



UNI
BASEL

Bachelor of Science (BSc) and Master of Science (MSc) in Nanosciences

**Studies in Nanosciences
at the University of Basel**

www.nanostudy.unibas.ch

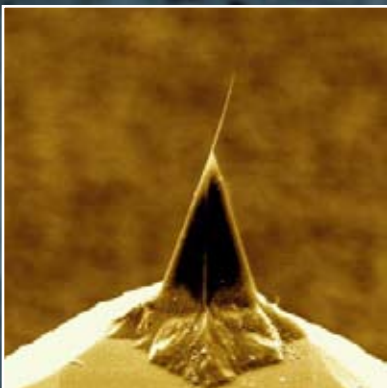
What is Nano?

What can we discover in a world where everything is millions of times smaller than a tiny ant where not even the sharpest eagle eyes can gain insight? For nanoscientists the small offers infinitely great possibilities! In this world of unimaginably small things, the world of atoms and molecules, there is an enormous potential for the future.

Approaches to the Nanoworld

The research subjects are unimaginably small. A single atom, for instance, has a diameter of only about 0.3 nm. This is less than a millionth of a millimeter and about three hundred thousand times smaller than the cross section of a human hair. This world of small things is governed by different laws than the familiar macro world.

Nanoscientists throughout the world are developing devices that are increasingly sensitive. They have learnt how to visualize single atoms and selectively arrange them. Devices allow them to observe how proteins fulfill their tasks as enzymes inside an intact cell. Very sensitive sensors can be developed that are able to measure minute chemical binding forces, masses, heat or mechanical stress. The foundation stone of this research was laid by the Nobel prize awarded for the invention of a special microscope, the scanning tunneling microscope. This microscope moves a fine measuring probe or a sensor over a surface in order to scan and sense it, producing an image of the surface topography.



A tool to scan atoms — an etched silicon tip with an attached nanotube.

Anchored in the Life Sciences

Nanosciences provide biology and medicine with new possibilities for a better understanding of the process and development of diseases. Diseases start at any time in single cells or on a molecular level. If these initial changes could be diagnosed, diseases could be recognized and treated in a much earlier stage. Medical intervention with nano-tools targeted at single cells could remedy defects very early. Physical stress to patients would be much smaller than with major surgeries that are necessary nowadays. As an additional bonus costs might be reduced drastically.

Versatile and Interdisciplinary

In Nanoscience, nature is consistently emerging as a model system. A motor that is driving a bacterium's flagellum might enable scientists in the future to construct novel types of nanomotors and machine elements that could be applied to completely different fields such as data storage.

to have a **high impact**
and thus offers **good prospects to young people.**“

Besides the use of nano components as storage media, nanoscience will exert further influence on computer technology. In the course of miniaturization, carbon nanotubes could be used in electronics. A completely novel approach is the development of a quantum computer.

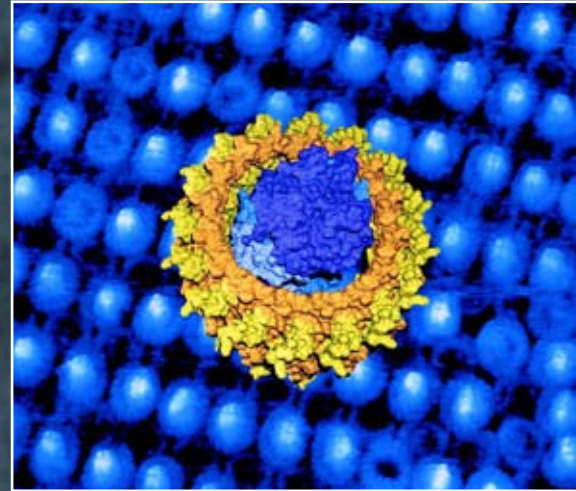
All areas of nanoscience have in common that the boundaries between classical disciplines such as biology, chemistry and physics vanish at the nanometer scale and only interdisciplinary research teams stand a chance of exploring and understanding the nanoworld.

Research in Basel

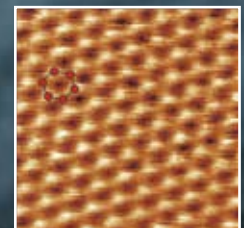
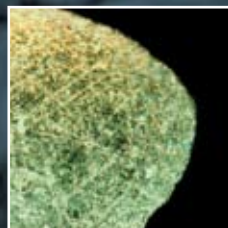
In Basel, research is concentrating on molecular machines in biology and chemistry, the manipulation and measurement of single atoms, nanorobots, quantum computers and quantum communication, as well as new nanomaterials.

Nanotechnology Today and in the Future

We already benefit from the achievements of nanotechnology without being aware of it. Non-reflecting coatings on glasses are optimized by nanotechnology, nanoparticles in suncreams provide superior protection from the sun whilst in automobiles they are used in paints with unique colour effects. Without nanotechnology the quality control of high-tech products such as integrated circuits or compact discs would be unimaginable. Time will tell what other innovations the key technologies of the 21st century will provide. Without question, there is plenty for Basel and the whole world to discover in this nanocosmos. As Nobel laureate Gerd Binnig commented: “The nano age has only just begun.”



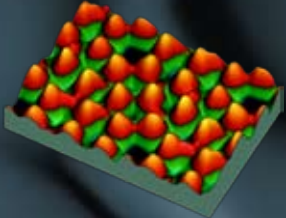
Model of a light-harvesting complex that is playing a crucial role in photosynthesis.



Magnification picture by picture: 300x

A pencil's tip with the naked eye, the light optical microscope, the scanning electron microscope and the atomic force microscope.

Nano goes Education



Silicon atoms illustrated with the help of an atomic force microscope.

Nanoscience deals with structures in the range of nanometers (1 nm = onethousandth of a millionth of a meter). In this nanoworld atoms and molecules are the protagonists and the boundaries between the classical disciplines such as biology, chemistry and physics vanish. Nanoscience is still young but is forward-looking branch of science that will strongly influence tomorrow's world. The University of Basel is the first Swiss university to provide a programme in nanosciences.

From the very beginning of studies, the interdisciplinary curriculum in nanosciences combines the three disciplines of biology, chemistry and physics into the word of nano systems. After three years a BSc with a Major in Nanosciences can be awarded. Three semesters later the degree of an MSc in Nanosciences becomes possible.

The structure of the course and conformity with the ECTS norm (European Credit Transfer and Accumulation System) enables students in nanosciences to continue their studies at another European university without interruption. Mobility within the University of Basel is also assured.

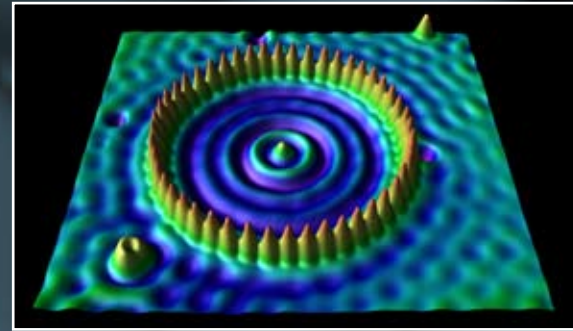
Thanks to the internationally respected interdisciplinary research tradition in Basel pioneered by the Biocentre and the Departments of Chemistry and Physics, the University of Basel has been the leading house of the National Competence Centre in Research in Nanoscience (NCCR Nano) since 2001. Basel coordinates this network of universities and industry partners. In addition to its internationally recognized research, the NCCR Nano is also actively involved in basic and higher level education, not least with the course of studies in nanosciences.

Future students interested in nanosciences are welcome to read more these studies on the website www.nanostudy.unibas.ch.



subject - now I am
doing all of them!“

Electron waves captured
inside a ring of single
atoms.



Requirements

Interest in biology, chemistry and physics
Enthusiasm to explore the nano cosmos

Studies

Bachelor of Science
with Major in
Nanosciences

Master of Science in
Nanosciences

Master of Science
in Biology,
Chemistry, Physics

Career opportunities

Basic research at universities,
research institutes and industry

Applied research in hi-tech industry

Applied research in chemical or
pharmaceutical companies

Applications and development of
nano-scientific measuring methods
and manufacturing technologies



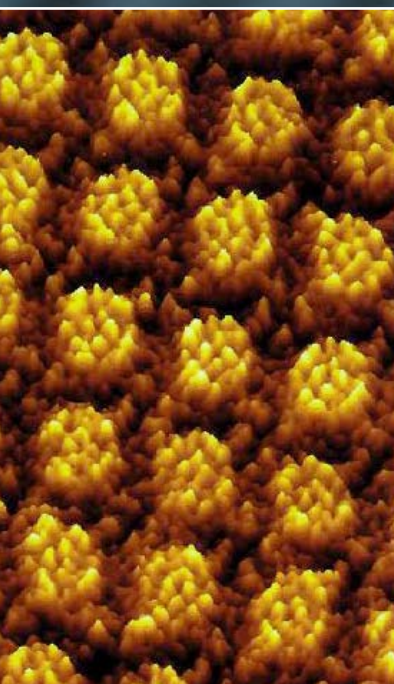
Course of Studies

Nanosciences are positioned within the main focus „Life Sciences“ of the Natural Science faculty of the University of Basel. The courses of studies in nanosciences are interdisciplinary and are focused on structures and phenomena in the nanometer range.

Basic and Advanced Studies (Bachelor of Science)

In the first instance, the Bachelor studies involve the scientific core subjects biology, chemistry, mathematics and physics as well as developing a knowledge of, and skills in current fields of nanosciences. Thanks to the large flexibility in the choice of courses, the advanced studies allow students to broaden their knowledge in all areas of nanosciences. Intensive courses provide the students with the opportunity to get experimentally involved with nanosciences.

Water canals (Aquaporins) are proteins within the cell membrane with a width of 3 nm that act as water filters. They are important in the kidneys for instance. The picture was recorded with an atomic force microscope.

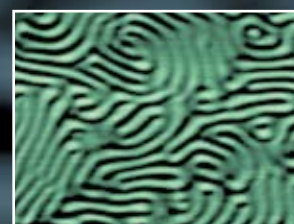


		Biology	Chemistry	Mathematics / Informatics
Basic Studies	1st Semester	Microbiology I Biology of Organisms	Chemistry I Practical (Inorganic)	Mathematics I Tools of Informatics
	2nd Semester	Cell Biology	Chemistry II	Mathematics II
Advanced Studies	3rd Semester	Biochemistry Genetics	Physical Chemistry Organic Chemistry Practical (Organic)	Mathematics III
	4th Semester	Microbiology II Structure Biology I Bioenergetics I Biophysical Chemistry Bioinformatics		
	5th Semester			
	6th Semester			

close to research, within a rapidly developing field.“

Master of Science

The MSc Program comprises two projects that introduce the students to autonomous scientific research and advanced lectures and seminars that aim to broaden knowledge in the nanosciences. The studies are concluded with a Master's thesis and a Master's examination.



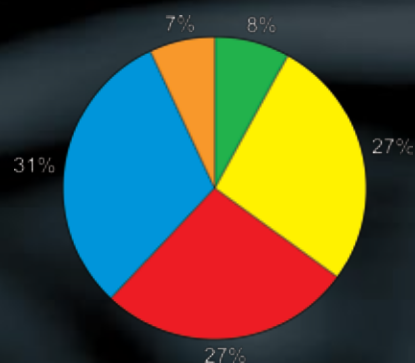
Cholesteric liquid crystals recorded with optical near field microscopy.

Doctorate

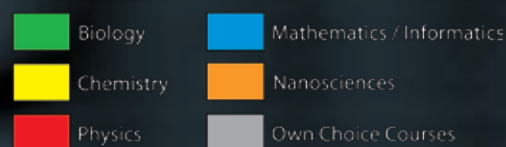
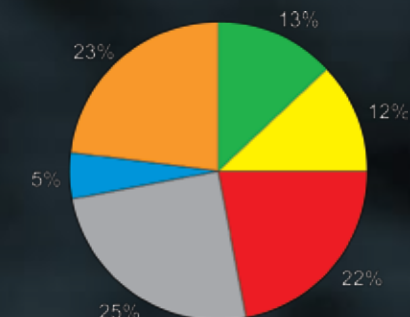
Finally the research groups dealing with nanosciences at the Biocentre and the Departments of Chemistry and Physics provide excellent opportunities for a PhD in nanosciences.

Physics	Nanoscience	Own Choice Courses
Physics I	Introduction (Nano I)	
Physics II Practical	Excursions (Nano II)	
Physics III		
Physics IV Practical	Nano III	Practical in Physical Chemistry Mathematics IV
Condensed Matter	Intensive Courses (Practicals)	Bioenergetics II Analytical Chemistry I Inorganic Chemistry I Bio-Organic Chemistry Practical in Organic Chemistry Nanophysics Quantum Mechanics
Statistical Mechanics	Intensive Courses (Practicals)	Molecular Motors Structure Biology II Analytical Chemistry II Inorganic Chemistry II Organic Synthesis Physical Chemistry II Numerics Elektrodynamics Proseminar in Experimental Physics

Basic Studies



Advanced Studies



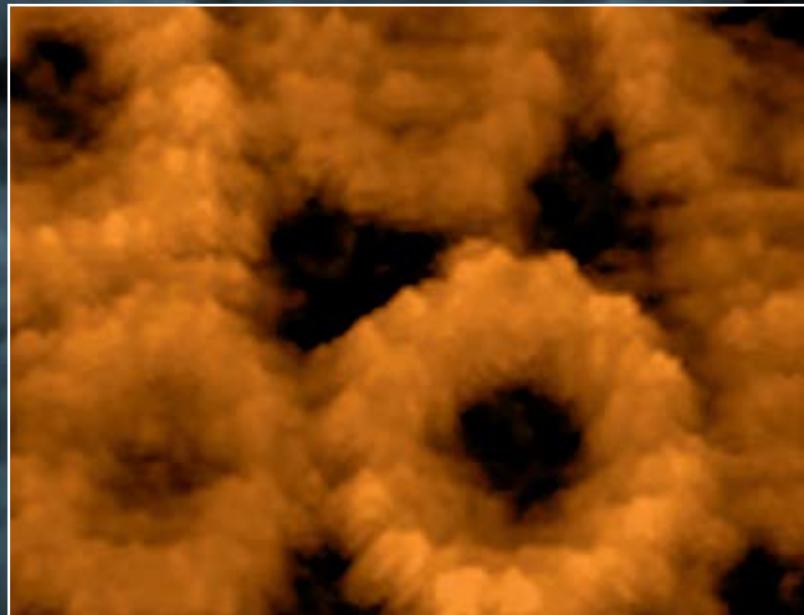
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Nano turbines working as energy suppliers of cells observed with an atomic force microscope.

www.nanostudy.unibas.ch



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