

## COURSE SYLLABUS

### TEXTS:

Raven, Peter H., Ray F. Evert, and Susan E. Eichhorn. 2013. Biology of Plants. Eighth Edition. W. H. Freeman & Co. ISBN: 1-4292-1961-0

Evert, Ray F., Susan E. Eichhorn, and Joy B. Perry. 2013. Laboratory Topics in Botany. Eighth Edition. W.H. Freeman & Co. ISBN: 1-4641-1810-8

Plotkin, Mark J. 1993. Tales of a Shaman's Apprentice. Penguin Books.  
ISBN: 0 14-012991-X

### OPTIONAL:

Leopold, Aldo. 1949. A Sand County Almanac. Balantine Books. This book is optional. You can purchase it in the bookstore for about \$12.00, or copies will be on reserve in Reeves Library. Plan on reading the last chapter, *The Land Ethic*, for our discussion on biodiversity.

### COURSE OBJECTIVES:

Biology 119 is an introductory course in plant science designed to introduce you to plants as living organisms. One of the principal goals is to examine the importance of plants in our every day lives. Not only do plants provide us with food and fiber, but also a broad array of important medicines, pharmaceuticals and pain killing drugs. Recent research has shown that certain plants produce potent anticancer drugs, and it is likely that drugs from tropical plants will be useful in treating AIDS. Ironically, the ecosystems which contain these plants are at risk and many of them may not survive the next two decades. We will discuss the rapid loss of biodiversity and its potential effects on our lives. Some attention will be given to how climate change may impact plant distribution patterns.

A second goal will be for us to see how plants have been used as experimental organisms to solve important biological problems. We will explore the relationships between structure and function in higher plants, especially photosynthesis, and we will see how the photosynthetic mechanism responds to environmental changes. We will also examine how plants control their growth and development and how the control mechanisms respond to environmental changes. Some time will be devoted to how plants respond to stress, in particular to how they defend themselves against herbivores. We may discuss some of the new advances in plant biotechnology to see how genetic manipulation of important plant species is accomplished.

Another goal will be to examine a few representative examples of major plant divisions and see how they reproduce. Based on differences in reproductive patterns we will discuss some of the major trends in plant evolution.

Finally, we will look at the historical and cultural significance of plants, particularly the pivotal role of plant domestication in the rise of civilization.

#### ATTENDANCE:

Plan to attend all regular classes, laboratories, and exams. Missing an exam means that the exam will be given a score of zero and averaged with other test grades for the semester. In the case where an exam is missed for a valid reason, the exam will not count against the final average and the remaining test scores will be averaged.

#### GRADING:

Grades are based on lecture exams, laboratory quizzes, a laboratory practical exam, and a final exam. Exams and quizzes are arranged so that in any given week only one item is scheduled.

|                                               | <u>Point<br/>Value</u> | <u>Percentage of<br/>Final Grade</u> |
|-----------------------------------------------|------------------------|--------------------------------------|
| Three (3) hour exams (100 points each)        | 300                    | 33.3%                                |
| Three (3) laboratory quizzes (60 points each) | 180                    | 20.0%                                |
| One (1) laboratory practical exam             | 150                    | 16.7%                                |
| Final exam (comprehensive)                    | <u>270</u>             | <u>30.0%</u>                         |
|                                               | 900                    | 100.0%                               |

|                |          |   |
|----------------|----------|---|
| GRADING SCALE: | 90 - 100 | A |
|                | 80 - 89  | B |
|                | 70 - 79  | C |
|                | 60 - 69  | D |
|                | < 60     | F |

#### ACADEMIC HONESTY:

The instructor adheres to the policy statement on academic integrity outlined in the current Student Handbook.

Students who wish to request accommodations in this class for a disability should contact the Academic Support Center, located in the lower level of Monocacy Hall, or by calling [610-861-1401](tel:610-861-1401). Accommodations cannot be provided until authorization is received from the Academic Support Center.

**Do not bring cell phones to class on days when exams are scheduled, or to the laboratory on days when a lab quiz is to be given. The instructor is singularly unforgiving about this.**

#### EXTRA CREDIT:

For those who wish to do so there are extra credit video DVDs which may be viewed in Reeves Library or you may check them out and view them on your computer. Each is worth 10 points. If you elect to do this, you need to advise the instructor in advance and then go to Reeves Library to locate the DVD. Some of the titles listed below are on the older VHS video cassette format. Since VHS cassettes are obsolete and most people no longer have them, you will probably have to view these in Reeves Library. Ask at the checkout desk. To receive credit you will need to turn in a one page abstract to the instructor summarizing the central ideas in the film. Your summary should be turned in within one week of viewing the film. All video summaries must be received by the instructor on or before **Friday 29 April at 4:00 pm**. Video summaries are not accepted during final exam week. Items below marked with an asterisk (\*) are particularly well done. Extra credit is optional.

You may select **no more than two** from the following titles excluding any that we might have used in class or the laboratory:

AMATE: The Great Fig Tree

Ecology of the Forest \*

Faces of the Rain Forest

Manu: Peru's Hidden Rainforest \*

Natural Connections \*\*

Pollination

Pollination: The Insect Connection

Queen of Trees \* (This is not in Reeves Library; see the instructor for this one.)

Race to Save the Planet 5: Remnants of Eden

Sexual Encounters of the Floral Kind

Spirit of the Rainforest \*

## LECTURE SCHEDULE

|                                                 |                        |                                                                                                                         |
|-------------------------------------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Mon.                                            | 18 Jan.                | Orientation; “What is a seed?”                                                                                          |
| Wed.                                            | 20 Jan.                | Seed structure, germination, and seed ecology                                                                           |
| Fri.                                            | 22 Jan.                | Seedling development and its control                                                                                    |
| Mon.                                            | 25 Jan.                | Flowers and floral anatomy                                                                                              |
| Wed.                                            | 27 Jan.                | How do flowering plants reproduce?                                                                                      |
| Fri.                                            | 29 Jan.                | How do flowering plants reproduce?                                                                                      |
| Mon.                                            | 1 Feb.                 | Pollination biology, the essence of mutualism                                                                           |
| Wed.                                            | 3 Feb.                 | Why are plants important to us? (Or, what might life be like without them?)                                             |
| Fri.                                            | 5 Feb.                 | Useful plants and plant products                                                                                        |
| Mon.                                            | 8 Feb.                 | Molecular composition of plant cells                                                                                    |
| Wed.                                            | 10 Feb.                | Molecular composition of plant cells                                                                                    |
| Fri.                                            | 12 Feb.                | <b>FIRST HOUR EXAM</b>                                                                                                  |
| Mon.                                            | 15 Feb.                | Enzymes, catalysts of life. Factors which affect their action                                                           |
| Wed.                                            | 17 Feb.                | The structure of plant cells                                                                                            |
| Fri.                                            | 19 Feb.                | The structure of plant cells                                                                                            |
| Mon.                                            | 22 Feb.                | How do plant cells divide? Mitosis and the concept of totipotency. Totipotent cells can be used to clone useful plants. |
| Wed.                                            | 24 Feb.                | Meiosis and sexual reproduction                                                                                         |
| Fri.                                            | 26 Feb.                | Cells, differentiation, and plant tissues                                                                               |
| Mon.                                            | 29 Feb.                | Stems and leaves                                                                                                        |
| Wed.                                            | 2 Mar.                 | Leaves and roots                                                                                                        |
| Fri.                                            | 4 Mar.                 | Plant growth and development: hormones and tropisms (MID TERM)                                                          |
| Sat. 5 Mar. - Sun. 13 Mar. <b>SPRING RECESS</b> |                        |                                                                                                                         |
| Mon.                                            | 14 Mar.                | Growth and development: How do plants see light? Phytochromes                                                           |
| Wed.                                            | 16 Mar.                | Growth and development: photoperiodism and flowering                                                                    |
| Fri.                                            | 18 Mar.                | <b>SECOND HOUR EXAM</b>                                                                                                 |
| Mon.                                            | 21 Mar.                | Alternation of generations: the fern life cycle (fern allies if time allows)                                            |
| Wed.                                            | 23 Mar.                | Moss life cycle as an example of bryophytes                                                                             |
| Fri.                                            | 25 Mar. - Sun. 27 Mar. | <b>EASTER RECESS</b>                                                                                                    |
| Mon.                                            | 28 Mar.                | Liverworts                                                                                                              |
| Wed.                                            | 30 Mar.                | The pine, a gymnosperm                                                                                                  |
| Fri.                                            | 1 Apr.                 | Photosynthesis: “Harvesting the Sun”                                                                                    |

|      |          |                                                                                                                                        |
|------|----------|----------------------------------------------------------------------------------------------------------------------------------------|
| Mon. | 4 Apr.   | The light reactions of photosynthesis                                                                                                  |
| Wed. | 6 Apr.   | C <sub>3</sub> , C <sub>4</sub> , and CAM plants                                                                                       |
| Fri. | 8 Apr.   | How do plants defend themselves against herbivores?                                                                                    |
|      |          |                                                                                                                                        |
| Mon. | 11 Apr.  | Principles of plant ecology                                                                                                            |
| Wed. | 13 Apr.  | Plant ecology                                                                                                                          |
| Fri. | 15 Apr.  | Plant ecology                                                                                                                          |
|      |          |                                                                                                                                        |
| Mon. | 18 Apr.  | Plant ecology                                                                                                                          |
| Wed. | 20 Apr.  | Plant domestication, the development of agriculture, and the rise of civilization                                                      |
| Fri. | 22 Apr.  | <b>THIRD HOUR EXAM</b>                                                                                                                 |
|      |          |                                                                                                                                        |
| Mon. | 25 Apr.  | Biodiversity: How many species are present on earth, and how fast are they disappearing? Why should we worry about species extinction? |
| Wed. | 27 Apr.  | Biodiversity                                                                                                                           |
| Fri. | 29 Apr.  | Last day of classes                                                                                                                    |
|      |          |                                                                                                                                        |
| Mon. | 2 May. - | Fri. 6 May     Final Exam Period                                                                                                       |
|      |          |                                                                                                                                        |
| Tue  | 3 May    | Final exam date for this course, 2 hours (3:00 pm)                                                                                     |

## LABORATORY SCHEDULE (Thursdays 1:15 – 4:15 PM)

Many of the laboratory exercises come from the lab manual by Evert and Eichhorn. The others are based on handouts from the instructor. **Lab exercises are closely related to lecture topics, so plan to bring your lecture notes and textbook to the lab.** Bringing your textbook to the lab is important because you will have occasion to use both frequently, particularly when we study plant anatomy and life cycles. Laboratory assignments should be read BEFORE coming to the laboratory. Three quizzes, each about 15 minutes, will be given as indicated. A practical exam emphasizing structure and function is scheduled for the last lab meeting.

| <u>Date</u>                                    | <u>Subject Material</u>                                                                                                                                                           | <u>Assignments</u>                       |
|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| 21 Jan.                                        | Start <i>Brassica rapa</i> seedlings & fern gametophyte cultures – to be done on Thursday 28 Jan.                                                                                 |                                          |
| 28 Jan.                                        | The light microscope<br>Plant cells                                                                                                                                               | Topic 1-1<br>Topic 3-1                   |
| 4 Feb.                                         | <b>FIRST LAB QUIZ</b><br>Seeds, germination, and seedling development<br>The structure of flowers                                                                                 | Handout, Topic 2-1<br>Topic 18-7 to 18-9 |
| 11 Feb.                                        | Plant water relations: determination of water potential of potato tuber tissue. Relevance of water potential to stomate regulation, sugar transport, and water movement in plants | Handout                                  |
| 18 Feb.                                        | Enzyme lab: extraction and assay of catalase from spinach leaves                                                                                                                  | Handout                                  |
| 25 Feb.                                        | <b>SECOND LAB QUIZ</b><br>Is catalase found throughout the plant? <sup>1</sup><br>Is the activity of the enzyme affected by light?                                                | Handout                                  |
| 3 Mar.                                         | Mitosis: root meristems<br>Meiosis                                                                                                                                                | Topic 4-1<br>Topic 8-1                   |
| Sat 5 Mar. - Sun. 13 Mar. <b>SPRING RECESS</b> |                                                                                                                                                                                   |                                          |
| 17 Mar.                                        | Three major tissue systems of plants and the cells which comprise them<br>Stems of dicots and monocots                                                                            | Topic 2-3, 2-4<br>Topic 23-1             |

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<sup>1</sup> Remember to bring with you the **handout on catalase assay** from last week's laboratory. You will need again it for the experiment on 26 February.

|                                                  |                                                                                                                                                                                               |                                          |
|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| 24 Mar.                                          | <b>THIRD LAB QUIZ</b><br>Leaves: dicots, monocots, C <sub>3</sub> and C <sub>4</sub> , abscission<br>Roots: root systems, primary growth, origin of<br>secondary roots, dicot & monocot roots | Topic 24-1<br>Topic 22-1                 |
| Fri. 25 Apr. - Sun. 27 Apr. <b>EASTER RECESS</b> |                                                                                                                                                                                               |                                          |
| 31 Mar.                                          | The fern life cycle: an example of alternation<br>of generations with dominant sporophytes<br>Mosses have dominant gametophyte generations                                                    | Topic 16-1<br>Topic 14-5 to 14-7         |
| 7 Apr.                                           | <i>Marchantia</i> , a liverwort<br>Pine life cycle: an example of the gymnosperms                                                                                                             | Topic 14-1 to 14-4<br>Topic 17-1 to 17-6 |
| 14 Apr.                                          | Field Trip                                                                                                                                                                                    |                                          |
| 21 Apr.                                          | Review                                                                                                                                                                                        |                                          |
| 28 Apr.                                          | <b>PRACTICAL EXAM</b>                                                                                                                                                                         |                                          |

**TIME LINE FOR READINGS IN *TALES OF A SHAMAN'S APPRENTICE***  
(Plotkin,1993)

Topics in Plotkin's book will be discussed at several points in lecture between 3 and 5 February and again between 25 and 27 April, so you should plan to read the book according to the following time line. In any event, be certain to complete the book prior to 16 March since it will be included on the **second exam**.

| <u>Assignment</u>          | <u>Completion Date</u> |             |
|----------------------------|------------------------|-------------|
| Foreword<br>Chapters 1 & 2 | Monday                 | 26 January  |
| Chapters 3 & 4             | Monday                 | 2 February  |
| Chapters 5,6 & 7           | Friday                 | 16 February |
| Chapters 8 & 9             | Friday                 | 6 March     |

**LIBRARY REFERENCE MATERIALS ON RESERVE**

When you read the assignments in these books, prepare a short, one or two paragraph summary of each and **incorporate it into your lecture notes**. These reading assignments will be included on exams.

Grube, Nikolai (Ed). 2001. *MAYA. Divine Kings of the Rain Forest*. Konemann Verlagsgesellschaft. Read *Maya Agriculture* (pp. 70-79) and *Tortillas and Tamales* (pp. 80-83).

Judson, Olivia, 2002. *Dr. Tatiana's Sex Advice to All Creation: The Definitive Guide to the Evolutionary Biology of Sex*. Metropolitan Books. Henry Holt and Co.  
Chapter 4: *Swords or Pistols* (read pp. 60-65 on fig wasps)

Leopold, Aldo. 1948. *A Sand County Almanac*. Ballantine Books. Read the last chapter, *The Land Ethic* (pp. 237-279).

Western, David and Mary Pearl. 1989. *Conservation for the Twenty-first Century*. Oxford University Press. Several chapters will be assigned. See the following list of reading assignments.

## SEMESTER READING ASSIGNMENTS

(Topics arranged in the order we will cover them. From Evert and Eichhorn. 2013. 8th Edition)

Reading assignments are selected to supplement lecture topics and should be read **BEFORE** coming to class on the day that the topics are to be discussed. Most assignments are from the textbook. A few are from reference books on reserve in the library. For the items marked with an asterisk (\*) additional reading assignments will be supplied in the form of handouts.

| <u>Lecture Topics</u>                                                                                                 | <u>Assignments</u> <sup>2</sup>                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Orientation                                                                                                           | EC, Ch. 1, pp. 1-15                                                                                                                                    |
| Seeds, germination, and the development of the plant body                                                             | EC, Ch 22, pp. 530-537                                                                                                                                 |
| Flowers, floral anatomy, and reproduction in flowering plants                                                         | EC, Ch. 19, pp. 457-476<br>EC, Ch. 20, pp. 477-500<br>EC, Ch, 22, pp. 526-530                                                                          |
| Pollination biology                                                                                                   | EC, Ch. 20, pp. 487-491<br>Judson, O. Ch. 4. <i>Swords or Pistols</i><br>pp. 60-65                                                                     |
| Why are plants important to us?                                                                                       | Handouts:<br>Useful Plants and Plant Products<br>Drugs of Plant Origin<br>EC, Ch. 21, pp. 501-523 (Read also<br>the essay on Origin of Maize, p. 510.) |
| Molecular components of plant cells *                                                                                 | EC, Ch. 2, pp 18-37                                                                                                                                    |
| Enzymes and factors which affect their action *<br>(especially pp 99-106)                                             | EC, Ch. 5, pp. 94-106                                                                                                                                  |
| Structure of plant cells *                                                                                            | EC, Ch. 3, pp. 38-62<br>EC, Ch. 4, pp. 75-91                                                                                                           |
| Mitosis *                                                                                                             | EC, Ch. 3, pp. 62-74                                                                                                                                   |
| Totipotency and its importance in plant biotechnology<br>(In particular note the essay on totipotency. Top of p. 202) | EC, Ch. 10, pp. 198-205                                                                                                                                |
| Meiosis *                                                                                                             | EC, Ch. 8, pp. 152-159                                                                                                                                 |
| (Note the basis for cytoplasmic inheritance, p. 168.)<br>Asexual reproduction                                         | EC, Ch. 8, pp. 169-173                                                                                                                                 |

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<sup>2</sup> EC = Raven, Evert, and Curtis.

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Cells, differentiation, and plant tissues<br>Note in particular the structures of tracheary elements of the <b>xylem</b> , and <b>sieve cells</b> , <b>companion cells</b> , <b>P-protein</b> and the <b>forisome</b> in the <b>phloem</b> . | EC, Ch. 23, pp. 538-557                                                                                                 |
| Stems *                                                                                                                                                                                                                                      | EC, Ch 25, pp. 579-589                                                                                                  |
| Leaves (including stem & leaf modifications) *                                                                                                                                                                                               | pp. 590-613                                                                                                             |
| Secondary growth in stems                                                                                                                                                                                                                    | EC, Ch. 26, pp. 614-635                                                                                                 |
| Plant growth and development<br>Hormones*                                                                                                                                                                                                    | EC, Ch. 27. pp. 638-659<br>(Including study questions, p. 659)                                                          |
| How plants respond to their environment<br>(especially phototropism, photoperiodism, and phytochrome)                                                                                                                                        | EC, Ch. 28. pp. 660-682                                                                                                 |
| Systematics and the major groups of living things                                                                                                                                                                                            | EC, Ch.12, pp. 234-250                                                                                                  |
| Alternation of generations *                                                                                                                                                                                                                 | EC, Ch. 12, pp. 250-255<br>(Including Life Cycles & Diploidy)<br>EC, Ch. 17, pp. 397-398 ( <b>Fig. 17-8</b> )           |
| Lower vascular plants (ferns and fern allies) *<br>Focus on the <b>fern life cycle</b> as a prototype for this group. Omit the life cycle of <i>Selaginella</i> on pp. 410-411.                                                              | EC, Ch. 17. pp. 391-429<br>(pp. 409-429 is the most important)<br>See the <b>fern life cycle</b> , pp. <b>422-423</b> . |
| Bryophytes *<br>In this chapter concentrate on the life cycle of <b>mosses</b> (pp. 378-387) and the <b>liverwort</b> <i>Marchantia</i> (pp. 373-377)                                                                                        | EC, Ch. 16. pp. 366-390<br>In particular, the life cycle of mosses (pp. 386-387) and <i>Marchantia</i> (pp. 376-377)    |
| Gymnosperms *<br>Here the most important part of the chapter is pp. 437-448. <b>Pines</b> will be our <u>one</u> example on the gymnosperms (see life cycle on pp. 442-443).                                                                 | EC, Ch. 18. pp. 430-456                                                                                                 |
| Photosynthesis *<br>This is an <b>especially important</b> chapter, and it is integral to the mission of the course. Look over the Summary and <b>study questions</b> carefully (pp. 147-149).                                               | EC, Ch. 7, pp. 122-149.                                                                                                 |

|                                                         |                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| How do plants defend themselves against herbivores?     | EC, Ch. 2. Secondary Metabolites<br>pp. 30-35<br>EC, Ch. 20. Biochemical Evolution<br>pp. 497-498<br>Handouts:<br>Anti-herbivore Defenses in<br>Tropical Plants<br><i>The night moves of pregnant<br/>Moths</i>                                                                                                                                                                           |
| Plant ecology <sup>3</sup><br>Biomes and global ecology | EC, Ch. 31, Ecology (on the Web)<br>EC, Ch. 32, Global ecology (Web)                                                                                                                                                                                                                                                                                                                      |
| Plant domestication and development of agriculture      | Grube, N. <i>Maya Agriculture</i> (pp. 70-79), <i>Tortillas and Tamales</i> (pp. 80-83)                                                                                                                                                                                                                                                                                                   |
| Biodiversity and conservation                           | Leopold, last chapter of the book, <i>The Land Ethic</i> , pp. 237-279.<br>Western and Pearl: (1) <i>Overview</i> , pp., (2) <i>Overview of Recent Extinctions</i><br>(Jared Diamond), pp. 37-41, (3) <i>A Major Extinction<br/>Spasm: Predictable and Inevitable?</i> (Norman Myers),<br>pp. 42-49, (4) <i>Cultural Approach to Conservation<br/>Biology</i> (Brian Horton), pp. 241-246 |

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3 The two chapters on ecology are not in the text. You can download them without charge from the publisher's Web site at [www.whfreeman.com/raven](http://www.whfreeman.com/raven). Save them as pdf files on your hard drive. You will need Adobe Acrobat v. 3 or higher. The files are fairly large (4.1 and 6.3 MB), so they may take a few minutes to load.