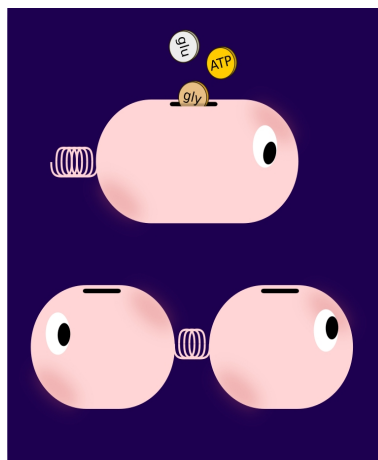


# Economic Principles in Cell Physiology

Summer school at Learning Planet Institute, Paris, July 8-11, 2024



**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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## Organizer of SEnS workshop:

Sophie Quinton ([sophie.quinton@inria.fr](mailto:sophie.quinton@inria.fr))

## Organizer at Learning Planet Institute (LPI):

Virginie Chomier ([virginie.chomier@learningplanetinstitute.org](mailto:virginie.chomier@learningplanetinstitute.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](mailto:wolfram.liebermeister@gmail.com)), Hidde de Jong ([hidde.de-jong@inria.fr](mailto:hidde.de-jong@inria.fr)), and for technical (zoom-related) questions Diana Széliová ([diana.szeliova@univie.ac.at](mailto:diana.szeliova@univie.ac.at)).

Web site of the course:

<https://principlescellphysiology.org/summer-school-2024/>

Supported by:



## Course schedule

Lectures for online participation are marked in **purple**. All other events are for in-person participants only.

### Monday July 8

10-11 am	<b>The economy of the cell</b> Meike Wortel <i>Hybrid lecture</i>
11-12 am	<b>An inventory of cell components</b> Diana Széliová and Pranas Grigaitis <i>Hybrid lecture</i>
noon	Lunch break and get-together
1-2 pm	<b>Optimality in biology</b> Markus Köbis <i>Hybrid lecture</i>
2-3 pm	<b>Cell metabolism</b> Orkun Soyer <i>Remote lecture</i>
3-3:30 pm	Coffee break
3:30-4:30 pm	<b>Optimization of metabolic fluxes</b> Steffen Waldherr <i>Hybrid lecture</i>
4:30-5:30 pm	<b>A guided tour of the LPI</b> Virginie Chomier <i>In-person only - no online participation</i>

## Tuesday July 9

10-11 am	<b>Principles of cell growth</b> Hollie J. Hindley <i>Hybrid lecture</i>
11-12 am	<b>Growth balance analysis</b> Hugo Dourado <i>Remote lecture</i>
noon	<b>Group photo</b> Lunch break
1-2 pm	<b>Free discussion/group work</b> <i>In-person only - no online participation</i>
2-3 pm	<b>Scaling laws in cell evolution</b> Sergio Munoz-Gomez <i>Remote lecture</i>
3-3:30 pm	Coffee break
3:30-4:30 pm	<b>Cells in the face of uncertainty</b> David Lacoste and Olivier Rivoire <i>Hybrid lecture</i>
4:30-5:30 pm	<b>Night Science</b> Martin Lercher <i>Remote lecture</i>

## Wednesday July 10

10-11 am	<b>Economy of organ form and function</b> Frédérique Noël <i>Hybrid lecture</i>
11-12 am	<b>Diversity of metabolic flux distributions in a cell population</b> Roberto Mulet <i>Hybrid lecture</i>
noon	Lunch break

1-2 pm	<b>Book – plans for the future</b> Plenary discussion <i>In-person only - no online participation.</i>
2-3 pm	<b>The origin of life</b> Sanjay Jain <i>Remote lecture</i>
3-3:30 pm	Coffee break
3:30-4:30 pm	<b>The return on investment</b> Hyun-Seob Song and Doraiswami Ramkrishna <i>Remote lecture</i>
4:30 pm	<b>Course feedback</b> <i>Hybrid session.</i>
7:30 pm	<b>Get-together</b> <i>In-person only - no online participation</i>

#### Thursday July 11

9 am-5 pm	<b>SEnS workshop</b> Moderators: Sophie Quinton and Natalia Kotelnikova-Weiler <i>In-person only - no online participation</i>
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**Note:** all times are CET (Paris time zone)

# General information

**General information about the course** can be found on our website:

<https://principlescellphysiology.org/summer-school-2024/>

**Course materials:** lecture notes and slides will be made available after the school, via the web site.

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 2024), 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 Zoom.

**Before the course.** To obtain a zoom link (valid for all the sessions), please register at

<https://univienne.zoom.us/meeting/register/u5wuce6tqz0rGdE3IT0frzuztcW4IzNMfqOX>

**During the course.** 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.

**Troubleshooting** If you have questions related to zoom or if you encounter technical any problems during the online sessions, please send a message to Diana Széliová ([diana.szeliova@univie.ac.at](mailto:diana.szeliova@univie.ac.at)).

**After the course.** Please participate in the course evaluation (see below).

## Information for on-site 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.

**Posters.** On-site participants are invited to bring posters about their own research. We will not have a formal poster session, but informal poster sessions can be done during the lunch breaks.

**Laptops** You don't have to bring your laptop, but please bring some device (smartphone or tablet) that allows you to connect to the internet to fill in online forms.

**Olympic games.** The course will be held just before the 2024 Olympic games in Paris (beginning on July 26). It is possible that there will be difficulties with public transport etc. For practical information about the Olympic games, you may want to consult the following web site of the Paris tourist office:

<https://parisjetaime.com/eng/things-to-do-in-paris/major-events-paris/olympic-paralympic-games-paris-2024-i101>

**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 other **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 Virginie Chomier ([virginie.chomier@learningplanetinstitute.org](mailto:virginie.chomier@learningplanetinstitute.org)).

**After the course.** Please participate in the course evaluation (see below).

**Certificate of attendance.** Certificates of attendance will be provided for on-site participants.

## Night science session

On Tuesday we will host a Night Science session, a course on the creative scientific process, developed by Itai Yanai and Martin Lercher.

**Website:** [night-science.org](http://night-science.org)

**Editorials:** [www.biomedcentral.com/collections/night-science](http://www.biomedcentral.com/collections/night-science)

**Podcast:** [nightscience.buzzsprout.com](http://nightscience.buzzsprout.com) (with links to spotify etc.)

## SEnS workshop

During the last day, there will be a 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, Society") will be held by Sophie Quinton and Natalia Kotelnikova-Weiler. 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**.

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.

## Please give us your feedback

We kindly ask you to give us your feedback about the course. Feedback about individual lectures can be given directly after the session in an online form:

[https://docs.google.com/forms/d/1cXzMuZbqIBTVkXWPFifC6ukD2yfJR-MwYEmFqM\\_TeuQ/](https://docs.google.com/forms/d/1cXzMuZbqIBTVkXWPFifC6ukD2yfJR-MwYEmFqM_TeuQ/)

In addition, please give us your feedback about the course as a whole. The form allows you to give feedback on the course and suggest ideas for improvements and extensions of the book:

[https://docs.google.com/forms/d/1EcJd\\_RPgYIS2i2vYPQK4w3\\_hWk\\_5X3N4mM\\_szS6wMp4/](https://docs.google.com/forms/d/1EcJd_RPgYIS2i2vYPQK4w3_hWk_5X3N4mM_szS6wMp4/)