BIOL313

Plants: Cells to Ecosystems

S1 External 2014

Dept of Biological Sciences

Contents

General Information

Unit convenor and teaching staff
Unit Convenor
Julia Cooke
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Credit points
3

Prerequisites
39cp including (BIOL206(P) or BIOL210(P) or BIOL227(P) or ENVE266(P) or BIOL347(P))

Corequisites

Co-badged status

Unit description
Plants are easily taken for granted, but they make complex life possible. They quietly provide us all with food to eat, shelter and habitat, clear air to breathe, and clean water to drink. How do they do it? And, importantly, how can we ensure that they keep doing it, in the face of increasing population pressure and climate change? This unit provides an in-depth understanding of how and why plants work the way they do. Covering plant function from the cellular to the landscape level, this unit is useful for students with interests at any scale, including plant breeding, conservation, ecology, and environmental science. Practical work is offered in compulsory block practicals and includes a mini-research project using the Macquarie glasshouse facility and fieldwork in the Ecology Reserve. Students also gain experience in data analysis and modelling.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

Describe the abiotic factors that affect plant growth and distribution

Explain how each of these factors acts to limit plant growth

Explain how plants have adapted to environmental limitations

Build, use and critique simple models of plant ecosystem function

Plan and execute experiments in plant ecophysiology

Collect, analyse and present ecophysiological data

Apply ecophysiological principles to analyse how plants respond to changes in environmental conditions

Assessment Tasks

Name	Weighting	Due
Numerical Exercises	10%	Monday 10 a.m. following week
Quizzes	8%	Monday 10 a.m. following week
Field trip analysis	5%	10 a.m. Wed 11th April
Midsemester test	10%	Sunday April 27
Experimental Wiki	5%	10 a.m. Mar 24; Apr 7; May 12
Experiment paper	22%	10 a.m. Monday 10th June
Final examination	40%	Exam Period

Numerical Exercises

Due: **Monday 10 a.m. following week**
Weighting: **10%**

Numerical Exercises

There are five sets of computer simulation exercises to illustrate the concepts taught in the lectures. Ecophysiology is a quantitative science, so it is important to gain experience with the use of equations, models and spreadsheets. The numerical exercises will be made available via iLearn. Support will be offered via discussion boards. The numerical exercises will be made available via iLearn, are completed online and will be assessed. Each of the five worksheets will be worth 2% of the final mark (10% in total).

On successful completion you will be able to:

- Describe the abiotic factors that affect plant growth and distribution
- Build, use and critique simple models of plant ecosystem function

- Collect, analyse and present ecophysiological data

Quizzes

Due: **Monday 10 a.m. following week**
Weighting: **8%**

Quizzes

There will be eight online quizzes following Brian Atwell's lectures (8 x 1% = 8%).

On successful completion you will be able to:

- Describe the abiotic factors that affect plant growth and distribution
- Explain how each of these factors acts to limit plant growth
- Explain how plants have adapted to environmental limitations
- Build, use and critique simple models of plant ecosystem function

Field trip analysis

Due: **10 a.m. Wed 11th April**
Weighting: **5%**

Field Trip Analysis

You will analyse the data obtained from the field trip and present a short report with your analysis and conclusions (5% of total mark).

Midsemester test

Due: **Sunday April 27**
Weighting: **10%**

Mid-session test

Students will sit a mid-session revision test on Sunday April 28, as part of the block practical. This test will count for 10% of the final mark.

On successful completion you will be able to:

- Describe the abiotic factors that affect plant growth and distribution
- Explain how each of these factors acts to limit plant growth
- Explain how plants have adapted to environmental limitations
- Apply ecophysiological principles to analyse how plants respond to changes in environmental conditions

Experimental Wiki

Due: **10 a.m. Mar 24; Apr 7; May 12**
Weighting: **5%**

Glasshouse Experiment

During the practicals, you will be design and run your own plant ecophysiology experiment, as part of a small group. The group experiments are related, so as well as analysing your own data, you will also be required to compare your results to those of the rest of the class. The practicals will be assessed in two ways:

1. Wiki

Each group will set up a wiki in iLearn that they will use to share the results of their experiment (5%). The wikis will be assessed three times during the semester:

Mon March 24th: Background to experiment and measurement protocol

Mon April 7th: Results from first set of measurements

Mon May 12th: Results from second set of measurements

On successful completion you will be able to:

- Explain how plants have adapted to environmental limitations
- Build, use and critique simple models of plant ecosystem function
- Plan and execute experiments in plant ecophysiology
- Collect, analyse and present ecophysiological data

Experiment paper

Due: **10 a.m. Monday 10th June**
Weighting: **22%**

Glasshouse Experiment

During the practicals, you will be design and run your own plant ecophysiology experiment, as part of a small group. The group experiments are related, so as well as analysing your own data, you will also be required to compare your results to those of the rest of the class. The practicals will be assessed in two ways:

2. Written manuscript

The glasshouse experiment is to be written up as a journal manuscript. This manuscript will present the methods and results from the group's experiment. In the discussion, you will be required to compare your results with those from the rest of the class and draw overall conclusions from the experiment as a whole.

On successful completion you will be able to:

- Explain how plants have adapted to environmental limitations
- Build, use and critique simple models of plant ecosystem function
- Plan and execute experiments in plant ecophysiology
- Collect, analyse and present ecophysiological data

Final examination

Due: **Exam Period**
Weighting: **40%**

On successful completion you will be able to:

- Describe the abiotic factors that affect plant growth and distribution
- Explain how each of these factors acts to limit plant growth
- Explain how plants have adapted to environmental limitations
- Build, use and critique simple models of plant ecosystem function
- Apply ecophysiological principles to analyse how plants respond to changes in environmental conditions

Delivery and Resources

Technology

Students will need access to iLearn, word, excel, pdf reader, a program to play mp3 files and the internet.

Lecture and Tutorial

The course consists of 2 one-hour lectures and follow-up exercises per week, plus block practicals which are compulsory for all students. Lecture and exercise materials will be made available on-line on the Monday of each week. The exercises follow on the lectures and must be completed by Monday of the following week. This is to encourage you to keep up with the course each week. Some of the exercises are on-line quizzes covering the lecture material. Others are more in-depth numerical exercises using Excel, which will allow you to explore the lecture concepts in detail and be completed online also.The compulsory practical sessions will run 9 am – 5.30 pm on the following dates:

- Saturday 15 March;
- Sat-Sun 29-30 March;
- Sat-Sun 26-27 April.
- Location: Glasshouses, F5A roof

Changes to the unit.

This year the unit is running in external-only mode, which means that you'll be listening to lectures online and doing tutorial exercises at home, supported via discussion boards. The practical component for this unit has always run in external-only mode, so it has not changed much from previous years. The main change we're making is to streamline the choice of experiments so as to make the pracs more efficient for you. We are also changing the format of the quizzes and numerical exercise to encourage adaptive learning and allow teaching staff to dedicate marking time to more comprehensive feedback for major assignments.

Information about iLearn or other resources for this unit.

All course content will be made available via iLearn.

iLearn and email will be the primary methods of communication in this subject. You are expected to use iLearn for:

- Regularly checking subject announcements;
- Downloading lecture, tutorial and reference materials;
- Submitting assignments;
- Checking your grades.

How do you log in? The URL for iLearn is: http://ilearn.mq.edu.au/.

You must log in to iLearn each time you use it. Your user name is your student number, and your

password is your myMQ student portal password, provided upon enrolment (unless you've changed it). If you are having trouble accessing your online unit due to a disability or health condition, please go to the Student Services Website at http://sss.mq.edu.au/equity/about for information on how to get assistance.

If you are having problems logging on, that is, if you cannot log in after ensuring you have entered your username and password correctly, you should contact Student IT Help, Phone: (02) 9850 4357 (in Sydney) or 1 800 063 191 (outside Sydney).

Changes since the last offering of this unit. This is mandatory under the Unit Guide policy. **Other material** i.e. additional sections (e.g. Reading lists).

REQUIRED AND RECOMMENDED TEXTS AND/OR MATERIALS

The course covers both plant physiology and terrestrial ecosystem ecology.

Plants in Action (available online) is probably the best reference covering both topics.

*** Atwell, B.J., Kriedemann, P.E. and Turnbull, *Plants in Action*. Macmillian Education Australia (2010, 1999). http://plantsinaction.science.uq.edu.au/edition1/**

For more detailed information on plant ecophysiology, see:

*** Lambers, H., Chapin, F.S. III and Pons, T.L. *Plant Physiological Ecology* Springer (2008)**

For more detailed information on terrestrial ecosystem ecology, see:

*** Chapin, F.S. III , Mooney, H.A., Chapin, M.C. and Matson, P. *Principles of Terrestrial Ecosystem Ecology*. Springer (2011, 2004).**

We also recommend the following books for more specific topics:

Plant physiology

* Taiz, L. and Zeiger, E. *Plant Physiology*. Benjamin/Cummings Publishing Co. (2006, 2002, 1998, 1991). QK711.2 .T35

* Salisbury, F.B. and Ross, C.W. *Plant Physiology*. Wadsworth Publishing. (1992). QK711.2 .S23

Biochemistry

* Lea, P.J. and Leegood, R.C. *Plant Biochemistry and Molecular Biology*. Wiley (1999). QK861 .P5533

* Dennis, D.T. and Turpin, D.H. *Plant Physiology*, *Biochemistry and Molecular Biology*. Longman Scientific and Technical. (1997, 1990). QK881 .P54

Water relations

* Nobel, P.S. *Physiochemical and Environmental Plant Physiology*. 3rd edition (2005,

1991).

Mineral nutrition and ion transport

*Marschner, H. *Mineral Nutrition of Plants*. 2nd edition. Academic Press (1995).

Plant response to stress (especially nutrition)

* Mooney, H.A. et al. *Response of Plants to Multiple Stresses*. Academic Press. (1991). QK754 .R47

Plant ecosystems

* Jones H.G. *Plants and Microclimate.* Cambridge University press, 2nd edition (1992). QK754.5 .J66

* Landsberg J & Sands P *Physiological Ecology of Forest Production* (2011) QH541.5.F6 L3

Unit Schedule

Lecture outline

A major theme of the course is “ecosystem services” – the things that ecosystems do for us, such as providing food and fibre, storing carbon, regulating water flow, and maintaining soil quality. We need to ensure that ecosystems continue to provide these services, and to do so, we need to understand the plant and environmental processes that determine them. In the course, we interweave lectures focusing on plant-level processes (given by Brian Atwell) with lectures that discuss how these processes interact to determine ecosystem-level processes (given by Belinda Medlyn).

WEEK	TOPIC	LECTURER
1	Introduction	Julia Cooke (JC)
	THE CARBON CYCLE	
1	Photosynthesis – carbon gain	Brian Atwell (BA)
2	Respiration – carbon loss	BA
2	Gross Primary Productivity	Belinda Medlyn (BM)

3	Net Primary Productivity	BM
3	Ecosystem Carbon Balance	BM
	THE WATER CYCLE	
4	Plant water relations	BA
4	Stomatal physiology	BA
5	Ecosystem Water Balance	BM
5	Plant Water Use	BM
	THE NUTRIENT CYCLE	
6	Plant Nutrient Uptake	BA
6	Plant Nutrient Requirements	BA
7	Nutrient cycling I	BM
7	Nutrient cycling II	BM
	SEMESTER BREAK	
	BALANCING THE CYCLES	
8	Growth and development	BA
8	Transport of resources	BA
9	Allocation from a whole-plant perspective	JC
	APPLICATIONS	
10	Responses to stress: cells to whole plants	BA

10	Responses to stress: plants to ecosystems	JC
11	Fire: an ecosystem sculptor	Michelle Leishman
11	Water: ecophysiology of aquatic plants	BA
12	Impacts of high CO_2 on plants	JC
12	Impacts of high CO_2 on ecosystems	JC
13	Stable isotopes	Margaret Barbour
13	Remote sensing and global ecophysiology	Martin De Kauwe

Follow up Exercises

Most weeks we will provide you with activities to check you have understood the lecture content. These activities will comprise on-line quizzes (following Brian's material, worth 1 mark each) and online numerical exercises with supporting Excel spreadsheet (following Belinda's material, worth 2 marks each). The numerical exercises will be supported with online discussion boards. Each exercise must be completed by 10 am Monday of the following week (excepting public holidays – due Tuesday instead).

Wk#	**ACTIVITY**
1	Quiz 1: Photosynthesis
2	Quiz 2: Respiration Numerical Exercises 1: Photosynthesis
3	Numerical Exercises 2: Net Primary Productivity
4	Quiz 3: Water Relations Quiz 4: Stomatal Physiology

5	Numerical Exercises 3: Water Balance
6	Quiz 5: Nutrient Uptake Quiz 6: Nutrient Requirements
	Mid-semester break
7	
8	Quiz 7: Growth & development Quiz 8: Transport
9	Numerical Exercises 4: Allocation and growth
10	
11	
12	Numerical Exercises 5: High CO_2 responses
13	

Practicals

The three block practicals will be held in the Plant Biology Complex on the rooftop of the F5A carpark (eastern end of campus) on 15 March, 29-30 March, 26-27 April. You can drive up into the opposite carpark if you have a university sticker or purchase a day ticket. The practicals will run from **9am sharp** to **5.30pm**, depending on the day's activities.

The practical work has two components. You will run a mini-experiment, in small groups, using the Macquarie University glasshouse facilities. You will be given a choice of experiments to do. We will also spend a day in the Macquarie University Ecology Reserve exploring field-based plant ecophysiology techniques. These practicals are **compulsory**

for all students.

Lab#	DATES	ACTIVITY
1	Mar 15	- Introduction to glasshouse facilities and equipment - Overview of experiments and techniques - Students placed in groups to commence designing their experiments
2	Mar 29	First set of experiment measurements
3	Mar 30	Field trip to Macquarie Ecology Reserve
4	April 26	Second set of experiment measurements
5	April 27	Mid-semester test Harvest of plant material

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and*

replaces the Special Consideration Policy.

In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit http://informatics.mq.edu.au/help/.

When using the University's IT, you must adhere to the Acceptable Use Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcomes

- Build, use and critique simple models of plant ecosystem function
- Plan and execute experiments in plant ecophysiology
- Collect, analyse and present ecophysiological data
- Apply ecophysiological principles to analyse how plants respond to changes in environmental conditions

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcomes

- Describe the abiotic factors that affect plant growth and distribution
- Build, use and critique simple models of plant ecosystem function
- Apply ecophysiological principles to analyse how plants respond to changes in environmental conditions

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Describe the abiotic factors that affect plant growth and distribution
- Explain how each of these factors acts to limit plant growth
- Explain how plants have adapted to environmental limitations
- Build, use and critique simple models of plant ecosystem function
- Plan and execute experiments in plant ecophysiology
- Collect, analyse and present ecophysiological data

- Apply ecophysiological principles to analyse how plants respond to changes in environmental conditions

Assessment tasks

- Quizzes
- Midsemester test
- Final examination

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Describe the abiotic factors that affect plant growth and distribution
- Explain how each of these factors acts to limit plant growth
- Explain how plants have adapted to environmental limitations
- Plan and execute experiments in plant ecophysiology
- Collect, analyse and present ecophysiological data
- Apply ecophysiological principles to analyse how plants respond to changes in environmental conditions

Assessment tasks

- Numerical Exercises
- Experimental Wiki
- Experiment paper

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Describe the abiotic factors that affect plant growth and distribution

- Explain how each of these factors acts to limit plant growth
- Explain how plants have adapted to environmental limitations
- Plan and execute experiments in plant ecophysiology
- Collect, analyse and present ecophysiological data
- Apply ecophysiological principles to analyse how plants respond to changes in environmental conditions

Assessment tasks

- Field trip analysis
- Experimental Wiki
- Experiment paper

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcomes

- Describe the abiotic factors that affect plant growth and distribution
- Build, use and critique simple models of plant ecosystem function
- Plan and execute experiments in plant ecophysiology
- Apply ecophysiological principles to analyse how plants respond to changes in environmental conditions

Assessment tasks

- Experimental Wiki
- Experiment paper

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcomes

- Explain how plants have adapted to environmental limitations

- Build, use and critique simple models of plant ecosystem function
- Collect, analyse and present ecophysiological data

Assessment tasks

- Experimental Wiki
- Experiment paper

Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

Learning outcome

- Plan and execute experiments in plant ecophysiology

Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

Learning outcomes

- Describe the abiotic factors that affect plant growth and distribution
- Explain how plants have adapted to environmental limitations
- Plan and execute experiments in plant ecophysiology