

# UNDERGRADUATE PROGRAM IN PLANT BIOLOGY



***For more information, contact:***

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# Why study plants?

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Plants have long been linked with human existence and play major roles in every aspect of human life from their production of vital oxygen, a food source, fuel production, discovery of natural products for medicinal drug discovery, adding aesthetic value, recreation, and much more. Given that plants are critical in various aspects of the survival of humans and the planet, the research and study of plants will always remain critical and necessary. Plant Biology is the scientific study of plant physiology and cell biology, molecular biology and genetics, and ecology and evolution. Applied plant research covers the study of plant pathogens, biofuels, pharmaceutical discoveries, or any area that focuses on plants and its environment for human application.

## **The Undergraduate Plant Biology Program at Rutgers**

The plant biology program at Rutgers is designed for students with career interests in areas related to food, fuel and fiber, turfgrass, natural products, plant breeding, plant pathology, and plant disease resistance. Independent research is a central theme in this program, which allows students to gain experience in field or laboratory with a faculty member on a specific research topic in plant related investigations. There are three program goals (understand, communicate and apply/solve) for students completing the Bachelor of Science in Plant Biology. Students completing degree requirements can:

1. Demonstrate an **understanding** of the role of plants in agriculture, society and the environment;
2. **Communicate**, in verbal and written forms, plant science knowledge to peers and others in society; and,
3. Students can critically formulate hypotheses, interpret data, and **apply** basic principles and practices to **solve** practical and fundamental problems.

The curriculum offers three options:

- ❖ **General Plant Biology** - for students intending to pursue careers in laboratories or graduate study
- ❖ **Horticulture and Turf Industry** - for students intending to pursue business careers
- ❖ **Horticulture Therapy Specialization** - for students intending to pursue careers in education or horticultural therapy.



## **Facilities:**

Students in our program have access to various resources that will assist in graduating with a degree in Plant Biology. Most faculty members in the department of Plant Biology and Pathology are housed Foran Hall on Cook campus. Foran Hall houses the School of Environmental and Biological Sciences Core Facility which offer instruments such as the Bio-imaging, Bio-sensing, Flow cytometry, Real-time PCR, and High throughput screening that can enhance research in the field of Plant Biology. The Genome Cooperative at SEBS



located in Foran Hall provides collaborative opportunities in genome studies to develop novel research and teaching resources. The department has numerous teaching labs which house computers and equipment for fundamental research. A Stephen and Lucy Change Science Library located in Foran Hall provides access to computers, online journal and books, and hard copy journals and magazines related to SEBS research areas.

The department also has joint faculty from the Department of Ecology, Evolution and Natural Resources and the Department of Biochemistry and Microbiology. Students can also have access to faculty and facilities at several outlying research stations

- Adelphia - Rutgers Plant Science Research and Extension Farm
- Marucci Blueberry – Cranberry Research Center
- Rutgers Fruit and Ornamental Research and Extension Center
- Rutgers Agricultural Research and Extension Center
- Rutgers Gardens

## **Experience-based Education at SEBS**

All SEBS students have to fulfill an experienced based education component that provides valuable applied skills to the students. Students can either choose to do an internship with local companies and programs or they can conduct independent research through a faculty mentorship program. Many of our students have participated in summer internship programs at local industries such as chemical companies, golf courses, landscape facilities, greenhouse productions, and outlying research stations as mentioned in the facilities accessible to students registered in the plant biology program. Students interested in gaining research skills conduct independent projects in with faculty who provides

invaluable mentorship in gaining lab bench skills, critical thinking and/or field based research so that students gain experience in both fundamental and applied research. Research areas include natural products, plant breeding, turf research, plant growth, and plant pathology.



### **Career opportunities for Graduates**

Graduates with Plant Biology degrees can apply for jobs in various plant related fields such as Horticulture, Plant Production, Farming, Turf industry, Chemical industries, Seed companies, Education, pharmaceutical companies, Plant Biotechnology companies, Plant breeding, and Plant research.

### **Faculty & Research Interests**

The faculty of the Department of Plant Biology & Pathology consists of over 50 members with research and teaching emphases in areas of Molecular Biology, Biotechnology, Natural Products, Plant Breeding and Genetic Improvement, Plant Diversity, Plant Management, Plant Pathology and Horticultural Engineering. We also have a strong extension component that seeks to provide service to and impact plant industries locally and globally.

#### **Current Faculty and research expertise:**

1. Albert Ayeni -- weed management, sustainable crop production, and international collaborations in Agriculture and Rural Development
2. Faith Belanger -- plant pathology/molecular biology/biotechnology: turfgrass molecular biology; endophyte interaction, fungal endophyte/grass interaction.
3. Joan W. Bennett -- Fungal Genetics, Mycology, Mycotoxins, Volatile Organic Compounds
4. Stacy Bonos -- Plant breeding and genetic improvement; perennial grasses for turf and biofuel; inheritance of disease resistance and stress tolerance; molecular and traditional breeding approaches

5. Bruce Clarke -- plant pathology: turfgrass pathology, ectotrophic root infecting fungi
6. Rong Di -- molecular biology/biotechnology: molecular biology, biotechnology, nutraceuticals, biofuel
7. Juan Dong -- plant cell and development/molecular genetics: cell polarity, asymmetric cell division, stomatal development and patterning,
8. Edward Durner -- plant management: applied physiology; statistics; CSA management, student farms, organic food production, *Physalis* production, statistical analysis
9. Joel Flagler -- people-plant relationships: horticultural therapy, ornamental horticulture
10. Chaim Frenkel -- Post harvest biology/ Cold stress/ Natural products/ Vanilla
11. Andrea Gallavotti -- plant development/molecular biology: maize genetics and functional genomics; plant architecture; meristem development
12. Thomas J. Gianfagna -- postharvest pathology and physiology of fruit and cut flowers; Plant natural products and human health, endophytic fungi, mechanisms of disease resistance
13. Joseph Goffreda -- plant breeding and genetic improvement: peach, nectarine, apple, and apricot breeding
14. Ann B. Gould -- plant pathology: woody and herbaceous ornamental crop pathology
15. Joseph Heckman -- plant management: Soil, soil fertility, soil testing, mineral nutrition, plant health, organic farming, organic farming history, compost, traditional food systems
16. Zane R. Helsel (Emertius) -- Agriculture Energy, Field and Forage Crop Production
17. Bradley I. Hillman -- plant pathology/molecular biology/biotechnology: plant and fungal virology; fungal molecular biology; biocontrol
18. Joshua A. Honig -- plant molecular biology/plant breeding: DNA genotyping, DNA fingerprinting, DNA sequencing, genetic linkage mapping, and marker assisted selection (MAS), turfgrass breeding
19. Bingru Huang -- Turfgrass stress physiology/biochemistry/molecular biology
20. Harry Janes -- plant management: controlled environmental agriculture; plant environmental interaction
21. H. Rodolfo Juliani -- Plant diversity for nutrition and health. International development and sustainable production of plant-based products (herbs, spices, medicinal, aromatic plants, non-timber forest products, ethnic plant products). Quality (safety and effectiveness), chemistry and biological activity of plant products. Horticulture and plant biotechnology. Undergraduate and graduate research.
22. Donald Kobayashi -- plant bacteriology: biological control; bacterial genomics; bacterial/fungal interactions; biotechnology
23. Norman Lalancette -- plant pathology: tree fruit pathology; epidemiology and plant disease control
24. Eric Lam -- epigenetics; programmed cell death; stress tolerance; renewable biomass; duckweeds; RNA therapeutics
25. Michael Lawton -- Disease Resistance, Fungal and Bacterial Pathogens, Fusarium Head Blight, Toxins, Programmed Cell Death, *Physcomitrella patens*, Functional Genomics.
26. Thomas Leustek -- metabolic control and engineering of plant metabolism, sulfur assimilation, nutrition, sensing, amino acid biosynthesis and regulation

27. Pal Maliga -- molecular biology/biotechnology/ plant breeding and genetic improvement: plastid molecular biology
28. John McLaughlin -- yeast genetics, plant pathology, trichothecene mycotoxins, ribosome inactivating proteins
29. Paul Meers – membrane dynamics and intercellular vesicle transport (including membrane fusion; protein-lipid interactions): drug delivery/transfection technologies, nanotechnology, biofilms, spectroscopic assays and imaging
30. William Meyer – plant breeding and genetic improvement: turfgrass breeding
31. Thomas Molnar – plant breeding and genetic improvement; ornamental and edible tree crops with a current focus on large-bracted dogwoods and hazelnuts
32. James Murphy -- turfgrass management, turf edaphology, adaptation of turfgrass species and cultivars to traffic stress
33. Thomas Orton – plant breeding and genetic improvement: vegetable crops; extension in value-added systems development
34. Peter Oudemans – plant pathology: blueberry/cranberry, *Colletotrichum physalospora* coleophoma, GIS, NEWA
35. Alexander Poulev -- natural product chemistry/biotechnology/natural products: isolation and purification; chromatography; mass spectrometry; structural determination
36. Ilya Raskin -- biotechnology/phytochemistry/natural products/dietary supplements/functional foods/plant diversity/pharmacognosy/international development/biodiversity
37. David M. Ribnicky -- natural product chemistry: isolation and purification; phytopharmaceuticals
38. Mark Robson -- Pesticide toxicology, human and ecological risk assessment.
39. James E. Simon -- plant diversity/natural products/plant breeding and genetic improvement: new crop development, plant domestication of high value crops, NonTimber Forest Species, sustainable development of indigenous resources
40. Lena Struwe -- Global plant diversity and evolution, biogeography and spatial patterns, historic and contemporary ethnobotany and sustainable bioprospecting of natural products
41. Nilgun Tumer -- molecular biology/biotechnology/biochemistry: molecular biology; cellular translation; viral infection
42. Nicholi Vorsa -- plant breeding, genetic improvement, fruit quality, polyphenolics, blueberry and cranberry breeding, genetic mapping
43. Dan Ward -- Pomology - cultural practices and crop management for fruit crops
44. James F. White Jr. -- plant pathology; symbiosis; endophytic microbes; nutritional endosymbiotic systems; associative nitrogen fixation
45. Qing-Li Wu -- natural products chemistry and plant medicine
46. C. Andrew Wyenandt -- *Phytophthora capsici* and anthracnose fruit rot control in bell and other peppers, cucurbit powdery and downy mildew control, fungicide resistance management, fungicide resistance guidelines, basil downy mildew control
47. Ning Zhang -- Fungal ecology, phylogenetics and genomics, and molecular detection of fungal pathogens.

48. Barbara Zilinskas (Emeritus) -- molecular biology/biotechnology: molecular biology and physiology of the response of plants to environmental stress; oxidative stress and antioxidant protective mechanisms; genetic modification of turfgrass species

### **Advising:**

Plant Biology students have a Faculty Advisor in the Department Plant Biology and Pathology. The Faculty Advisor meets with students to guide them in academic and professional pursuits. Advisors can discuss student's specific area of interest, course plans and specializations, research prospects, internships, career paths, and the potential for graduate education. The Faculty Advisor can also provide advice on admission to the program.

**Degree:** Bachelors of Science in Plant Biology

**Director:** Dr. Donald Kobayashi ([kobayashi@aesop.rutgers.edu](mailto:kobayashi@aesop.rutgers.edu))

<b>Advisers</b>	<b>Code</b>	<b>Office</b>	<b>Phone</b>
Dr. Donald Kobayashi (General)	KN	Foran 337	848 932-6393
Dr. Josh Honig (Hort and Turf Industry)	(BF)	Foran 284	848 932-6281
Joel S. Flagler (Hort Therapy)	(FE)		201-599-6162

### **Graduation Requirements for the Plant Biology Major**

Plant Biology is an undergraduate major offered at the School of Environmental and Biological Sciences (SEBS). All students majoring in Plant Biology are required to fulfill SEBS core requirements, as listed at the following website: [http://catalogs.rutgers.edu/generated/nb-ug\\_current/pg743.html](http://catalogs.rutgers.edu/generated/nb-ug_current/pg743.html)

In addition to core SEBS requirements, all students are required to fulfill the following curriculum requirements:

#### **A. REQUIRED COURSES (19-21)**

##### Introductory Life and Physical Sciences

01:119:115	General Biology I (4)
01:119:116	General Biology II (4)
01:119:117	Biological Research Laboratory (2)
01:160:161	General Chemistry (3)
01:160:162	General Chemistry (3)
01:160:171	Introduction to Experimentation (1)

Experienced-Based Education (3)

11:776:495,496      Special Problems in Plant Science

Quantitative Skills

See 01:640:\_\_\_ in VIII B below.

One of the following Professional Ethics courses (3):

01:730:250      Environmental Ethics (3)

01:730:251      Ethics and Business (3)

Additional Requirements (16-18):

11:776:211      Introduction to Horticulture (3)

11:776:242      Plant Science (3)

11:776:210      Principles of Botany (4)

One of the following soils courses (3-4):

11:776:102      Soil and Society (3)

11:776:405      Soil Fertility (3)

11:776:413      Soil Quality (3)

11:375:453      Soil Ecology (3)

11:375:360      Soils and Water (4)

One of the following courses\* (3-4):

11:776:302      General Plant Pathology (3)

11:776:305      Plant Genetics (4)

11:776:382      Plant Physiology (4)

\*At least one of these courses is listed as a requirement in the General Plant Biology and the Horticulture and Turf Industry options.

**B. CURRICULUM OPTIONS (49-60 cr) \*(Intended as a general guide for coursework; slight alterations to actual requirements may change over time.)**

One of the following three options is required:

- 1. General Plant Biology (research focus area) (49-60 cr)**
- 2. Horticulture and Turf Industry (49-59 cr)**
- 3. Horticulture Therapy Specialization (46-50 cr)**



## **1. General Plant Biology (55-60)**

### **Required courses (44)**

01:160:307-308	Organic Chemistry (4,4)
01:640:135-136	Calculus I,II (4,4) or equivalent
01:750:203-204	General Physics (3,3)
11:115:403,404	General Biochemistry (4,3)
11:126:413	Plant Molecular Biology (3), or 11:126:481 Molecular Genetics
11:776:305	Plant Genetics (4), or 01:447:380 Genetics
11:776:382	Plant Physiology (4)
11:776:452	Plant Tissue Culture (3)

### **Electives (11-16)**

At least four additional courses selected from the following list, or any 776 listed as but not fulfilling as “Additional Requirements”:

01:960:401	Basic Statistics for Research (3)
11:015:492	Tropical Agriculture (3)
11:126:427	Methods in Recombinant DNA Technology (4)
11:370:350	Agricultural Entomology and Pest Management (3)
11:370:381	Insect Biology (4)
11:550:230	Environmental Design Analysis (3)
11:550:233-234	Landscape Plants I,II (3,3)
11:550:238	Landscape Management and Maintenance (3)
11:550:239	Planning and Planting the Residential Environment (3)
11:680:390	General Microbiology (4)
11:704:332	Plant Ecology (4)
11:776:402	Mycology: Fungi in the Environment (3)
11:776:200	Modern Crop Production (3)
11:776:202	Applied Physiology of Horticultural Crops (3)
11:776:221	Principles of Organic Crop Production (3)
11:776:231	Commercial Floral Design (3)
11:776:302	General Plant Pathology (3)
11:776:304	Turfgrass Management (4)
11:776:310	Plant Propagation (3)
11:776:312	Medicinal Plants (3)
11:776:341	Fruit Production (3)
11:776:401	Postharvest Physiology of Horticultural Crops (3)
11:776:402	Weeds: Impact & Management in Rural and Urban Landscapes (3)
11:776:404	Soil Management for Sports and Landscape Applications (3)

11:776:408	Turfgrass Pest Science (4)
11:776:439	Nursery Crop Production (3)
11:776:451	Fine and Sports Turf (3)
11:776:452	Plant Tissue Culture (3)
11:776:495,496	Special Problems in Plant Science (BA,BA)

## **2. Horticulture and Turf Industry (49-59)**

### **Required courses (26-27)**

01:460:101	Introductory Geology I: Physical (4)
01:640:115	Pre-calculus Mathematics (4) or 01:960:401 Basic Statistics for Research (3)
11:370:350	Agricultural Entomology and Pest Management (3)
11:373:231	Introduction to Marketing (3)
11:373:241	Introduction to Management (3) or 11:373:341 Management: Human Systems Development (3)
11:776:302	General Plant Pathology (3)
11:776:382	Plant Physiology (4)
11:776:406	Plant Breeding (3)

### **Electives (23-32)**

At least eight additional courses selected from the curriculum electives listed in the General Plant Biology option, above and the courses listed below.

11:776:305	Plant Genetics (4)
11:126:413	Plant Molecular Biology (3)

## **3. Horticulture Therapy Specialization (52-56)**

### **Required courses (46-50)**

11:015:432	Jr/Sr Colloquium: People-Plant Relationships (3) (fulfills SEBS Area I. School Mission: Interdisciplinary Critical Analysis requirement)
01:640:115	Pre-calculus Mathematics (4) or 01:960:401 Basic Statistics for Research (3)
11:776:225	Introduction to Horticultural Therapy (3)
11:776:325	Horticultural Therapy Techniques and Programming (3)
11:776:425	Special Topics in Horticultural Therapy (2)
11:776:495,496	Special Problems in Plant Science ( $\geq 8$ credits, approved by the adviser)

At least eight of the following human science courses (24-26):

01:830:101	General Psychology (3)
01:830:303,304	Memory and Memory Laboratory (3,1)
01:830:321	Social Psychology (3)
01:830:326,327	Small Groups and Laboratory (3,1)

01:830:330	Developmental Psychology (3)
01:830:333	Adolescent Development (3)
01:830:335	Adult Development and Aging (3)
01:830:340	Abnormal Psychology (3)
01:830:361	Developmental Psychobiology (3)
01:830:377	Health Psychology (3)
01:920:210	Sociology of Medicine and Health Care (3)
09:910:352	Groups at Risk in Cont. Society (3) or 09:910:220 Intro Soc Work & Soc Serv. (3)
10:832:416	Mental Illness: Social and Public Policy (3)
11:300:327	Applications of Psychology in Education (3)
11:373:341	Management: Human Systems Development (3)

### Electives (6)

Additional courses selected from the curriculum electives listed in the horticulture and turf industry option, above.

Recommended electives are:

01:704:332	Plant Ecology (4)
11:370:350	Agricultural Entomology and Pest Management (3)
11:776:302	General Plant Pathology (3)
11:776:231	Introduction to Marketing (3)
11:776:310	Plant Propagation (3)
11:776:321	Principles and Practices of Fruit Production (4)
11:776:439	Nursery Crop Production (3)

### **Unspecified Electives (5-26 credits)**

In addition to courses meeting the above requirements, students can take any other courses offered by the university, for which they meet the course eligibility requirements, to bring their total number of credits to the minimum of 128 required for graduation.