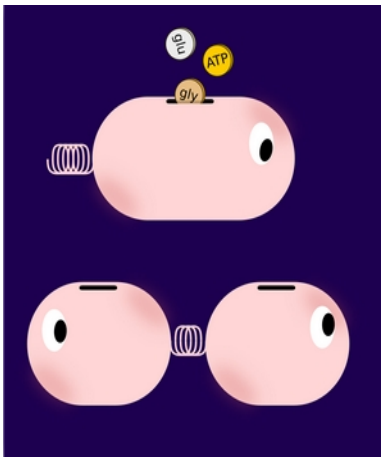
Economic Principles in Cell Physiology

Summer school at Learning Planet Institute, Paris, July 4-6, 2022



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 3-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.

Contacts

Organising committee

Anne Goelzer (anne.goelzer@inrae.fr)
Diana Széliová (diana.szeliova@univie.ac.at)
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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

Hidde de Jong (epcp-summer-school-2022@googlegroups.com)

Course website

principlescellphysiology.org/summer_school_2022.html

Supported by:

Course schedule

Monday July 4

10-10:45 am hybrid	**Exploring the economy of the cell** Wolfram Liebermeister, Elad Noor, Markus Köbis, Ohad Golan *Chat moderator: Anne Goelzer*
10:45-12 am hybrid	**What makes up a cell?** Diana Széliová and Pranas Grigaitis *Chat moderator: Elad Noor*
noon	Lunch break
1-2 pm	**Get-together**
2-3 pm online	**Optimality problems in cells** Markus Köbis and Wolfram Liebermeister *Chair: Wolfram Liebermeister, Chat moderator: Diana Széliová*
3-3:30 pm	Coffee break
3:30-4:30 pm hybrid	**A dynamic view of metabolism** Orkun Soyer *Chat moderator: Frank Bruggeman*
4:30-5:30 pm	**A guided tour of the Learning Planet Institute** Cecilia Patitucci and LPI students

Tuesday July 5

10-11 am online	**Balanced cell growth** Frank Bruggeman *Chat moderator: Hidde de Jong*
11-12 am hybrid	**Flux balance analysis** Steffen Waldherr *Chat moderator: Meike Wortel*
noon	Lunch break
1-2 pm online	**How to write a book that is useful to the community** Discussion with Ron Milo *Chair: Elad Noor, Chat moderator: Ohad Golan*
2-3 pm hybrid	**The cost of metabolic pathways** Elad Noor and W. Liebermeister *Chat moderator: Orkun Soyer*
3-3:30 pm	Coffee break

3:30-4:30 pm hybrid	**Optimal metabolic states** Meike Wortel *Chat moderator: Steffen Waldherr*
4:30-5:30 pm	**Tutorials/exercises** Depending on participants' interests

Wednesday July 6

10-11 am hybrid	**Self-replicator cell models** Ohad Golan *Chat moderator: Anne Goelzer*
11-12 am hybrid	**Resource allocation models** Anne Goelzer and Wolfram Liebermeister *Chat moderator: Wolfram Liebermeister*
noon	Lunch break
1-2 pm hybrid	**Plans and collaborations** *Chat moderator: Diana Széliová*
2-3 pm hybrid	**Optimal cell behavior in time** Hidde de Jong and Markus Köbis *Chat moderator: Elad Noor*
3-4 pm hybrid	**Closing discussion** All participants *Chat moderator: Frank Bruggeman*
4 pm	**Farewell party**

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_2022.html
- Link to book *Cell Biology by the Numbers* by Ron Milo (including free pdf version): http://book.bionumbers.org/

The course accompanies a community-wide **book project**. For details, including a list of chapter titles and authors, see principlescellphysiology.org/book.html.

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 with the followin link**:

https://cri-paris-dot-yamm-track.appspot.com/1unnBQP7IP4HlFZtnHhVW7ucnlu46RLNzyuZG5FZWwbeiXvykgQEUaW--v0o-JHdOiAHQJ04ZGQJmiUJgTlO4D0tzu2v3Xf3kB9sV02JNAbX9wBL4NxdqL3D0RcNSgx0B12jf5Ia34utIaA

If you have any questions during the course, please ask them via the chat. Each course has a 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, make sure to shut off your camera and mute your microphone at all times.

If you have any questions or encounter any problems during the online sessions, please send a message to Hidde de Jong (epcp-summer-school-2022@googlegroups.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. As you may have heard, there is a string resurgence of the Covid pandemic in France, and in the Paris region in particular. In order to protect yourself and others, we strongly recommend you to **bring masks and wear them during the lectures**. We also recommend **doing a Covid self-test before the start of the school** and when you experience symptoms. 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.