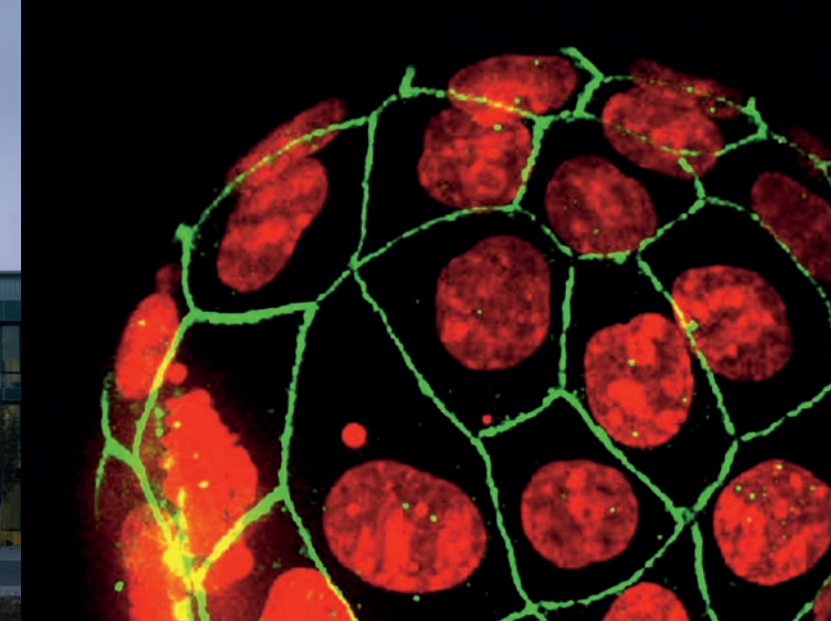




The Max Planck Society



Institute – Facts & Figures



Innovative research topics, attractive working conditions and an open philosophy allowing top researchers great freedom in their research – with this concept the Max Planck Society has gained a secure place among the world’s top research institutes.

A strong community

All together, 80 institutes with more than 16,000 employees make up this independent, non-governmental research organization. Whether in the field of natural sciences, life sciences, or in the social sciences and humanities, all institutes pursue basic research for the good of the public.

A broad spectrum

Like the Max Planck Institute for Molecular Biomedicine, every institute in the Society is dedicated to a specific research area. The spectrum of topics encompassed by the Society ranges from A, as in Astrophysics, and D, as in Developmental Biology, to P, as in Private Law, and Z, as in Zebrafish Chronology.

International success

A number of Max Planck scientists have received prestigious national and international awards since the foundation of the Society in 1948. It is no wonder that it is often likened to a “Nobel Prize factory”: Since its foundation, 17 Max Planck Society scientists have been awarded the coveted prize in Stockholm.

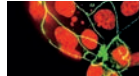
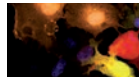
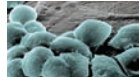
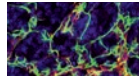
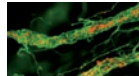
Founded: in 2001; assumed its present name in 2004.

International team: A total of more than 270 researchers – including biologists, physicians and physicists – and support staff from 30 countries are currently working here.

Structure: The Institute consists of three departments and a further ten research groups. Each department is headed by a director, who is autonomous in his research activity. The position of Managing Director of the Institute rotates among the directors.

Closely linked: All three Institute directors are members of the medical faculty of the University of Münster and hold a professorship there.

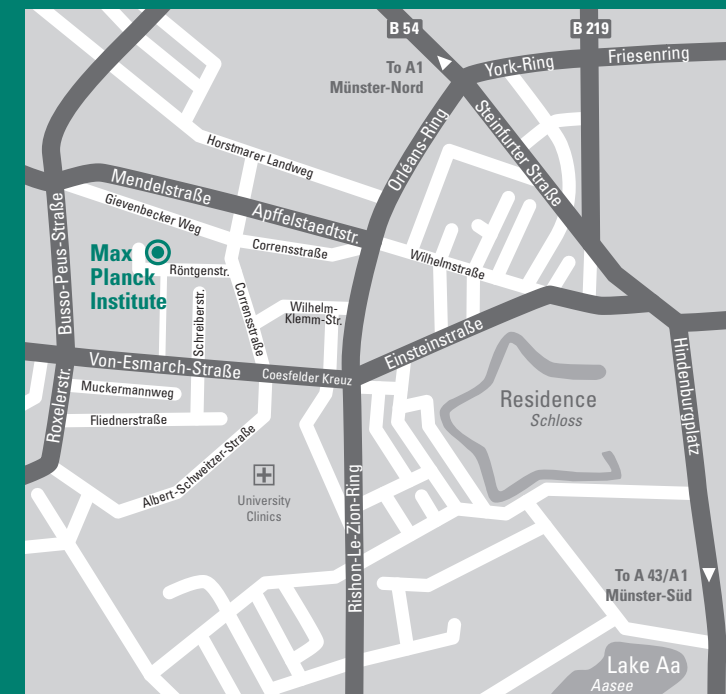
Captions

-  At the beginning of life: Mouse embryo in the blastocyst stage (red: cell nuclei; green: cell-cell junctions)
-  Glowing cells in action: Using modern techniques, cells can be marked with fluorescent proteins, so that their fate can be followed in the living organism.
-  Jacks-of-all-trades under the electron microscope: Colony of mouse embryonic stem cells (light-blue)
-  Complex network: Intact blood vessels (here: in connective tissue, blue) are completely lined by endothelial cells (red) and wrapped by pericytes (green).
-  The hunt for microbes: Inflamed tissue, in which the immune cells (red) migrate through the blood vessels (green) to the source of the infection.

Photos: building Max Planck Institute Münster: Christian Richters, Münster; building Max Planck Society: MPG/Wolfgang Filser
Map: © Max Planck Institute Münster | Revised: January 2013

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Max Planck Institute
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Expedition into the wonder world of the cell



Yet they do
transform themselves...



How lifelines find their way



When the immune system comes to the rescue

Department of Cell and Developmental Biology Professor Hans Robert Schöler, PhD

It is hardly visible to the naked eye, yet it contains everything it takes to form a complete organism. The average human cell is only a few micrometers in size. And, the average adult human being is made up of more than 50 billion cells, which work together to ensure that we can see and walk, fight disease and even think about ourselves.

But how can an entire human being develop from a fertilized egg cell? How do the cells of an embryo “know” when and exactly where they are supposed to form blood vessels, nerves, or muscles? And what tricks do immune cells use to migrate from the blood vessels into the infected tissue – although the blood vessels comprise a closed system?

The **Max Planck Institute for Molecular Biomedicine** strives to solve these riddles. Using gene technology, molecular biology as well as electron and laser microscopy, researchers investigate how cells exchange information, which molecules regulate their behavior and which crosstalk errors between cells lead to diseases like cancer and multiple sclerosis.

The focus of our work is on basic research. However, Institute scientists collaborate closely with physicians at the nearby University of Münster – so that the insights gained in the labs of the Max Planck researchers can be rapidly applied to clinics to benefit patients.

Until just a few years ago everything seemed clear: With the birth of a human being, the organism reaches a point of no return. Whether skin or hair, fat or blood – no differentiated cell of the body – so one thought – can ever become different from what it is.

But this dogma has been toppled from its pedestal. Initial studies have shown that mature body cells can in fact be transformed into jacks-of-all-trades, similar to embryonic stem cells. Like these, the reprogrammed cells have a fascinating capability called pluripotency: They are able to transform themselves into more than 200 types of body cells. Much hope has been placed in these cells, as it may be possible to treat incurable diseases like Parkinson's or diabetes using the patient's own healthy replacement cells.

But, how is pluripotency established? Hans Schöler and his team have made good progress in answering this question. The researchers were able to show that a gene called Oct4 plays a key role. Normally it is only expressed in two kinds of cells which are completely undeveloped: embryonic stem cells and egg and sperm cells (gametes). By contrast, in all mature cells Oct4 is in a Sleeping Beauty-like state. If we want to transform them into pluripotent cells, Oct4 has to be specifically activated.

Today we already have several techniques at our disposal. However, none of them have yet proved optimal. Max Planck researchers are therefore striving to develop methods with which the reprogramming can take place in a more targeted way and with as few adverse effects as possible for the cells.

Department of Tissue Morphogenesis Professor Ralf Heinrich Adams, PhD

If devised by an engineer, such a perfect system would set a Guinness World Record: A hundred thousand times a day – more than 36 million times a year – our heart pumps blood through a 90,000 kilometer-long network of blood vessels and minute capillaries. It supplies every organ in the body with life-sustaining oxygen and nutrients.

However, the mechanisms controlling the formation of this complex network are not completely understood. Not only is angiogenesis essential for the formation of organs during embryonic development, it also plays a role in pathological processes, such as the growth of tumors and metastases.

Ralf Adams and his team seek to elucidate which molecular signals regulate these processes – both in the healthy and the diseased organism. Research has revealed that there is no single command center for generating organs and tissue. Rather, their development occurs in a series of processes which build on each other and in which the involved cells are in continual crosstalk with their surroundings.

Adams and his team just recently discovered a vitally important molecule which mediates such crosstalk: Only when specific membrane cells of the capillaries express the protein ephrin-B2 on their surface can the cells connect firmly enough with the new sprouting vascular tubes to make these functional. Studies on mice have shown that if this molecule is lacking, the organism dies shortly after birth.

Department of Vascular Cell Biology Professor Dietmar Vestweber, PhD

One heedless moment, a stabbing pain – and you've got a rusty nail in your finger. Now your immune system must rush to respond and stop the rapidly proliferating microbes from causing serious infection. As fast as possible, your immune cells must recognize that they have to leave the vascular system and migrate from your blood into the injured tissue to destroy the pathogens.

To achieve this, the immune cells carry out a particularly sophisticated 'dragnet search', as Dietmar Vestweber and his team discovered. Wherever inflammation occurs in the body, the inner cell lining of the blood vessels – the endothelium – changes. Suddenly proteins otherwise not found there appear on the surface. And these proteins are what the immune cells target: As soon as they come into contact with them, they stick so tightly to them that they cannot be washed away in the rapidly flowing blood.

The researchers are also beginning to understand how immune cells migrate through the endothelium to reach the source of the inflammation. Findings of Max Planck scientists indicate that endothelial cells, in order to facilitate immune cell migration, open and shut the specific junctions connecting them in Velcro-like interactions. The immune cells supply the code for this: Once they dock, the endothelium starts the opening process. In future studies, researchers want to elucidate how the body regulates this process. One thing is certain: If inflammation processes get out of control, as in rheumatoid arthritis and multiple sclerosis, even healthy tissue is not safe from attacks by the immune cells.