

EVOLUTIONARY PHYSIOLOGY



A complete advanced undergraduate/graduate course with:

- 12 online lectures by leading authorities
- Resources for workshops, tutorials, journal clubs, projects and seminars
- Suggested exam questions and model answers
- Multiple choice questions and answers
- Recommended reading: original papers and review articles



View the content of the course on our website: hstalks.com/EvolutionaryPhysiology



View our in-depth HSTalks: hstalks.com/CoursesBrochure

Course module with video lectures, material for tutorials (case studies, projects, workshops and recommended reading), multiple choice questions and suggested exam questions with model answers. A comprehensive course on a subject of major importance.

The material is especially designed to support research and teaching staff when presenting a comprehensive course at graduate or advanced undergraduate level with seminars, journal clubs, laboratory exercises, data workshops, online tests and end of course examinations.

The course is also suitable for continuing professional development/education programmes.

This brochure provides brief details of the complete module, including the lectures, lecturers and additional learning material.

Who is the course for?

The comprehensive material is especially suitable for teachers and researchers who wish to offer courses on specialist subjects to small groups of students (or even a single student) when it is not possible to justify the time and expense of preparing, internally, a course or there is not the range of expertise available locally to do so. All the lecturers are highly regarded experts in their fields and few institutions are likely to have a comprehensive group of faculty members with a similar range of experience and knowledge of the subject matter.

The course material is designed to be used by local faculty and staff acting as course directors, tutors and mentors.

The material is suitable for flipped classroom, blended, team and distance learning courses.

New courses are time consuming and expensive to create. These modules cut both the cost and the time, enabling a wider range of options to be offered on specialist topics. Graduate students can take the courses, mentored by their supervisors, while pursuing their research.

Ideal for Virtual Learning Environments (VLE)

All course material, including the additional learning material, is arranged in a standard format that allows easy embedding into virtual learning environments such as Moodle, Blackboard or your institute's own system.

Supporting learning and teaching goals

In an age when faculty and staff face ever greater demands on budgets and time, these lectures and additional learning material will be of great help when preparing and delivering graduate and advanced undergraduate courses.



Course Summary

The premise of this course exploits the concept that the mechanisms of multicellular physiology evolved from unicellular organisms and their interactions, giving insight to how and why physiology evolved as an integrated whole. This is in contrast to the way physiology is currently perceived, as an association of loosely related parts without a *raison d'être*. For example, rather than the conventional way in which homeostasis is perceived as a 'snapshot' for maintaining the integrity of the organism, the cellular approach focuses on homeostasis as the organizing principle for life. Complex life emerged in a series of transitions of individuality, e.g. molecules within simple cells, simple cells within complex cells, and complex cells within multicellular organisms. In each transition, conflicts among lower-level units had to be mediated. Co-opted features of lower-level units produced conflict mediation and ultimately homeostasis. The recognition that structural and functional relationships emerged from selection for homeostatic mechanisms further illuminates central concepts. Concepts such as the life cycle, endothermy, pleiotropy, reproduction, and others will be examined in the context of cellular mechanisms, offering a mechanistically-based, scale-free continuum from development to homeostasis, regeneration and death for the first time. As a result of the fundamental understanding of physiology, predictive models for hypothesis testing can be generated for stability and change at all levels, from the zygote to the organism.

At the end of this course the student will have an understanding of physiologic principles based on First Principles. This perspective will enable students to devise ways of 'trouble-shooting' their own biologic problems. A blog will be provided in which to query Prof. Torday as to how to address specific problems.



Prof. John S. Torday
Harbor-UCLA Medical Center,
USA



Prof. Neil Blackstone
Evolutionary Biology,
Northern Illinois University, USA

**The course
module is
designed
for:**

This course will be of interest to graduate and undergraduate students in the areas of physiology, molecular biology, biochemistry and paleontology; medical students; biomedical researchers; informaticists; philosophy majors with an interest in the theory of science; theoreticians and physicists.

Course Lectures

*Click
the lecture title
to access*

On the utility of a mechanistic approach to physiology

Prof. John S. Torday
Harbor-UCLA Medical Center, USA



A brief history of evolutionary biology

Prof. Neil Blackstone
Evolutionary Biology, Northern Illinois University, USA



Major transitions in the history of life

Prof. Neil Blackstone
Evolutionary Biology, Northern Illinois University, USA



On the origins of life

Dr. William B. Miller Jr.
OmniBiome Therapeutics, USA



The origin of eukaryotes

Prof. Neil Blackstone
Evolutionary Biology, Northern Illinois University, USA



Trichoplax and the origin of animal complexity

Prof. Bernd Schierwater
Institute for Animal Ecology and Cell Biology, Germany



12 specially recorded, animated lectures
by world leading authorities

*Click
the lecture title
to access*

On the value of comparative physiology

Prof. Karen L. Sweazea
Arizona State University, USA



How to 'deconvolute' lung evolution

Prof. John S. Torday
Harbor-UCLA Medical Center, USA



Using lung evolution as a cipher for physiology

Prof. John S. Torday
Harbor-UCLA Medical Center, USA



The Unicellular Origins of Complex Physiology

Prof. John S. Torday
Harbor-UCLA Medical Center, USA



Pleiotropy: cellular-molecular evolution in action

Prof. John S. Torday
Harbor-UCLA Medical Center, USA



**The dynamic interactions between cellular-molecular physiology
and the environment**

Prof. John S. Torday
Harbor-UCLA Medical Center, USA



Examples of Course Materials

For each lecture the course offers tutorials, workshops, recommended reading, multiple-choice questions, and suggested exam questions with model answers.



HST Moodle My Courses ▸ Evolutionary Physiology

Tutorial: The Cellular-Molecular Basis for Embryogenesis- paracrine signaling

Lecturer: Prof. John S. Torday – Harbor-UCLA Medical Center, USA

1. Discuss the advantage of knowing the signaling pathways for the embryogenesis of the various organs shown in the presentation, particularly the way that the ligands and their receptors are positioned on cell-types of different germline origins
2. With respect to the above, it is important to bear in mind that the genes involved in embryogenesis are specific to one of the three embryonic compartments- endoderm, mesoderm, ectoderm- which is fundamental for the internal consistency of the interactions between the organism and the physical environment
3. Discuss ways of analyzing such pathways across ontogeny and phylogeny to find homologs
4. How could such homologs be exploited to understand complex physiologic interactions?
5. How could such homologs be exploited in medicine?



Exam Questions and Model Answers

Question 1

Not yet answered
Marked out of 1.00

 Flag question

 Edit question

Discuss the implications of unidirectional vs bidirectional communication between cells during development.



Multiple-choice questions and answers

Question 4

Not yet answered
Marked out of 1.00

 Flag question

 Edit question

Epithelial-Mesenchymal Interactions mediate:

Select one:

- a) Axial body orientation
- b) Peristalsis
- c) Digit formation
- d) Organ growth and differentiation



Recommended reading supporting each lecture: Original research papers and review articles

1. Torday JS, Rehan VK. The evolutionary continuum from lung development to homeostasis and repair. *Am J Physiol Lung Cell Mol Physiol*. 2007 Mar;292(3):L608-11. Epub 2006 Nov 3. Review. PubMed PMID: 17085519.
2. Torday JS, Rehan VK. Lung evolution as a cipher for physiology. *Physiol Genomics*. 2009 Jun 10;38(1):1-6. doi: 10.1152/physiolgenomics.90411.2008. Epub 2009 Apr 14. Review. PubMed PMID: 19366785; PubMed Central PMCID: PMC2696147.
3. Torday JS, Rehan VK. The Evolution of Cell Communication: The Road not Taken. *Cell Commun Insights*. 2009 Sep 9;2:17-25. PubMed PMID: 25892907; PubMed Central PMCID: PMC4398024.
4. Torday JS, Rehan VK. A cell-molecular approach predicts vertebrate evolution. *Mol Biol Evol*. 2011 Nov;28(11):2973-81. doi: 10.1093/molbev/msr134. Epub 2011 May 18. PubMed PMID: 21593047; PubMed Central PMCID: PMC3199438.



How to access the course

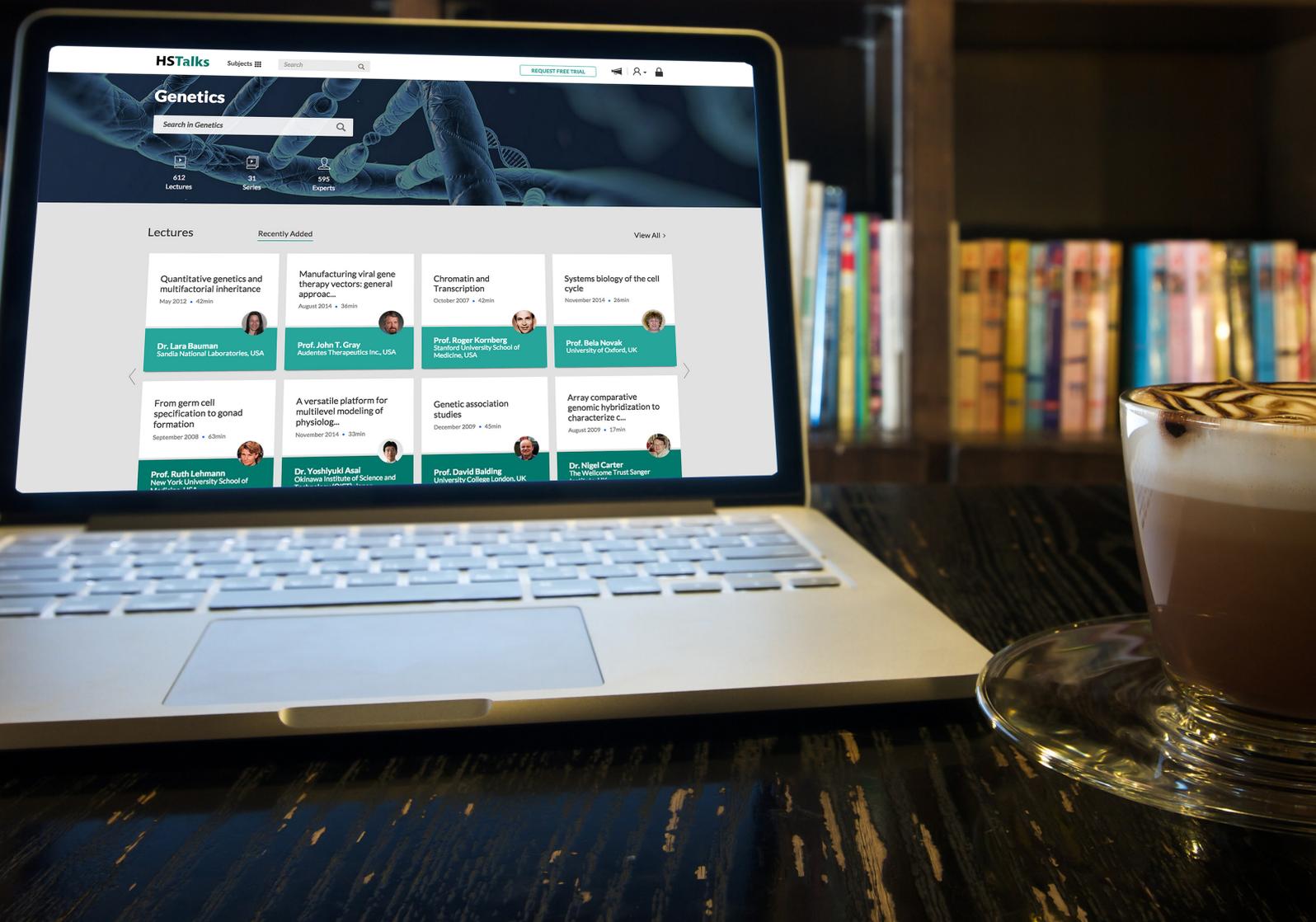
Extracts of lectures can be viewed at hstalks.com/biosci/. The full length lectures can be viewed by all members of universities, colleges and medical schools currently subscribing to The Biomedical & Life Sciences Collection. Institutions that do not subscribe to The Biomedical & Life Sciences Collection may take annual licenses at US \$2,000 covering an unlimited number of students.

Full supporting material: video lectures, material for tutorials (case studies, projects, workshops and recommended reading), multiple choice questions and suggested exam questions with model answers are provided to faculty members of subscribers.

To subscribe, obtain additional information and/or the additional learning material contact Dr. Eyal Kalie at eyalk@hstalks.com.

Upload to your VLE

The complete course (lectures and additional learning material) can be loaded into Moodle, Blackboard and other virtual learning environments.



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