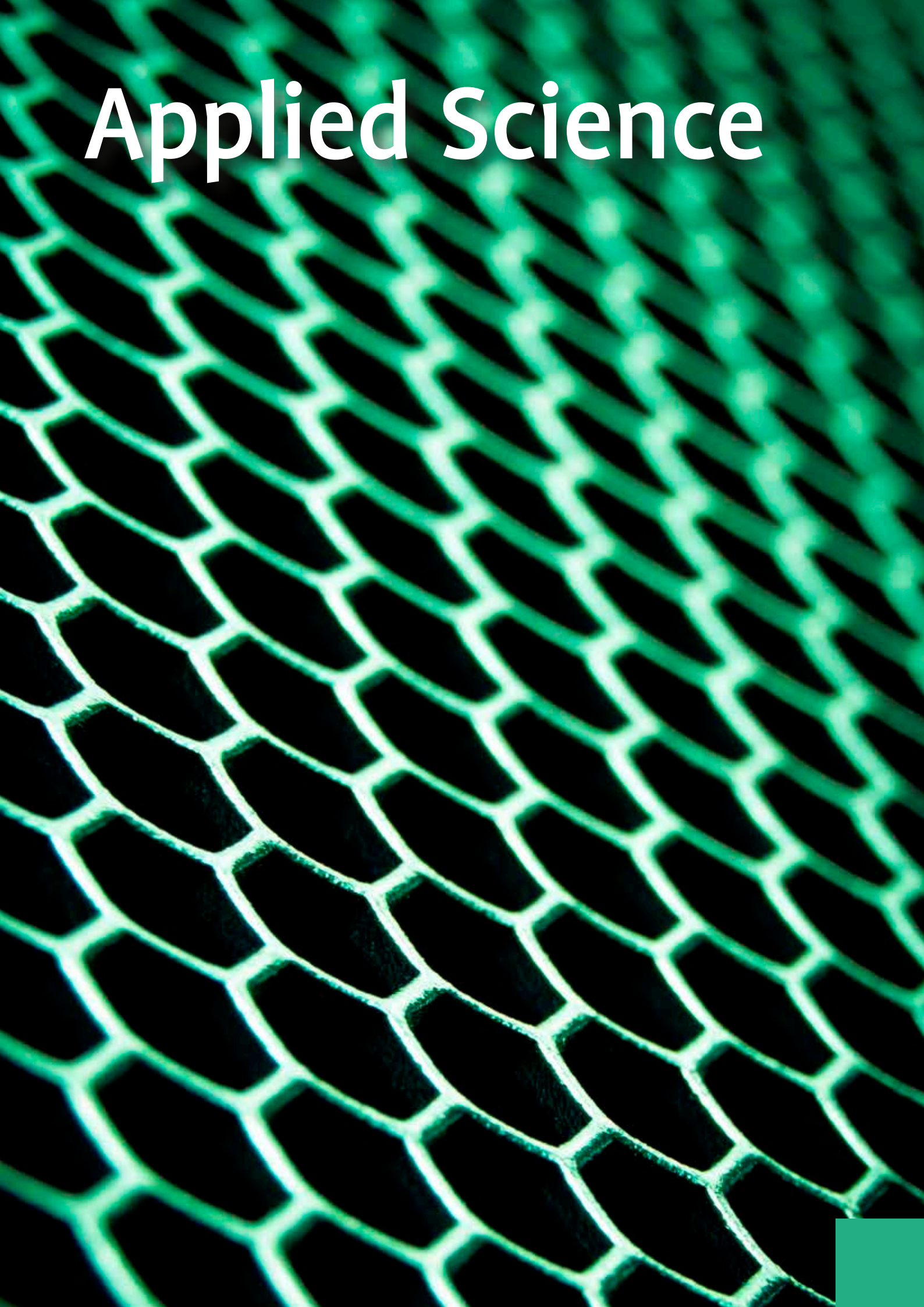
Applied Science



APPLIED SCIENCE trains students for a range of jobs, from the microbiology to the chemistry and technology fields, from researcher to analyst. Its main features are its broad orientation in the first year in the fields of biology, chemistry, materials science and technology and a wide range of graduate project places in commercial companies, the health sector, universities and research institutes.

After the first year, students choose a specialisation that best suits their interests and ambitions. These learning specialisations are variable, which means that there is also great flexibility in the professional domains in which the graduates will find employment. A lot of attention is focused on the competence of self-management during the programme because of the wide range of choices that it offers.

Institutions that offer the programme

- Fontys University of Applied Sciences, Eindhoven
- Zuyd University of Applied Sciences

National programme profile

	Competence							
	Research	Development	Experimentation	Management	Advice	Instruction	Leadership	Self-management
Minimum national attainment target adopted for the programme	**III**	**–***	**II***	**I***	**I***	**I***	**I***	**III**

* at least one of these competences must be raised one level

ILLUSTRATION OF PROFESSIONAL FIELD

Occupations, jobs and roles for graduates are mostly to be found in the following professional domains (for a full description of the professional domains, see Section 2). A few examples are given for each domain.

Research and development
- Biological laboratory research worker
- Chemical laboratory research worker
- Vaccine development
- Materials research
- Food research

Application and production
- Analytical chemist for quality control of products

Medical laboratory diagnostics
- Analyst in hospital or diagnostic centre

Engineering and manufacturing
- Process engineer

Commerce and customer service
- Patent law assistant

TYPICAL TEXTBOOKS

- *Chemistry*, J.E. McMurry. R.C. Fay e.a.
- *Organic Chemistry*, D. Klein
- *Principles of Instrumental Analysis*, D.A. Skoog, F.J. Holler e.a.
- *Campbell Biology*, L.A. Urry, M.L. Cain e.a.
- *Molecular Biology of the Cell*, B. Alberts, A. Johnson
- *Brock Biology of Microorganisms*, M.T. Madigan, K.S. Bender e.a.
- *Klinische Chemie en Hematologie voor Analisten*, E. ten Boekel, B.A. de Boer
- *Procestechnologie, delen 2, 3 en 4*, VAPRO
- *Kunststof- en Polymeerchemie*, R. van der Laan
- *Statistiek om mee te werken*, A. Buijs

The list of typical textbooks serves as an illustration to give an impression of the level at which the subject is taught in the study programme.

Applied Science

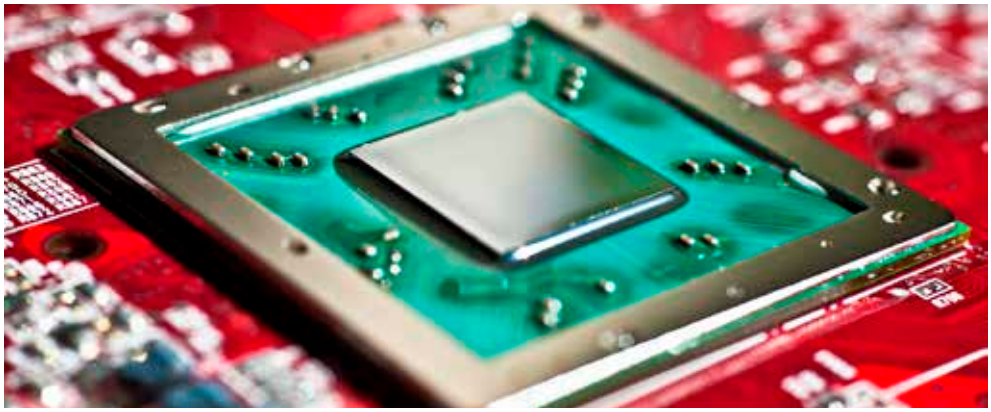
KNOWLEDGE

- **Basic chemistry:** atomic and molecular structure, hybridisation, molecular structures, molecular bonds and interactions, reaction equations, chemical balances, reaction kinetics, redox reactions, buffer solutions
- **Analytical chemistry:** spectroscopy, chromatography
- **Physical chemistry and physics:** electrochemistry, electronics, gas law, mass and energy balances
- **Organic chemistry:** synthesising functional groups, reaction mechanisms, substitution and elimination reactions, alkanes, alkenes, carboxylic acids, esters, aromatics, alcohols, ethers, alkyl halides, isomers, eniantomers, stereochemistry
- **Materials science:** monomers, polymers, biopolymers, radical polymerisation, thermal and mechanical properties
- **Statistics:** data processing, normal distribution, confidence intervals, testing
- **Mathematics:** chemical arithmetic, functions, differential calculus
- **Biochemistry:** biomolecules, DNA (structure, translation, transcription, replication), RNA, nucleic acids, proteins, cell membrane, heredity
- **Cell biology:** structure and function of eukaryotic and prokaryotic cells, cell division, metabolism, transport
- **Microbiology:** growth and classification of micro-organisms, pathogenetic mechanisms, infectious diseases
- **Health, safety and environment:** sustainability

SKILLS

- **General laboratory skills:** weighing, pipetting, making solutions (buffers), keeping a lab journal, chemical arithmetic, microscopy
- **Chemical analysis methods:** titrimetry, spectrometry (e.g. UV/VIS, IR, AAS, NMR), chromatography (e.g. GC, GC-MS, electrochemistry, enzyme analysis, bonding analysis)
- **Using standard laboratory equipment:** pH meter, spectrophotometer, centrifuge, power sources, microscope, fume cupboard
- **Laboratory techniques:** distillation, extraction, microbiological techniques
- **Safety at work:** in the laboratory and in the professional field
- **Computer skills:** word processing, spreadsheets, chemical drawing programs and presentations
- **Research skills:** problem analysis, research questions, desk research, research planning and implementation
- **Social and communication skills:** collaborating, meetings, reporting (lab journal, research report), oral presentation, project-based work, self-management

The Body of Knowledge and Skills is a summary of graduates' basic knowledge and basic skills which has been prepared by the HBO-programmes in consultation with the professional field. These are obtained during the first two years of education.



R&D engineer Esther Roeven:

‘I was given time to decide what direction to take’

Name: Esther Roeven
Age: 22
Course of study: Applied science
Place of employment: Surfix BV, Wageningen
Job: R&D engineer in surface chemistry

‘When I started my course, I found it difficult to make a choice. I knew that I wanted to do a technical course but I had no specific preference for a particular subject. The first year of the applied science programme is very wide-ranging (both biology and chemistry/technology and food); as you progress through the course you can choose between four learning pathways. Because of this, I felt I had more time to make a decision about the direction I really wanted to take.

Nano

During the first year, I discovered that I liked chemistry a lot more than biology. After that first year, I chose my subjects and projects in that discipline. During my internship at TNO in the third year, I was involved in a nanotoxicology project and found out that I liked nanotechnology much more than “bulk” chemistry. The programme offers an internal “deepening minor” in which you can carry out six pieces of research into a number of subjects of your choice for six months. I used this minor to delve further into micro- and nanotechnology and then ended up in surface chemistry, which eventually also became my graduation project.

I now work at Surfix BV, a young company within Wageningen University. We develop chemical surface modifications in the form of nanocoatings for the micro-and nanotechnology markets, in particular microchips and biosensors.

I feel that study and practice fitted seamlessly together. There was already a lot of contact with the private sector during the programme. From the first year, every project was linked to a business, which quickly gives you an idea of how things are done in businesses. At the end of the day, I think that the competences you really use will very much depend on your job. I also supervise interns and graduating students, where I regularly use the competences of **instruction | supervision | teaching | coaching** and **leadership | managing people**. The competence of **management | coordination** also comes up almost every day because I work for a young company, which still requires a lot of organisation, and I think it’s really great that I’m making a contribution. The competence of **advice | procurement and sales** sometimes comes up when materials, systems or chemicals have to be sourced and ordered.

There are certainly opportunities for advancement in the company. At present, my ambition for advancement is therefore in this company but, in the long-term, it may be in another job. We are based in the organic chemistry department of Wageningen University so I can also take subjects and courses here. I’m happy to do so!’ ■

QCT Lukas Balk:

‘There’s a reason why there are so many competences!’

‘On the prevocational course, my interest in applied science was aroused by an inspirational chemistry lecturer. Both of my parents work in education so teaching has always been in my blood. The plan was therefore to become a chemistry teacher but for that I needed at least a higher professional degree. When studying laboratory technology at senior secondary vocational level, I found that Applied science suited me; I obtained good results and it was decided that I could start the higher professional course. I wanted to gain some practical experience first and therefore decided not to start on the teacher training programme immediately but the more practice-oriented applied science programme. I wanted to study in depth what I already knew from my senior secondary specialisation (analytical chemistry) and expand my studies to include what I did not yet know (organic chemistry/process technology/material science). During my graduation project, I conducted fundamental research into the formation of nanocrystals with fluorescent properties (quantum dots) made of semiconductor materials.

As a Quality Control Technician FP, I am currently responsible for analysing pharmaceutical and nutritional finished products in the form of gel capsules (finished product: Banner Pharmacaps EU) mainly by means of HPLC and GC analysis. I am also charged with planning and delegating in the distribution of analyses and in the near future I will be providing assistance in the establishment/acquisition of new analysis techniques. The widening of knowledge that I found in the higher professional course means that I contribute to and share ideas in many different subjects. However, I do think that the programme has a very strong emphasis on research and less, fro example, on working within strict guidelines (GMP, FDA, EP, USP, etc.). Yes, a lot of people opt for research but I myself think that graduates have greater opportunities for advancement within a quality control environment than in a research environment.

Self-management

The competence of **management | coordination** plays a great part in my job. Also, as a QC technician, I do have a lot to do with **experimentation**, a little with **research** and **development**, but mostly with **self-management**. Here, we work within very strict guidelines in which almost every operation is laid down. You aren’t allowed to deviate from them and that makes self-reliance and self-management essential. As an analyst/technician, you also have to **instruct** and **train** new colleagues. There is a reason why a Bachelor of Applied Science* has such a variety of competences!

Over the next few years, I would like to progress within the QC department to a job such as senior technician and would like to concentrate on introducing new methods. After that, I would like to progress to a management position in QC/R&D or perhaps use my qualities in another company. That’s all in the distant future, but a job such as QC or R&D manager also appeals to me. And teaching is always another option.’ ■

Name: Lukas Balk
Age: 23
Course of study: Applied science
Place of employment: Banner Pharmacaps Europe, Tilburg
Job: Quality Control Technician Finished Products

* At the time of this interview, the title of Bachelor of Applied Science was used.