

## Photosynthesis

IB 421, BIOPH 432, CPSC 489

Credit: 3 hrs

607 IGB

Tuesday & Thursday

9:30 – 10:50 AM

Semester Course – Fall 2019

Instructors: Don Ort, Carl Bernacchi, Lisa Ainsworth

Instructors: Don Ort, 1406 IGB, 333-2093, [d-ort@illinois.edu](mailto:d-ort@illinois.edu)

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**Course Description:** Photosynthesis is the primary source of energy for all of life on Earth and is the process by which plants harvest sunlight energy, convert it to chemical energy, and use it to fix atmospheric carbon dioxide to produce sugars. In doing so, plants emit oxygen and water vapor to the atmosphere. Since the process of photosynthesis evolved over 2000 million years ago, it has shaped the atmospheric composition and climate of the planet, and today photosynthesis is ultimately responsible for the vast majority of humankind's food, feed, fiber, and fuel. This course covers many aspects of the photosynthetic process, including photosynthetic energy transformations; photosynthetic metabolism; measuring, modeling and scaling photosynthesis; the central role of photosynthesis in the global C cycle and the potential for improving photosynthesis to increase crop yields. **Learning outcomes:** Students will gain understanding of the biochemistry, molecular biology, physiology, evolution and ecology of photosynthesis in this course. Students learn hands-on how to measure photosynthesis using infrared gas analysis and how to scale rates of photosynthesis from the leaf to the canopy. Students also gain critical thinking and quantitative reasoning in applying fundamental knowledge of photosynthesis to real world problems.

**Pre-requisites:** It is strongly recommended that students have taken Plant Physiology or Plant Biochemistry before taking IB 421.

**Assigned Reading.** There will be assigned readings and/or a handout for each class with key information. Readings will be posted on the website and students are expected to come to class having read the assignments.

**Grades.** The course grade will be based on the take-home Final Exam (40%), the Mid-term Exam (35%), homework assignments (10%), and discussions (15%).

**Discussions.** Once a month, students will lead in class discussions to review key concepts covered in the lectures. Students should come prepared with class notes and readings for these discussions. Along with in class participation, student involvement in these discussion periods accounts for the discussion portion of the grade.

**Background Texts.** Blankenship R.E. (2014) *Molecular Mechanisms of Photosynthesis*. Wiley. Available from UIUC library, <http://onlinelibrary.wiley.com/book/10.1002/9780470758472>.

**Course Attendance Policy.** Regular class attendance is expected of all students. Students should inform instructors in advance of missing class and generally adhere to the guidelines specified in the UIUC Student Code ([http://studentcode.illinois.edu/article1\\_part5\\_1-501.html](http://studentcode.illinois.edu/article1_part5_1-501.html)).

**Academic Integrity.** As specified in the UIUC Student Code, “*It is the responsibility of each student to refrain from infractions of academic integrity, from conduct that may lead to suspicion of such infractions, and from conduct that aids others in such infractions.*” It is our responsibility as instructors to uphold the academic integrity policy of the University ([http://studentcode.illinois.edu/article1\\_part4\\_1-401.html](http://studentcode.illinois.edu/article1_part4_1-401.html)).

**Disability Accommodation:** To ensure that disability-related concerns are properly addressed from the beginning of the semester, students with disabilities who require assistance to participate in this class are asked to see an instructor as soon as possible.

## Course Calendar

Date	Day	Topic	Instructor
Aug 27	Tues	Photosynthesis in a Global & Human Context	Ort

## Flux and Gas Exchange

Aug 29	Thur	Stomata	Ainsworth
Sep 3	Tues	Flux	Bernacchi
Sep 5	Thur	Gas Exchange	Cavanagh/Stutz

## Photosynthetic Energy Transformations

Sep 10	Tues	Photosynthetic Reaction Centers	Ort
Sep 12	Thur	Electron Transport	Ort
Sep 17	Tues	ATP Synthesis/Regulation	Ort
Sep 19	Thur	Water Splitting	Ort
Sep 24	Tues	Light Harvesting	Ort
Sep 26	Thur	Review/Discussion	

## Photosynthetic Metabolism

Oct 1	Tues	C3 – Photosynthetic Carbon Reduction Cycle	Bernacchi
Oct 3	Thurs	C2 – Photosynthetic Carbon Oxidation Pathway	Bernacchi
Oct 8	Tues	Rubisco & Rubisco Activase	Ort
Oct 10	Thur	C4 Photosynthesis – The process and its variants	Ainsworth
Oct 15	Tues	C4 Photosynthesis – Evolution and environment	Ainsworth
Oct 17	Thur	CAM & other concentrating mechanisms	Ainsworth/McGrath
<i>Oct 22</i>	<i>Tues</i>	<i>Review/Discussion</i>	
<b>Oct 24</b>	<b>Thur</b>	<b>Midterm Exam</b>	
Oct 29	Tues	Chloroplast Development & Division	Ainsworth
Oct 31	Thur	Plastid Evolution	Ainsworth
Nov 5	Tues	Improving Photosynthesis	Long
Nov 7	Thur	Photosynthesis and Bioenergy	DeLucia
<i>Nov 12</i>	<i>Tues</i>	<i>Review/Discussion</i>	
Nov 14	Thur	Stable isotope discrimination/mesophyll conductance	Boyd
Nov 19	Tues	Photosynthesis modeling – theory	Bernacchi
Nov 21	Thur	Photosynthesis modeling - practice	Bernacchi
<i>Nov 26, 28</i>		<i>Thanksgiving Break</i>	
Dec 3	Tues	Scaling photosynthesis	Bernacchi
Dec 5	Thur	Photosynthesis and Global Change	Ainsworth
Dec 10	Tues	<i>Review/Discussion, Final take home exam distributed</i>	
<b>Dec 12</b>	<b>Tues</b>	<b>FINAL EXAM due by 5:00 pm</b>	