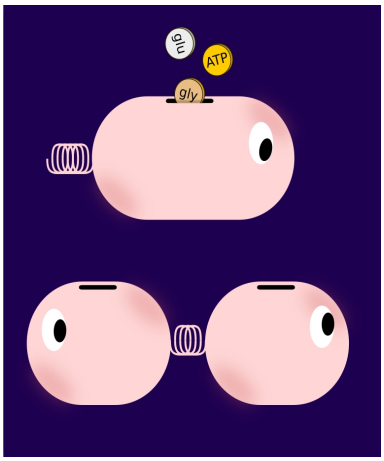
Economic Principles in Cell Physiology

Summer school at Learning Planet Institute, Paris, July 10-13, 2023



Information for participants

Summary

How can a cell maintain itself as a living being? Living cells, shaped by billions of years of evolution, have developed many ways to adapt to their environment, e.g. by regulation of gene expression. But the rules of physics and chemistry enforce certain boundaries on what cells can achieve and how they can allocate their own resources. Our goal is to uncover some of these governing principles. Shaped by evolution, cells "do certain things right", and computational models of cells often assume that this "doing something right" can be described by evoking optimality principles.

While biological optimality is often contested for good reasons, theories based on economic principles can explain many observations (about cell growth or the usage of cellular resources) much better than purely mechanistic models. Methods such as Flux Balance Analysis are well established, but the idea of resource allocation is gaining ground, and metaphors like "currency metabolites" or "energy budget" are common in cell biology, optimality principles are often applied ad hoc, and a coherent picture - in which many single observations or models would have their place - is still missing.

In this 4-day summer school we give an overview of established approaches to "cellular economics", from descriptions of simple metabolic systems to cell growth and dynamic behavior. The course is based on chapters of a textbook that we are writing as a community project.

In the final day of the summer school, we bring up a larger question: Which role can we play as scientists in constructing a world corresponding to our values in the age of the Anthropocene?

Contacts

Organising committee:

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Organiser of SEnS workshop:

Sophie Quinton (sophie.quinton@inria.fr)

Organiser at Learning Planet Institute (LPI):

Cecilia Patitucci (cecilia.patitucci@cri-paris.org)

Host:

Learning Planet Institute Paris, 8 Rue Charles V, 75004 Paris (Map)

Contact for any questions during the summer school:

Wolfram Liebermeister (wolfram.liebermeister@gmail.com)

Course web site:

https://principlescellphysiology.org/summer-school-2023/

Supported by:

Course schedule

Monday July 10

10-11 am	**Exploring the economy of the cell** Meike Wortel *Chat moderator: Anne Goelzer*
11-12 am	**What makes up a cell?** Diana Széliová *Chat moderator: Anne Goelzer*
noon	Lunch break and get-together
1-2 pm	**Participants' projects** Group dicussions
2-3 pm	**Autocatalytic cycles** Rami Pugatch (remote lecture) *Chat moderator: Elad Noor*
3-3:30 pm	Coffee break
3:30-4:30 pm	**Self-replicator cell models** Andrea Weiβe (remote lecture) *Chat moderator: Meike Wortel*
4:30-5:30 pm	**A guided tour of the LPI** Cecilia Patitucci and LPI students

Tuesday July 11

10-11 am 	**Flux balance analysis** Steffen Waldherr *Chat moderator: Diana Széliová*
11-12 am 	**A dynamic view of metabolism** Orkun Soyer (remote lecture) *Chat moderator: Anne Goelzer*
noon	Lunch break
1-2 pm	**Book chapter reviews I** Group work
2-3 pm 	**Metabolic diversity** Andrea de Martino and Daniele de Martino (remote lecture) *Chat moderator: Wolfram Liebermeister*
3-3:30 pm	Coffee break
3:30-4:30 pm 	**Return on investment in cells** Hyun-Seob Song (remote lecture) *Chat moderator: Ohad Golan*
4:30-5:30 pm 	**Night Science** Martin Lercher (remote course)

Wednesday July 12

10-11 am 	**Cell division coordination** Mattia Corigliano *Chat moderator: Steffen Waldherr*
11-12 am 	**Behaviour under uncertainty** David Lacoste and Olivier Rivoire *Chat moderator: Wolfram Liebermeister*
noon	Lunch break
1-2 pm	**Book chapter reviews II** Group work
2-3 pm 	**Organ scaling and function** Frédérique Noël and Cyril Karamaoun

	Chat moderator: Meike Wortel
3-3:30 pm	Coffee break
3:30-4:30 pm 	**Book - plans for the future** Plenary discussion *Chat moderator: Diana Széliová*
4 :30 pm	**Course feedback and get-together**

Thursday July 13

9 am-5 pm	**SEnS workshop** In-person only - no online participation *Moderators: Sophie Quinton, Simon Castellan, Noé Lahaye*

Note : all times are CET (Paris time zone)

General information

Course material: lecture notes and slides will be made available after the school, via the web site: https://principlescellphysiology.org/summer-school-2023/

The course accompanies a **community-wide, free textbook** on economic principles in cellular physiology. For details about the book project, and access to the current release (April 2023), see https://principlescellphysiology.org/book-economic-principles/.

If you are interested in the subject of the book and the course, you may also be interested in joining the **forum Economic Principles in Cell Physiology**, which organizes regular online seminars. The forum has a dedicated slack space for **young scholars**, including the organization of monthly meetings. If you are interested in participating in and contributing to the forum and the young scholars activities, please go to https://principlescellphysiology.org/.

Information for online participants

Online participants can follow the course via **Google Meet.** The link will be distributed by email.

If you have any questions during the course, please ask them via the chat. Each course has a chat moderator, as indicated in the course schedule. During the Q&A session after the course, the moderator invites online participants to pose their question to the teacher. Unless you are invited by the moderator to pose your question, please switch off your microphone during the course. The lectures are recorded. If you do not want to be recorded, then shut off your camera and microphone at all times.

If you have any questions or encounter any problems during the online sessions, please send a message to Wolfram Liebermeister (wolfram.liebermeister@gmail.com).

Information for onsite participants

Before the course. Please bring a water bottle (for the water fountain) and a cup (for coffee or tea). If you do not want to appear on photos (to be published on the web), please let us know in advance.

Covid notice. There are currently no Covid restrictions in France. For up-to-date information on the Covid situation in France and practical information (what to do in case of a positive test, for example), please consult the web site of the Paris tourist office:

https://en.parisinfo.com/practical-paris/info/guides/info-disruption-paris.

During the course. The course takes place at the **Learning Planet Institute (LPI)**, 8 Rue Charles V, 75004 Paris (Map) in the Learning Center Extension room. The room is equipped with (a few) electric sockets. The wifi code will be shown in the room. A **lunch buffet** is provided within the LPI premises on all three days and a **farewell party** takes place on Wednesday, after the concluding discussion. We have not organized any official **social activities** in the evenings, but whoever would like to go to a bar in the Marais district around the institute (on Monday), or for a walk by the Seine (on Tuesday), is welcome to join (departure at 5:30, after the last course event of the day). For any practical questions about LPI, please contact Cecilia Patitucci (cecilia.patitucci@cri-paris.org).

After the course. A link to a **course evaluation form** will be sent to the participants after the course. The form allows you to give feedback on the lectures and suggest ideas for improvements and extensions of the book.

SEnS workshop

During the last day, we will do one-day workshop about political/personal questions, including one's personal values and how they relate to our work as researchers. This workshop for young scientists or engineers (called Atelier SEnS: science, environment, societies) will be held by Sophie Quinton, Simon Castellan and Noé Lahaye. While attendance is not mandatory, we believe that this extra day will be a great opportunity, especially for PhD students, to think about defining decisions for their future life and career. Information can be found on the SEnS.workshop home page.

The SEnS workshop is **limited to in-person participants**. There will be groups in English and French.

The SEnS workshop has been designed to provide tools and resources for this purpose, to a group of 5 to 15 people working in academia. It aims to offer a venue to collectively discuss the consequences of our research, the values that it conveys, and more generally how scientific research fits in the Anthropocene; provide an introduction to science and technology studies, in particular to the philosophy, history, and sociology of science; and initiate a collective construction of a social and environmental responsibility of research. The objective is not to reach a consensus between the

participants, but rather to provide everyone with the opportunity to reflect and take a stance on current environmental issues in a respectful and constructive setting. By confronting ideas and sharing knowledge, the goal is then to find common ground.