CONCENTRATION REQUIREMENTS FOR THE PLANT SCIENCES MAJOR
EFFECTIVE FALL 2015

All students who matriculate into the Plant Sciences major in Fall 2015 or later must declare a concentration. This will provide a more focused approach to coursework with the aim of providing Plant Sciences students with marketable skills for immediate post-graduation employment or transition to graduate or professional study.

All PS students who matriculate as freshmen or sophomores must declare a concentration by the beginning of their junior year. Students matriculating as junior transfer students must declare an intended concentration by the end of their first semester at Cornell. Plant Sciences majors must satisfy all course requirements for at least one of the concentrations listed below.

The current Plant Sciences concentrations are:

1. Ecology of Managed Landscapes (Ecology)
2. Organic Agriculture (Organics)
3. Plant Breeding & Genetics (Breeding)
4. Plant Computational Biology (Big Data)
5. Plant Evolution and Systematics (Evolution)
6. Plant Molecular, Cellular & Developmental Biology (Physiology)
7. Plant Pathology & Plant-Microbe Biology (Disease)
8. Plants and Human Health (Phytotherapy)
9. Soil Science (Soils)
10. Sustainable Plant Production (Sustainability)
11. Design Your Own Concentration (DYOC)

Students who matriculated in Spring 2015 or earlier may complete the concentration requirement for the major under the old course guidelines or under the current ones outlined herein.

Although incoming freshmen have two years to settle on a concentration, it is prudent to begin to develop at least one back-up plan early on. Academic advisors will provide some guidance, but final decisions are at the discretion of each student.

1. Ecology of Managed Landscapes (Ecology): minimum of 15 credits
   We focus on creating healthy urban landscapes that provide many valuable ecosystem services. Students will learn skills that will lead to careers in public garden management, municipal forestry, arboriculture, professional landscape management, landscape design and build, environmental landscape assessment and soils remediation, turfgrass management, and outreach education.

   **Required Courses:**
   - PLHRT 4400: Restoration Ecology (5 credits, fall)
   - PLHRT/LA 4910-4920: Creating the Urban Eden (4 + 4 credits, fall, spring)
Choose one additional course from the following list:
LA 1410-1420: Grounding in Landscape Architecture (4 + 4 credits, fall, spring)
PLHRT 2240: Urban Ecosystems: (3 credits, spring)
PLHRT 3000: Annual and Perennial Plant Identification and Use (3 credits, fall—even years)
PLHRT 3050: Arboriculture (3 credits, fall)
PLHRT 4850: Public Garden Management (3 credits, spring)
PLHRT 4931: Grassing the Urban Eden (2 credits, spring—odd years)
PLSCS 3150: Weed Biology and Management (4 credits, fall)
PLSCS/ENTOM 4440: Integrated Pest Management (4 credits, spring)

2. Organic Agriculture (Organics): minimum of 12 credits
Students in this concentration will learn about the philosophy and regulations involved with certified organic crop production and will learn practical ways of growing crops and managing pests using organic methods.

Required Courses:
PLHRT 4730: Ecology of Agricultural Systems (3 credits, fall)
PLSCS 3210: Soil and Crop Mgmt. for Sustainability (4 credits, spring)
PLSCS 3800: Principles and Practices in Certified Organic Agriculture (2 credits, fall)

Choose at least one production course with organic content:
PLHRT/VIEN 3440: Viticulture and Vineyard Management (2 credits, spring)
PLHRT 3500: Principles of Vegetable Production (3 credits, fall—even years)
PLHRT 4420: Berry Crops: Culture and Management (3 credits, fall—even years)
PLHRT 4450: Ecological Orchard Management (3 credits, spring—odd years)
PLSCS 3150: Weed Biology and Management (4 credits, fall)
PLSCS 4050: Field Crop Systems (4 credits, fall)
PLSCS/IARD 4140: Tropical Cropping Systems (4 credits, fall)

Additional course work in integrated pest management including insects and plant diseases is strongly recommended. Students may substitute PLPPM 3010 or PLSCS 4440 if they are not also concentrating in Sustainable Plant Production.

3. Plant Breeding & Genetics (Breeding): minimum of 13 credits
Students graduating with extra coursework in this concentration will be prepared to compete successfully for graduate study opportunities or to enter the job market directly.

Students who take PLBRG 2250, Plant Genetics, for the Plant Sciences Core Coursework are also required to take PLBRG 3250: Plant Genomics Approaches (1 credit, spring) for this concentration.

Required Courses:
PLBRG 4030: Genetic Improvement of Crop Plants (3 credits, fall)
PLPPM 3010: Biology and Management of Plant Diseases (4 credits, fall)

Choose at least three courses from the following:
PLBIO 3430: Molecular Biology and Genetic Engineering of Plants (2 credits, spring)
PLBIO 4440: Plant Cell Biology (4 credits, fall—odd years)
PLBIO 4620: Plant Biochemistry (3 credits, spring)
PLBRG 4060: Methods of Plant Breeding Laboratory (2 credits, fall)
PLBRG 4070: Nutritional Quality Improvement of Food Crops (2 credits, fall)
PLBRG 4110: High-Throughput Plant Phenotyping (2 credits, spring—odd years)
4. **Plant Computational Biology (Big Data):** minimum of 15 credits
   Plant computational biologists analyze large datasets and devise computer modeling simulations for practical and research applications in academia, in biotechnology and pharmaceutical companies, in health science-related fields, and in governmental research institutions.

   Students in this concentration are encouraged to perform an Internship in a *Bioinformatic Applications Workshop*. The Cornell Core Laboratories Center runs a series of bioinformatics workshops to teach users how to do data analysis. The workshops cover a broad range of topics, from introduction to the Linux computing environment to next generation sequencing data analysis. Each workshop includes both lectures and hands-on sessions.

   http://www.biotech.cornell.edu/brc/bioinformatics-facility/services/bioinformatics-workshops-and-training

   1. **BIOMG 4000:** Genomics (3 credits, fall)
   2. **CS 1110:** Introduction to Computing Using Python (4 credits, fall, spring, summer) OR **CS 1112:** Introduction to Computing Using MATLAB (4 credits, fall, spring)
   3. **MATH 1110:** Calculus I (4 credits, fall, spring, summer)
   4. **MATH 2310:** Linear Algebra with Applications (3 credits, fall, spring)
   5. **PLBRG 3250:** Plant Genomics Approaches (1 credit, spring)

5. **Plant Evolution and Systematics (Evolution):** minimum of 9 credits
   An important component of this concentration is learning methods for measuring and studying biodiversity across large scales, both in geologic time and globally. This concentration prepares students to enter graduate school and for careers in academia, governmental, private and international organizations focused on biodiversity and conservation issues, major natural history museums, and private and governmental research institutions.

   **Required Courses:**
   - **PLBIO 4400:** Phylogenetic Systematics (3 credits, spring—on demand)
   - **PLBRG 3250:** Plant Genomics Approaches (1 credit, spring)

   **Choose any two of the following courses:**
   - **PLBIO 2300:** Global Plant Biodiversity and Vegetation (3 credits, fall—odd years)
   - **PLBIO 4220:** Comparative Plant Development: Evo-Devo (2 credits, fall)
   - **PLBIO 4470:** Molecular Systematics (3 credits, spring—even years)
   - **PLBIO 4480:** Plant Evolution and the Fossil Record (3 credits, spring—even years)
   - **PLBIO 4520:** Systematics of Tropical Plants (3 credits, fall—offered only every three years)

6. **Plant Molecular, Cellular & Developmental Biology (Physiology):** minimum of 14 credits
   Coursework in Plant Molecular, Cellular, and Developmental Biology focuses on the study of how plants function at the subcellular, cellular, and organismal levels. The concentration prepares students to enter graduate school and for careers in academia, in biotechnology and pharmaceutical companies, in health science-related fields, and in governmental research institutions.

   **Required Courses:**
   - **PLBIO 3430:** Molecular Biology and Genetic Engineering of Plants (2 credits, spring)
   - **PLBIO 3431:** Laboratory in Molecular Biology and Genetic Engineering of Plants (2 credits, spring)
   - **PLBIO 4841:** Plant Form and Function (3 credits, spring)
   - **PLBRG 3250:** Plant Genomics Approaches (1 credit, spring)

   **CHEM 2070:** General Chemistry I (4 credits, fall) and **CHEM 2080:** General Chemistry II (4 credits, spring). Physiology concentrators must complete CHEM 2070-2080, not CHEM 1560.
Complete at least 6 additional credits from the list below:
PLBIO 4220: Comparative Plant Development: Evo-Devo (2 credits, fall)
PLBIO 4440: Plant Cell Biology (4 credits, fall—odd years)
PLBIO 4470: Molecular Systematics (3 credits, spring—even years)
PLBIO 4620: Plant Biochemistry (3 credits, spring)
PLBIO 4831: Concepts and Techniques (3 credits, fall)
PLBRG 4030: Genetic Improvement of Crop Plants (3 credits, fall)
PLBRG 4070: Nutritional Quality Improvement of Food Crops (2 credits, fall)
PLHRT 4250: Postharvest Biology of Horticultural Plants (2 credits, spring—odd years)
PLSCS 4100: Plant Responses to Environmental Stress and Climate Change (3 credits, fall—odd years)
PLSCS 4420: Mineral Nutrition: From Plants to Humans (3 credits, spring—even years)

7. **Plant Pathology & Plant-Microbe Biology (Disease):** minimum of 13 credits

Students interested in plant diseases and their control, host-pathogen coevolution, microbial symbiosis, fungal biology and/or sustainable agriculture/biocontrol are good fits for this concentration. This concentration prepares students for careers related to disease and pest management, and for graduate study in plant pathology, mycology, and the biology of plant-microbe interactions.

**Required Courses:**
- BIOMI 2900: General Microbiology Lectures (3 credits, fall, spring)
- PLPPM 3010: Biology and Management of Plant Diseases (4 credits, fall)
- PLPPM 4490: Mycology (3 credits, fall—odd years)

Complete at least 3 credits from the list below:
- BIOMI 2911: General Microbiology Laboratory (2 credits, fall, spring)
- PLPPM 2950: Biology of Infectious Disease: From Molecules to Ecosystems (3 credits, fall)
- PLPPM 3190: Mushrooms of Field and Forest (2 credits, fall)
- PLPPM 4010: Microbial Pathogens vs. Plants: Molecular weapons, Defenses, and Rules of Engagement (3 credits, spring)
- PLPPM 4020: Biology of Plant Pathogens (3 credits, spring—even years)
- PLPPM 4090: Principles of Virology (3 credits, fall) *(inactive)*
- PLPPM 4330: Infectious Disease Ecology and Evolution (3 credits, fall) *(inactive)*
- PLPPM 4380: Filamentous Fungal Genomics & Development (3 credits, spring—even years)
- PLPPM 4480: Symbioses: Evolution and Ecology (3 credits, spring) *(inactive)*
- PLPPM 6810: Plant Pathology and Plant-Microbe Biology Seminar (1 credit, fall, spring)

8. **Plants and Human Health (Phytotherapy):** minimum 14 credits

This concentration addresses the growing interest in the role of plants in various health-related sub-disciplines that study disease prevention and therapy. Furthermore, it fulfills the academic responsibility to educate future professionals in the health-care field on the importance of this relationship.

**Required Courses:**
- ANTHR 2468: Medicine, Culture, and Society (3 credits, spring)
- PLBIO 2210: Natural Remedies and Ethnohealth (2 credits, fall) *(inactive)*
- PLBIO 3800: Strategies and Methods in Drug Discovery (2 credits, spring) *(inactive)*
- PLBRG 4070: Nutritional Quality Improvement of Food Crops (2 credits, fall)
- PLHRT 2350: Food, Fiber and Fulfillment (2 credits, spring—odd years)
- PLSCS 4420: Mineral Nutrition: From Plants to Humans (3 credits, spring—even years)
Students who declare the Phytoptherapy concentration in Fall 2017 or later must substitute the following courses for PLBIO 2210 and PLBIO 3800, which are no longer offered:

**PLBIO 2100**: Medical Ethnobotany (currently listed as PLBIO 1100) (2 credits, spring)

**PLBIO 3100**: Medicinal Botany and Health (2 credits, fall)

Students who declared the concentration earlier and were able to take PLBIO 2210 and PLBIO 3800 do not have to take PLBIO 2100 or PLBIO 3100.

9. **Soil Science (Soils)**: minimum 12 credits
   This concentration prepares students for work on agricultural and natural ecosystems by learning to identify, understand, and manage soils in agriculture and forestry in an environmentally responsible way. Graduates with soils training can choose from a range of excellent professional opportunities and challenging careers, including those with government agencies.

   **Complete at least 9 credits from the list below:**
   - ANSC 4120: Whole-Farm Nutrient Management (4 credits, spring)
   - EAS 4830: Environmental Biophysics (3 credits, fall—odd years)
   - PLSCS 3210: Soil and Crop Management for Sustainability (4 credits, spring)
   - PLSCS 3620: Soil Morphology (1 credit, fall, spring)
   - PLSCS 3630: Soil Genesis, Classification, and Survey (4 credits, fall)
   - PLSCS 3650: Environmental Chemistry: Soil, Air, and Water (3 credits, spring)
   - PLSCS 4660: Soil Ecology (4 credits, spring)
   - PLSCS 4720: Nutrient Management in Agro-Ecosystems (4 credits, spring)

   **Complete at least 3 credits from the list below:**
   - BEE 3710: Physical Hydrology for Ecosystems (3 credits, spring—odd years)
   - BEE 4730: Watershed Engineering (4 credits, fall)
   - BEE 4740: Water and Landscape Engineering Applications (3 credits, spring)
   - EAS/NTRES 3030: Introduction to Biogeochemistry (4 credits, fall)
   - PLSCS/CEE 4110: Applied Remote Sensing and GIS for Resource Inventory and Analysis (3 credits, fall)
   - PLSCS 4200: Geographic Information Systems (3 credits, spring)

10. **Sustainable Plant Production (Sustainability)**: minimum 12 credits
    Intended to provide intensive working knowledge and hands-on experience in the commercial production of plants, including field, fruit, vegetable, nursery and greenhouse crops. Students completing this concentration will be prepared for a career in regulatory or governmental agencies like the EPA and USDA, NYS Ag and Markets, or the DEC.

    **Required Courses:**
    1. **One course** of at least 3 credits at the 3000 level or greater that has a major focus on pest management:
       - PLPPM 3010: Biology and Management of Plant Diseases (4 credits, fall)
       - PLSCS 3150: Weed Biology and Management (4 credits, fall)
       - PLSCS 4440: Integrated Pest Management (4 credits, spring)
       - PLPPM/ENTOM/VIEN 3200: Grape Pest Management (3 credits, fall)
    2. **One course** of at least 3 credits at the 3000 level or greater that has a major focus on soil and/or nutrient management:
       - PLHRT 4551: Principles of Nutrient Mgmt. in Crops and Landscape Plants (3 credits, spring—even years)
       - PLSCS 3210: Soil and Crop Mgmt. for Sustainability (4 credits, spring)
       - PLSCS 3630: Soil Genesis, Classification and Survey (4 credits, fall)
       - PLSCS 4660: Soil Ecology (4 credits, spring)
       - PLSCS 4720: Nutrient Management in Agroecosystems (4 credits, spring)
3. **Two courses** that have a primary focus on plant production:

- **PLHRT 3025**: Hydroponic Food Crop Production and Management (4 credits, spring—even years)
- **PLHRT 3100**: Production and Marketing of Greenhouse Crops (4 credits, spring—odd years)
- **PLHRT 3440**: Viticulture and Vineyard Management (2 credits, spring)
- **PLHRT 3500**: Principles of Vegetable Production (3 credits, fall—even years)
- **PLHRT 4000**: Principles of Plant Propagation (3 credits, fall—odd years)
- **PLHRT 4420**: Berry Crops Culture and Management (3 credits, fall—even years)
- **PLHRT 4450**: Ecological Orchard Management (3 credits, spring—odd years)
- **PLSCS 4050**: Field Crop Systems (4 credits, fall)
- **PLSCS 4130**: Physiology and Ecology of Yield (3 credits, spring)
- **PLSCS/IARD 4140**: Tropical Cropping Systems (3 credits, fall)

11. **Design Your Own Concentration (DYOC)**

If none of the above concentrations piques a student’s interest for more in-depth study, the student may petition the Plant Sciences Curriculum Committee to design his/her own concentration in Plant Sciences. The course and credit requirements for this concentration will be determined on a case-by-case basis.