To meet the educational needs of a student population with interests ranging from the biology of plants to landscape design/installation to fruit and vegetable production to golf course construction and management, considerable flexibility is built into the horticulture curriculum. The diversity of interests and need for flexibility are reflected in the impressive array of horticulture courses.

The Department of Horticulture offers six options within the horticulture major:

1. Greenhouse Plant Production
2. Horticultural Food Crop Production and Management
3. Landscape Design, Installation, and Management
4. Public Horticulture
5. Horticulture Research
6. Turfgrass Management

Graduates possess the technical knowledge and skills to become professional horticulturists. They understand principles of life science, plant growth and development, and are familiar with cultural and management principles for a wide assortment of horticultural crops. They are able to work and communicate effectively with fellow horticultural professionals and other citizens who share an interest in horticulture. Graduates also understand the ethical and environmental dimensions of problems and issues facing horticultural professionals.

A degree in horticulture opens the door to employment opportunities with production nurseries, seed companies, interior landscaping firms, greenhouses, garden centers, conservatories, landscape design/installation firms, public gardens and arboreta, orchards and vineyards, food processing companies, vegetable farms, golf courses, sports fields, sod production companies, and lawn care businesses. Several allied plant-science industries also provide employment opportunities in the areas of sales, management, and communication. Opportunities exist for careers in research, teaching, extension, and business after obtaining advanced training in graduate school.

Minors

The Department of Horticulture offers two minors: 1) Horticulture and 2) Landscape Management. Both minors are earned by taking HORT 221 Principles of Horticulture Science plus 12 additional credits with a maximum of 3 credits at the 200-level and a minimum of 9 credits at the 300-level or above.

The Horticulture minor is a broad-based minor that does not focus within a specific area of horticulture. The 12 additional credits for this minor can be selected from the full list of Horticulture courses.

The Landscape Management minor focuses on landscape management including plant selection, landscape installation and management, and turfgrass management. The 12 additional credits for this minor can be selected from the following courses: HORT 240 Trees, Shrubs, and Woody Vines for Landscaping, HORT 281 Landscape Graphics, HORT 330 Herbaceous Ornamental Plants, HORT 341 Woody Plant Cultivars: Shade Trees, Ornamental Trees and Woody Shrubs, HORT 342 Landscape Plant Installation, Establishment, and Maintenance, HORT 351 Turfgrass Establishment and Management or HORT 444 Landscape Construction Management.

Visit our departmental website at www.hort.iastate.edu (http://www.hort.iastate.edu).

Curriculum in Horticulture

Students majoring in horticulture will select an option in which to specialize before reaching junior standing and will fulfill the requirements described below under Options.

The Department of Horticulture offers two minors: 1) Horticulture and 2) Landscape Management. The requirements appear under Horticulture, Courses and Programs.

Total Degree Requirement: 129 credits (cr.)

Only 65 cr. from a two-year institution may apply which may include up to 16 technical cr.; 9 P-NP cr. of free electives; 2.00 minimum GPA.

**Biological Sciences: 18 cr.**

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<tr>
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<th>Title</th>
<th>Credit</th>
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<tr>
<td>BIOL 211</td>
<td>Principles of Biology I</td>
<td>3</td>
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<tr>
<td>BIOL 211L</td>
<td>Principles of Biology Laboratory I</td>
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<tr>
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<td>AGRON 260</td>
<td>Soils and Environmental Quality</td>
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<td>AGRON 316</td>
<td>Crop Structure-Function Relationships</td>
<td>1</td>
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<tr>
<td>AGRON 317</td>
<td>Principles of Weed Science</td>
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<tr>
<td>AGRON 354</td>
<td>Soils and Plant Growth</td>
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<td>AGRON 354L</td>
<td>Soils and Plant Growth Laboratory</td>
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<td>BIOL 212</td>
<td>Principles of Biology II</td>
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<td>BIOL 212L</td>
<td>Principles of Biology Laboratory II</td>
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<tr>
<td>BIOL 312</td>
<td>Ecology</td>
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<tr>
<td>BIOL 313</td>
<td>Principles of Genetics</td>
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<tr>
<td>&amp; 313L</td>
<td>and Genetics Laboratory</td>
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<td>or GEN 320</td>
<td>Genetics, Agriculture and Biotechnology</td>
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<tr>
<td>BIOL 314</td>
<td>Principles of Molecular Cell Biology</td>
<td>1</td>
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<tr>
<td>BIOL 355</td>
<td>Plants and People</td>
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<td>BIOL 366</td>
<td>Plant Systematics</td>
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<tr>
<td>BIOL 430</td>
<td>Principles of Plant Physiology</td>
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<tr>
<td>BIOL 454</td>
<td>Plant Anatomy</td>
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<td>BIOL 474</td>
<td>Plant Ecology</td>
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<td>ENT 201</td>
<td>Introduction to Insects</td>
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<td>ENT 211</td>
<td>Insects and Society</td>
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<tr>
<td>ENT 370</td>
<td>Insect Biology</td>
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<td>ENT 375</td>
<td>Plant Protection Using Natural Enemies</td>
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<td>ENT 376</td>
<td>Fundamentals of Entomology and Pest Management</td>
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<td>FOR 416</td>
<td>Forest Insects and Diseases</td>
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<td>PL P 408</td>
<td>Principles of Plant Pathology</td>
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**Total Credits: 18**

**Communications Proficiency (with a grade of C or better)**

- 6 credits of English composition (see approved courses below)
- 3 credits of speech fundamentals (see approved courses below)

**Communication/Library: 13 cr.**
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<tr>
<td>ENGL 250</td>
<td>Written, Oral, Visual, and Electronic Communication</td>
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<td>ENGL 314</td>
<td>Technical Communication</td>
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<tr>
<td>or ENGL 302</td>
<td>Business Communication</td>
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<tr>
<td>Lib 160</td>
<td>Information Literacy</td>
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<td>One of the following:</td>
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<td></td>
<td>SP CM 212          Fundamentals of Public Speaking</td>
<td>3</td>
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<tr>
<td></td>
<td>AGEDS 311          Presentation and Sales Strategies for Agricultural Audiences</td>
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<td></td>
<td>COMST 214 Professional Communication</td>
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<td></td>
<td><strong>Total Credits</strong></td>
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</table>

**Ethics: 3 cr.**

- 3 cr. from approved list

**Humanities and Social Sciences: 6 cr.**

- Approved Humanities course
- Approved Social Science course

**Total Credits**

**International Perspective: 3 cr.**

- 3 cr. from approved list

**Total Credits**

**U.S. Diversity: 3 cr.**

- 3 cr. from approved list

**Total Credits**

**Life Sciences: 6 cr.**

- BIOL 211 Principles of Biology I
- Approved Life Sciences course

**Total Credits**

**Mathematical Sciences: 6 cr.**

- Select one course from the following:
  - MATH 140 College Algebra
  - MATH 150 Discrete Mathematics for Business and Social Sciences
  - MATH 165 Calculus I
  - MATH 181 Calculus and Mathematical Modeling for the Life Sciences I

- AND select one of the following:
  - STAT 101 Principles of Statistics
  - STAT 104 Introduction to Statistics
  - STAT 226 Introduction to Business Statistics I
  - STAT 301 Intermediate Statistical Concepts and Methods
  - STAT 401 Statistical Methods for Research Workers

**Total Credits**

**Physical Sciences: 11 cr.**

- Complete one of the following:
  - CHEM 163 College Chemistry & 163L and Laboratory in College Chemistry
  - or CHEM 177 General Chemistry I & 177L and Laboratory in General Chemistry I

- AND complete one course from the following:
  - AGRON 259 Organic Compounds in Plants and Soils
  - BBMB 221 Structure and Reactions in Biochemical Processes
  - CHEM 178 General Chemistry II & 178L and Laboratory in College Chemistry II
  - CHEM 231 Elementary Organic Chemistry & 231L and Laboratory in Elementary Organic Chemistry
  - CHEM 331 Organic Chemistry I & 331L and Laboratory in Organic Chemistry I
  - PHYS 101 Physics for the Nonscientist
  - PHYS 111 General Physics
  - PHYS 115 Physics for the Life Sciences

- AND complete one course from the following:
  - BBMB 221 Structure and Reactions in Biochemical Processes
  - CHEM 231 Elementary Organic Chemistry & 231L and Laboratory in Elementary Organic Chemistry
  - CHEM 331 Organic Chemistry I & 331L and Laboratory in Organic Chemistry I

**Total Credits**

**Horticultural Sciences: Minimum of 30 cr.**

- HORT 110 Professional and Educational Development in Horticulture.
- HORT 221 Principles of Horticulture Science
- HORT 321 Horticulture Physiology
- HORT 445 Horticulture Management and Administration

- Select 21 cr. hours from courses within selected option.

**Total Credits**

**Soil Sciences: 3 cr.**

- AGRON 154 Fundamentals of Soil Science
- or AGRON 155 Soils for Horticultural Scientists

**Total Credits**

**Electives**

No more than 4 cr. of Hort 490 may count toward graduation.

**Options**

**Greenhouse Plant Production**

The following courses are required to meet the Horticulture requirement:

- HORT 240 Trees, Shrubs, and Woody Vines for Landscaping
- HORT 322 Plant Propagation
- HORT 330 Herbaceous Ornamental Plants
- HORT 331 Hydroponic Food Crop Production
- HORT 332 Greenhouse Operation and Management
- HORT 434 Fall Greenhouse Crop Production
HORT 435  Spring Greenhouse Crop Production  3

Other recommended courses are:

HORT 376  Field Production of Horticultural Crops
HORT 391  Horticultural Management Experience
HORT 424  Sustainable and Environmental Horticulture Systems
HORT 442  Nursery Production and Garden Center Management

Required for option:

ACCT 284  Financial Accounting  3

And select 9 cr. hours from the following:

ACCT 215  Legal Environment of Business
ACCT 285  Managerial Accounting
ACCT 316  Business Law

Horticultural Food Crop Production and Management

The following courses are required to meet the Horticulture requirement:

HORT 276  Understanding Grape and Wine Science  3
HORT 376  Field Production of Horticultural Crops  3
HORT 461  Fruit Crop Production and Management  3
HORT 471  Vegetable Production and Management  2
HORT 471L  Vegetable Production and Management Lab  1

Other recommended courses:

HORT 322  Plant Propagation
HORT 331  Hydroponic Food Crop Production
HORT 332  Greenhouse Operation and Management
HORT 338  Seed Science and Technology
HORT 391  Horticultural Management Experience
HORT 484  Organic Agricultural Theory and Practice

Required for option:

ACCT 284  Financial Accounting  3

And select 9 cr. hours from the following:

ACCT 215  Legal Environment of Business
ACCT 285  Managerial Accounting
ACCT 316  Business Law

Horticulture Research

The following courses are required for this option:

AGEDS 312  Science With Practice  3
HORT 322  Plant Propagation  3

Biological Sciences:

BIOL 430  Principles of Plant Physiology  3

Other recommended course:

HORT 391  Horticultural Management Experience

Mathematical Sciences Requirement:

8

MATH 165  Calculus I
or MATH 181  Calculus and Mathematical Modeling for the Life Sciences I
MATH 166  Calculus II
or MATH 182  Calculus and Mathematical Modeling for the Life Sciences II

Physical Sciences Requirement:

BBMB 301  Survey of Biochemistry
or BBMB 404  Biochemistry I

CHEM 177  General Chemistry I
CHEM 177L  Laboratory in General Chemistry I

CHEM 178  General Chemistry II
CHEM 178L  Laboratory in College Chemistry II

CHEM 331  Organic Chemistry I
CHEM 331L  Laboratory in Organic Chemistry I

CHEM 332  Organic Chemistry II

CHEM 332L  Laboratory in Organic Chemistry II
**Horticulture**

PHYS 111 & PHYS 112 General Physics and General Physics

And select 5 cr. hours from the following:

- BBMB 404 Biochemistry I
- BBMB 405 Biochemistry II
- BBMB 411 Techniques in Biochemical Research
- BIOL 313 Principles of Genetics
- BIOL 313L Genetics Laboratory
- BIOL 314 Principles of Molecular Cell Biology
- BIOL 315 Biological Evolution
- CHEM 211 Quantitative and Environmental Analysis
- CHEM 211L Quantitative and Environmental Analysis Laboratory
- CHEM 316 Instrumental Methods of Chemical Analysis
- CHEM 316L Instrumental Analysis Laboratory
- CHEM 321L Laboratory in Physical Chemistry
- CHEM 322L Laboratory in Physical Chemistry
- CHEM 324 Introductory Quantum Mechanics
- COM S 107 Applied Computer Programming
- or COM S 207 Fundamentals of Computer Programming
- GEN 409 Molecular Genetics
- GEN 410 Analytical Genetics

**Landscape Design, Installation and Management**

The following courses are required to meet the Horticulture requirement:

- HORT 240 Trees, Shrubs, and Woody Vines for Landscaping 3
- HORT 281 Landscape Graphics 2
- HORT 330 Herbaceous Ornamental Plants 3
- HORT 341 Woody Plant Cultivars: Shade Trees, Ornamental Trees and Woody Shrubs 2
- HORT 342 Landscape Plant Installation, Establishment, and Maintenance 3
- HORT 351 Turfgrass Establishment and Management 3
- HORT 380 Principles of Garden Composition 2
- HORT 381 Beginning Garden Composition Studio 2
- HORT 444 Landscape Construction Management 3
- HORT 481 Advanced Garden Composition 2

Other recommended courses are:

- HORT 322 Plant Propagation
- HORT 332 Greenhouse Operation and Management
- HORT 391 Horticultural Management Experience
- HORT 442 Nursery Production and Garden Center Management

Required for option:

- ACCT 284 Financial Accounting 3

And select 9 cr. hours from the following:

- ACCT 215 Legal Environment of Business
- ACCT 285 Managerial Accounting
- ACCT 316 Business Law
- COM S 103 Computer Applications
- ECON 234 Small Business Management
- ECON 334 Entrepreneurship in Agriculture

- MGMT 310 Entrepreneurship and Innovation
- MGMT 313 Feasibility Analysis and Business Planning
- MGMT 370 Management of Organizations
- MGMT 371 Organizational Behavior
- MKT 340 Principles of Marketing
- MKT 343 Personal Sales
- MKT 442 Sales Management
- MKT 447 Consumer Behavior
- TSM 324 Soil and Water Conservation Management

**Public Horticulture**

The following courses are required to meet the Horticulture requirement:

- HORT 240 Trees, Shrubs, and Woody Vines for Landscaping 3
- HORT 282 Educating Youth Through Horticulture 3
- HORT 332 Plant Propagation 3
- HORT 330 Herbaceous Ornamental Plants 3

Other recommended courses:

- HORT 281 Landscape Graphics
- HORT 332 Greenhouse Operation and Management
- HORT 341 Woody Plant Cultivars: Shade Trees, Ornamental Trees and Woody Shrubs
- HORT 342 Landscape Plant Installation, Establishment, and Maintenance
- HORT 351 Turfgrass Establishment and Management
- HORT 351L Turfgrass Establishment and Management Laboratory
- HORT 376 Field Production of Horticultural Crops
- HORT 380 Principles of Garden Composition
- HORT 381 Beginning Garden Composition Studio
- HORT 391 Horticultural Management Experience

And select 12 credit hours from the following:

- ACCT 215 Legal Environment of Business
- ACCT 284 Financial Accounting
- ACCT 285 Managerial Accounting
- ACCT 316 Business Law
- AGEDS 310 Foundations of Agricultural Education Programs
- AGEDS 401 Planning Agriculture and Life Sciences Education Programs
- COMST 102 Introduction to Interpersonal Communication
- COMST 214 Professional Communication
- COMST 317 Small Group Communication
- ECON 234 Small Business Management
- ECON 334 Entrepreneurship in Agriculture
- ENGL 220 Descriptive English Grammar
- ENGL 303 Free-Lance Writing for Popular Magazines
- ENGL 305 Creative Writing: Nonfiction
- ENGL 309 Proposal and Report Writing
- ENGL 313 Rhetorical Website Design
- ENGL 415 Business and Technical Editing
- ENGL 416 Visual Aspects of Business and Technical Communication
**Freshman**

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<th>Fall</th>
<th>Credits</th>
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<th>Credits</th>
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<td>B IOL 211</td>
<td>3</td>
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<td>PSYCH OR SOC OR ECON</td>
<td>3</td>
<td>HORT 221</td>
<td>3</td>
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<td>ENGL 150</td>
<td>3</td>
<td>AGRON 155</td>
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<td>HORT 110</td>
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<td>STAT 104</td>
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**Sophomore**

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<td>HORT 276</td>
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<td>ECON 101</td>
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<td>HORT 322</td>
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<td>PHYS 101 or 111 or 115</td>
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**Junior**

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<td>HORT 424</td>
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<td>HORT 391</td>
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<td>1 General Elective</td>
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<td>HORT 445</td>
<td>2</td>
<td>HORT 471</td>
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**Senior**

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**Total Credits: 125-127**

Horticulture, B.S. - Landscape Design, Installation, and Management

**Freshman**

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<th>Fall</th>
<th>Credits</th>
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<tr>
<td>ENGL 150</td>
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Horticulture, B.S. - Horticulture Food Crop Production and Management Option
### Sophomore

#### Fall Credits
- **AGRON 260**: 3
- **ECON 101**: 3
- **ENT 201**: 1 Select from the following: 3-4
- **ENT 211**: 2
- **HORT 281**: 2
- **HORT 330**: 3
- **HORT 444**: 3

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<th>Course</th>
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<td>AGRON 260</td>
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<td>HORT 330</td>
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<td>HORT 444</td>
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#### Spring Credits
- **AGRON 260**: 3
- **ACCT 284**: 3
- **ECON 101**: 3

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<td>ACCT 284</td>
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<tr>
<td>ECON 101</td>
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### Junior

#### Fall Credits
- **AGEDS 311 or SP CM 212**: 3
- **HORT 240**: 3
- **HORT 321**: 3
- **HORT 341**: 2
- **HORT 481**: 2
- **HORT 391**: 1

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<th>Course</th>
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<td>HORT 240</td>
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<td>HORT 341</td>
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<td>HORT 481</td>
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<td>HORT 391</td>
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#### Spring Credits
- **ENGL 302 or 314**: 3
- **HORT 322**: 3
- **HORT 324**: 3
- **HORT 391**: 1
- **HORT 392**: 1

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### Senior

#### Fall Credits
- **HORT 321**: 3
- **HORT 342**: 3
- **HORT 391**: 1

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#### Spring Credits
- **HORT 330**: 3
- **Elective**: 3
- **HORT 392**: 1

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### Total Credits: 125-128

Horticulture, B.S. - Horticulture Research Option

### Freshman

#### Fall Credits
- **ENGL 150**: 3
- **ENGL 250**: 3
- **ENGL 150**: 3
- **HORT 110**: 1
- **PL P 408**: 3

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<td>PL P 408</td>
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#### Spring Credits
- **Chemistry**: 3
- **Biology**: 3
- **Chemistry**: 3
- **Mathematics**: 2

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### Sophomore

#### Fall Credits
- **AGRON 260**: 3
- **ACCT 284**: 3
- **Biological Science**: 3
- **Select from the following: CHEM 231**: 3-4

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#### Spring Credits
- **AGRON 260**: 3
- **ACCT 284**: 3
- **Biological Science**: 3
- **Select from the following: CHEM 231**: 3-4

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### Junior

#### Fall Credits
- **ENGL 302 or 314**: 3
- **HORT 322**: 3
- **HORT 324**: 3
- **HORT 391**: 1

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#### Spring Credits
- **International Perspectives**: 3

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Horticulture, B.S. - Turfgrass Management Option

| ENGL 150 | 3 | ENGL 250 | 3 |
| CHEM 163 | 4 | CHEM 163L | 1 |
| CHEM 163L | 4 | BIOL 211 | 3 |
| PSYCH or SOC | 3 | AGRON 155 | 3 |
| HORT 121 | 2 | HORT 221 | 3 |
| LIB 160 | 1 | BIOL 211L | 1 |
| HORT 110 | 1 |
| **Total Credits: 130** | | |

Horticulture, B.S. Greenhouse Plant Production Option

| ACCT 284 | 3 | AGRON 260 | 3 |
| Biological Science | 3 | ENT 376 | 3 |
| HORT 240 | 3 | Elective | 3 |
| International Perspectives | 3 | US Diversity | 3 |
| MATH 140 | 3 | HORT 332 | 4 |
| **Total Credits: 123-126** | | |
Graduate Study

The graduate major in horticulture leads to the M.S. (thesis and non-thesis option) and Ph.D. Some faculty members of the department serve as major professors for students in interdepartmental graduate majors in plant biology; genetics and genomics; molecular, cellular, and developmental biology; ecology and evolutionary biology; sustainable agriculture; and environmental science.

Graduates possess a broad understanding of horticulture and the allied plant sciences. They are able to communicate effectively with members of the scientific community, industry groups, and other interested citizens. They are experienced in conducting research and communicating the results from that research. They are capable of addressing and solving complex problems that confront the many horticultural, agricultural, and plant science professions. They also understand the ethical, legal, social, and environmental issues associated with modern agricultural/horticultural practices.

Courses primarily for undergraduates:

HORT 110: Professional and Educational Development in Horticulture.
(1-0) Cr. 1. F.
Intended for first-year students and others new to the horticulture curriculum. Introduction to professional and educational development within horticulture. Focus is on university and career acclimation. Assessed service-learning component.

HORT 112: Orientation to Learning and Productive Team Membership
(Cross-listed with AER E, CON E, FS HN, NREM). (2-0) Cr. 2. F.
Introduction to developing intentional learners and worthy team members. Learning as the foundation of human enterprise; intellectual curiosity; ethics as a personal responsibility; everyday leadership; effective team and community interactions including team learning and the effects on individuals; and growth through understanding self, demonstrating ownership of own learning, and internalizing commitment to helping others. Intentional mental processing as a means of enhancing learning. Interconnectedness of the individual, the community, and the world.

HORT 114: Developing Responsible Learners and Effective Leaders
(Cross-listed with CON E, FS HN, NREM). (2-0) Cr. 2. S.
Prereq: Hort 112 or NREM 112
Focus on team and community. Application of fundamentals of human learning; evidence of development as a responsible learner; intentional mental processing as a habit of mind; planning and facilitating learning opportunities for others; responsibility of the individual to the community and the world; leading from within; holding self and others accountable for growth and development as learners and leaders.

HORT 121: Home Horticulture
(2-0) Cr. 2. F.S.
Growing plants in and around the home including requirements for growing house plants; plant propagation; designing and maintaining flower, fruit, and vegetable gardens; lawn, tree, and shrub maintenance.

HORT 122: Hands-On Home Horticulture
(1-0) Cr. 1. F.S.
Demonstration and activities that illustrate principles of growing plants for the home garden. Topics include floral and landscape design, plant identification, propagation, selection, and management for indoor and outdoor gardens.

HORT 131: Floral Design
(0-2) Cr. 1. S.
Introduces basic geometric design of fresh arrangements, corsages, and holiday arrangements. Includes use of tools and supplies.

HORT 193: Topics in Horticulture
Cr. arr. Repeatable. F.S.SS.
Practical courses in the field of horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.

HORT 193A: Topics in Horticulture: Greenhouse Crops
Cr. arr. Repeatable. F.S.SS.
Practical courses in the field of horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.

HORT 193B: Topics in Horticulture: Nursery Crops
Cr. arr. Repeatable. F.S.SS.
Practical courses in the field of horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.

HORT 193C: Topics in Horticulture: Turfgrass
Cr. arr. Repeatable. F.S.SS.
Practical courses in the field of horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.

HORT 193D: Topics in Horticulture: Fruit Crops
Cr. arr. Repeatable. F.S.SS.
Practical courses in the field of horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.

HORT 193E: Topics in Horticulture: Vegetable Crops
Cr. arr. Repeatable. F.S.SS.
Practical courses in the field of horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.

HORT 193F: Topics in Horticulture: Cross-Commodity
Cr. arr. Repeatable. F.S.SS.
Practical courses in the field of horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.

HORT 193G: Topics in Horticulture: Landscape Horticulture
Cr. arr. Repeatable. F.S.SS.
Practical courses in the field of horticulture. A maximum of 6 credits of Hort 193 may be used toward the total of 128 credits required for graduation.

HORT 221: Principles of Horticulture Science
(2-2) Cr. 3. F.S.
Prereq: Biol 211 or concurrent enrollment
Biological principles of growing horticultural crops including anatomy, reproduction, light, temperature, water, nutrition, and growth and development. Laboratory exercises emphasize environmental factors and permit detailed observation of plant growth.
HORT 225: Spanish for Horticulture  
(3-0) Cr. 3. S.  
Introduction to basic conversation and communication skills in Spanish, and cross-cultural skills for working with Spanish speakers in the Horticulture industry, emphasizing the use of vocabulary and expressions common in the workplace.

HORT 240: Trees, Shrubs, and Woody Vines for Landscaping  
(3-0) Cr. 3. F.  
Identification of trees, shrubs, and woody vines. Factors influencing the horticultural use of woody plants. Field trips outside of regular class time may be required.

HORT 276: Understanding Grape and Wine Science  
(3-0) Cr. 3. Alt. S., offered even-numbered years.  
Prereq: High school biology and chemistry.  
A scientific introduction to viticulture (grape-growing) and enology (wine-making). Topics include grape species and varieties, viticulture practices, fruit quality, geography, history, principles of fermentation and aging, wine classification, appreciation, evaluation, storage and service, regulations, wine as food. No wine tasting.

HORT 281: Landscape Graphics  
(0-4) Cr. 2. F.  
Introduction to computer and hand rendering techniques of landscape graphics. Students will gain proficiency in plan view and elevation graphics. Intensive studio and computer based instruction.

HORT 282: Educating Youth Through Horticulture  
(2-3) Cr. 3. Alt. S., offered even-numbered years.  
Planning, developing, and implementing science-based educational programs in a garden setting. Through hands-on experiences students will learn about horticulture, learning theory, and the application of science principles as they pertain to educating youth. Assessed service-learning component.

HORT 283: Pesticide Application Certification  
(Cross-listed with AGRON, ENT, FOR). (2-0) Cr. 2. S.  
Core background and specialty topics in agricultural, and horticultural pesticide applicator certification. Students can select certification categories and have the opportunity to obtain pesticide applicator certification at the completion of the course. Commercial pesticide applicator certification is emphasized.

HORT 321: Horticulture Physiology  
(3-0) Cr. 3. F.  
Prereq: HORT 221 or BIOL 211  
Principles of plant physiology relating to growth and development of horticultural plants including plant water relations, membrane transport, photosynthesis, photomorphogenesis, respiration, and phytohormones. Emphasis on plant's responses to environmental factors (temperature, water, and light) including cellular and whole-plant physiology under stressful environments.

HORT 322: Plant Propagation  
(2-2) Cr. 3. S.  
Prereq: HORT 221 or BIOL 211  
Fundamental principles underlying sexual and asexual propagation of plants; practice in reproducing plants by use of seeds, cuttings, layering, grafting and budding and tissue culture.

HORT 330: Herbaceous Ornamental Plants  
(2-2) Cr. 3. F.  
Prereq: HORT 221 or by permission of instructor  
Identification, botanical characteristics, origins, propagation, uses and general culture of herbaceous annual and perennial plants for Midwestern gardens and landscapes.

HORT 331: Hydroponic Food Crop Production  
(2-2) Cr. 3. Alt. F., offered even-numbered years.  
Prereq: HORT 221 or AGRON 114 or 3 credits in biological sciences  
Principles and practices of hydroponic systems, crop production and culture, aquaponic systems, and new foods crops for hydroponic systems will be discussed. Laboratories will focus on demonstration and participation in practices and procedures used in hydroponic food crop production. Assessed service-learning component.

HORT 332: Greenhouse Operation and Management  
(3-3) Cr. 4. S.  
Prereq: HORT 221  
Operation and management of greenhouses and other controlled environment agriculture structures. Methods of monitoring and manipulating environmental, cultural, and management factors such as light, temperature, fertility, substrate, etc., to maximize production efficiency. Emphasis placed on the production of ornamental and food crops. Greenhouse design and specification project required. Field trips outside scheduled class time required.

HORT 338: Seed Science and Technology  
(Cross-listed with AGRON). (2-3) Cr. 3. F.  
Prereq: AGRON 114 or HORT 221, BIOL 211  
Seed production, maturation, dormancy, vigor, deterioration, and related aspects of enhancement, conditioning, storage, and quality evaluation. Aspects of the seed industry and regulation of seed marketing.

HORT 341: Woody Plant Cultivars: Shade Trees, Ornamental Trees and Woody Shrubs  
(2-0) Cr. 2. S.  
Prereq: HORT 240 or LA 221 or LA 222  
Cultivars of the most prevalent and economically important woody landscape plants will be taught. The importance of cultivars to the nursery and landscaping professions and suggestions for their proper usage will be discussed.

HORT 342: Landscape Plant Installation, Establishment, and Maintenance  
(2-3) Cr. 3. F.  
Prereq: HORT 240 or LA 221 or LA 222  
Principles and practices involved with establishment and maintenance of managed landscapes. Laboratory work involves site evaluation, installation techniques, postplant care, and maintenance of established landscape plants.

HORT 351: Turfgrass Establishment and Management  
(Cross-listed with AGRON). (3-0) Cr. 3. F.  
Prereq: HORT 221 or AGRON 114 or BIOL 211  
Principles and practices of turfgrass propagation, establishment, and management. Specialized practices relative to professional lawn care, golf courses, athletic fields, highway roadways, and seed and sod production. The biology and control of turfgrass pests.
HORT 351L: Turfgrass Establishment and Management Laboratory
(Cross-listed with AGRON). (0-3) Cr. 1. F.
Prereq: Credit or enrollment in HORT 351
Those enrolled in the horticulture curriculum are required to take 351L in conjunction with 351 except by permission of the instructor.

HORT 354: Soils and Plant Growth
(Cross-listed with AGRON). (3-0) Cr. 3. F.S.
Prereq: AGRON 154 and BIOL 101 or BIOL 211
Effects of chemical, physical, and biological properties of soils on plant growth, with emphasis on nutritive elements, pH, organic matter maintenance, and rooting development.

HORT 354L: Soils and Plant Growth Laboratory
(Cross-listed with AGRON). (0-3) Cr. 1. F.S.
Prereq: Agron or Hort major with credit or enrollment in AGRON 354
Laboratory exercises in soil testing that assess a soil’s ability to support nutritive requirements for plant growth.

HORT 376: Field Production of Horticultural Crops
(3-0) Cr. 3. F.
Prereq: HORT 221 or Agron 114
An introduction to field production of fruit and vegetable crops and the theoretical and practical knowledge required for successfully producing them. Topics will include basic principles and practices of fruit and vegetable production, site selection, soil techniques, irrigation management, equipment and tools, integrated pest management, season extension strategies, postharvest handling and food safety, marketing, and basic business planning for fruit and vegetable enterprises. Additionally, this course will prepare students for HORT 461 and HORT 471, that are advanced level courses focusing on fruit and vegetable production.

HORT 380: Principles of Garden Composition
(2-0) Cr. 2. S.
Prereq: HORT 240
Functional and aesthetic aspects of landscape planning as a basis for design decisions; emphasis on spatial design and plant selection. Includes site analysis, development process, and design principles.

HORT 381: Beginning Garden Composition Studio
(0-4) Cr. 2. S.
Prereq: HORT 240, HORT 281, HORT 330, concurrent enrollment in HORT 380
Introduction to landscape design process. Intensive studio-based projects implementing principles of landscape design, concept development, and graphic communication. Not available as credit for L A majors.

HORT 391: Horticultural Management Experience
Cr. 1. Repeatable. F.S.S.S.
Prereq: HORT 221 or permission of instructor
A structured work experience for the student to gain insight into management operations associated with production and management of horticultural crops. A report of 10 or more pages describing the student’s experience is required. One credit is given for each term the student is enrolled in the course. A maximum of two credits may be used toward the horticultural sciences course requirements, and two additional credits may be used toward the 128 credits required for graduation.

HORT 398: Cooperative Education
Cr. R. Repeatable. F.S.S.S.
Prereq: Permission of department resource and career center coordinator
Students must register for this course before commencing each work period.

HORT 421: Introduction to Plant Breeding
(Cross-listed with AGRON). (3-0) Cr. 3. F.
Prereq: GEN 320 or BIOL 313
Breeding methods used in the genetic improvement of self-pollinated, cross-pollinated and asexually reproducing agronomic and horticultural crops. Applications of biotechnology techniques in the development of improved cultivars.

HORT 424: Sustainable and Environmental Horticulture Systems
(Dual-listed with HORT 524). (Cross-listed with ENV S). (3-0) Cr. 3. Alt. S., offered odd-numbered years.
Inquiry into ethical issues and environmental consequences of horticultural cropping systems, production practices and managed landscapes. Emphasis on systems that are resource efficient, environmentally sound, socially acceptable, and profitable.

HORT 434: Fall Greenhouse Crop Production
(2-3) Cr. 3. Alt. F., offered odd-numbered years.
Prereq: HORT 332
Principles and practices of greenhouse floriculture production. Emphasis is placed on production of foliage and containerized flowering species produced in greenhouses and other controlled environments. Field trips outside scheduled class time required. Greenhouse scheduling and costs of production projects are required.

HORT 435: Spring Greenhouse Crop Production
(2-3) Cr. 3. Alt. S., offered odd-numbered years.
Prereq: HORT 330 and HORT 332
Principles and practices of greenhouse production of ornamental crops for the spring garden market. Emphasis placed on the production of several ornamental crops, along with the complete palate of spring garden crops. Field trips outside scheduled class time required.

HORT 442: Nursery Production and Garden Center Management
(2-0) Cr. 2. Alt. F., offered odd-numbered years.
Prereq: HORT 221
Nursery layout, design, and cultural practices important for growing and shipping field and container-grown nursery crops. Overview of garden center design and retailing and marketing strategies. Field trip(s) outside scheduled class time may be required.

HORT 444: Landscape Construction Management
(2-3) Cr. 3. F.
Principles and practices of residential landscape construction. Encompasses business and project management, landscape estimating and overview of common landscape materials. Laboratory work involves construction project management and installation.

HORT 445: Horticulture Management and Administration
(2-0) Cr. 2. F.
Prereq: HORT 221 and junior or senior classification
In-depth presentation and discussion of skills and strategies needed to manage a horticultural enterprise. Topics include motivating employees, managing meetings, conducting performance appraisals, dealing with conflict, and managing an increasingly diverse work force.
HORT 451: Professional Turfgrass Management  
(2-0) Cr. 2. Alt. S., offered odd-numbered years.  
**Prereq:** HORT 351  
Turfgrass science including the study of (1) specific information on soil chemistry and soil modification as they relate to the development and maintenance of turfgrass areas, (2) specialized management practices used in athletic field care, professional lawn care, and golf course industries, and (3) construction methods for golf courses and sports fields.

HORT 452: Integrated Management of Diseases and Insect Pests of Turfgrasses  
(Dual-listed with HORT 552). (Cross-listed with ENT, PL P). (3-0) Cr. 3. Alt. S., offered even-numbered years.  
**Prereq:** HORT 351  
Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

HORT 453: Sports Turf Management  
(3-0) Cr. 3. Alt. F., offered even-numbered years.  
**Prereq:** HORT 351  
Management techniques for today’s specialized athletic fields. The horticultural and budgetary aspects of football, soccer, baseball, and softball fields will be presented. Field trips and laboratory exercises will develop a practical understanding of actual principles in field development, construction, and management.

HORT 454: Turf & Landscape Irrigation  
(3-0) Cr. 3. Alt. F., offered odd-numbered years.  
Irrigation systems and principles for turf and landscape environments. Topics include design, installation, equipment, management, and trouble shooting of irrigation systems for golf, athletic fields, residential lawns and landscapes. Participation in practical exercises and local field trips to irrigation sites is required.

HORT 461: Fruit Crop Production and Management  
(2-2) Cr. 3. Alt. S., offered odd-numbered years.  
**Prereq:** HORT 221  
Principles and practices of small fruit, tree fruit, and nut culture and production. Morphology, physiology of growth and development, plant establishment, pest management, pruning, training, harvesting, storage, and marketing of commercial temperate fruit and nut crops. Emphasis on sustainable practices. Participation in practical exercises and local field trips is required.

HORT 465: Horticulture Enterprise Management  
(Cross-listed with AGEDS). (1-6) Cr. 3. F.  
**Prereq:** Junior or senior classification.  
Participation in the management and operation of fruit and vegetable enterprises for local markets. Principles and practices of researching and developing a commercial business plan that will meet industry standards and that will be linked to the operations and production associated with the Hort 465 class. Laboratory work includes development of a horticulture enterprise business plan, high tunnel site preparation and planting, development of summer crop protocols, seedling production for the summer crop (if applicable) and land preparation and planting of a portion of the summer crop.

HORT 465A: Horticulture Enterprise Management - Planting  
(Cross-listed with AGEDS). (1-6) Cr. 3. S.  
**Prereq:** Junior or senior classification.  
Participation in the management and operation of fruit and vegetable enterprises for local markets. Principles and practices of researching and developing a commercial business plan that will meet industry standards and that will be linked to the operations and production associated with the Hort 465 class. Laboratory work includes development of a horticulture enterprise business plan, high tunnel site preparation and planting, development of summer crop protocols, seedling production for the summer crop (if applicable) and land preparation and planting of a portion of the summer crop.

HORT 465B: Horticulture Enterprise Management: Harvesting  
(Cross-listed with AGEDS). (1-6) Cr. 3. SS.  
**Prereq:** Junior or senior classification.  
Participation in the management and operation of fruit and vegetable enterprises for local markets. Principles and practices of harvesting and marketing high tunnel crops and the planting and growing of a variety of summer vegetables in the field. Laboratory work includes all operation and production aspects involved with the day-to-day running of a horticultural enterprise. The class will be responsible for crop selection and crop protocols for the fall high tunnel crop and seedling production for this crop (if applicable). Additionally, the class will be responsible for all crop maintenance decisions and record keeping during the season.

HORT 465C: Horticulture Enterprise Management: Marketing  
(Cross-listed with AGEDS). (1-6) Cr. 3. F.  
**Prereq:** Junior or senior classification.  
Participation in the management and operation of fruit and vegetable enterprises for local markets. Principles and practices of researching and developing a commercial horticulture enterprise market plan that could be used by a startup business and that will be linked directly to the operations and production associated with the Hort 465 class. Laboratory work includes completing the summer crop harvest, development of a horticulture marketing plan, high tunnel site preparation and planting, development of spring high tunnel crop protocols and all crop maintenance decisions and the record keeping for the fall high tunnel crop.

HORT 471: Vegetable Production and Management  
(2-0) Cr. 2. Alt. S., offered even-numbered years.  
**Prereq:** HORT 221  
Principles of vegetable production with emphasis on sustainable production practices, market outlets, business aspects, and risk management. Topics will include crop classification and rotation; planting methods; crop climatic conditions, physiological growth & development; soil, water, and pest management; cover cropping; season extension strategies; harvest and postharvest management and marketing. Course involves visits to growers fields to observe/experience their production enterprise.

HORT 471L: Vegetable Production and Management Lab  
(0-3) Cr. 1. Alt. S., offered even-numbered years.  
**Prereq:** Junior or Senior status and concurrent enrollment in Hort 471 is required.  
Hands-on training in the area of vegetable crop production. Students will have an opportunity to grow a variety of vegetables in a heated greenhouse and also conduct greenhouse and lab experiments. The lab also involves visits to vegetable production sites in Iowa to observe/experience and learn from growers and other agricultural professionals.
HORT 475: Urban Forestry  
(Cross-listed with FOR). (2-3) Cr. 3. F.  
Prereq: Junior or senior classification, 3 credits in biology  
Discussion of establishment and management of woody perennials in  
community-owned urban greenspaces, consideration of urban site and  
soil characteristics, plant physiology, plant culture, urban forest valuation,  
inventory methods, species selection, and urban forest maintenance  
(health care and pest management).

HORT 481: Advanced Garden Composition  
(0-4) Cr. 2. F.  
Prereq: HORT 240 and HORT 330 and HORT 380 and HORT 381  
Limited to Landscape Design Installation and Management option  
students. Development of residential landscapes using design principles  
and the design process. Projects encompass site analysis, concept  
development, preliminary design, final design, and graphic presentation  
techniques. Techniques will include hand and computer rendering.

HORT 484: Organic Agricultural Theory and Practice  
(Dual-listed with HORT 584). (Cross-listed with AGRON). (3-0) Cr. 3. Alt. S.,  
offered odd-numbered years.  
Prereq: 9 cr. in biological or physical sciences  
Understanding of the historical origins and ecological theories  
underpinning the practices involved in organic agriculture.  
Interdisciplinary examination of crop and livestock production and socio-  
economic processes and policies in organic agriculture from researcher  
and producer perspectives.

HORT 490: Independent Study  
Cr. arr. Repeatable.  
Prereq: Junior or Senior classification in horticulture or permission of  
instructor  
Investigation of topic holding special interest to the student.  
Comprehensive report required. Election of course and topic must be  
approved by department head. A maximum of 4 credits of Hort 490 and  
an additional 2 credits of 490 from outside Horticulture may be used  
toward the total of 128 credits required for graduation.

HORT 490A: Independent Study: Greenhouse Crops  
Cr. arr. Repeatable.  
Prereq: Junior or Senior classification in horticulture or permission of  
instructor  
Investigation of topic holding special interest to the student.  
Comprehensive report required. Election of course and topic must be  
approved by department head. A maximum of 4 credits of Hort 490 and  
an additional 2 credits of 490 from outside Horticulture may be used  
toward the total of 128 credits required for graduation.

HORT 490B: Independent Study: Nursery Crops  
Cr. arr. Repeatable.  
Prereq: Junior or Senior classification in horticulture or permission of  
instructor  
Investigation of topic holding special interest to the student.  
Comprehensive report required. Election of course and topic must be  
approved by department head. A maximum of 4 credits of Hort 490 and  
an additional 2 credits of 490 from outside Horticulture may be used  
toward the total of 128 credits required for graduation.

HORT 490C: Independent Study: Turfgrass  
Cr. arr. Repeatable.  
Prereq: Junior or Senior classification in horticulture or permission of  
instructor  
Investigation of topic holding special interest to the student.  
Comprehensive report required. Election of course and topic must be  
approved by department head. A maximum of 4 credits of Hort 490 and  
an additional 2 credits of 490 from outside Horticulture may be used  
toward the total of 128 credits required for graduation.

HORT 490D: Independent Study: Fruit Crops  
Cr. arr. Repeatable.  
Prereq: Junior or Senior classification in horticulture or permission of  
instructor  
Investigation of topic holding special interest to the student.  
Comprehensive report required. Election of course and topic must be  
approved by department head. A maximum of 4 credits of Hort 490 and  
an additional 2 credits of 490 from outside Horticulture may be used  
toward the total of 128 credits required for graduation.

HORT 490E: Independent Study: Vegetable Crops  
Cr. arr. Repeatable.  
Prereq: Junior or Senior classification in horticulture or permission of  
instructor  
Investigation of topic holding special interest to the student.  
Comprehensive report required. Election of course and topic must be  
approved by department head. A maximum of 4 credits of Hort 490 and  
an additional 2 credits of 490 from outside Horticulture may be used  
toward the total of 128 credits required for graduation.

HORT 490F: Independent Study: Cross-Commodity  
Cr. arr. Repeatable.  
Prereq: Junior or Senior classification in horticulture or permission of  
instructor  
Investigation of topic holding special interest to the student.  
Comprehensive report required. Election of course and topic must be  
approved by department head. A maximum of 4 credits of Hort 490 and  
an additional 2 credits of 490 from outside Horticulture may be used  
toward the total of 128 credits required for graduation.

HORT 490G: Independent Study: Landscape Horticulture  
Cr. arr. Repeatable.  
Prereq: Junior or Senior classification in horticulture or permission of  
instructor  
Investigation of topic holding special interest to the student.  
Comprehensive report required. Election of course and topic must be  
approved by department head. A maximum of 4 credits of Hort 490 and  
an additional 2 credits of 490 from outside Horticulture may be used  
toward the total of 128 credits required for graduation.

HORT 490H: Independent Study: Honors  
Cr. arr. Repeatable.  
Prereq: Junior or Senior classification in horticulture or permission of  
instructor  
Investigation of topic holding special interest to the student.  
Comprehensive report required. Election of course and topic must be  
approved by department head. A maximum of 4 credits of Hort 490 and  
an additional 2 credits of 490 from outside Horticulture may be used  
toward the total of 128 credits required for graduation.
HORT 490: Independent Study: International Study  
Cr. arr. Repeatable.  
Prereq: Junior or Senior classification in horticulture or permission of instructor  
Investigation of topic holding special interest to the student. Comprehensive report required. Election of course and topic must be approved by department head. A maximum of 4 credits of Hort 490 and an additional 2 credits of 490 from outside Horticulture may be used toward the total of 128 credits required for graduation.

HORT 490: Independent Study: Entrepreneurship  
Cr. arr. Repeatable.  
Prereq: Junior or Senior classification in horticulture or permission of instructor  
Investigation of topic holding special interest to the student. Comprehensive report required. Election of course and topic must be approved by department head. A maximum of 4 credits of Hort 490 and an additional 2 credits of 490 from outside Horticulture may be used toward the total of 128 credits required for graduation.

HORT 491: Seed Science Internship Experience  
(Cross-listed with AGRON). Cr. 1-2. Repeatable, maximum of 1 times. F.S.SS.  
Prereq: Agron 338, advanced approval and participation of employer and instructor  
A professional work experience and creative project for seed science secondary majors. The project requires the prior approval and participation of the employer and instructor. The student must submit a written report.

HORT 493: Workshop in Horticulture  
Cr. arr. Repeatable. Off campus. Offered as demand warrants. Workshops in horticulture.

HORT 494: Service Learning  
Cr. arr. Repeatable, maximum of 12 credits. F.S.SS.  
Prereq: Permission of instructor  
Selected projects that result in outcomes benefiting a non-Iowa State University entity while instilling professional ethics and accomplishing student learning goals. Course expenses paid by student. A maximum of 4 credits of 494 may be used toward the Horticulture credits required for graduation. Assessed service-learning component.

HORT 494A: Service Learning: International  
Cr. arr. Repeatable, maximum of 12 credits. F.S.SS.  
Prereq: Permission of instructor  
Selected projects that result in outcomes benefiting a non-Iowa State University entity while instilling professional ethics and accomplishing student learning goals. Course expenses paid by student. A maximum of 4 credits of 494 may be used toward the Horticulture credits required for graduation. Assessed service-learning component.

HORT 494B: Service Learning: Domestic  
Cr. arr. Repeatable, maximum of 12 credits. F.S.SS.  
Prereq: Permission of instructor  
Selected projects that result in outcomes benefiting a non-Iowa State University entity while instilling professional ethics and accomplishing student learning goals. Course expenses paid by student. A maximum of 4 credits of 494 may be used toward the Horticulture credits required for graduation. Assessed service-learning component.

HORT 495: Horticulture Travel Course Preparation  
Cr. R. Repeatable. F.S.SS.  
Prereq: Permission of instructor  
Limited enrollment. Students enrolled in this course also intend to register for Hort 496 the following term. Topics include preparation for safe international travel, the horticultural/agricultural industries, climate, crops, economics, geography, history, marketing, soils, culture, traditions, and horticultural/agricultural development of the country to be visited. Students enroll in this course the term immediately before travel to the foreign country.

HORT 496: Horticulture Travel Course  
Cr. 1-4. Repeatable. F.S.SS.  
Prereq: Permission of instructor  
Limited enrollment. Study and tour of production methods in major horticultural regions of the world. Influence of climate, economics, geography, soils, landscapes, markets, cultures, and history of horticultural crops. Location and duration of tours will vary. Tour expenses paid by students. Meets International Perspectives Requirement.

Courses primarily for graduate students, open to qualified undergraduates:

HORT 506: Crop Genetics  
(Cross-listed with AGRON). Cr. 3. F.  
Introduction to genetics of reproductive systems, recombination, segregation and linkage analysis, inbreeding, quantitative inheritance, fertility regulation, and polyploidy to prepare students for subsequent courses in crop improvement. Enrollment is restricted to off-campus MS in Plant Breeding students.

HORT 511: Integrated Management of Tropical Crops  
(Cross-listed with ENT, PL P). (3-0) Cr. 3. Alt. S., offered odd-numbered years.  
Prereq: PL P 408 or PL P 416 or ENT 370 or ENT 376 or HORT 221  
Applications of Integrated Crop Management principles (including plant pathology, entomology, and horticulture) to tropical cropping systems. Familiarization with a variety of tropical agroecosystems and Costa Rican culture is followed by 10-day tour of Costa Rican agriculture during spring break, then writeup of individual projects. Meets International Perspectives Requirement.

HORT 524: Sustainable and Environmental Horticulture Systems  
(Dual-listed with HORT 424). (3-0) Cr. 3. Alt. S., offered odd-numbered years.  
Inquiry into ethical issues and environmental consequences of horticultural cropping systems, production practices and managed landscapes. Emphasis on systems that are resource efficient, environmentally sound, socially acceptable, and profitable.

HORT 530: Research Orientation  
(1-3) Cr. 2. F.  
Instruction in scientific methods and communication skills.

HORT 542: Introduction to Molecular Biology Techniques  
(Cross-listed with B M S, EEOB, FS HN, GDCB, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS.  
Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.
HORT 542A: Introduction to Molecular Biology Techniques: DNA Techniques
(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.
Includes genetic engineering procedures, sequencing, PCR, and genotyping. Offered on a satisfactory-fail basis only.

HORT 542B: Introduction to Molecular Biology Techniques: Protein
(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, NREM, NUTRS, VDPAM). Cr. 1. Repeatable. S.S.
Prereq: Graduate classification
Techniques. Includes: fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, immunophenotyping, and monoclonal antibody production. Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

HORT 542C: Introduction to Molecular Biology Techniques: Cell Techniques
(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.
Includes: immunophenotyping, ELISA, flow cytometry, microscopic techniques, image analysis, confocal, multiphoton and laser capture microdissection. Offered on a satisfactory-fail basis only.

HORT 542D: Introduction to Molecular Biology Techniques: Plant Transformation
(Cross-listed with B M S, EEOB, FS HN, GDCB, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.
Includes: Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. Offered on a satisfactory-fail basis only.

HORT 542E: Introduction to Molecular Biology Techniques: Proteomics
(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.
Includes: two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. Offered on a satisfactory-fail basis only.

HORT 542F: Introduction to Molecular Biology Techniques: Metabolomics
(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.
Includes: metabolomics and the techniques involved in metabolite profiling. For non-chemistry majoring students who are seeking analytical aspects into their biological research projects. Offered on a satisfactory-fail basis only.

HORT 542G: Introduction to Molecular Biology Techniques: Genomic
(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.
Offered on a satisfactory-fail basis only.

HORT 543: Seed Physiology
(Cross-listed with STB). (2-0) Cr. 2. Alt. F., offered even-numbered years.
Prereq: Admission to the Graduate Seed Technology and Business Program or approval of the instructor
Brief introduction to plant physiology. Physiological aspects of seed development, maturation, longevity, dormancy and germination. Links between physiology and seed quality.

HORT 546: Strategies for Diversified Food and Farming Systems
(Cross-listed with AGRON, SUSAG). (3-0) Cr. 3. Alt. S., offered odd-numbered years.
Prereq: SUSAG 509
Project-focused engagement in food and farming systems using tools and perspectives drawn from multiple disciplines. Includes a field component.

HORT 551: Growth and Development of Perennial Grasses
(Cross-listed with AGRON). (2-0) Cr. 2. Alt. S., offered even-numbered years.
Prereq: Junior or senior or graduate classification or permission of instructor
Selected topics on anatomy, morphology, and physiology relative to growth and development of perennial grasses. Emphasis on growth and development characteristics peculiar to grasses and variations of such characteristics under natural and managed conditions.

HORT 552: Integrated Management of Diseases and Insect Pests of Turfgrasses
(Dual-listed with HORT 452). (Cross-listed with ENT, PL P). (3-0) Cr. 3. Alt. S., offered even-numbered years.
Prereq: HORT 351
Identification and biology of important diseases and insect pests of turfgrasses. Development of integrated pest management programs in various turfgrass environments.

HORT 576: Interdisciplinary Food and Agriculture Systems
(Cross-listed with AGRON, SUSAG). (3-0) Cr. 3. Alt. S., offered odd-numbered years.
Prereq: 9 cr. in biological or physical sciences
Interdisciplinary examination of crop and livestock production and socio-economic processes and policies in organic agriculture from researcher and producer perspectives.

HORT 590: Special Topics
Cr. arr. Repeatable.
Prereq: a major or minor in horticulture

HORT 593: Workshop in Horticulture
Cr. arr. Repeatable.
Workshops in horticulture, with emphasis on off-campus instruction.

HORT 593A: Workshop in Horticulture: Greenhouse Crops
Cr. arr. Repeatable.
Workshops in horticulture, with emphasis on off-campus instruction.

HORT 593B: Workshop in Horticulture: Nursery Crops
Cr. arr. Repeatable.
Workshops in horticulture, with emphasis on off-campus instruction.

HORT 593C: Workshop in Horticulture: Turfgrass
Cr. arr. Repeatable.
Workshops in horticulture, with emphasis on off-campus instruction.

HORT 593D: Workshop in Horticulture: Fruit Crops
Cr. arr. Repeatable.
Workshops in horticulture, with emphasis on off-campus instruction.

HORT 593E: Workshop in Horticulture: Vegetable Crops
Cr. arr. Repeatable.
Workshops in horticulture, with emphasis on off-campus instruction.
HORT 593F: Workshop in Horticulture: Cross-Commodity  
Cr. arr. Repeatable.  
Workshops in horticulture, with emphasis on off-campus instruction.

HORT 593G: Workshop in Horticulture: Landscape Horticulture  
Cr. arr. Repeatable.  
Workshops in horticulture, with emphasis on off-campus instruction.

HORT 599: Creative Component  
Cr. arr. Repeatable.

Courses for graduate students:

HORT 610: Graduate Seminar  
Cr. 1. Repeatable. F.S.  
Offered on a satisfactory-fail basis only.

HORT 690: Advanced Topics  
Cr. arr. Repeatable.

HORT 696: Research Seminar  
(Cross-listed with AGRON, BBMB, FOR, GDCB, PLBIO). Cr. 1. Repeatable. F.S.  
Research seminars by faculty and graduate students. Offered on a satisfactory-fail basis only.

HORT 698: Horticulture Teaching Practicum  
(1-0) Cr. 1. S.  
Prereq: Graduate student classification  
Discussions are intended to foster the development of graduate students as teaching assistants and future horticulture/plant science teachers. Topics include establishing a classroom presence, improving lectures, motivating students, dealing with difficult or disruptive students, and developing a teaching philosophy. Offered on a satisfactory-fail basis only.

HORT 699: Thesis and Dissertation Research  
Cr. arr. Repeatable.

HORT 699A: Thesis and Dissertation Research: Greenhouse Crops  
Cr. arr. Repeatable.

HORT 699B: Thesis and Dissertation Research: Nursery Crops  
Cr. arr. Repeatable.

HORT 699C: Thesis and Dissertation Research: Turfgrass  
Cr. arr. Repeatable.

HORT 699D: Thesis and Dissertation Research: Fruit Crops  
Cr. arr. Repeatable.

HORT 699E: Thesis and Dissertation Research: Vegetable Crops  
Cr. arr. Repeatable.

HORT 699F: Thesis and Dissertation Research: Cross-Commodity  
Cr. arr. Repeatable.

HORT 699G: Thesis and Dissertation Research: Landscape Horticulture  
Cr. arr. Repeatable.

HORT 699I: Thesis and Dissertation Research: Biotechnology  
Cr. arr. Repeatable.