

## MINERAL NUTRITION AND MEMBRANE PHYSIOLOGY - PLB 425

**Instructor:** Dr. Stephen Ebbs, 469B LS II, sebbs@plant.siu.edu

**Meeting times:** Lecture MWF 1:00 p.m. - 1:50 p.m.; Lab T 2:00 p.m.- 5:50 p.m.

**Office Hours:** MWF 10-12 or by appointment

**Texts<sup>1</sup>:** *Mineral Nutrition of Higher Plants*, 2<sup>nd</sup> ed. Marschner, 1995 (required)

**Course description:** This course will explore the mechanistic and energetic basis of water relations and membrane transport in plants as well as historical and modern perspectives on plant mineral nutrition. Laboratory exercises will emphasize contemporary methods in these areas, including measurement of plant water status, enzyme and transport kinetics, diagnosis and alleviation of plant mineral deficiencies, and the use of stable and radioisotopes.

**Course objectives:** The objectives for this course are to:

1. Provide students with an understanding of plant mineral nutrition, the functions of the various mineral nutrients, and the recognition and treatment of mineral deficiencies in plants;
2. Train students in modern methods used in plant physiology and how to interpret the data obtained;
3. Familiarize students with the analysis and critique of primary scientific literature and their writing skills.

**Grades:** Finals grades for this course will be based on a total of 500 points.

|                                |                        |   |             |
|--------------------------------|------------------------|---|-------------|
| Lecture exams (3, drop lowest) | 100 pts each x 2 exams | A | 450-500 pts |
| Final exam                     | 100 pts                | B | 400-449 pts |
| Literature Summaries           | 10 pts x 15            | C | 320-399 pts |
| Lab project                    | 50 pts                 | D | 300-319 pts |

Lecture exams will utilize a variety of question formats but will predominantly be short answer essay questions. Material for these exams may be drawn from lecture material or from any of the assigned readings. The final exam, scheduled for **Friday, May 9 at 10:10 a.m.**, will test over the few remaining lectures, reading assignments, and assess the student's grasp of the first two of the course's learning objectives. In addition, every two weeks during the semester, students will be required to read and summarize two papers from the primary literature. These papers may be assigned or the student may be required to locate one or both on their own. The literature summaries will require students to summarize, analyze, and critique these works. Some special instructions may also be included for specific weeks during the semester. This exercise is intended to increase students' familiarity with primary scientific literature in this area while also sharpening their cognitive and writing skills (Objective #3). Additional information on the content of these summaries will be provided on a separate handout.

**Isotope training:** During the course of the semester, we will be using radioisotopes to study membrane transport. Although students require no formal training to do these experiments, the university offers an online, self-paced training system that ends with a simple certification quiz. If you read these online modules and pass the quiz then you will be a certified isotope user on the SIUC campus. While this training does not extend beyond SIUC, it represents important fundamental knowledge to those who may continue working in this area. Taking the course is **optional**. If you are interested, I can direct you to the appropriate web site.

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<sup>1</sup> A copy of this book is on reserve in Morris Library.

## COURSE SCHEDULE AND READING ASSIGNMENTS

| <b>Lecture Topics</b>                               | <b>Lecture Date(s)</b> | <b>Readings<sup>1</sup></b> | <b>Lab Topic</b>                            | <b>Lab Date</b>   |
|---|------------------------|-----------------------------|---|-------------------|
| Course Introduction                                 | 1/14                   | pp. 3-5                     | 1. Soils and Soil Analyses                  | 1/15              |
| Plants and Mineral Nutrients                        | 1/14-1/16              | pp. 128-196                 |   |                   |
| Soil-Water-Nutrient Relations                       | 1/18-1/25              | pp. 483-507                 | 2. Elemental Analysis                       | 1/22              |
| Root-level phenomena                                | 1/28-2/1               | pp. 6-73                    | 3. Water Relations and Mineral Nutrition    | 1/29 <sup>§</sup> |
| Membrane structure and biophysics                   | 2/4-2/6                | pp. 6-73                    | 4. Mineral Nutrient Transport               | 2/5               |
| <b>Exam #1</b>                                      | <b>2/8</b>             |                             |   |                   |
| Membrane Transport Proteins                         | 2/11-2/13              | pp. 6-73                    | 5. Mineral Nutrient Transport               | 2/12 <sup>§</sup> |
| Nutrients in the Xylem and Phloem                   | 2/15-2/20              | pp. 79-107                  | 6. Xylem and Phloem                         | 2/19              |
| Nutrient Deficiency                                 | 2/22                   | pp. 461-478                 |   |                   |
| Classification of mineral nutrients                 | 2/25                   |                             | 7. Mineral Nutrient Deficiencies I          | 2/26 <sup>§</sup> |
| Nitrogen and nitrogen assimilation                  | 2/27-2/29              | pp. 596-680                 |   |                   |
| Nitrogen fixation                                   | 3/3-3/5                | pp. 231-254                 | 8. Mineral Nutrient Deficiencies II         | 3/4               |
| <b>Exam #2</b>                                      | <b>3/7</b>             |                             |   |                   |
| <b>SPRING BREAK</b>                                 | <b>3/10-3/14</b>       |                             |   |                   |
| Sulfur and phosphorus                               | 3/17-3/19              | pp. 201-228                 | 9. Mineral nutrient assimilation - Nitrogen | 3/18 <sup>§</sup> |
| Base cations – Ca, K, Mg                            | 3/21-3/24              | pp. 255-265                 |   |                   |
| Iron  | 3/26-3/28              | pp. 265-277                 | 10. Mineral nutrient assimilation - Sulfur  | 3/25              |
| Micronutrients                                      | 3/31-4/2               | pp. 277-312                 | 11. TBA                                     | 4/1               |
| <b>Exam #3</b>                                      | <b>4/4</b>             |                             |   |                   |
| Micronutrients                                      | 4/7-4/9                | pp. 313-324                 | 12. Data collection for project             | 4/8 <sup>§</sup>  |
| Beneficial Elements and Nutrient Analogs            | 4/11-4/14              | pp. 324-404                 | 13. Biotechnology of Mineral Nutrition      | 4/15              |
| “Extreme” mineral nutrition                         | 4/16-4/18              | pp. 405-435                 |   |                   |
| Mycorrhizal Fungi                                   | 4/21-4/23              | pp. 508-595                 | 14. Biotechnology of Mineral Nutrition      | 4/22 <sup>§</sup> |
| Biotechnology of Mineral Nutrition                  | 4/25-4/28              |                             |   |                   |
| Relating Plant Mineral Nutrition to Human Nutrition | 4/30-5/2               |                             | 15. Data collection for project             | 4/29              |
| <b>Final Exam</b>                                   | <b>5/9</b>             |                             |   |                   |

<sup>1</sup> Additional readings for each topic will be indicated in class or on the course website. Some of these readings may be required reading for exams.

<sup>§</sup> Indicates a date when two Literature Summaries are due.