6. Markus Wagner: Working as a plant ecologist at the Centre for Ecology & Hydrology (CEH): Aiding the understanding, prediction and mitigation of threats to UK biodiversity

Biodiversity is the variety of all life, and of the natural systems that support them. The responsibilities of the Centre for Ecology & Hydrology (CEH) include the understanding, prediction and mitigation of threats to UK biodiversity, through measuring change in terrestrial ecosystems and resident species in response to multiple drivers. This involves targeted, integrated monitoring and mechanistic experiments, as well as working with recording schemes and societies to assess the status and long-term trends of species populations through monitoring and predictive modelling. To fulfil this requirement, plant ecologists and botanists work closely together with other scientists and data specialists, with tasks varying from mostly field-based to mostly desk-based, depending on the role in the organization. This poster gives a background to working at CEH and the various roles occupied by plant scientists, as exemplified by plant ecologists based at CEH Wallingford.

7. Alastair Culham: #mygreenstudy

Human life is enhanced through contact with plants. One of the most challenging times in many people's life is that of doing a university degree. #mygreenstudy is a student-led project that aims to bring students in touch with plants and to provide advice on how to grow them in student rooms. We present links to our blog and social media activities.

8. Fi Young: The Plant Monographer

The monograph is a 'one stop shop' on a plant family. I write species' descriptions then a species identification key is built. I cannot visit every herbaria (4,000+) or botanical library so vital information was omitted, however digitization of these sources means today's monograph is online, interactive and constantly updated.

9. Helen Hicks: Engaging secondary pupils in the work of the Millennium Seed Bank Partnership

Visits to RBG Kew's Millennium Seed Bank are particularly popular with A-level teachers wanting to help their students understand the importance of plant ex situ conservation and seed conservation methods. Behind the scenes tours, interesting seed stories and Kew science career cards help to bring the importance of the MSB partnership alive.

10. Simon Mortimer: Careers in agricultural plant ecology

With societal concern about the environmental impacts of feeding a growing and more demanding population, understanding the interaction between farming and biodiversity is of immense importance. Interactions between plants, microbes, animals and the environment play an important part in the structuring of agro-ecosystems in both crop and livestock farming systems. Plants structure habitats for other organisms and are influential in the delivery of the goods and services that ecosystems provide to humanity. Consequently, working as a plant ecologist in the interaction between agriculture and the environment offers a rewarding career. This poster will illustrate some of the opportunities for careers in this area, including the interface between the traditional realms of agricultural botany and nature conservation.

11. The Brilliant Club

We are an award-winning university access charity that works with schools and universities across the UK and run two core programmes: The Scholars Programme and Researchers in Schools. We exist to increase the number of pupils from under-represented backgrounds progressing to highly selective universities by mobilising the PhD community to share its academic expertise with state schools. The Scholars Programme recruits, trains and places doctoral and postdoctoral researchers in schools to deliver programmes of university-style tutorials, supplemented by two university trips. Researchers in Schools recruits PhD graduates, places them as trainee teachers in schools and supports them to develop as excellent teachers and research leaders committed to closing the gap in attainment and university access. For more information, contact: hello@thebrilliantclub.org

12. South London Botanical Institute: Urban Botany for Aspiring Plant Scientists

This summer school is designed for school leavers planning to move on to further education in biology, botany, horticulture and related subjects. The event includes a mix of classroom and hands-on practical field work making use of our herbarium, library and garden as well as botanical walks in parks and local streets. This will be an action packed three days exploring plant science, biology and related subjects in new and exciting ways and led by some of the country's most experienced botanists and tutors, including Dr Mark Spencer and Dr Jonathan Mitchley ('Dr M' of www.drmgoeswild.com).

13. John Warren and Jonathan Mitchley: The plant content of UK degree programmes

The decline in botany and plant biology degrees is well documented. The decline in content of plant based material within biology degrees has been rather overlooked, but is potentially even more important in terms of the future of our society. We have carried out an online survey of the explicit plant content of a random sample of biology degrees from old Russell Group Universities, Plate-Glass-Universities and Post 1992-Universities. The picture that emerges is stark, with more than a quarter of biology degrees appearing to have no plant content at all. We discuss the implications of this and what can be done to improve the situation.

14. Will Simpson: Investigating young people's attitudes towards plants

A greater understanding of the way in which humans connect with nature is needed following concern over a weakening or loss of this connection, particularly in young people. Not only is nature connectedness of direct importance to human welfare, it can help motivate pro-environmental behaviour in a future threatened by global environmental crises. This study focuses on a specific aspect of nature connectedness; the relationship between people and plants. Given the importance that plants have within nature, little research has been conducted into the variability in people's love of plants shown at different ages and the role that plants have for humans in the wider context of nature connectedness. In a cross-sectional sample of 584 participants aged 8-21 years, mainly from the Reading-London area of the UK, mean plant love was found to drop (starting from the age of 12 and continuing to the age of 14) before gradually being regained throughout early adulthood. No significant difference was found between ages however, which does not support the findings of recent studies into general nature connectedness. The influence of gender, amongst other factors, may better explain these results. Female participants reported significantly ($p = <0.01$) higher plant love (mean score = 8.07/10) than males (mean score = 7.36/10); findings which are consistent with previous research into gender differences in attitudes towards plants, as well as towards nature in general. The fact that there are seemingly few reasons to dislike plants is reflected in generally positive attitudes towards them, but further research and improved methodology are needed to accurately identify when are more effective times in young people's lives to inspire them about plants.

SYMPOSIUM PARTICIPANT BIOGRAPHIES AND ABSTRACTS

Symposium Keynotes:

Stephen Blackmore CBE, VMH, FRSE. Stephen studied botany for BSc (1973) and PhD (1976) at the University of Reading before working at the Aldabra Research Station in the Seychelles and the University of Malawi. He joined the Botany Department of the Natural History Museum in 1980, as Head of Palynology, becoming Keeper of Botany in 1990. In 1999 he moved to the Royal Botanic Garden Edinburgh (RBGE) as Regius Keeper. Since retiring in 2013 he has chaired the board of Botanic Gardens Conservation International (BGCI) and, until recently, chaired the UK Government's Darwin Initiative.

Keynote Abstract: The Plight of British Botany – International Perspectives.

My presentation will explore the decline in botany, offering some personal interpretations of what has happened in recent decades. I maintain that children are innately interested in nature, but are dissuaded from pursuing it as a serious educational option or career path. Circumstances are different in some other countries, notably China, which has seen dramatic expansion in its botanical institutes. I will argue that this growth reflects a strategic approach, lacking in the UK but strong in China, in which every aspect of botany is seen as providing the science needed to address the global challenges of food security, biodiversity conservation and climate change. There are no easy solutions, but growing awareness of the ecological crisis in wider society provides an opportunity to reposition botany as a key science for the future.

Julie Hawkins (Professor of Plant Systematics and Evolution, University of Reading).

Julie has taught Botany at Reading for 21 years, as lecturer, Reader and now Professor. She was discouraged from studying Botany by an A-level chemistry teacher, so has a first degree in Biophysics. She side-stepped with an MSc from Birmingham (plant genetic resource conservation and utilisation) and D.Phil from Oxford (plant systematics). In the early years in Reading she served as admissions tutor and programme director for BSc Botany. Her research is in the areas of plant evolution and evolutionary ethnobotany, and she has led on women in STEMM initiatives for the School of Biological Sciences in Reading.

Keynote Abstract: The plant pipeline: teaching challenges. The "leaky pipeline" metaphor is used to illustrate declining representation of women in STEMM at progressively higher career levels. I will use the pipeline metaphor to consider the interest in and representation of Botany in academia and society.



Alastair Culham
@botanyRNG

Session 1: Fascinating plants and their stories

Frank Mayle (Professor of Tropical Palaeoecology, University of Reading). Frank's pioneering work in the Amazon (Science 2000) demonstrated the responsiveness of southern Amazonian forests to millennial-scale climate change. Much of his research since has focused on forest-savanna ecotonal responses to Late Quaternary climatic change in Amazonian Bolivia, where he has led 10 field expeditions together with the Natural History Museum of Santa Cruz, Bolivia. His lab has assembled a world-renowned neotropical pollen reference collection (> 1200 Amazonian taxa) and has made important methodological advances in pollen analysis and other palaeoenvironmental techniques. More recently, Frank has become increasingly interested in the complex interplay between human land use, fire, climate change and ecosystem dynamics through the Holocene - across Amazonia and elsewhere in tropical South America. This has led to fruitful, inter-disciplinary collaboration with palaeoenvironmental scientists, biologists, and archaeologists across the world - in the UK, Germany, USA, Bolivia, and Brazil. Frank has a BSc in Botany (Reading 1986), MSc in Palynology (Sheffield 1988), and a PhD in Palaeoecology (New Brunswick 1993).

Abstract: Plants from the Amazon – a multitude of everyday uses. The Amazon rainforest is world-famous for its incredibly high biodiversity and huge carbon store, but most school students are unaware that it is home to many plant species – both wild and domesticated – which are of global economic importance and part of our everyday lives. This talk will show-case key Amazonian plant species and cultigens which have fascinating stories to tell; e.g. rubber, vanilla, chili pepper, cacao, cotton, sweet potato, manioc/cassava. The hope is to make direct tangible links between this far-way ecosystem and everyday foods and objects that young people are very familiar with – e.g. vanilla ice-cream, chocolate, spicy food, cotton clothing, bicycle tyres – in order to enhance school students' interest in this globally important ecosystem.

Robbie Blackhall-Miles (Fossil Plants). Robbie is one of a new generation of innovative horticulturalists blending the spheres of gardening and conservation. He is the driving force behind Fossil Plants, a BGCI-accredited backyard botanic garden, which houses a collection of early evolutionary plants. Robbie's specialism is propagating rare and unusual plants for horticulture, including some of the more unusual members of the *Proteaceae*. A fellow of The Linnaean Society of London, he sits on the Royal Horticultural Society's Nagoya Protocol working group and is Chair of the Australasian Plant Society in Great Britain. His writing for 'The Guardian' has enticed gardeners to step out of the boundaries set by mainstream horticulture, often engaging with uncomfortable concepts and issues such as non-native invasive species, the worldwide illegal trade in plants and 'Plant Blindness' – a concept that, until Robbie's 2015 article, had been stuck in the realms of scientific literature.

Abstract: Some weird fern relatives and the great Carbon challenge! Secondary school students from Oxford recently started a petition asking for climate change to be made a core part of the National Curriculum in England. We can interpret and start to understand climate change in a balanced and scientific way by looking at a strange group of plants that have been around for hundreds of millions of years: the clubmosses, horsetails and quillworts. The coal we burn today got its start with those plants over 300 million years ago, and the carbon entering the atmosphere from our use of fossil fuels is the same carbon that was locked up by these plants' early relatives. The challenge now is, how do we lock up that carbon again? Who are the scientists, technologists, engineers and mathematicians of the future that will manage the current rate of change and help humanity to survive it?

Nigel Chaffey (Plants R Us). Nigel is a Botanist who loves nothing more than reading, writing, thinking, and talking about plants (and plants-and-people interactions in particular). He practised that until recently via his monthly Plant Cuttings collections in the international plant science journal *Annals of Botany*, and as a Lecturer in Botany at Bath Spa University. He recognises the dangers

inherent in mankind's general lack of appreciation of the relevance and importance of plants in human affairs, and is keen to do something about it. Having recently left his university post he now describes himself as a 'Freelance Botanical Communicator'. In that role he continues to spread the word of the importance of plants in his writings (e.g. book reviews and Plant Cuttings items on *Botany One*, the *Annals of Botany's* blog site) and talks (such as the Big Botany Challenge! Symposium at Reading).

Abstract: Teaching botany by stealth... Greater botanical literacy amongst the public is desirable and its development can begin in our schools. An alternative to a plant-based session is to 'smuggle' a bit of botany into lessons on other subjects. Embedding botanical awareness in this cross-curricular way should help to emphasise the contribution – and therefore relevance – of plants to the modern world. Using cotton, this presentation shows how plants have relevance to topics as diverse as the Cold War, environmental stewardship of the planet, slavery, the Industrial Revolution, and mass entertainment (i.e. National Curriculum KS3 subjects such as History, Geography, Design and Technology, Science, and Citizenship – as well as Politics, Health Studies, Media Studies, etc...). This 'botany by stealth' approach can be extended to many other plants, and subjects and may play a role in helping to cure plant blindness in the longer-term.

Chris Thorogood (Oxford Botanic Garden & Arboretum). Chris is botanist and plant hunter and Deputy Director and Head of Science for the University of Oxford Botanic Garden and Arboretum in the UK. Chris is a Fellow of the Linnean Society of London, and is a Research Fellow at Linacre College, University of Oxford, where he teaches plant sciences, he is also an editor for the journal *Plants People Planet*. Chris's research focusses on the evolution of parasitic and carnivorous plants, and plant diversity in the Mediterranean Basin and Japan. He is a best-selling author including 'Weird Plants' and 'Perfectly Peculiar Plants'. A passionate communicator and ambassador for public engagement with plant sciences, Chris has made regular national and international TV appearances. Chris has painted since he was a child and seeks to capture the beauty of plants and animals in their natural habitats in a super-real style, using oil on canvas. His latest exhibitions 'Weird Plants' in Edinburgh and 'Flower to Frame' in Oxford, feature plants he has seen around the world, from the Middle East to the Old World tropics. See an example of Chris's work on the back cover.

Abstract: The evolution of new species of "killer plant"! Carnivorous plants are the green predators of the plant kingdom that fascinated Darwin, and generations of natural historians ever since. These 'killer plants' have evolved all sorts of leafy traps and snares to attract, trap, kill and digest animal prey. This talk will explore the process of speciation (the evolution of new species) in tropical pitcher plants. Pitcher plants have evolved all sorts of different strategies for acquiring nutrients – from leaves that trap insects, to 'tree shrew toilets' that capture animal droppings. Different pitcher shapes are associated with each strategy, and this appears to be driving the evolution of new species in this fascinating group of plants. Inspiring a new generation of plant scientists to explore, understand and conserve the diversity of tropical pitcher plant is essential: many face extinction, or are already lost to science forever.



Session 2: Connecting young people with career opportunities

Celia Knight MBE (Celia Knight Consulting). Celia's professional focus is to promote and facilitate plant science research, teaching and skills development, especially where relevant to the employment market. Celia is Academic Advisor for The Gatsby Plant Science Summer School for undergraduates, which she initiated at The University of Leeds and now continues at The University of Cambridge. Celia is chair of the advisory board for Royal Society of Biology's Plant Health Professional Register, (<http://www.rsb.org.uk/careers-and-cpd/registers/plant-health-register>). Working with government colleagues she developed the competency framework for plant health. Celia chairs the selection panel for the Plant Health Undergraduate Studentship programme (PHUGS) <https://www.rsb.org.uk/get-involved/grants/plant-health-ug-studentships>. Working with colleagues at Defra and the UK Plant Science Federation, she has increased the number of funding opportunities available. Celia was awarded an MBE in the Queen's Birthday honours list 2019 for services to plant science education.

Abstract: Career opportunities in biology. Wait a minute – shouldn't that be Career opportunities in Botany? Well, no. I will argue that we shouldn't need to be making a special case for plant science. Plants are not a niche element of Biology, they represent the major group of life-forms on earth. Over 80% of all living things are plants compared with just 0.01% for humans¹. Students interested in Biology should know that an understanding of plants opens up career opportunities, rather than narrows their options. I will discuss why our current careers advice to school students is limited and how we might address this in future.

¹Yinon M. Bar-On, Rob Phillips, and Ron Milo. PNAS June 19, 2018 115 (25) 6506-6511. The biomass distribution on earth.

Tamjid Mujtaba (UCL Institute of Education). Tamjid is Principal Investigator: Focus4Taps Evaluation and Co-Investigator: Chemistry For All; Co-Director: Broadening Secondary School Science. Tamjid has worked on a variety of funded research projects rooted in psychology, education and social sciences since 1999 at University College London Institute of Education. She has skills in quantitative and qualitative instrument design and analysis. Her particular interests focus around equity in education, girls' achievements and researching barriers and enablers of progression of those from disadvantaged backgrounds. She supervises doctoral students within the field of psychology and education with a particular interest in student achievement.

Abstract: Supporting progression in plant sciences. Research on effective careers education, factors which motivate students in science and the barriers to progression have implications for schools, teachers, families and outreach providers. Some factors have more impact on specific social groups such as students from socially disadvantaged families and may be affected by students' gender. The research and its implications can inform the actions and further work of the plant science community wishing to promote progression in this area across all social groups.

Session 3: Making the best of plants in the secondary curriculum

Hannah Cheek (Pearson Edexcel Sciences). Hannah is the Senior Qualification Manager for Edexcel GCSE Sciences. She joined Pearson at the start of 2019 after fifteen years of teaching Science in Secondary Schools and Sixth Form Colleges. She is responsible for ensuring that GCSE Science qualifications are meeting teachers and learners' needs and ensuring that all Edexcel's schools feel fully supported.

Abstract: Does assessment contribute to the lack of emphasis on plants in the curriculum?

The presentation will consider the coverage of plant biology across the Key Stages of the National Curriculum. As well as seeing where plant biology is covered – both in mandatory subject content as well as that selected for inclusion by Awarding Bodies – there will also be consideration of where teachers may select plant biology examples to illustrate biological principles during their teaching. Some examples of recent questions on plant biology and using plant biology contexts will be included.

Ann Scott (University of York). Ann is an honorary fellow in the University of York Science Education Group (UYSEG) and a part-time PGCE science curriculum area lecturer. Ann has worked on a number of curriculum development projects including Salters-Nuffield Advanced Biology which developed a context-led A level biology course, and Twenty First Century GCSE science producing textbooks and extensive online resources for both courses. She also undertakes consultancy work, for example reviewing Egyptian biology textbooks for UNESCO on behalf of the Egyptian Ministry of Education, and reviewed the new IB biology curriculum. Ann joined UYSEG after 10 years teaching in a large comprehensive school where she was Head of Biology. Prior to this Ann obtained a PGCE at the University of Bath after working for the Marine Conservation Society on a campaign to reduce coastal pollution.

Abstract: How can context-led A level teaching raise the profile of plant biology? The Salters-Nuffield Advanced Biology (SNAB) project developed a context-led A level biology course, assessed by Edexcel. Interesting and motivating stories frame each topic, providing a reason to learn the relevant biology content. Teachers following any A level course can teach content using mini-contexts similar to those found throughout the chapters of the SNAB resources. Teachers can provide plant-based contexts not only for traditional plant topics such as photosynthesis and plant structure, but also for the broader topics such as biodiversity, biochemistry, genetics and control of gene expression.

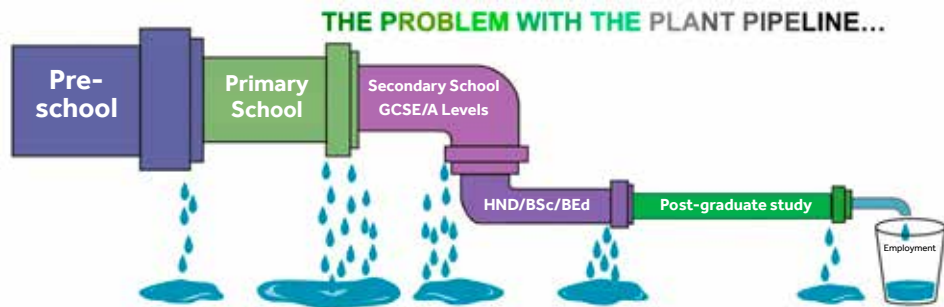


Dan Jenkins (Science and Plants for Schools (SAPS)). Dan is Head of the Gatsby Plant Science Education Programme and Director of the Science and Plants for Schools (SAPS) project. SAPS aims to boost the teaching of plant science through support for UK science teachers and technicians. Dan led the redevelopment of the SAPS portfolio of school science teaching resources to reflect ongoing curriculum developments and developed a 'Train the Trainer' scheme working with PGCE students and their tutors; the scheme currently works with over 70% of HEI teacher training centres in England to cascade positive plant science teaching ideas to the next generation of science teachers. Previously Dan managed the science education labs at the Institute of Education, University College London, and the Science Learning Centre London. Following his undergraduate studies in Botany, and roles at Kew and in botanical epidemiology research, Dan specialised in science education, and now has strategic oversight over the Gatsby Plant Science Education Programme which includes the undergraduate Gatsby Plant Science Summer School.

Abstract: Just because plants are amazing ... (What can research tell us about good botany teaching and learning?) The Gatsby Plant Science Education programme has been collaborating with the University of York to produce an Evidence Synthesis on better ways of teaching plant science in schools. The report will gather together evidence for those pre-conceptions in students which may present barriers to understanding plant science. In turn, these may produce barriers to progression in botany. Initial findings from this work will showcase ways to overcome these barriers; the report will inform a Gap Analysis to establish what further work may be needed.

Marcus Grace (University of Southampton). Marcus is a Professor of Science Education at the University of Southampton where for many years he has taught on the Science PGCE and maintained the outdoor science strand of the course. He is chair of the Academic Committee of ERIDOB (European Research in Didactics of Biology), and co-chair of the Royal Society of Biology's Biology Education Research Group (BERG). One of his research interests is looking at ways to engage children and adults in decision-making about conservation issues. Earlier in his career Marcus taught science at comprehensive schools in London and was Headteacher at a school in Tokyo, and he joined and led botanical expeditions to the Himalayas and North American tundra. He has a particular passion for mosses and liverworts and has recently developed an interest in growing dahlias!

Abstract: What role should plant science play in citizenship science? Citizen Science and Outdoor Science can be central to the education of young people, whether or not they plan to continue with a career in science. Plant stories are central to some of the big questions that students and their families might need to address. The controversies which arise in, for example, environmental issues, provide an opportunity for students to develop the knowledge and skills needed to make informed decisions. The contexts of real-world issues increase the relevance and importance of plants.



Session 4: What makes a great plant resource to inspire teachers & school students?

John-Paul Flavell (Kingston Grammar School). John Paul took the Masters in Plant Diversity at the University of Reading in 2015/2016. Following that he completed his PGCE training through a partnership of the University of Buckingham and the Headmaster' and Headmistresses' Conference (HMC) last year, John-Paul is now in his third year at the school. As well as teaching Biology across all Key Stages and First Year Science, John-Paul runs the school's Junior Science Club and has run events for Biology and Science Week. John-Paul has a BSc in Biological Sciences from Christ Church at the University of Oxford. From there, he spent half a year working for a conservation charity and then taught English in China for 5 months.

Sue Townsend (Biodiversity Learning Manager, Field Studies Council). Sue's career has spanned from her early desire to learn how to identify yellow dandelion-like plants to working as Biodiversity Learning Manager and the exciting role of managing biodiversity initiatives such as the Biodiversity Fellowship for the FSC. When Sue was a young field tutor at a non-FSC centre in the Lake District she was worried that she couldn't identify those difficult yellow dandelion-like plants and didn't know her Hawkbit from her Cat's Ear! She was advised to go on an FSC identification training course and was lucky enough to choose Preston Montford where her tutor was the late Franklyn Perring. This was she says, a wonderful and life-changing happenstance! She now works for the FSC having joined as an employee in 1988, she managed Preston Montford from 1994 to 2011 and still works in FSC Head Office.

Alastair Culham (Associate Professor of Botany, University of Reading). He is an avid promoter of science with a great love for Botany. He is a plant taxonomist combining molecular and morphological approaches with an interest in rate and tempo of speciation in plant lineages. He is co-author of 'Flowering Plant Families of the World' and 'Gardening in a Changing Climate'. His research team have worked on many different plant genera and botanical problems resulting in papers and many outreach events. Currently in the midst of preparing the #mygreenstudy launch week commencing next week.

Aaron Mills (Andover College). Aaron says: "I am A Level Biology teacher and I love plants. Like, properly love plants! However, I'm concerned that the majority of students I come into contact with have, at best, little interest in botany. I feel my students have been part of an education system where plant science is under-represented in GCSE syllabuses and, equally as important, a societal culture where 'grow your own' is no longer the norm. It's surprising to me that many of the 16/17 year olds I teach have never sown seeds – I mean, how can you get to that age and never sown a tray of seeds, let alone taken cuttings? By the time the students come to me it's no surprise they want to enter the medical profession, become marine biologists or the next greatest biochemist – because that's what they've been exposed to for the previous eleven years at school. Pleasingly, their negative view of botany can change. I've found that if they're engaged in practical botany like taking Geranium cuttings, growing herbs from seeds they can take home and competitions such as 'who can grow the tallest broad bean?'; even the most sceptical student can start to appreciate the fascination of plants. I'm convinced that if we teachers were able to integrate simple plant-based practical activities with their students, it would spark a life-long interest of botany for some of them. At the very least, I'd have fewer 16 year olds begrudgingly tolerating the botanical topics until the next zoology part of the syllabus is reached."

SYMPOSIUM COMMITTEE BIOGRAPHIES

Jonathan Mitchley (University of Reading). Jonathan is Associate Professor of Field Botany at Reading and teaches plant identification and vegetation survey and assessment at master's level. His research interests include grassland biodiversity and ecological restoration. He is increasingly spending time developing botanical outreach projects with schools and local communities and, as the web persona Dr M, curates a botanical website www.drmgoeswild.com. Dr M says: *"For too long now plants have been ignored or relegated to the position of green wallpaper, but currently there is a rekindling of interest and awareness of the greatness of the green stuff. The debate on plant blindness has made a significant contribution here, but also there is a groundswell of concern for global environmental issues such as extinction rebellion and the climate crisis and this provides a framework for positive growth in appreciation of plants and what they do for us. Plants are fascinating, beautiful and drivers of our sustainable biosphere, they are central to every critical environmental issue on the planet – we ignore them at our peril, let's embrace them and make the 21st century the century of plants!"*

John-Paul Flavell (Kingston Grammar School). See session 4.

Angela Hall (STEM Education Consultant). Angela's background is in science teaching, followed by curriculum design based at the Nuffield Foundation. At Nuffield she worked closely with scientists, schools, publishers and awarding bodies to develop curricula and resources for school science. Angela was the first Director of Science Learning Centre, London, at UCL Institute of Education, and has also been involved in teacher professional development. Her PhD from UCL IoE, is in Educational Design, working at the interface between science education, educational research and the design of learning resources. Angela has a particular interest in widening participation in science, having led on a variety of national intervention projects. Currently, she works in a freelance capacity, recently including initial teacher education at home and abroad and managing the Royal Society of Chemistry's Chemistry for All outreach project.

Andrew Happle (Lecturer in Secondary Science Education, University of Reading). Andrew is a lecturer in science education at the Institute of Education, University of Reading. He works across primary and secondary science. He's particularly keen on engaging and motivating students through hands-on practical activities that have a relevance to everyday life. He's also interested in how science links with other subject areas.

Julie Hawkins (Professor of Plant Systematics and Evolution, University of Reading). See Keynotes.

John Warren (Chair Training and Education Committee, BSBI). John says: "If you slice me in half it says "Botanist". John graduated in Plant Biology from Newcastle University and he has a PhD on *Senecio* (Ragworts) from York. His careers have included eight different universities, sowing wild oats, breeding chocolate and finally being the Vice Chancellor of the University of Natural Resources and Environment in Papua New Guinea. He has published widely on ecological genetics in the scientific journals and also written a number of more popular-styled books including "The Nature of Crops: How We Came to Eat the Plants We Do". Within these pages John explains why the Egyptians worshipped onions, why red-flowering runner beans provide fewer beans than white-flowering, the inherent dangers of being a pineapple worker and why a bird will always beat you in a chilli pepper eating competition!

Susan Medcalf (Botanical consultant, RSK Biocensus). My passion for plants grew as a kid with an immense curiosity of small things like plant galls, mosses and liverworts and sundews probably because I was very short-sighted. This blossomed into a resolve when I was 12 to study plants which led me on to read Botany at St Hilda's College, Oxford University. Along the way since then I've looked at plant chromosomes, counted pollen grains, propagated and weeded at two wonderful Botanic Gardens, sung about many things (including plants) in recitals and on opera stages all over the world, shared my love of plants with my children and family and had my life transformed by University of Reading's MSc in Plant Diversity. Now my lifelong passion for plants and my training enables me to work as a botanical consultant to make sure they have a voice.

Aaron Mills (Andover College). See session 4.

Simon Mortimer (Professor of Environmental Land Management, University of Reading). Simon Mortimer is Professor of Environmental Land Management and Head of the Department of Sustainable Land Management at the University of Reading. He read BSc Botany at UCL and gained a PhD in Plant Ecology at the University of Cambridge. His interests are in the relationship between land management and biodiversity and the delivery of ecosystem services in agro-ecosystems. With a vast experience of ecological field work, consultation with stakeholders, expert panels and farmer attitudinal surveys, he is author of over 75 scientific papers, lead author on reports for JNCC and English Nature, has worked for CAB International (an intergovernmental organisation that applies scientific expertise to solve problems in agriculture and the environment) and sat on the Chilterns Conservation Board. He is currently on the Executive Board of the Berkshire Local Nature Partnership.

Sue Townsend (Biodiversity Learning Manager, Field Studies Council). See session 4.

Tim Utteridge (Royal Botanic Gardens, Kew). Tim is a tropical botanist working on the plants of South-East Asia. He is Head of the Naming Department at the Royal Botanic Gardens, Kew, which undertakes fundamental taxonomic research and inventories and manages the curation of the 7 million Herbarium specimens. He first worked at Kew in 1991 doing a placement year during his undergraduate studies before doing the Pure and Applied Plant and Fungal Taxonomy MSc at Reading (1993-1994), and then going to the University of Hong Kong for his PhD (1995-1998). Returning to Kew in 1999 he undertook expeditions to New Guinea with the Mt Jaya Flora project. He has also held a variety of other roles at Kew including Head of the Millennium Seed Bank. Tim initiated Kew's Tropical Plant Identification course which has been run annually since 2004. He is currently finishing off a generic guide to the Trees of New Guinea, mapping important plant areas for conservation, and completing taxonomic revisions for several plant groups on the island.



Jonathan Mitchley
@drmgoeswild

Appendix 1: Plants in the curriculum audit

A curriculum audit has been compiled by Angela Hall which identifies plant science topics in the National Curriculum and suggests which general biology topics could be taught in the context of plants. A summary of this audit is provided below.

The full audit can be found on at: www.readingbotany.net. We encourage delegates to look at this working document and fill in, where indicated, examples of plant stories, resources and assessment relevant to curriculum topics. Some examples will be provided during the symposium discussions. Sample A (advanced) level and GCSE specifications are also provided to demonstrate the balance of plant science topics, non-plant science topics and those which could be taught using plant examples.

Summary of plant topics at Advanced level

At A level (using the example of Edexcel A, Salters–Nuffield): of the 18 core practicals, 6 are plant-based. Of the 120 statements in the specification, 15 are specifically plant topics, 59 could be illustrated by both plants and other organisms and 44 can only be illustrated by other organisms (not plants).

A level plant-based topics:

- Mitosis root tip squash
- Ultrastructure of plant cells and function of organelles
- Biochemistry and properties of cellulose and starch in relation to their functions in plants
- Sclerenchyma, xylem and phloem structure and function in transport and support
- Plant nutrition
- Drug development using plant-based compounds
- Antimicrobial properties of plant-based chemicals
- Role of plant material in sustainable plastic alternatives
- The role of seed banks in conservation
- Photosynthesis
- Plant productivity and respiration
- Evidence of climate change from peat bogs and dendrochronology
- Reforestation and use of sustainable biofuels
- Plant responses including effect of IAA and phytochrome on transcription

Summary of plant topics at GCSE

At GCSE, using the example of AQA Biology GCSE: of the 10 required practical activities, 3 are plant based. Of the 102 statements in the specification, 9 are specifically plant topics, 52 could be illustrated by both plants and other organisms and 41 can only be illustrated by other organisms (not plants).

GCSE plant-based topics

- Meristems and differentiation into specialised plant tissues
- Plant cloning and its role in conservation and horticulture
- Adaptations of roots and leaves for exchange
- Uptake of water by osmosis
- Structure and function of plant tissues
- Plant organ systems, including transpiration, transport, nutrition and active transport
- Viral, bacterial and fungal plant diseases and mineral deficiencies, and their effects on plants
- Development of digitalis and aspirin from plants
- Physical and chemical defence mechanisms
- Photosynthesis and the effect of light intensity on rate
- Starch and cellulose in plants
- Control and coordination through hormones – applications in horticulture
- Effect of light and gravity on seedlings
- Sexual and asexual reproduction
- Selective breeding
- Genetic engineering and GM crops
- Commercial uses of cloning
- Mendel and plant breeding
- Competition between species in a community
- Producers in food chains

Appendix 2: The Big Botany Challenge – relevant publications

Listed below are some selected publications relevant to the symposium themes which have been used by Jonathan Mitchley during the symposium planning stages. We have put pdfs of these on our website: www.readingbotany.net. We are keen to build on this collection so please send us further references, web links and pdfs of any relevant material to add to this portfolio.

- Bebbington, A. (2005).** The ability of A-level students to name plants. *Journal of Biological Education*, 39(2), 63-67. <https://doi.org/10.1080/00219266.2005.9655963>
- Buck, T., Bruchmann, I., Zumstein, P., & Drees, C. (2019).** Just a small bunch of flowers: the botanical knowledge of students and the positive effects of courses in plant identification at German universities. *PeerJ*, 7, e6581. <https://doi.org/10.7717/peerj.6581>
- Drea, S. (2011).** The End of the Botany Degree in the UK. *Bioscience education*, 17(1), 1-7. <https://doi.org/10.3108/beej.17.2>
- Flannery, M. C. (2019).** Interview with Maura C. Flannery: Drawing trees to see and appreciate them. *Plants, People, Planet*, 1(3), 150-152. <https://doi.org/10.1002/ppp3.47>
- Friedersdorff, J. C., Thomas, B. J., Hay, H. R., Freeth-Thomas, B. A., & Creevey, C. J. (2019).** From treetops to tabletops: a preliminary investigation of how plants are represented in popular modern board games. *Plants, People, Planet*, 1(3), 290-300. DOI: <https://doi.org/10.1002/ppp3.10057>
- Hartman, T., Lydon, S. J., & Rasmussen, A. (2019).** Hunting for answers: Linking lectures with the real world using a mobile treasure hunt app. *Plants, People, Planet*. <https://doi.org/10.1002/ppp3.33>
- Hiscock, S. J., Wilkin, P., Lennon, S., & Young, B. (2019).** Plants matter: Introducing Plants, People, Planet. *Plants, People, Planet*, 1(1), 2-4. <https://doi.org/10.1002/ppp3.14>
- Jose, S. B., Wu, C. H., & Kamoun, S. (2019).** Overcoming plant blindness in science, education, and society. *Plants, People, Planet*, 1(3), 169-172. <https://doi.org/10.1002/ppp3.51>
- Knapp, S. (2019).** Are humans really blind to plants? *Plants, People, Planet*. <https://doi.org/10.1002/ppp3.36>
- Kramer, A. T., Zorn-Arnold, B., & Havens, K. (2013).** Applying Lessons from the US Botanical Capacity Assessment Project to Achieve 2020 Global Strategy for Plant Conservation Targets1. *Annals of the Missouri Botanical Garden*, 99(2), 172-180. <https://doi.org/10.3417/2011110>

Krishnan, S., Moreau, T., Kuehny, J., Novy, A., Greene, S. L., & Khoury, C. K. (2019). Resetting the table for people and plants: Botanic gardens and research organizations collaborate to address food and agricultural plant blindness. *Plants, People, Planet*. <https://doi.org/10.1002/ppp3.34>

Lampert, P., Scheuch, M., Pany, P., Müllner, B., & Kiehn, M. (2019). Understanding students' conceptions of plant reproduction to better teach plant biology in schools. *Plants, People, Planet*, 1(3), 248-260. <https://doi.org/10.1002/ppp3.52>

Law, L. (2019). Interview with Lucinda Law: Finding inspiration in plants - The life and work of a botanical artist. *Plants, People, Planet*, 1(3), 146-149. <https://doi.org/10.1002/ppp3.50>

Levesley, A., Jopson, J., & Knight, C. (2012). The Gatsby Plant Science Summer School: inspiring the next generation of plant science researchers. *The Plant Cell*, 24(4), 1306-1315. <https://doi.org/10.1105/tpc.111.094326>

Loving the alien (2019). *Nature Plants* 5, 551. <https://doi.org/10.1038/s41477-019-0463-3>

McDonough MacKenzie, C., Kuebbing, S., Barak, R. S., Bletz, M., Dudney, J., McGill, B. M., ... & Tonietto, R. K. (2019). We do not want to "cure plant blindness" we want to grow plant love. *Plants, People, Planet*, 1(3), 139-141. <https://doi.org/10.1002/ppp3.10062>

Pany, P., Lörnitzo, A., Auleitner, L., Heidinger, C., Lampert, P., & Kiehn, M. (2019). Using students' interest in useful plants to encourage plant vision in the classroom. *Plants, People, Planet*, 1(3), 261-270. <https://doi.org/10.1002/ppp3.43>

Royal Society of Biology Strategic Plan 2019-2021. Biology Changing the World. Stagg, P., Stanley, J., & Leisten, R. (2004). Life Study: Biology A level in the 21st century. Report. London, UK: Wellcome Trust. https://www.rsb.org.uk/images/bcw/Biology_Changing_the_World_2019-2021.pdf

Stagg, P., Wahlberg, W., Laczik, A., & Huddleston, P. (2009). The uptake of plant sciences in the UK. A research project for the Gatsby Charitable Foundation. Coventry, UK: University of Warwick, The Centre for Education and Industry. <https://www.gatsby.org.uk/uploads/plant-science/reports/pdf/cei-uptake-of-plant-science-in-uk-feb-09.pdf>

The Royal Society of Biology. Mapping the biology curriculum. https://www.ase.org.uk/system/files/SSR_September_2018_23-29_McLeod_0.pdf

Thomas, H. (2019). Grass blindness. *Plants, People, Planet*. <https://doi.org/10.1002/ppp3.28>

Wyner, Y., & Doherty, J. H. (2019). Seeing the trees: what urban middle school students notice about the street trees that surround them. *Journal of Biological Education*, 1-23. <https://doi.org/10.1080/00219266.2019.1667407>





Bat and pitcher plant from a painting
by Chris Thorogood
@thorogoodchris1

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