

# UNIVERSITY OF THE PHILIPPINES

## SCIENCE 11 – Living Systems: Concepts and Dynamics 1<sup>st</sup> Semester AY2018-2019

### COURSE GUIDE

#### COURSE DESCRIPTION

Living systems are complex systems with particular characteristics and which exhibit specific processes. A human being is a living system that interact with other living systems and which is part of larger ecosystems. We affect our environment by our actions just as much as changes in the environment affect us. Many of our actions have led to the destruction of habitats of other living systems, thus leading to biodiversity loss, which have serious implications. This course aims to develop a better understanding and appreciation of the interactions within and between living systems, and their significance.

#### COURSE LEARNING OUTCOMES

After completing this course, you should be able to —

- 1) Relate the underlying concepts and principles of living systems with those in other disciplines;
- 2) Analyze the interactions within and among entities in living systems; and
- 3) Utilize scientific inquiry, critical, creative and integrative thinking in making informed decisions on issues concerning living systems and their environments.

#### COURSE OUTLINE

The course covers the following topics:

##### **Module 1 - Perspectives on Living Systems**

Topic 1 - Living Systems in Oral Traditions

Topic 2 - Living Systems from Antiquity to the Renaissance

Topic 3 - Living Systems in the 19<sup>th</sup> and 20<sup>th</sup> Century

##### **Module 2 - Living Systems from the Biological Perspective**

Topic 1 - Hierarchies of Living Systems

Topic 2 - Properties of Living Systems

### **Module 3 - Productivity in Living Systems**

- Topic 1 - Energy Flow
- Topic 2 - Biogeochemical Cycles

### **Module 4 - Cycles and Patterns**

- Topic 1 - Reproductive Cycles
- Topic 2 - Patterns in Living Systems

### **Module 5 - Population Dynamics**

- Topic 1 - Demographic Factors
- Topic 2 - Population Growth
- Topic 3 - Population Regulation

### **Module 6 - Changes in Populations Over Time**

- Topic 1 - The Gene Pool
- Topic 2 - The Hardy-Weinberg Equilibrium
- Topic 3 - Factors that Change Populations Over Time

### **Module 7 - Ecosystems as Complex Systems**

- Topic 1 - Parameters of Complex Systems
- Topic 2 - Measures of Complexity in an Ecosystem
- Topic 3 - Concepts of Adaptation, Survival, and Extinction in Other Disciplines

### **Module 8 - Biodiversity**

- Topic 1 - Levels of Biodiversity
- Topic 2 - Biodiversity Attributes and Ecosystems Processes
- Topic 3 - Measuring and Monitoring Biodiversity Using Surrogate Species
- Topic 4 - Biodiversity Hotspots

### **Module 9 - Sustaining Living Systems**

- Topic 1 - Biodiversity Conservation
- Topic 2 - Other Approaches to Natural Resource Management

### **Module 10 - Health and Wellness as Ecosystem Services**

- Topic 1 - Ecosystem Services
- Topic 2 - Provisioning for Nutrition and Food Security
- Topic 3 - Regulating Services that Impact on Health

## **COURSE MATERIALS**

The learning materials for each module consists of required readings and a module study guide. These will be **accessible to you via the SCIENCE 11 course site on your campus's virtual learning environment (VLE)**. The required readings are listed below.

*NOTE: Your teacher may specify other required readings and learning resources.*

## Module 1 - Perspectives on Living Systems

- UNESCO. (2010). Online Course on Teaching and Learning for a Sustainable Future. Activity 4 “Living by Indigenous Knowledge”. Available at [http://www.unesco.org/education/tlsf/mods/theme\\_c/mod11.html?panel=1#top](http://www.unesco.org/education/tlsf/mods/theme_c/mod11.html?panel=1#top)
- Hidalgo, MP. (2018). Background reading on Indigenous Knowledge, Systems, and Practices and Environmental Movements
- History of Biology: Advances to the 20<sup>th</sup> Century. In Rogers, K; Green, ER and Joshi, SH. (2018) *Biology*, Encyclopedia Britannica. Available at <https://www.britannica.com/science/biology#ref48843>.
- Meadows, DH. (1999) Systems Thinking and Sustainability Lecture (Parts 1, 2, and 3). Available at <https://www.youtube.com/watch?v=HMmChiLZZHg>

## Module 2 - Living Systems from the Biological Perspective

- Meadows, DH. (2008). *Thinking in Systems: A Primer*. London: Earthscan. Available at <http://wtf.tw/ref/meadows.pdf>

## Module 3 - Energy Flow and Biogeochemical Cycles

- The Flow of Energy: Primary Production to Higher Trophic Levels. (2017). In *Global Change - Science of Sustainability*. University of Michigan. Available at <https://globalchange.umich.edu/globalchange1/current/lectures/klings/energyflow/energyflow.html>
- Campbell, NA; Reece, JB; Urry, LA; Cain, ML; Wasserman, SA; Minorsky, PV; and Jackson, RB. (2008). Chapter 55 - Ecosystems. In *Campbell Biology*, 8<sup>th</sup> ed. Pearson Publishing, pp. 1222-1244.
- Reece, JB; Urry, LA; Cain, ML; Wasserman, SA; Minorsky, PV; and Jackson, RB. (2011). Chapter 55 - Ecosystems and Restoration Ecology . In *Campbell Biology*, 9<sup>th</sup> ed. Pearson Publishing, pp. 1264-1283.

## Module 4 - Cycles and Patterns

- Selvarajoo, K. (2013). Interpreting the Dynamics and Patterns of Living Systems. *BioScience*. Vol. 63, No. 9 (September 2013), pp. 721-722. Available at <https://academic.oup.com/bioscience/article/63/9/721/260600>
- Campbell, NA; Reece, JB; Mitchell, LG; and Taylor, MR. (2003). *Campbell Biology: Concepts and Connection*, 4<sup>th</sup> ed. Benjamin Cummings. (selected chapters)
- Wilson, EO and Holldobler, B. (2005). Eusociality: origin and consequences. *PNAS* 102(38): 13367-13371. Available at <http://www.pnas.org/content/102/38/13367>
- *Various online resources on cycles and patterns in living systems (refer to the module study guide)*

## Module 5 - Population Dynamics

- Dupo, ALB. (2016). *Dynamics in population*. UP Talks. 100 Master Voices. Available at <http://tvup.ph/?p=3935>
- Khan Academy. *Life tables, survivorship, & age-sex structure*. Available at <https://www.khanacademy.org/science/biology/ecology/population-ecology/a/life-tables->

### survivorship-age-sex-structure

- Cuevas, V. (2016). *Population regulation*. UP Talks. 100 Master Voices. Available at <http://tvup.ph/?p=3934>
- Khan Academy. *Population regulation*. Available at <https://www.khanacademy.org/science/biology/ecology/population-growth-and-regulation/a/mechanisms-of-population-regulation>
- Bongaarts, J. (2009). Human population growth and the demographic transition. *Philos Trans R Soc Lond B Biol Sci*. 2009 Oct 27; 364(1532): 2985–2990. Available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2781829/>
- Khan Academy. (2014, April 28). Demographic transition (video file). Available at <https://www.youtube.com/watch?v=6P2bsPWCRvM>
- LeeLee. (2012, October 12). Manila - 20 million and rising (video file). Available at <https://www.youtube.com/watch?v=KuDDvYhmCTE>
- Khan Academy. (2014, April 27). Population dynamics (video file). Available at <https://www.youtube.com/watch?v=4CAQN-nc8Ac>
- Bozeman Science. (2015, October 1). *Population ecology* (ecology file). Available at <https://www.youtube.com/watch?v=PQ-CQ3CQE3g>

### **Module 6 - Changes in Populations Over Time**

- Campbell, NA; Reece, JB; Mitchell, LG; and Taylor, MR. (2003). Sections 13.6 to 13.21. *Campbell Biology: Concepts and Connection*, 4<sup>th</sup> ed. Benjamin Cummings.

### **Module 7 - Ecosystems as Complex Systems**

- Complex Environmental Systems Lab (2014). *Ecological complexity*. Available at <http://complexity.ok.ubc.ca/about/ecological-complexity/>
- Anand, M; Gonzalez, A; Guichard, F; Kolasa, J and Parrott, L. (2010). Ecological systems as complex systems: Challenges for an emerging science. *Diversity*, 2, 395-410.
- Parrott, L. (2010). Measuring ecological complexity. *Ecological Indicators*, 10, 1069–1076.
- Loehle, C. (2004). Challenges of ecological complexity. *Ecological Complexity*, 1(1), 3-6.

### **Module 8 - Biodiversity**

- Biodiversity BC. 2007. *Ecological concepts, principles and application to conservation*. Retrieved 12 Jan 2018, from <http://www.biodiversitybc.org/EN/main/where/131.html>
- Tubbataha Youth Ambassador. 2014. *Module 1: Ecology and biodiversity basics*. Retrieved 08 Jan 2018 from <http://tubbatahareef.org/wordpress/wp-content/uploads/2014/09/Module-One-Ecology-and-Biodiversity-Basics2.pdf>
- Andelman, S.J., and W.F. Fagan. 2000. Umbrellas and flagships: Efficient conservation surrogates or expensive mistakes? *PNAS* 97(11):5954-5959. doi: 10.1073/pnas.100126797
- Marchese, C. 2015. Biodiversity hotspots: A shortcut for a more complicated concept. *Global Ecology and Conservation* 3:297-309.
- Conservation International. 2005. *CI facts: biodiversity hotspots*. Retrieved 13 Jan 2018, from [http://www.cnrs.fr/inee/recherche/fichiers/Biodiversite\\_hotspots.pdf](http://www.cnrs.fr/inee/recherche/fichiers/Biodiversite_hotspots.pdf)
- Millenium Ecosystem Assessment. 2005. Ecosystems and human well-being: biodiversity synthesis. World Resources Institute, Washington, D.C. pp. 2-10.

### Module 9 - Sustaining Living Systems

- Asaad, I., Lundquist, C. J., Erdmann, M. V., Costello, M. J. 2017. Ecological criteria to identify areas for biodiversity conservation. *Biological Conservation*, 213: 309-316.
- Congress of the Philippines. 1992. Republic Act No. 7586, An act providing for the establishment and management of national integrated areas system, defining its scope and coverage, ang for other purposes (Section 1 to Section 4).
- UNEP-WCMC and IUCN. 2016. Protected Planet Report 2016. UNEP-WCMC and IUCN: Cambridge UK and Gland, Switzerland (pages 1-50)
- Ambal, R.G.R., Duya, M.V., Cruz, M.A., et al. 2012. Key biodiversity areas in the Philippines: priorities for conservation. *Journal of Threatened Taxa*, 4(8): 2788-2796.
- Hooland, R.A., Darwall, W.R.T, Smith, K.G. 2012. Conservation priorities for freshwater biodiversity: The key biodiversity area approach refined and tested for continental Africa. *Biological conservation*, 148: 167-179.
- Stucki, V., Smith, M. 2011. Integrated approaches to natural resources management in practice: The catalyzing role of national adaptation programmes for action. *Ambio*, 40:351-360

### Module 10 - Health and Wellness as Ecosystem Services

- World Health Organization and Secretariat of the Convention on Biological Diversity. (2015). *Connecting Global Priorities: Biodiversity and Human Health. A State of Knowledge Review*. Available at <https://www.cbd.int/health/SOK-biodiversity-en.pdf>
- Conceptual Framework Working Group of the Millennium Ecosystem Assessment. (2003). *Ecosystems and Human Well-being: A framework for assessment*. World Resources Institute. Available at [http://pdf.wri.org/ecosystems\\_human\\_wellbeing.pdf](http://pdf.wri.org/ecosystems_human_wellbeing.pdf)

## STUDY SCHEDULE

The table below shows in which weeks and sessions specific modules will be taken up. There are usually two sessions per week. The third column shows the learning activities for each module. **Note that you are expected to go through the module study guide and read the required readings/learning resources for each topic BEFORE the class session** where these will be taken up through a class discussion or other learning activities. Specific dates for specific activities, including assignment deadlines, will be set by your teacher.

Week and Session Number	Module/Topic	Activities
Week 1 Session 1	Course Orientaton	Checking of class list; explanation of syllabus and requirements; instructions on how to access module study guides and readings on the SCIENCE 11 course site on the VLE

Week 2 Sessions 2 & 3	Module 1 - Perspectives on Living Systems	<p><u>Before the class session</u> Independent study of the module study guide and required readings</p> <p><u>In-class</u> Discussion of key concepts</p>
Week 3 Sessions 4 & 5	Module 2 - Living Systems from the Biological Perspective	<p><u>Before the class session</u> Independent study of the module study guide and required readings</p> <p><u>In-class</u> Video presentation Discussion of key concepts</p>
Week 4 Sessions 6 & 7	Module 3 - Energy and Biogeochemical Cycles (Productivity in Living Systems)	<p><u>Before the class session</u> Independent study of the module study guide and required readings</p> <p><u>In-class</u> Discussion of key concepts Workshop: Who is eating whom? Activity: My own biogeochemical cycle Group report on an altered biogeochemical cycle</p>
<b>Week 5</b>		<b>1st Long Exam</b>
Week 6 Sessions 8 & 9	Module 4 - Cycles and Patterns	<p><u>Before the class session</u> Independent study of the module study guide and required readings</p> <p><u>In-class</u> Video presentation Discussion of key concepts</p>
Week 7 Sessions 10 & 11	Module 5 - Population Dynamics	<p><u>Before the class session</u> Independent study of the module study guide and required readings</p> <p><u>In-class</u> Discussion of key concepts Exercises: graphing population growth, plotting the survivorship curve</p>

Week 8 Sessions 12 & 13	Module 6 - Changes in Populations Over Time	<u>Before the class session</u> Independent study of the module study guide and required readings  <u>In-class</u> Discussion of key concepts Problem sets Simulations Thought experiment
<b>Week 9</b>		<b>2nd Long Exam</b>
Week 10 Sessions 14 & 15	Module 7 - Ecosystems as Complex Systems	<u>Before the class session</u> Independent study of the module study guide and required readings  <u>In-class</u> Discussion of key concepts Case analysis
Weeks 11-12 Sessions 16, 17 & 18	Module 8 - Biodiversity	<u>Before the class session</u> Independent study of the module study guide and required readings  <u>In-class</u> Discussion of key concepts Outdoor observation Problem tree building  <u>Assignment</u> Development of IEC materials
Weeks 12-13 Sessions 19, 20 & 21	Module 9 - Sustaining Living Systems	<u>Before the class session</u> Independent study of the module study guide and required readings  <u>In-class</u> Discussion of key concepts and cases  <u>Assignment</u> Case study of a protected area

Week 14 Sessions 22 & 23	Module 10 - Health and Wellness as Ecosystem Services	<u>Before the class session</u> Independent study of the module study guide and required readings  <u>In-class</u> Discussion of key concepts Data analysis
<b>Week 15</b>		<b>Presentation of Assignments</b>
<b>Week 16</b>		<b>3rd Long Exam/Final Exam</b>

## COURSE REQUIREMENTS

Your grade in this course will be based on your performance in the following:

1. Three long exams (including the final exam)
2. Assignments: IEC material, case study
3. Participation in in-class group work and/or exercises
4. Class attendance and participation in discussion

### Long Exams

*(brief description — e.g. the exam scope and type, weight relative to final grade)*

### Assignments

*(brief description)*

### In-class group work and exercises

These will vary per module. Instructions are given in the module study guides. Your instructor may modify activities in class.

### Participation in discussion

Required readings and other learning resources as well as the results of learning activities will be discussed in class. Be sure to study the required readings and other learning resources before coming to class.