Program Procedures for Obtaining Approval of a New Area of Specialization or a Change in an Area of Specialization in a Graduate Degree

(Check one)

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Request for New Specialization

The following describes the material which should be included in a proposal for a new area of specialization in an existing graduate degree or for a change in an existing area of specialization. Areas of specialization are recognized on a student's permanent record (transcript). Approval is required by the department or program curriculum committee, the College Curriculum Committee, the GCCC, Graduate Council, and by the Graduate Dean. The proposal should be sent to the Graduate Curriculum and Catalog Committee (GCCC) with documentation of approvals by the department and college:

Graduate Curriculum and Catalog Committee
1137 Pearson Hall
Iowa State University
Ames, IA 50011-2206

1. Name of the area of specialization. **PREDICTIVE PHENOMICS OF PLANTS (P3)**

2. Name of the major. **Bioinformatics and Computational Biology**

3. Graduate degrees to which it applies. **Ph.D.**

4. Name of the department(s) or program.
   INTERDEPARTMENTAL Bioinformatics and Computational Biology

5. What is the change you are requesting? (Answer only if you checked the Change box)
   N/A

6. Other existing areas of specialization for the same major and same degree.
   N/A

7. Are areas of specialization optional or required? (Can a student choose the major without selecting an area of specialization?)
   OPTIONAL

8. Reasons for proposing the new area of specialization or change in the area of specialization.

In October of 2015, the Interdepartmental Bioinformatics and Computational Biology (BCB) faculty voted in favor of establishing a specialization within this BCB major at the Ph.D. level entitled, "Predictive Phenomics of Plants" (also known as P3).

Faculty at Iowa State University received NSF NRT Research Traineeship Funding for this area of specialization. Students within this specialization will be trained in Engineering, Plant Sciences and Data Sciences. www.predictivephenomicsinplants.iastate.edu The NSF NRT P3 Trainees will be predominantly majoring in Agricultural and Biosystems Engineering, Electrical and Computer Engineering, Bioinformatics and Computational Biology, Mechanical Engineering, Genetics and Genomics, and Plant Biology.

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Value to the Ph.D. student: Recognition of intensive and innovative program on their transcript.

Value to the program: Recruitment of students who will be trained to address major agronomic challenges of the 21st century.

Value to Iowa State University: This specialization is designed to encourage the development and implementation of bold, new, potentially transformative, and scalable models for STEM graduate education training including one NSF priority interdisciplinary research theme—Data-Enabled Science and Engineering (DESE)." (2015, Patrick S. Schnable, Agronomy).

Value to the world: Broaden the thinking on how to solve growing populations and climate change; and adapt agriculture to meet global needs (i.e. food security).

9. Requirements for the area of specialization (how are the requirements different for this area of specialization compared to other areas of specialization or to the major without an area of specialization). (For new specialization only.)

Predictive Phenomics of Plants Specialization:

Coursework includes:

- STAT 430: Empirical Methods for the Computational Sciences (3 credits)
- BCB/GDCB/ME 585X: Fundamentals of Predictive Plant Phenomics (4 credits)
- BR C/BRT 507 Technology Led Entrepreneurship in Biorenewables (1 credit)
- GR ST 565 Responsible Conduct of Research in Science and Engineering (1 credit)
- ME 600 (sec P3): P3C Seminar. Taken by all students and faculty of the P3 program (1 credit each semester)
- Three Electives from two areas: Engineering Technical and Plant Sciences Technical (total 9 credits) in addition to the three technical electives within the BCB program (the P3 Program student's discipline of focus). Possible electives are listed here: http://www.predictivephenomicsinplants.iastate.edu/curriculum.html

Mapping of P3 course work onto BCB requirements:

Table 1 shows the requirements for the BCB PhD and how they map to the P3 specialization. The main changes are that the students must take the P3 core course and lab (BCB/GDCB/ME 585X Fundamentals of Predictive Plant Phenomics) in their first fall semester, the requirement for taking BR C/BRT 507 (technology-led entrepreneurship), and the seminar replacement with the P3C research seminars. However, we anticipate overlap with the seminar series for the other interdisciplinary majors in areas such as building communications skills, data sciences approaches to biological data analysis, etc.

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Requirement	Course Number (Semester Offered)	Course Name	BCB PhD	P3 PhD
Background coursework	STAT 430 (F) Variable	Empirical Methods for Computational Science	3 cr	**3 cr**
BCB core courses	BCB 567 (F) BCB 568 (S) BCB 569 (F) BCB 570 (S) GDCB 511 (S) or equivalent	Fundamentals of Genomic Informatics Advanced Genomic Informatics Structural Genome Informatics Computational Functional Genomics and Systems Biology	3 cr 3 cr 3 cr 3 cr 3 cr	Fits within the P3 3-2-1 structure: 3 Data Science: BCB 567, BCB 568, BCB 570 2 Biology: BCB 569, GDCB 511
Advanced group requirements	Variable	At least 3 cr from Group I and 3 cr from Group II or Group III	6 cr	1 Engineering course P3 core course and Lab (BCB 585X) taken first semester **7 cr**
Workshops and symposia	BCB 593	BCB Workshop	2 times	2 times
Student research seminars	BCB 690 (S)	BCB Student Research Seminar	2 times	Replace with P3C Research Seminars (**2 cr**)
Faculty seminars	BCB 691 (F)	BCB Faculty Research Seminar	2 times	Replace with P3C Research Seminars (**2 cr**)
Research rotation (first year only)	BCB 697 (F S)	BCB Research Rotations	3 labs	3 labs
Research	BCB 699 (F S SS)	Research	Variable cr	Variable cr
Bioethics training	GR ST 565 (F)	BCB-approved bioethics course/modules	1 cr	**1 cr**
Entrepreneurship	BR C/BRT 507 (S)	Technology Led Entrepreneurship in Biorenewables	N/A	**1 cr**
Total Credit Hours			72	

Table I P3 Sample Coursework.

CORE COURSES		
BCB/GDCB/ME 585X: Fundamentals of Predictive Plant Phenomics (4 credits) STAT 430: Empirical Methods for the Computational Sciences (3 credits) BR C/BRT 507: Technology Led Entrepreneurship in Biorenewables (1 credit) GR ST 565: Responsible Conduct of Research in Science and Engineering (1 credit) ME 600 (sec P3): P3C Seminar. Taken by all students and faculty of the P3 program (1 credit each semester)		
TECHNICAL ELECTIVES*		
ENGINEERING	**PLANT SCIENCE**	**DATA SCIENCE**
B M E 450X: Biosensors	GDCB 511: Molecular Genetics	CPR E 425: High Performance Computing for Science and Engineering Applications
CH E 356 Transport Phenomena I	GDCB 513: Plant Metabolism	BCB 570: Computational Functional Genomics and Systems Biology
ABE 504: Instrumentation for Agricultural and Biosystems Engineering	GDCB 545: Plant Molecular, Cell and Developmental Biology	BCB 567: Fundamentals of Genome Informatics
CH E 554 Integrated Transport Phenomena	AGRON 404: Global Change	BCB 568: Advanced Genome Informatics
EE 528 Digital Image Processing	AGRON 506: Crop Genetics	EE 547 Pattern Recognition
EE 530M: MEMS and BioMEMs	PL P 477: Bacterial Plant Interactions	COM S 572, 573: Artificial Intelligence, Machine Learning
ME 475 Modeling and Simulation		CPR E 419: Software Tools for Large Scale Data Analysis

*NSF NRT Fellows take three technical electives in the student's discipline of focus, two courses in the second discipline, and one course in the remaining discipline during their training. This table only lists example courses. Additional courses can be allowed with approval of the student's POS committee
ABE: Agricultural and Biological Engineering; AGRON: Agronomy; BCB: Bioinformatics and Computational Biology; B M E: Biomedical Engineering; CH E: Chemical Engineering; COM S: Computer Science; CPR E: Computer Engineering; EE: Electrical Engineering; GDCB: Genetics, Development and Cell Biology; ME: Mechanical Engineering; PL P: Plant Pathology; STAT: Statistics

10. Estimate the number of students who will graduate with this major and degree each year and the number who will graduate with this area of specialization. (For new specialization only.)

BIOINFORMATICS AND COMPUTATIONAL BIOLOGY Ph.D: 9
PREDICTIVE PHENOMICS OF PLANTS SPECIALIZATION: 2

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11 What resources (faculty, courses, research facilities, library facilities, etc) are available to support the area of specialization? (For new specialization only.)

NSF NRT Ph.D. TRAINEESHIP AWARD #1545453 AUGUST 13, 2015
http://www.nsf.gov/awardsearch/showAward?AWD_ID=1545453 $2,866,938.00

Grant PI's and team members are dedicated to the success of this specialization through several different majors at Iowa State University:
http://www.predictivephenomicsinplants.iastate.edu/team.html
http://www.predictivephenomicsinplants.iastate.edu/details.html

Courses: Most coursework exists. BCB/GDCB/ME 585X has been approved with the first offering in Fall 2016 (4 credits).

12. What future financial support will be needed? (For new specialization only.)

After NSF NRT grant ends, funding would likely be necessary to provide for introductory course which includes lab elements (BCB/GDCB/ME 585X has been approved with the first offering in Fall 2016). Funding could be provided by the program or passed onto graduate students as course lab fees. This course would be available to students not enrolled in the specialization and depending upon yearly enrollment, offered in alternate Fall semesters instead of yearly.

All other courses exist and will serve students inside and outside of the specialization.