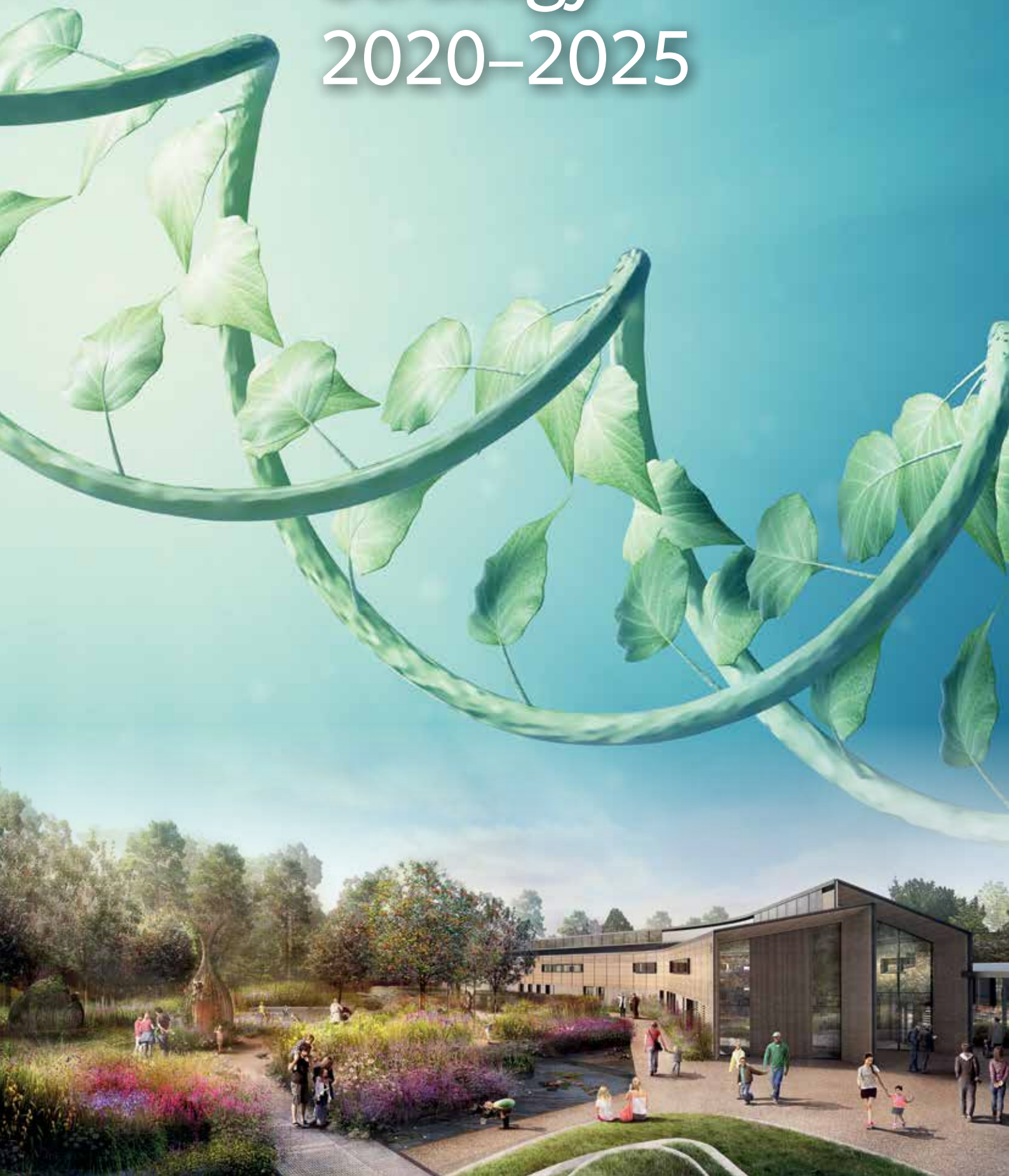


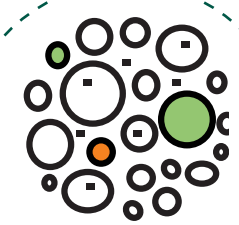
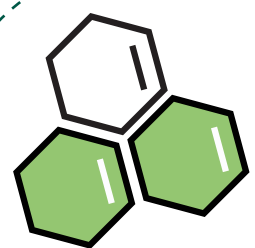
RHS Science Strategy 2020–2025



The RHS Vision

To enrich everyone’s life through plants, and make the UK a greener and more beautiful place.

- 3 Introduction to the RHS Science Strategy
- 4 The RHS Science Strategy and the RHS Vision
- 5 RHS Greening Great Britain
- 6 Our Scientific Mission; Our Scientific Vision
- 7 The new National Centre for Horticultural Science and Learning
- 11 Key Science Themes
 - 12 1 Garden Plant Diversity: optimising the genetic potential of garden plants
 - 14 2 Plant Health: healthy plants, gardens and wildlife
 - 16 3 Environmental Gardening for Wellbeing
- 18 The Global Knowledge Bank on gardens, gardening and garden plants
- 20 Delivering our research
- 22 Growing a strong future for UK Horticultural Science
- 24 Where will you see the results?
- 26 Timeline



Introduction to the RHS Science Strategy

The next five years will be an exciting time for RHS Science, as our scientific resources are focused in their new home – the National Centre for Horticultural Science and Learning at RHS Garden Wisley, Surrey. For the first time, this brings together our laboratories, research facilities, our collections, learning spaces and gardens together in one dedicated area – demonstrating that science and education are at the heart of the RHS and all its horticultural endeavours.

This marvellous centre will equip us to meet the challenge of the skills shortage in UK horticulture, and help us share with everyone our deep knowledge of, and our enthusiasm for, plants and their role in our world.

It will also enable us, over the next five years, to focus our scientific work on garden plants: their diversity, their health and their effect on our wellbeing. Enriching everyone’s life through plants in this way will help us achieve the RHS Vision.



Professor Alistair Griffiths
RHS Director of Science & Collections



The RHS Science Strategy and the RHS Vision

The founding purpose of the Royal Horticultural Society was to improve ‘the science, art and practice of horticulture’, placing horticulture and science firmly at the heart of the RHS from its first day. This strategic vision, as defined by Sir Joseph Banks, John Wedgwood and others, has guided the RHS’s activities throughout its history and provides a sound basis to meet the challenges facing today’s gardeners. Through scientific research and our collaboration with universities and other research and education organisations, the horticulture industry, RHS members and gardeners, we are able to provide the knowledge to inspire people to grow. And this will improve their health and their environment, and fulfil the RHS Vision **‘to enrich everyone’s life through plants, and make the UK a greener and more beautiful place’.**



The 21st century poses new horticultural and societal challenges for Britain’s population and our planet. Key issues we face include:

- climate change, extreme weather events and increasing demand for water
- increasing biosecurity risks such as pests, diseases and weeds
- challenges of managing pests, diseases and weeds, with limited availability of pesticides
- poor connection with nature and decreasing social, mental and physical wellbeing
- reduced spaces for growing and reduced resources, due to population growth and increasing urbanisation.

The RHS Greening Great Britain (GGB) campaign is a key contributor to achieving the RHS Vision. Our scientific research supports this campaign by growing and sharing our knowledge bank on how plants and gardening can improve our health, and benefit the environments in which we live.

By building understanding and encouraging engagement with all aspects of horticultural science and garden heritage, we can develop a nation of gardeners equipped and motivated to deal with the challenges of our changing world.



Greening Great Britain

This second RHS Science Strategy will support RHS Greening Great Britain by:



Improving health (of people and plants)



Supporting the environment and wildlife



Building opportunities for learning



Growing fulfilling horticultural careers

Our Scientific Mission

We will conduct authoritative and high-quality research on the science, art and practice of gardening to help more people grow a greener Great Britain that enriches everyone's life through plants.



Our Scientific Vision

To be recognised as the pre-eminent research hub and knowledge bank for gardening science. To provide evidence and new knowledge that advances the practice of horticulture to improve the health of people, plants, the environment and wildlife.

The new National Centre for Horticultural Science and Learning

Our new, state-of-the-art building at RHS Garden Wisley, Surrey, will be the base for RHS Science & Collections. For the first time it brings together scientific research, our collections, education and public engagement.

The centre will provide a brand new visitor and research library, along with inspirational spaces for events, exhibitions, interpretation of science, networking and conferences. The centre and its surrounding gardens will be a place to teach and enthuse primary and secondary school pupils about science, technology, engineering and mathematics (STEM).

This brand new facility will enable us to:

- Develop and use our scientific research to advance horticultural practices
- Engage the public and the horticulture industry with science and gardens by making research results relevant and actionable
- Train the next generation of horticultural scientists to grow fulfilling careers and address the skills shortage (Horticulture Matters)
- Understand and represent the interests of gardeners to inform, influence and work with policy-making bodies
- Be recognised as the pre-eminent research hub and knowledge bank for gardening science
- Embed our scientific research results in our education programmes
- Safeguard and share our nationally important heritage and scientific collections (see the forthcoming *RHS Collections Strategy* for details).

All of these will help us in Greening Great Britain and achieving the RHS Vision of improving everyone's life through plants and making the UK a greener and more beautiful place.



New Research Facilities

The Herbarium Suite

This will ensure that our herbarium collections are stored in optimal environmental and pest-free conditions, preserving them for the future. Additional storage space in this environmentally controlled herbarium makes possible our objective to collect samples of all the cultivated plants found in gardens throughout the UK.

Additional workspace will allow more researchers and students to use these herbarium collections for taxonomic research and for writing much needed monographs on key UK garden plants. The RHS herbarium will become the reference and research resource for garden plants in the UK.

The Plant Health and Molecular Laboratories

These will have containment standards, so for the first time we will have the necessary facilities to undertake scientific work on regulated pests and diseases affecting UK gardens. Along with new equipment, this will greatly improve our diagnostic capability

through the use of techniques such as Real Time PCR (Polymerase Chain Reaction). The molecular laboratory facilities will increase our capability in the identification and taxonomic understanding of key garden plants through molecular methods. Our existing pathology and entomology collections will be stored in suitable environmental conditions and we will have more space to develop these important reference and training collections, so as to more fully represent invertebrates and key disease groups from UK gardens.

The Environmental Horticulture Laboratory

This will complement our existing Field Research Facility (FRF) and will benefit from new equipment that will improve our research around soils, water, air and plant interactions in gardens.

The Research Library

The library will focus on works in the fields of horticultural taxonomy, plant health and the environment and will for the first time bring together the best scientific literature from our existing research library and the RHS Lindley Library at Vincent Square, London. See the forthcoming *RHS Collections Strategy* for more details.



Horticulture Matters

These new facilities will allow us to increase the number of collaborative PhDs and Fellowships that we can support – as well as benefiting RHS staff, apprentices, plant committees, School of Horticulture students, external researchers, schoolchildren, teachers, volunteers and communities. All of which helps inspire and train the next generation of horticultural scientists.

Atrium Space

This new centre will provide students and staff, our collaborators and external scientists, as well as horticulturists and plantspeople, with a unique opportunity to talk face-to-face with visitors and draw on the knowledge and experiences of UK gardeners to produce research that answers key questions with real-world applications – truly making a difference.

Gardens

The centre will be surrounded by new Wellbeing, Wildlife and World Food experimental gardens designed for teaching and directly involving the general public, RHS members, communities and school visitors in our research. The focus of these gardens will be on health (people, plants, planet), the environment and wildlife and to inspire everyone to grow – whether as a hobby or as a fulfilling career in horticulture.



Key Science Themes

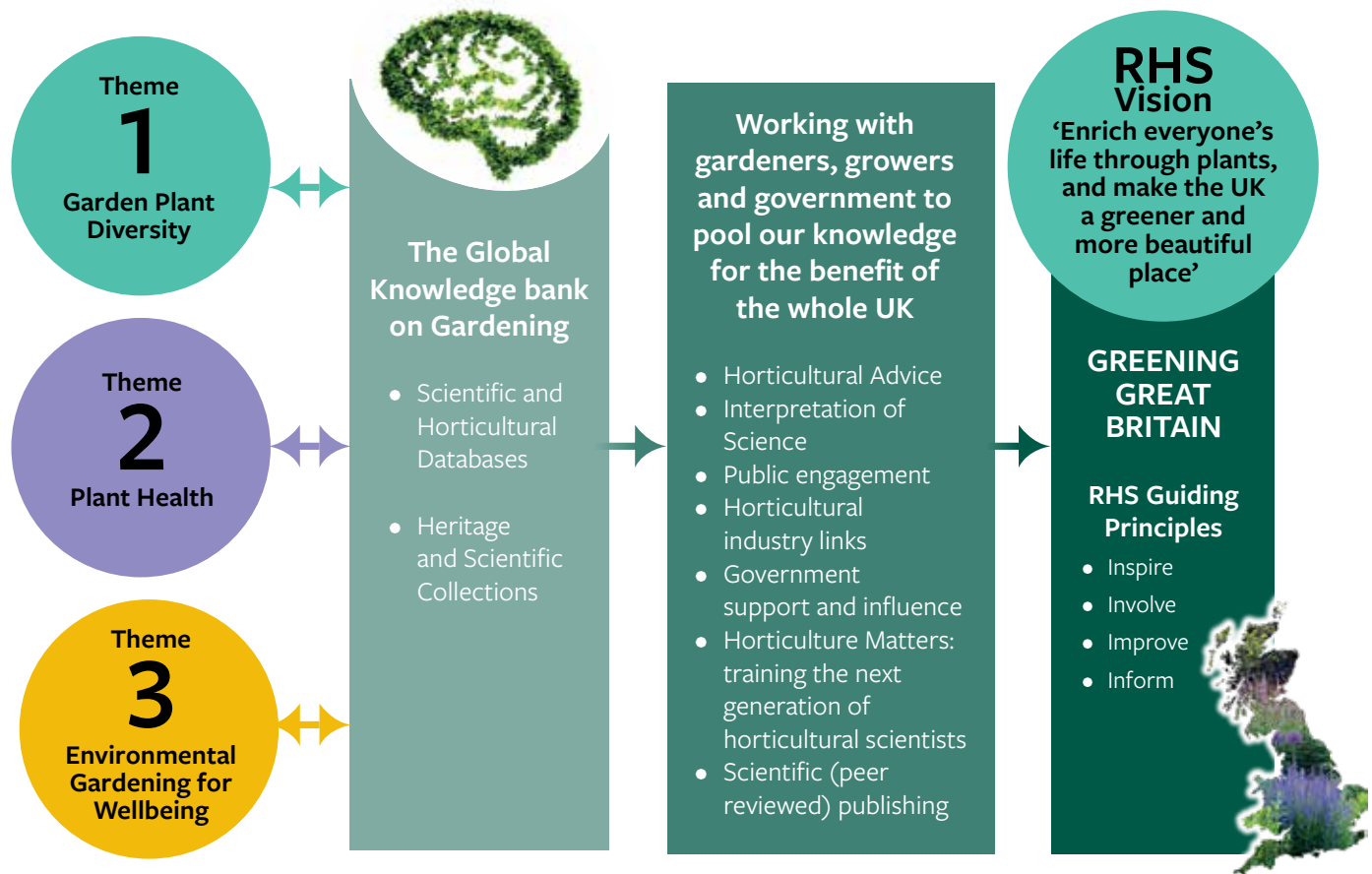
In this strategy, we continue to build on the key themes from the *RHS Science Strategy 2015–2019* with changes that reflect our developing strengths and opportunities to make a difference.

Having worked with the UK government on invasive plants, we will now step back from this area. Instead, we will focus on the positive role of cultivated plants in the environment and concentrate our efforts on improving their use, cultivation and conservation as well as further developing our work in molecular genetic studies on cultivated plants.



This will in turn fuel our focus on better understanding how plants, gardens and gardening affect individuals, communities and the wider ecosystem. Another new focus will be on growing food in domestic, community and school gardens as we seek to connect more people with nature and improve understanding of our food.

In addition to this strategy we are developing a separate *RHS Collections Strategy*. This will, for the first time, focus on the vital role of our scientific and heritage collections in supporting scientific and historical research and in communicating our knowledge of the rich history and heritage of gardening in the UK.



1 Garden Plant Diversity: optimising the genetic potential of garden plants

With almost 4,000 new plants entering the plant trade in the UK each year through *RHS Plant Finder* nurseries alone, knowing what we are growing and the impacts of what we choose to grow is crucial to supporting decision-making among gardeners, growers and the government. The RHS is uniquely placed with its focus on cultivated plants to provide a hub of expertise on the correct naming and identity of plants in cultivation that improves the quality of both our own research and that of partners across the UK and globally.

The diversity of plants in UK gardens is poorly documented, and this makes conserving and taking advantage of that diversity difficult for gardeners, the horticultural industry and the government. Correct taxonomy and identification is the key to unlocking the potential of our garden flora to provide us with ecosystem services (the health and environmental benefits garden plants can offer) such as pollution and flood mitigation, wellbeing, wildlife support, and mental, physical and social health benefits.

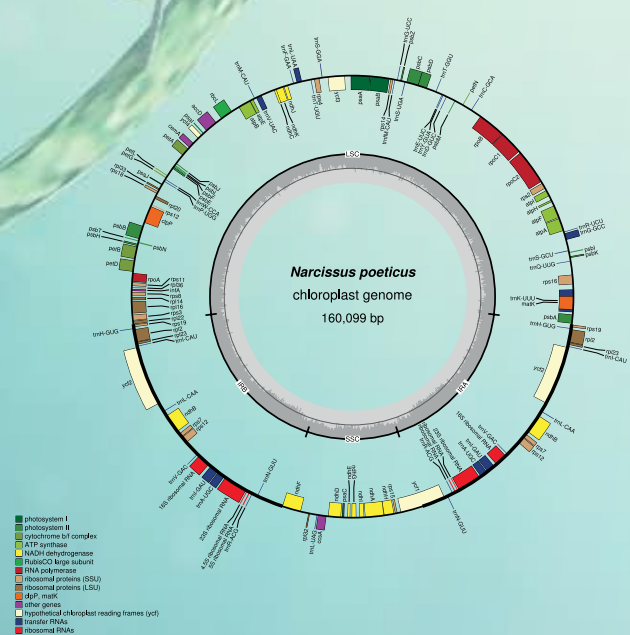
Understanding popular plants

Daffodils (*Narcissus*) are popular and widely grown bulbs in the UK. While more than 30,000 cultivars are recorded in the *International Daffodil Register and Classified List*, there are approximately 1,700 cultivars currently available in trade in the UK. The genus contains 25 to 30 species that have given rise to the wide range of cultivated daffodils in our gardens. There is no modern reference work on the

Our work to characterise and document cultivated plants, using traditional and molecular means, will support wider scientific research and government decision-making. Building our herbarium (the only UK herbarium dedicated to cultivated plants) will provide a comprehensive reference collection for researchers.

Meanwhile, our thorough study of popular garden plants such as daffodils will help gardeners access a much wider pool of plants. As an International Cultivar Registration Authority for nine plant groups (Clematis, Conifer, Daffodil, Dahlia, Delphinium, Dianthus, Lily, Orchid and Rhododendron), we want to improve name reliability for users by keeping track of plant names and making this information available online. The RHS monograph series will continue to draw gardeners' attention to the vast diversity of plants available, encouraging them to plant a greater range and to consider their wider benefits.

genus, and the aims of the research programme are to deepen our knowledge of its taxonomy and understand how the diversity of daffodil cultivars has arisen. This will help inform future breeding as well as support accurate naming of species and cultivars. This research, carried out in collaboration with the University of Reading, uses a wide range of molecular approaches alongside the study of daffodils both in the wild and in cultivation.



2 Plant Health: healthy plants, gardens and wildlife



- Monitor plant pests and diseases in gardens
- Improve detection and identification of plant pests and diseases
- Advance control and management strategies for plant pests, diseases and weeds in gardens, while decreasing chemical use (working towards minimising pesticide use in gardens)
- Encourage good stewardship of nature in gardens for environmental benefit

The RHS is uniquely placed among gardeners, growers and the government to share insights and strategies around the increasingly grave plant health risks facing the UK. Under our previous 2014–2019 strategy, a foundation of in-house research supported by collaborative projects has enabled the Plant Health team to significantly step up its work on both existing and emerging pests and diseases – advising both gardeners and policy-makers on what they should do to keep gardens and the wider environment healthy.

Through close connection with RHS Gardening Advice, the team identifies and explores the threats being experienced in UK gardens right now. Priority in-house research areas will focus on delivering practical control and management strategies for key gardener concerns such as:

- slugs and snails
- problems affecting box plants (especially box blight and box tree moth)
- *Armillaria* (honey fungus).

Emerging threats to UK horticulture will also be explored through collaboration with government and partners on key projects including:

- BRIGIT on *Xylella fastidiosa*
- EU 2020 project HOMED on forest health.

Policy, procedures and training for RHS Gardens and RHS Shows will be implemented and embedded under this strategy in order to ensure that the RHS models good plant health practice and demonstrates how our approach must change to safeguard plants and gardens for the future.

Wildlife

Understanding how to achieve maximum value for wildlife from gardens and green spaces, particularly in urban environments, is a key challenge under this strategy. Rebuilding people's connection to nature for their wellbeing requires good stewardship of that natural world to ensure a healthy and sustainable ecosystem.

Reducing pesticide use is a key concern for many gardeners, and central to an integrated approach to garden pest and disease management. Exploration of biological and cultural approaches and an improved understanding of plant resilience to threats are therefore vital in all our research.



Xylella fastidiosa is a bacterium which causes disease in more than 500 species of plants, from herbaceous perennials to trees, both ornamental and crop plants, and native flora. Infected plants have scorched or wilted leaves, and may eventually die. There is no cure for the disease.

The disease was restricted to the Americas, where it caused serious damage to citrus, grape and peach crops. In 2013, *Xylella* was identified in olive groves (below) in the south of Italy and it has killed millions of trees. It has subsequently been identified in ornamentals, such as lavender, oleander and rosemary, in France, Portugal and Spain.

The bacterium is transmitted

by leafhoppers and froghoppers/spittlebugs, insects common in the UK, that feed on xylem fluid. If infected plants are imported, the bacterium could establish – with serious consequences for horticulture and native ecosystems.

It is not known how the bacterium might behave in northern Europe as most research has been done in warmer climates. To reduce the risk of *Xylella* being introduced and to increase our capability to respond to an outbreak, the BRIGIT project (<https://www.jic.ac.uk/brigit>) has been funded by the government. Scientists in twelve UK research organisations, including the RHS, are involved in this project.



3 Environmental Gardening for Wellbeing

- Advance the understanding of cultivated plants, gardens and gardening to adapt and mitigate against climate change and improve our environment
- Encourage sustainable resource use in gardens for environmental benefit
- Advance knowledge for growing food in domestic, community and school gardens to improve nutrition and wellbeing
- Better understand the role of plants, gardens and gardening in improving social, physical and mental wellbeing, for individuals and communities



Gardens, plants and gardening could play an ever-greater role in addressing a wide range of problems affecting society at large. Understanding how the choices we make about our plants and gardens affect our health and environment and studying what we can do to maximise the positive impact is central to the RHS Science Strategy.

The positive impact of being outdoors and engaging with nature has been well documented. However, we still need to better understand the impact that various colours, styles, scents and features in gardens have on our wellbeing. The Wellbeing Garden at the new National Centre for Horticultural Science and Learning will provide a living laboratory for exploring these questions with our visitors.

A new feature of this strategy is the exploration of food growing in domestic, school and community gardens and the role that it can play in inspiring people about food and horticulture – building understanding of nutrition and creating social and community conversations.

Continuing our exploration of the ecosystem services provided by plants and gardens, we will increasingly be able to advise gardeners on plants they can choose to solve challenges such as a changing climate, air pollution, urban heat islands, wildlife decline and home energy efficiency. Understanding how both plant physiology and husbandry impact on ecosystem service provision is a key part of this strategy.

With so much potential for positive impacts on people, mindfulness of the resource use within gardens is vital in ensuring that gardens are climate-proof and sustainable now and in the future. As weather patterns change, population increases and pressure grows on natural resources including water, soils and energy, we must find ways to be more efficient in our gardening. Our research into sustainable water use, growing media, soil carbon and greenhouse gas mitigation will deliver practical information for gardeners and growers on how to balance resource use and garden more environmentally.



Knowledge Transfer Partnership (KTP) on garden water use

In order to answer enduring watering questions for gardeners, the RHS has recruited the UK's first Garden Water Scientist. Janet Manning (left) is working on a three-year collaborative KTP project with Cranfield University investigating innovative and cost-effective ways to cope with the changing water levels in gardens.

'I've suffered gardeners' problems first-hand, frequently asking myself all the common questions, such as how much water does this plant need? Through my work as a water scientist, I want to fill this gap in knowledge.'

The KTP is jointly funded with Innovate UK, a non-departmental public body that supports delivery of the UK Government's Industrial Strategy.

The Global Knowledge Bank on gardens, gardening and garden plants

The ultimate aim of research is to collect, collate, integrate and generate knowledge. The RHS is a knowledge-driven organisation: what we know and being able to share it is perhaps our biggest asset.

Under this strategy we will grow our Global Knowledge Bank through research and through our collaborations, connections and conversations with gardeners, industry, academia, the government and our horticultural network. Integrating the best of the available information with our own, we will use it to advance our thinking and know-how.

We will manage our knowledge, information and data to ensure that it is secure, accessible and able to support us now and in the future.

Crucially we will share and publicise our knowledge through a wide range of channels in order to change behaviour and realise the RHS Vision through others. To do that we need gardeners to adopt best practices, garden more environmentally and choose a diverse array of plants that deliver benefits that improve lives and the environment. We need growers to use resources mindfully and develop products that gardeners want and need to get the most from their gardens.

Finally, we need government to support research, maximise the value of plants in our towns and cities and build safeguards in legislation that protect both the heritage and future of our gardens.



The RHS Collections Strategy

What the RHS knows about plants and gardening has its roots in our history and the heritage of gardening in the UK. This is a key strength of our collections, enabling us to provide a social, economic and cultural view as well as a scientific one. In 2020 we will publish the *RHS Collections Strategy* that brings together the development, management and use of diverse collections such as the herbarium, photographs, artwork, books and archives. The Collections

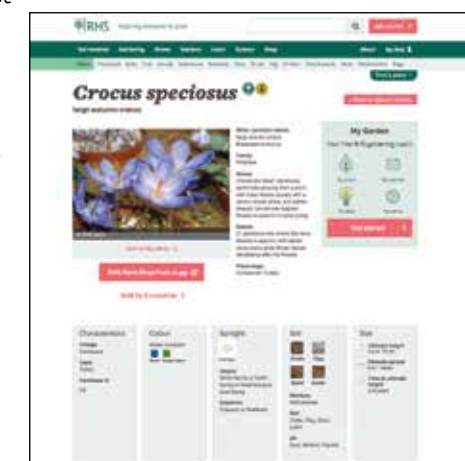
Strategy will strengthen and support the Science Strategy by ensuring that our scientific research is informed by the wealth of our collections. Through the Collections Strategy we will further build our reputation as the go-to place for gardening and garden plants for a wider audience including historians, artists, designers and a host of others.



A modern, accessible Horticultural Database – managing what we know

Having begun it under the *RHS Science Strategy 2015–2019*, work to ensure that our Horticultural Database will support our research and communications ambitions will be completed in 2020/21. The new solution will be deeply embedded in the new National Centre for Horticultural Science and Learning, providing access to gardening information for both staff and visitors and facilitating the online experience for those who cannot visit in person.

Containing everything the RHS knows about plants – including taxonomy, plant records for our gardens, nursery stockists for *RHS Plant Finder*, growing know-how, cultivar registrations, herbarium records and much more – this database is both huge and complex, but this project will bring it into the 21st century in terms of technology, accessibility and connectivity. It will create a strong foundation for future research and make our information more usable and flexible, allowing us to better support gardeners.



RHS Gardening Advice – sharing what we know

A key aspect of the RHS's charitable mission is to share what we know for the benefit of gardeners and UK gardening. It is therefore critical that we not only carry out research but that we publish and interpret that research so that it can be used by the wider gardening world.

RHS Gardening Advice will continue to play a key role in getting our know-how to gardeners, through the members' one-to-one service, at shows and increasingly online. New services such as the online enquiry service, face-to-face advice at RHS Gardens Harlow Carr, Hyde Hall and Rosemoor, and our Twitter and Instagram clinics will continue to be embedded and improved to ensure that gardeners are getting information that helps them garden more and better.

All major RHS-led research projects will be developed into practical advice for home and community gardeners, schools and the wider horticultural world. These will be made available through rhs.org.uk/advice and widely shared through national media.

We will work towards having comprehensive online growing guides for all 200 of the UK's most popular garden genera, making use of the improved connectivity of the Horticultural Database and making some information available online for the first time. Improving our online navigation will make cultivar level plant profiles and detailed 'how-to' information more easily accessible to gardeners of all experience levels – supporting them to build their understanding and have success in the garden, benefiting their health and the environment.



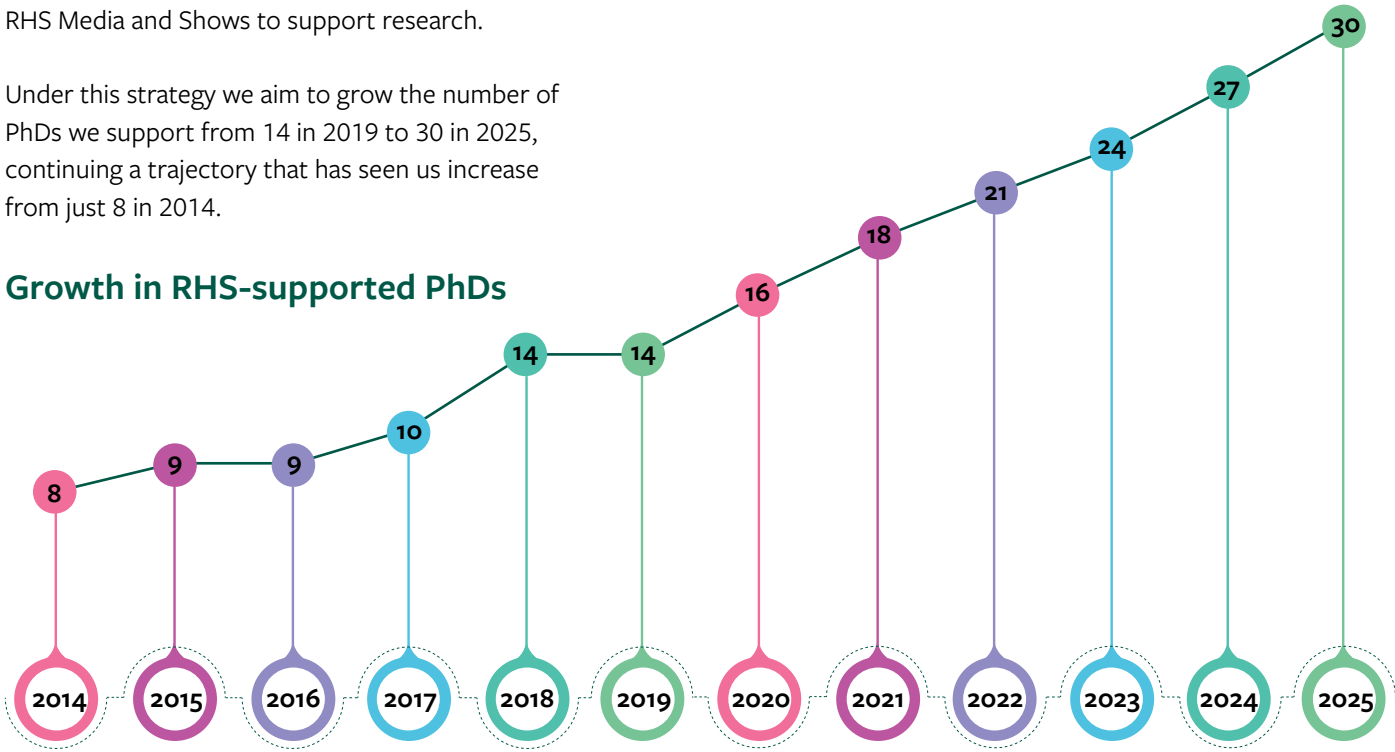
Delivering our research

Independent research that will take place at the new National Centre for Horticultural Science and Learning receives funding from the RHS and also relies upon securing funding from government, industry, universities, other charities and donors. Collaboration both across the RHS and beyond is key to maximising our impact, and during this strategy we will further build our relationships for the benefit of the whole UK.

The RHS also supports PhD and post-doctoral fellowships (from 2020) that deliver against the themes and priorities of this strategy in collaboration with universities, research institutes and industry partners. Support is provided both as funding and as research support with use of RHS research facilities and scientists as supervisors along with access to RHS Media and Shows to support research.

Under this strategy we aim to grow the number of PhDs we support from 14 in 2019 to 30 in 2025, continuing a trajectory that has seen us increase from just 8 in 2014.

Growth in RHS-supported PhDs



Theme 1

Our work on garden plant diversity will make a difference by:

- Delivering the UK Garden Flora: Knowing, optimising and realising the genetic potential of ornamental horticultural crops to benefit the environment and human health
- Improving identification to enable better plant cultivation and conservation
- Promoting plant selection and breeding for environmental and health benefits.



Theme 2

Our work on plant health will make a difference by:

- Improving and safeguarding plant health and biodiversity in UK gardens
- Reducing the risk of new pests and diseases entering and negatively affecting UK gardens and the wider environment
- Providing Integrated garden pest management solutions to reduce reliance on pesticides and have healthy plants and gardens.




Theme 3

Our work on environmental horticulture will make a difference by:

- Developing solutions towards better adaptation for and mitigation against a changing climate
- Improving understanding of the potential of gardens, garden plants and gardening to improve human and environmental health
- Building resilience through better resource management, soil health, garden plant choice and sustainability.



Growing a strong future for UK Horticultural Science



If we are to truly make a difference under this strategy, our commitment must extend beyond today and equip the UK with the skills and know-how that are needed to secure a sustainable, healthy future for people, plants and the planet. Commitments made by the RHS, industry and government under the Horticulture Matters campaign remain a focus in order to boost the numbers of young people choosing horticulture and horticultural science as careers. By working with RHS Education, universities and other horticultural institutions we will improve the appeal and visibility of horticultural science careers as well as providing exciting new opportunities.



Work Experience Provide opportunities for young people to experience the variety of horticultural science careers by delivering three secondary school work experience student (age 18 upwards) placements each year plus three summer placements for degree students by 2021.

STEM Ambassadors Better engage primary and secondary schoolchildren at RHS Gardens and Shows by increasing our Science, Technology, Engineering and Mathematics (STEM) ambassadors from three to nine by 2025.

Horticultural Students Inspire and engage horticultural students by embedding exciting new science and know-how from our research in the RHS curriculum across both the School of Horticulture and RHS qualifications taught at colleges across the country.

Education in Environmental Horticulture Communicate the environmental and wellbeing insights developed by RHS Science through the broad range of learning activities offered by the RHS. This will include everything from school visits to RHS Gardens to RHS qualifications, through to degree level and upwards. We will support the development of high-level environmental horticultural skills through the implementation of new programmes of learning for professionals.

Staff development Cement our position as the pre-eminent research hub for horticultural science by attending and presenting at conferences and events, building our peer-review publishing profile and promoting our work through the media. Develop our staff skills in scientific techniques, experimental design and statistics as well as communication and engagement across a wide range of audiences.

Professional Training Build an informed, up-to-date cohort of professionals by delivering training for horticulturists and scientists on plant health, environmental horticulture, botany and other insights from our research.

Explore the possibility of a masterclass on horticultural science (one week) in collaboration with other leading horticultural and landscape organisations..

Gardener Learning Engage home and community gardeners, schools and our horticultural network to be advocates for best practice by building insights from our scientific research into leisure learning courses, RHS Gardening Advice and online content.



Where will you see the results?

RHS Community and Education Programmes
Embedding our scientific research and advice into the full spectrum of RHS education resources and connecting with community outreach work helps ensure our work reaches across the UK, maximising the benefit to people and the environment.

UK Gardens Through gardeners, industry and government we will make the UK a greener and more beautiful place.

RHS Online A revamped Science section on rhs.org.uk will provide access to our research, communications and events for digital visitors. RHS Gardening Advice online will develop further to support gardeners, and the improved Horticultural Database will enable new information products that give access to RHS knowledge, information and collections in exciting new ways.

Media & Publications Communicating both ‘the what’ and ‘the why’ of our research is central to our media strategy. Sharing actionable insights through interpretations of research communicated via popular media channels sits alongside

publication of peer-reviewed scientific papers and books such as *RHS Plant Finder* and the monograph series in helping us reach the widest possible audience.

Government Policy We will be providing expertise and input into policy and legislation as well as facilitating discussions under the Ornamental Horticulture Roundtable Group.

Citizen Science We will leverage the 27 million potential garden citizen scientists in the UK to both improve our understanding of what’s happening in gardens and to inform and inspire others about the important role of gardens in the environment.

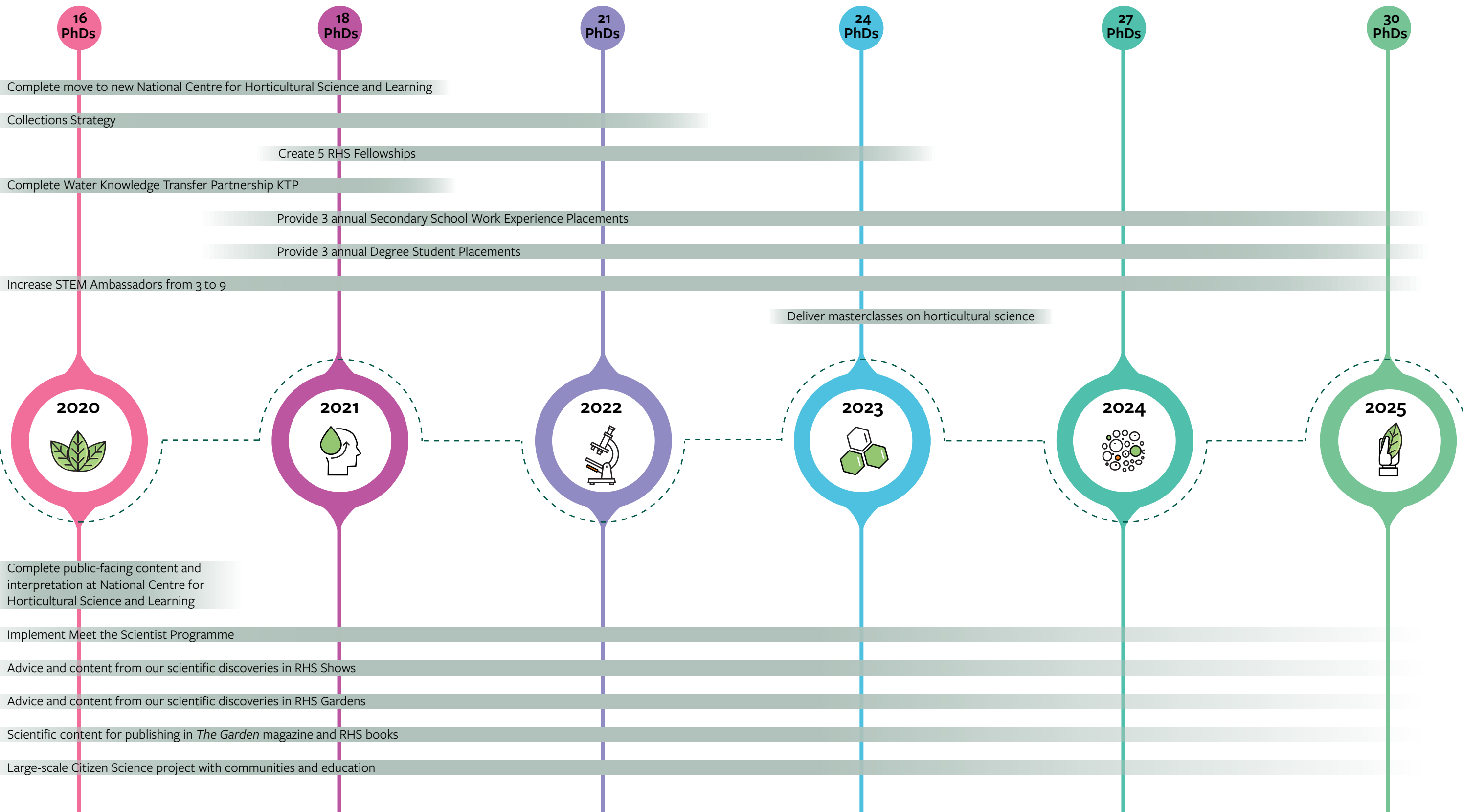
Conferences, Shows and Events The new National Centre for Horticultural Science and Learning will host a range of science-focused conferences and events, including the annual John MacLeod lecture. RHS scientists will be sharing their findings at international science conferences, shows and events as well as through a new Meet the Scientist programme at RHS Garden Wisley.



Timeline

RHS Science Strategy Timeline from 2020

Increase PhD Projects





rhs.org.uk

Royal Horticultural Society

RHS Garden Wisley, Woking, Surrey GU23 6QB

scienceadmin@rhs.org.uk

All photographs and artists impressions of the National Centre for Science and Learning © RHS
Additional images © stock.adobe.com

RHS Registered Charity Number 222879 / SC038262