# Plant-Insect-Microbe Interactions

With hands-on bioinformatics analyses in entomology and plant disease - 3 credits

**Prerequisites:** General entomology (required), any course related to plant science (required), molecular biology (preferred).

**Textbook and resources:**
Required reading from the primary literature will be used for each week's background material. Every student is required to have access to a laptop (Windows or Mac). Students will have to install required programs to access the Hopper Cluster to conduct required analyses. All programs that will be used in the course are free to the public.

**Learning goals and outcomes:**
Students are able to understand the complex relationship of plant-insect-microbe interactions and the basic methodologies being used in the primary literature. They are able to apply next-generation sequencing based analyses on their own.

**Overview:** The plant-insect-microbe interactions course is designed for senior level undergraduate students and graduate students who are interested in ecological interactions of microbes, plant-feeding insects, and plants in agroecosystems. The course will focus on three primary topics: 1. Soil microbes and their impact on plant-feeding insects that improve plant defense, 2. Endosymbionts of plant-feeding insects, 3. Vector-borne plant diseases. The course will involve various in-class activities, including in-class reading, discussion, group projects, and presentations. In addition, the course highlights hands-on experience of analyzing next-generation sequencing data that were collected in real experiments. This will help students to understand the basic concepts of how big data can be used in applied entomology and plant pathology. For the team project, students are required to acquire publicly available data, and conduct similar or novel analysis to address interesting questions that involve one or more components of plant-insect-microbe species complexes. Students are required to use the Hopper Cluster (high performance computing) at Auburn to accomplish their assignments while writing very simple scripts using R, which is an open-source and freely-available programming language.

**<u>Detailed course arrangement</u>** (10 lectures, 10 labs, 2 journal discussions and a lab tour):

**Module 1**: Refreshment of basic knowledge in genetics
**Module 2**: Soil microbes and their impact on plant-feeding insects that improve plant defense
**Module 3**: Endosymbionts of the plant-feeding insects
**Module 4**: Vector-borne plant disease
**Module 5**: Group presentation

| Week | Module | Topic | Activity Type |
|---|---|---|---|
| **1** | 1 | Introduction, gene and genome | Lecture |
| **1** | 1 | Access Hopper and basic Linux commands | Lab |
| **2** | 1 | DNA/RNA sequencing | Lecture |
| **2** | 1 | Make simple plots using R | Lab |
| **3** | 2 | Microbes that live in the soil | Lecture |
| **3** | 2 | Analyze 16S rRNA data using DADA2 | Lab |
| **4** | 2 | Plant-feeding insects and natural enemies | Lecture |
| **4** | 2 | Analyze fungal ITS using DADA2 | Lab |
| **5** | 2 | Interactions of insects and plant defense mediated by microbes | Lecture |
| **5** | 2 | Same as above | Journal discussion |
| **6** | 3 | Endosymbiont | Lecture |
| **6** | 3 | Manipulation of fasta file | Lab |
| **7** | | Mid term | Exam |
| **7** | | Tour of Genomics and Sequencing Lab | Tour |
| **8** | 3 | Effect of endosymbionts on insect hosts | Lecture |
| **8** | 3 | Same as above | Journal discussion |
| **9** | 3 | Genome assembly (Illumina, bacteria) | Lab |
| **9** | 3 | Genome assembly (Pacbio, bacteria) | Lab |
| **10** | 4 | Plant virus vectored by aphids | Lecture |
| **10** | 4 | RADseq and application | Lab |
| **11** | 4 | Psyllid-bacterial pathogen interaction | Lecture |
| **11** | 4 | Genome alignment and SNP calling | Lab |
| **12** | 4 | Insect vector biology | Lecture |
| **12** | 4 | Population genetic analysis | Lab |
| **13** | 5 | Group presentation | Presentation |
| **13** | 5 | Group presentation | Presentation |
| **14** | 5 | Group presentation | Presentation |
| **14** | 5 | Group presentation | Presentation |

**<u>Grading</u>:** Grades are based on the following system:

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|---|---|
| In-class discussion | 10% |
| Lab participation | 20% |
| Two exams | 40% |
| Group project | 30% |