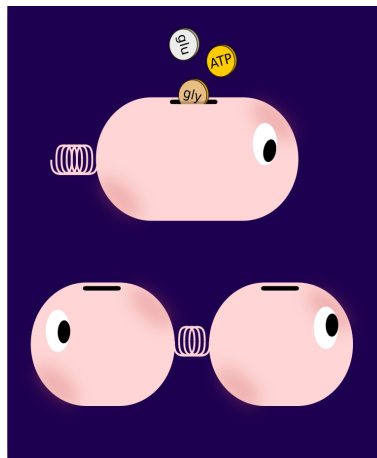


Economic Principles in Cell Biology

University of Vienna, July 23-26, 2025



Information for participants

Course supported by:

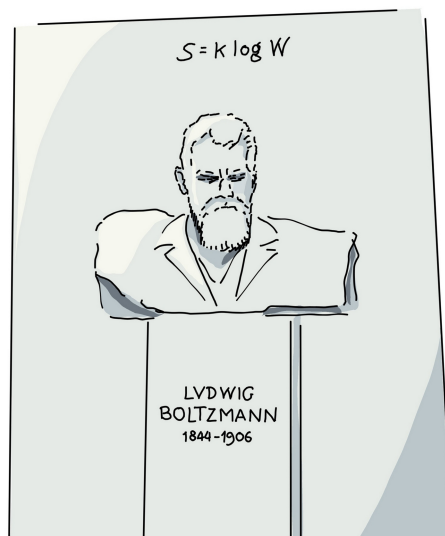


Summer school “Economic Principles in Cell Biology”

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.



What better place to spend the summer than with the scientist who turned chaos into science?



When visiting Vienna, at the Zentralfriedhof, among composers such as Beethoven, Brahms, Schoenberg, and Schubert, you can find the grave of Ludwig Boltzmann, one of the founders of statistical physics.

Course schedule

Lectures that can be followed on-line are marked in **purple**. All other events are for on-site participants only. All times are CEST (Vienna time zone)

Wednesday July 23 – Topic: Basics

10-10:30 am	The economy of the cell Meike Wortel
10:30-11 am	Practical announcements Wolfram Liebermeister and Diana Széliová
11-12 am	An inventory of cell components Diana Széliová and Pranas Grigaitis
noon	Lunch break
1 -2 pm	Get-together – Participants discuss their own projects
2-3 pm	Cell metabolism Pranas Grigaitis and Steffen Waldherr
3-3:30 pm	Coffee break
3:30-4:30 pm	Practical work Introduction to Python & Jupyter (Elad Noor / Michela Pauletti)
4:30-5:30 pm	Group photo, a little game, and poster session with drinks

Thursday July 24 – Topic : Metabolic models

10-11 am	Optimization of metabolic fluxes Felipe Scott and Steffen Waldherr
11-12 am	The enzyme cost of metabolic fluxes Elad Noor
noon	Lunch break
1-2 pm	Practical work Flux Balance Analysis (Felipe Scott Contador)
2-3 pm	Optimization of metabolic states Meike Wortel
3-3:30 pm	Coffee break
3:30-4:30 pm	Practical work Elementary Flux Modes (Diana Széliová)

4:30-5:00 pm	Break
5:50 pm	Night Science Martin Lercher

Friday July 25 – Topic : Cell models

10-11 am	Principles of cell growth Hollie J. Hindley
11-12 am	Growth balance analysis Hugo Dourado
noon	Lunch break
1-2 pm	Practical work Optimal enzyme profiles (Elad Noor)
2-3 pm	Perspectives lecture “Constraint-based modeling of microbial communities” Stefan Müller and Michael Predl
3-3:30 pm	Coffee break
3:30-4:30 pm	Practical work Optimal metabolic states (Meike Wortel)
4:30-5:30 pm	Practical work Self-replicating cells (Hollie J. Hindley)

Saturday July 26 – Topic : Advanced

10-11 am	Optimal cell behavior in time Hidde de Jong
11-12 am	Diversity of metabolic flux distributions Marcelo Rivas-Astroza / Roberto Mulet
noon	Lunch break
1-2 pm	Practical work Flux variability and entropy (Marcelo Rivas-Astroza / Roberto Mulet)
2 pm -3 pm	Economy of organ form and function Frédérique Noël
3-3:30 pm	Coffee break
3:30-4:30 pm	Practical work Dynamic Flux Balance Analysis (Steffen Waldherr)

4:30-5:30 pm	Course feedback
6 pm	Farewell dinner

Night science session

On Thursday 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

Editorials: www.biomedcentral.com/collections/night-science

Podcast: nightscience.buzzsprout.com (with links to spotify etc.)

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/1DTUiYwWXYbpJTxQKZoIR5yxK2kp0S7MrFGCz0UnBhfl/>

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/1CGMEjX5DAw2vmYYi0IH-PkMi-4wDPMgXN1wAvhkDFoY/>

Contacts

Course web site

<https://principlescellphysiology.org/summer-school-2025/>

Venue

University of Vienna, main building, [HS 21 \(Lecture Room 21\)](#)

Contacts for questions during the summer school

Diana Széliová (diana.szeliova@univie.ac.at)

Jürgen Zanghellini (juergen.zanghellini@univie.ac.at)

Contact for questions regarding registration

Asja Hocevar (asja.hocevar@univie.ac.at)

Organising committee:

Diana Széliová (diana.szeliova@univie.ac.at)

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Wolfram Liebermeister (wolfram.liebermeister@inrae.fr)



Follow us on bluesky : <https://bsky.app/profile/economic-cell.bsky.social>

General information

General information about the course

can be found on our website: <https://principlescellphysiology.org/summer-school-2025/>

Course materials

Lecture notes and slides will be made available after the school on the course web site.

Textbook

The course is based on a **collaborative open-access textbook** on economic principles in cellular physiology. For details about the book project, and access to the current release (July 2025), see <https://principlescellphysiology.org/book-economic-principles/>.

If you would like to join us in writing the book, please get in touch! (Contact: Wolfram Liebermeister, wolfram.liebermeister@gmail.com)

Monthly zoom seminar and young scholars group

If you are interested in the topic 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

Lectures (but not the other activities) will be held in a hybrid format using zoom.

Before the course.

To participate online, please register here to obtain a zoom link valid for all the lectures:

<https://univiennea.zoom.us/joining/register/JLuUA2ecTKy3u8RoAe5Ibw>

After registering, you will receive a confirmation email containing information about joining the meeting.

During the course

During the lectures, please keep your camera off and mute your mike at all times. If you have questions, please write them in the chat. Each lecture has a chat moderator. During the Q&A session after the course, the moderator invites online participants to pose their question to the teacher.

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). If there are technical problems that may also concern everyone else, please tell us about them in the zoom chat.

After the course

Please participate in the course evaluation (see below).

Information for on-site participants

Before the course: register as an external student. Students who are not enrolled at the University of Vienna may apply as external students. By registering, they will receive the following services during the summer school “Economic Principles in Cell Biology”:

- **Access to all IT services** of the University of Vienna (u:space, Moodle, Wi-Fi...)
- **Grading** as part of the course set up for your summer school
- **Official transcript of records** (for credit recognition of earned ECTS at their home university)

Posters. On-site participants are invited to bring posters about their own research. The poster session takes place on Wednesday, July 23.

During the course. If you do not want to appear on photos (to be published on the web), please let us know in advance or at the beginning of the course.

Laptops. Please bring your laptop or tablet for the computer exercises sessions. Only a few laptops can be provided by the organizers.

Access to wifi, servers, moodle. As a registered external student, you get access to all IT services of the University of Vienna (u:space, Moodle, Wi-Fi...). For details, see <https://epcp.univie.ac.at/univie-summer-school/univie-summerwinter-schools/>

Credit points As a registered external student, you get access to the official transcript of records (for credit recognition of earned ECTS at your home university). For details, see <https://epcp.univie.ac.at/univie-summer-school/univie-summerwinter-schools/>.

After the course. Please participate in the course evaluation (see above, under “Please give us your feedback”).

Travel Information

Venue

The summer school will take place in [HS 21 \(Lecture Room 21\)](#) at the Main Building of the [University of Vienna](#), [Universitätsring 1](#), 1010 Wien.

Venue location: [Main Building Map \(PDF\)](#)

Getting to Vienna by Train

Vienna is well connected to the international railway network. Major train stations include

- [Wien Hauptbahnhof \(Vienna Main Station\)](#)
- [Wien Mitte / Landstraße](#)

From either station, you can easily reach the University via underground lines, trams, or buses.

Directions to the University of Vienna

From Wien Hauptbahnhof Take U1 (direction Leopoldau) → Change at Karlsplatz to U2 (direction Seestadt) → Get off at Schottentor-Universität (*approx. 15 minutes*)

From Wien Mitte / Landstraße Take U4 (direction Heiligenstadt) → Change at Schottenring to U2 (direction Karlsplatz) → Get off at Schottentor-Universität (*approx. 10 minutes*)

From Praterstern Take U2 (direction Karlsplatz) → Get off at Schottentor-Universität

From Vienna International Airport (VIE)

Option 1: Vienna Airport to Vienna Main Station (Wien Hauptbahnhof)

ÖBB Railjet

- Daily service from 6:33 am to 12:02 am (every 30 minutes)
- [Schedule and tickets](#)

Option 2: Vienna Airport to Wien Mitte / Praterstern

S-Bahn (S7) – Rapid transit railway

- Daily service from 4:49 am to 1:19 am (every 30 minutes)
- [Schedule and tickets](#)

Option 3: Vienna Airport to Wien Mitte

City Airport Train (CAT) – *Non-stop service (but more expensive)*

- Daily service from 6:07 am to 11:37 pm (every 30 minutes)
- [CAT Schedule and tickets](#)

Getting around Vienna

Public Transport

Vienna has an excellent public transport system including subways, trams, and buses. Tickets and travel cards and special visitor cards are available:

- At ticket machines in subway stations
- Online
- [WienMobil app](#) (also useful for route planning)
- At the airport and most hotels (e.g., Vienna Card)
- More information: [Wiener Linien – Public Transport](#)

By Bike / On Foot

Vienna is (somewhat) [bike-friendly](#) and definitely a walkable city, with well-marked bike paths and pedestrian zones. It's a great way to explore Vienna's historic and cultural landmarks. If you download the [WienMobil app](#), you can use the discount code **KULTUR25** to get two free 30-minute rides on the [city bikes](#).