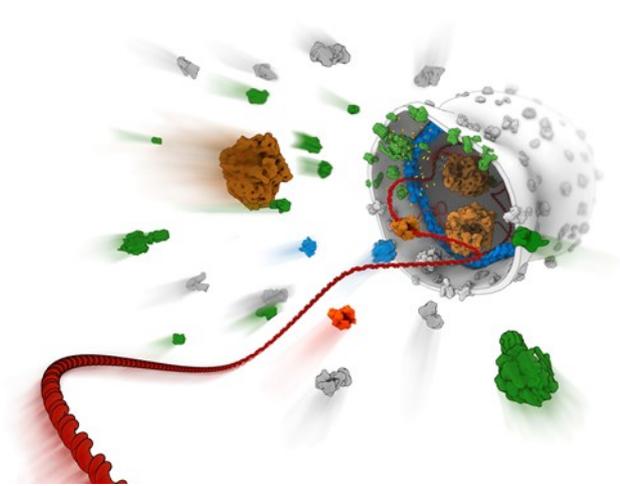


# 15 PhD/Postdoc positions: Building a Synthetic Cell

We are looking for 15 talented PhD students and postdocs with background in biology, chemistry and engineering, with whom we would like to embark on the formidable challenge of building a synthetic cell.

We will combine biomolecular building blocks to create an autonomous self-reproducing cell - a synthetic cell that can sustain itself, grow, replicate and divide. Our efforts are part of a bigger national initiative, the [NWO Gravitation Program BaSyC](#).



One of the following six professors from the [Groningen Biomolecular Sciences and Biotechnology Institute](#) at the University of Groningen (ranked at position 59 in the latest Shanghai ranking) will be your advisor:



Prof. Bert Poolman  
ERC Advanced Grant,  
NWO TOP grant



Prof. Giovanni Maglia  
ERC Consolidator Grant



Prof. Arnold Driessen  
NWO TOP grants



Prof. Matthias Heinemann  
VIDI grant, DuPont Young  
professor award



Prof. Siewert-Jan Marrink  
ERC Advanced Grant



Prof. Dirk-Jan Slotboom  
ERC Starting Grant  
VIDI grant

## We are looking for:

- excellence,
- enthusiasm,
- team players,
- commitment for research and science,
- with a background in the area of bioengineering, biochemistry, biophysics, multiscale modeling, (computational) systems biology, synthetic biology, ....

## What we can offer:

- a great team of scientists,
- excellent mentoring and career support,
- work on a joint endeavor, with room for also individual excellence,
- state-of-the-art research facilities.

The 15 PhD and Postdoc positions are available for both computational and experimental research:

- to develop computational models at different levels of complexity with the aim to generate a feasible design of the synthetic cell,

- to experimentally reconstruct metabolism for cell fuelling, with the ability to produce energy carriers and molecular building blocks,
- to build pathways that are responsible for the biosynthesis of lipids and macromolecules and integrate these pathways into a synthetic cell.

### **Application deadline: January 7<sup>th</sup>, 2018**

To apply, send your application to [BaSyC@rug.nl](mailto:BaSyC@rug.nl). The application should contain a CV including a brief description of your research interests and accomplishments, and two letters of recommendation from former advisors/professors. Please indicate a preference for 1-2 of the respective host labs (see below). Note, that the project descriptions are just rough indications. With our excellent students, we are typically tailoring the projects to their expertise and interest.

In case we should remind you about the deadline one week before the closing date, please send us *now* an email to [BaSyC@rug.nl](mailto:BaSyC@rug.nl), with the subject “reminder”.

### **Project descriptions**

*Prof. Bert Poolman, Membrane Enzymology ([b.poolman@rug.nl](mailto:b.poolman@rug.nl))*

*Prof. Dirk-Jan Slotboom, Structural Membrane Biology ([d.j.slotboom@rug.nl](mailto:d.j.slotboom@rug.nl))*

We will design and synthesize vesicle systems for metabolic energy generation (ATP and electrochemical ion gradients) and equip them with mechanisms for cellular homeostasis (control of pH, ionic strength, redox). A further challenge will be to connect the energy conservation with ATP- and ion gradient-dependent reactions of the synthetic cells, including the uptake of sufficient nutrients and excretion of reaction products, and the synthesis of cell components. The vesicles will be equipped with fluorescence-based sensors to obtain quantitative data about the performance of the cells (fluxes, physiochemical conditions, volume). We have different project for which expertise in protein chemistry, membrane biology, microfluidics and advanced microscopy (including data analysis) is required. PhD and Post doc candidates will closely collaborate with colleagues in other teams to bridge the multidisciplinary challenges both in experimental work and theory.

*Prof. Siewert-Jan Marrink, Molecular Dynamics ([s.j.marrink@rug.nl](mailto:s.j.marrink@rug.nl))*

One project centers around cell fission, a key step in cell replication. We will use classical molecular dynamics mostly based on the Martini coarse-grain model to be able to access the large spatio-temporal scales involved. Challenges are to predict how different lipid types and membrane proteins together with the cytoskeleton can help in generating the necessary curvature gradients and drive the final fission. The second project involves developing new multiscale simulation methods to bridge the gap between individual molecules to the scale of an entire cell. In particular, we would like to combine classical molecular dynamics simulations to chemical rate equations and to Green's function reaction dynamics. This combination of techniques allows us to extrapolate from the detailed molecular interactions all the way to the system's level, providing a solid theoretical framework for the synthetic cell project.

*Prof. Matthias Heinemann, Molecular Systems Biology ([m.heinemann@rug.nl](mailto:m.heinemann@rug.nl))*

From our recent work in yeast, we know that metabolic pathway activity is separated in time during the cell division cycle. We hypothesize that such temporal metabolic separation, for instance in protein and lipid synthesis, facilitates the cell division process. In this project, we will first study this in yeast (by means of microscopy, metabolic

modeling, biophysical models) and then develop the respective 'design models' for the synthetic cell, and finally - in collaboration with the groups of Poolman and Driessen - will apply the gained insights to experimentally implement a metabolism-induced cell division. The program outlined here includes major challenges, meaning that at least two PhD students/postdocs will work on this. The specific projects can be tailored to the prior experience and interest of the candidates, which could have a background from engineering, (bio)physics or molecular biology/biochemistry.

*Prof. Arnold J Driessen, Molecular Microbiology ([a.j.m.driessen@rug.nl](mailto:a.j.m.driessen@rug.nl))*

The project aims at the design and construction of a membrane system that grows from within vesicles by using a cascade of phospholipid biosynthesis enzymes and simple precursors that will be supplied from the outside. Further, the membrane biosynthesis module will be functionally integrated with other critical modules of synthetic cells. Specifically, this concerns the system for membrane protein biogenesis that is responsible for the functional integration of newly synthesized membrane proteins (transporters, membrane bound enzymes) into the lipid bilayers, as well as the system for metabolic energy generation to satisfy the energetic requirements for membrane biogenesis and protein synthesis. Ultimately, we aim to couple membrane growth to vesicle division. The project will be carried out in close collaboration with other teams of the BaSyC program. Candidates with expertise in protein chemistry and membrane biology are preferred.

*Prof. Giovanni Maglia, Chemical Biology ([g.maglia@rug.nl](mailto:g.maglia@rug.nl))*

One of the first events of cellular life was the formation of a permeable protective barrier that allowed the communication between the cell and the environment. The aim of this project is to recreate the spark that ignited cellular life by designing, engineering and evolving molecular components that specifically control cellular communication. This will recreate in vitro the evolutionary processes that lead to the formation of the complex control of transport of nutrients in living cells. One project consists on evolving small amyloid-forming peptides to partition into a lipid membrane to recreate an ancestral membrane protein. This process will shed light on the evolutionary origin of membrane proteins and the evolution of enzymatic functions. A second project will design artificial pore-forming proteins that, in analogy to outer membrane proteins, will allow the transport of molecules across membranes. Finally, we will develop a multicomponent molecular transporter that uses chemical fuel to actively transport molecules across a phospholipid membrane.

These projects are ideally suited to scientist that have interest / experience in molecular biology, protein chemistry, protein engineering and (membrane) biophysics

More information about our research institute:

[www.rug.nl/gbb](http://www.rug.nl/gbb)

More information about Groningen:

<http://www.rug.nl/about-us/who-are-we/discover-groningen/>

