TEMPLATE FOR REVISED COURSE CONTENT

Academic Year	2018/19	**Semester**	2
Course Coordinator	Anna Lagerstroem		
Course Code	ES3301		
Course Title	Plant and Animal Physiology		
Pre-requisites	BS1001 Introductory Biology, ES2003 E2S2 Biosphere, ES2301 Principles of Heredity and Ecological Genetics		
No of AUs	4		
Contact Hours	Total of 52 hours (Lectures: 39 hours; Tutorials: 13 hours)		
Proposal Date	25/07/2018		

Course Aims

Students will synthesise information in two ways: (1) they will be expected to link physiological processes across various levels of organisation from genes to populations and ecosystems, and (2) to take a comparative approach to the study of physiology. Moreover, you will be expected to see physiological processes through the lens of natural selection in order to understand how physiological mechanisms evolve and diversify in response to the physical and biotic environments in which organisms live.

Intended Learning Outcomes (ILO)

By the end of this course, you (as a student) would be able to:

1. Know the basic functioning of organ systems that sustain the life of plants and animals.
2. Draw conclusions on organisms' niche adaptation from looking at physiological organs in both animals and plants in practical exercises and drawings.
3. Link molecular processes of organisms to the levels of community, population and ecosystem.
4. Use physiological concepts to explain current and future effects of changing environmental conditions on organisms.
5. Express intellectual flexibility by finding new approaches to issues in physiology/ecophysiology.
6. Formulate relevant scientific research questions.
7. Synthesise, communicate and evaluate scientific information, both orally and in writing.
8. Critically assess and give constructive suggestions for improvements of the work of peers.
9. Demonstrate ethical values in physiological issues as well as research code of conduct.

Course Content

Week 1: Course introduction. What is physiology? Basic principles for life. Overview of organ systems in animals. Basic concepts: homeostasis, metabolic rate etc.

Week 2: Visit to Natural History Museum at NUS. Evolution, biological diversity, phylogeny and basic morphology.

Week 3: The digestive system and excretory system

Week 4: External respiration, circulation, gas exchange

Week 5: Communication: Nervous system and Endocrine physiology

Week 6: Reproduction in animals and repetition.

Week 7: Quiz and student presentations

Week 8: Intro to plant physiology. Basic plant organs and tissues. Plant phylogeny.

Week 9: Plant life cycles and reproduction.

Week 10: Photosynthesis, photorespiration, C4 and CAM

Week 11: Communication in plants

Week 12: Mineral nutrition and mycorrhiza

Week 13: Quiz and hand in Plant Essay

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team/Individual	Assessment Rubrics
Continuous Assessment 1 (CA1): Animal Phys. Quiz	1, 2, 3, 4, 5, 6, 7	1, 2, 3, 4, 6, 7, 8	20%	Individual	See appendix 1
CA2: Oral Presentation	1, 2, 3, 4, 5, 6, 7, 9	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	25%	Team	See appendix 2
CA3: Plant Phys. Quiz	1, 2, 3, 4, 5, 6, 7	1, 2, 3, 4, 6, 7, 8	20%	Individual	See appendix 1
CA4: Plant Phys. Essay	1, 2, 3, 4, 5, 6, 7, 9	1, 2, 3, 4, 5, 6, 7, 8, 9	25%	Individual	See appendix 3
CA5: Peer feedback	1, 2, 3, 4, 5, 8, 9	1, 2, 3, 4, 6, 7, 8, 10	10%	Team/Individual	See appendix 4
Total			100%		

Formative feedback

2. After each lecture I provide a quick Kahoot! quiz on the most important theory in the lecture that the students take anonymously. This way I know if there is something that many or someone did not understand, it also gives the students a feeling for how they are doing and if they know what I expect them to know.
2. In class I regularly break the lecture off with group discussion or practical exercises. This gives me a chance to interact with the students, check their understanding and give general feedback. For these exercises I use questions similar to what I use in the quizzes.
3. For the two major assignments, the oral presentation and the essay, I have the students hand in topic and outline to me for feedback. I give the students the opportunity to e-mail me for feedback throughout their working process (some use this, most not), and they also have to show me what they have accomplished so far the week before hand-in, so that I can give them some hints on what they should work on before the final hand-in.

Learning and Teaching approach

Approach	**How does this approach support students in achieving the learning outcomes?**
General	I try to offer a variety of learning approaches, to cater for different learning profiles.
Group discussion	After some lecturing, the students are presented with a real world problem that they have to apply the theory in the lecture to solve. In group discussions I often mix the students to they sit with someone that they don't usually sit next to, I think that makes them focus better and hopefully learn more.
Practical exercises	In physiology we talk a lot about different parts of plant and animal physiology. To actually dissect a fish, or a leaf or stem and look at real structures reinforces the theory and is fun. In plant physiology I often bring fresh plants as examples.
Projects with an element of free choice	For the essay and presentation, the students get to pick a topic within physiology that interests them (I provide a list of suggestions, but they may also come up with their own). I find that working with a topic of their own choice enhances students' motivation and therefore learning.

Reading and References

Literature: Reece, Jane B. et al. *Campbell Biology: Concepts & Connections*, 8th or 9th edition. Lecture material and other assigned reading.
Additional reading:
Hill, Wyse and Anderson *Animal Physiology* (latest edition)
Sailsbury and Ross *Plant Physiology 4th ed*.

Course Policies and Student Responsibilities

(1) General

Students are expected to complete all assigned pre-class readings and activities, attend all seminar classes punctually and take all scheduled assignments and tests by due dates. Students are expected to take responsibility to follow up with course notes, assignments and course related announcements for seminar sessions they have missed. Students are expected to participate in all seminar discussions and activities.

(2) Absenteeism

This course requires you to be present in class and contribute to class activities. The quiz part of the assessment will build on material from the lectures. Absence from class without a valid reason will affect your overall course grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies.

If you miss a lecture or tutorial, you must inform the teacher via email prior to the start of the class.

(3) Compulsory Assignments

You are required to submit/present compulsory assignments on due dates.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Anna Lagerstroem	N2-01c-65 (Room 11)	97724306	alagerstroem@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Course introduction. What is physiology? Basic principles for life. Overview of organ systems in animals. Basic concepts: homeostasis, metabolic rate etc.	1, 2, 3, 4, 5, 9	Readings*
2	Visit to Natural History Museum at NUS. Evolution, diversity, phylogeny and basic morphology.	1, 2, 3, 4, 5, 6, 7, 9	Pick a topic for group project. Start to make outline and research.
3	The digestive system and excretory system	1, 2, 3, 4, 5, 6, 7, 9	Continue to work on project. Hand in outline by Friday.
4	External respiration, circulation, gas exchange	1, 2, 3, 4, 5, 6, 7, 9	Continue to work on project.
5	Communication: Nervous system and Endocrine physiology	1, 2, 3, 4, 5, 6, 7, 9	Continue to work on project.
6	Reproduction in animals and repetition	1, 2, 3, 4, 5, 6, 7, 9	Continue to work on project.
7	Quiz and student presentations	1, 2, 3, 4, 5, 6, 7, 8, 9	Present project work in class.
8	Intro to plant physiology. Plant phylogeny. Basic plant organs and tissues.	1, 2, 3, 4, 5, 6, 7, 9	Pick a topic for plant essay.
9	Life cycles and reproduction in plants.	1, 2, 3, 4, 5, 6, 7, 9	Plant essay first outline Friday.
10	Photosynthesis, photorespiration, C4 and CAM	1, 2, 3, 4, 5, 6, 7, 9	Continue to work on plant essay.
11	Communication in plants	1, 2, 3, 4, 5, 6, 7, 9	Continue to work on plant essay.
12	Mineral nutrition and mycorrhiza	1, 2, 4, 5, 6, 7, 8, 9	Continue to work on plant essay. Give feedback on peer's essay drafts.
13	Quiz and hand in Plant Essay	1, 2, 3, 4, 5, 6, 7, 9	Finalize plant essay.

*Directions for reading will be given at the start of and throughout the course. Reading assignments will involve the course literature as well as other material (like scientific articles), and can vary between years.

Literature: Reece, Jane B. et al. Campbell Biology: concepts & connections, 8th or 9th edition. Lecture material and other assigned reading.
Additional reading: Hill, Wyse and Anderson *Animal Physiology*
Sailsbury and Ross *Plant Physiology 4th ed*.

Appendix 1: List of Programme Learning Outcomes

OBTL Approved ASE learning outcomes

At the completion of your course of study in ASE, you will be able to:

1) Apply environmental knowledge and concepts to make sound decisions

- Interpret evidence to give sound environmental advice to stakeholders
- Give advice to industry regarding existing environmental legislation
- Synthesise the views of key stakeholders to make decisions involving environmental issues

2) Demonstrate intellectual flexibility and critical thinking

- Demonstrate intellectual flexibility to view environmental issues from multiple perspectives
- Question assumptions behind current ways of solving environmental problems
- Show willingness to adopt new ways of approaching environmental problems.

3) Demonstrate passion and use advanced communication skills to share that passion

- Learn independently and then share that knowledge with others
- Effectively communicate environmental concepts in writing
- Effectively communicate environmental concepts in speech
- Effectively communicate environmental concepts in various forms of media such as data visualisation, diagrams, animation, video, or podcasts

4) Formulate key scientific questions and develop hypotheses

- Research and formulate questions involving environmental issues
- Express and explain why these questions are important
- Create and evaluate hypotheses to research such questions

5) Conduct research

- Search for relevant scientific literature
- Interpret scientific literature
- Synthesize findings from scientific literature into current laboratory or field work
- Make first-hand observations in order to draw conclusions

6) Solve environmental problems

- Solve environmental problems systematically
- Solve environmental problems creatively
- Solve environmental problems reflexively
- Express and explain why the problems are important

7) Synthesize interdisciplinary approaches to solving problems

- Apply techniques from disciplines beyond your own field to solve environmental problems
- Express and explain how a problem solving approach may impact the environment
- Express and explain how an approach to solving an environmental problem may impact human society

8) Demonstrate the willingness and skills for lifelong learning

- Demonstrate good observation skills and a curiosity about the world
- Demonstrate critical thinking skills such as analysis, discrimination, logical reasoning, prediction and transforming knowledge

9) Demonstrate ethical values

- Use knowledge and skills to contribute to the world
- Debate the ethical implications of scientific processes and results
- Respect regulations involving plagiarism and copyright
- Respect requirements regarding confidentiality, data protection, conflict of interest, and falsification of data

10) Demonstrate collaboration and leadership skills

- Learn collaboratively and be willing to share expertise with peers
- Demonstrate leadership of small teams

Appendix 2: Assessment Criteria for Quizzes

Marks	**Criteria**
A+ (Exceptional) A (Excellent	Exhaustive answer showing excellent ability to apply knowledge of physiology to new situations and make extensive connections from molecular and individual levels to populations and ecosystems. The student can link physiological traits to evolutionary adaptation and use physiological concepts to explain current and future effects of changing environmental conditions on organisms.
A- (Very good) B+ (Good)	All relevant points are identified, but some deficiencies in argumentation; or compelling argumentation but fails to mention some aspects
B (Average) B- (Satisfactory) C+ (Marginally satisfactory)	Some relevant points not identified, and argumentation not entirely compelling. Answer is broadly correct, but the student clearly struggles to explain it in detail. Any errors are relatively minor ones.
C (Borderline unsatisfactory) C- (Unsatisfactory)	Only some points of the answer are identified, leaving important omissions. Argumentation is somewhat confused and/or poorly developed, and there are significant errors.
D, F (Deeply unsatisfactory)	Major points are omitted, there are significant inaccuracies, and any argumentation is rudimentary and confused.

Appendix 3: Assessment Criteria for oral group presentation

Standards	Criteria
A+ (Exceptional) A (Excellent)	- Exceptionally well prepared presentation, well timed and rehearsed. - Content is exceptionally well structured and presented in a clear and engaging way. - Content reflects the important aspects of the reading, highlighting key points and issues exceptionally well. -Introduces additional knowledge through secondary readings at appropriate times. - Any questions are answered knowledgably. - Shows engagement and understanding by asking thoughtful questions to the other presenters.
A- (Very good) B+ (Good)	- Well prepared presentation, well timed and rehearsed. - Content is well structured and presented in a clear and engaging way. - Content reflects the important aspects of the reading, highlighting key points and issues well. -Introduces some additional knowledge through secondary readings at appropriate times. - Any questions are answered correctly. - Shows engagement and understanding by asking questions to the other presenters.

B (Average) B- (Satisfactory) C+ (Marginally satisfactory)	- Shows some preparation for presentation, reasonable timing and no reading from notes. - Content is adequately structured and presented. - Content reflects some important aspects of the reading, highlighting some key points and issues. - Any questions are answered correctly. - Shows some engagement and understanding by sometimes asking questions to the other presenters.
C (Bordering unsatisfactory) C- (Unsatisfactory)	- Presentation preparation limited, timing not consistent with instructions. - Content has little structure and the presentation is difficult to follow. - Content reflects some aspects of the reading, failing to highlight one or two key points and issues. - Any questions are answered mostly correctly. - Shows limited engagement and understanding by asking questions to the other presenters.
D, F (Deeply unsatisfactory)	- Presentation poorly prepared and carried out. - Content poorly structured and difficult to follow. - Content fails to reflect key aspects of assigned reading. - Cannot answer relevant questions. - Does not engage or ask questions during other students' presentations. OR failure to deliver presentation.

Appendix 4: Assessment Criteria for plant physiology essay

Standards	**Criteria**
A+ (Exceptional) A (Excellent)	- Exceptionally good synthesis of literature, well-structured, and with a variety of very well-chosen sources. - Exceptionally thoughtful and solid conclusions. Clear evidence of original and lateral thinking. - Correct use of referencing throughout. - Excellent scientific style and language. - Provides excellent suggestions for future work.
A- (Very good) B+ (Good)	- Very good synthesis of literature, well-structured, with varied and well-chosen sources. - Thoughtful and solid conclusions. Some evidence of original and lateral thinking. - Correct use of referencing throughout. - Very good scientific style and language. - Provides very good suggestions for future work.
B (Average) B- (Satisfactory) C+ (Marginally satisfactory)	- Adequate synthesis of literature, and structure of content with relevant several relevant sources. - Conclusions are well motivated. - Adequate use of referencing throughout most of the paper. - Adequate scientific style and language throughout most of the paper. - Provides some suggestions for future work.
C (Bordering unsatisfactory) C- (Unsatisfactory)	- Synthesis of literature with limited structure, unclear and limited choice of sources. - Conclusions presented with limited support. - Adequate use of referencing throughout some of the paper.

	- Adequate scientific style and language throughout some of the paper. - Provides limited suggestions for future work.
D, F (Deeply unsatisfactory)	- Poor synthesis of literature, unclear and difficult to follow, very few and/or non-scientific sources. - Limited or no basis for conclusions. - Inadequate use of referencing. - Lack of scientific style and language. - No suggestions for future work. OR failure to submit the proposal and/or article, and/or failure to deliver oral presentation.

Appendix 5: Assessment Criteria for peer feedback

Marks	**Criteria**
A+ (Exceptional) A (Excellent	- Demonstrates curiosity, engagement and/or understanding by briefly summarizing the main points of the presentation exceptionally well. - Gives excellent well-chosen feedback on the most relevant strengths and points for improvement of both presentation and content. - Capacity to articulate and present points of view very clearly. - Demonstrates intellectual flexibility by providing excellent additional viewpoints and/or questioning of assumptions or conclusions when appropriate. - Asks very thoughtful, insightful and sometimes unexpected questions.
A- (Very good) B+ (Good)	- Demonstrates curiosity, engagement and/or understanding by briefly summarizing the main points of the presentation very well. - Gives very good well-chosen feedback on the most relevant strengths and points for improvement of both presentation and content. - Capacity to articulate and present points of view very clearly. - Demonstrates intellectual flexibility by providing very good additional viewpoints and/or relevant questioning of assumptions when appropriate. - Asks thoughtful, insightful and sometimes unexpected questions.
B (Average) B- (Satisfactory) C+ (Marginally satisfactory)	- Demonstrates curiosity, engagement and/or understanding by briefly summarizing the main points of the presentation. - Gives helpful feedback on the most relevant strengths and points for improvement of both presentation and content. - Capacity to articulate and present points of view clearly. - Demonstrates some intellectual flexibility by providing additional viewpoints and/or relevant questioning of assumptions when appropriate. - Asks relevant questions.
C (Borderline unsatisfactory) C- (Unsatisfactory)	- Demonstrates limited curiosity, engagement and/or understanding of presentation. - Feedback on strengths and points for improvement has limited relevance and/or does not cover both presentation and content. - Limited capacity to articulate and present points of view clearly. - Does not provide additional viewpoints and/or relevant questioning of assumptions. - No questions or irrelevant questions. Lacking in engagement.

D, F (Deeply unsatisfactory)	- Cannot properly summarize presentation. Lack of engagement and understanding. - Feedback not constructive or helpful, or failure to deliver feedback. - Points of view confusing or based on inaccurate information/assumptions. - No questions or irrelevant questions. Lacking in engagement and curiosity.