

# Temporal Biology Seminar: Phenology

Phenology, the timing of annual life cycle events, is a critical trait for organisms, influencing and being influenced by evolution and ecology across many scales. In this graduate seminar we will discuss the biological underpinnings and implications of phenology through primary scientific literature.

**Course objectives:** The goal of this course is for students to broadly consider the role that phenology plays in biological, ecological and evolutionary processes. Specifically, students will:

- Understand the biological and evolutionary underpinnings of phenology.
- Consider the role of phenology in structuring ecological and evolutionary processes.
- Gain exposure to the diverse application of phenological research within the field of biology, and consider phenology's role in their own field of interest.

**Course Structure:** This seminar will meet once per week for two hours. Meetings will consist of brief introductory and concluding remarks by the instructor and a student facilitated discussion.

**Prerequisites:** Advanced academic standing with introductory coursework in ecology and evolution, or permission of instructor.

Week	Topic	Lecture Focus	Readings
Part I: Fundamentals			
Week 1	Introductory Remarks	What is phenology anyway? Is phenology a “trait”?	Forest and Rushing 2010 Lechowicz 1984, Ollerton 1992,
Week 2	Environmental Cues	Environmental factors influencing phenology Modeling phenological responses to environments	Rathke and Lacey 1985 Chuine 2000, Fu 2014
Week 3	Physiology of Phenology	How/Where do plants perceive their environment? Genetic regulation of phenology	Bernier 2005 Wilczek 2010, Visser 2010
Week 4	Evolution of Phenology	Heritability and local adaptation of phenology	Liepe 2016 McDonough-MacKenzie 2018, Vitasse 2009
Week 5	Carryover Effects	Phenological sequences Maternal effects	Gougherty 2018 Johnsen 2005, Auge 2017
Part II: Function			
Week 6	Ecosystem Ecology	Phenology, fluxes and feedbacks	Richardson 2013 Fitzjarrald 2001, McKown 2012
Week 7	Community Ecology	Temporal Niches Phenology and competition	Fargione 2005 Ross 1972, Wainwright 2011
Week 8	Evolutionary Biology	Phenological speciation: Allochrony Phenology and life history evolution	Taylor 2017 Burghardt 2015, Rubin 2018
Part III: Phenology in a Changing World			
Week 9	Phenological Shifts	Observed changes	Menzel 2006 Ffrench-Constant 2016, Fu, 2015
Week 10	Invasion	Phenology as a mechanism of invasion Rapid evolution of phenological response	Wolkovich 2013, Gioria 2017 Erfmeier 2005
Week 11	Phenology and Extremes	False Spring Drought	Gu 2008 Ivits 2014, Cui 2017
Week 12	Phenological Mismatches	Pollinator networks Herbivory and predation	Kudo 2003 Kharouba 2015, Petanidou 2014

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