Chemistry

The higher professional course in CHEMISTRY leads to a job as experimental laboratory worker. The professional field of chemistry is the key element. It can be roughly divided into three major components: analytical chemistry, research into and synthesis of molecules and compounds and the development of products based on functional molecules or components.

Chemists working in research laboratories in government institutions and large companies are responsible for the practical implementation of a complete or partial research project. They develop and build experimental test setups, conduct and interpret experiments (or arrange for this to be done), draw conclusions and make recommendations. In research laboratories in the SME sector, the approach adopted is often less fundamental and more applied. In this case, the chemists tasks also include directing, organising and coordinating the work.

In other domains, including application or manufacture, the chemist is mainly employed as an experimental laboratory worker. This can be in environmental laboratories or quality control and production laboratories in the organic, biochemical and analytical fields or similar laboratories. This usually involves conducting complex and intricate experiments that challenge graduates' practical skills and analytical ability. In the manufacturing domain, chemists are involved in product development and introduction, particularly the aspects completed in the laboratory.

Institutions that offer the programme

- Avans University of Applied Sciences, Breda
- Avans University of Applied Sciences, Den Bosch
- HAN University of Applied Sciences, Nijmegen
- Hanze University of Applied Sciences, Groningen
- HU University of Applied Sciences Utrecht
- HZ University of Applied Sciences, Vlissingen
- Inholland University of Applied Sciences, Amsterdam
- NHL Stenden University of Applied Sciences, Emmen
- NHL Stenden University of Applied Sciences | VHL University of Applied Sciences, Leeuwarden
- Rotterdam University of Applied Sciences
- Saxion University of Applied Sciences, Deventer
- Saxion University of Applied Sciences, Enschede
- University of Applied Sciences Leiden
- Zuyd University of Applied Sciences, Heerlen

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
- Chemical laboratory research worker
- Product development based on functional components
- Analytical chemist
- Research into new functional molecules or compounds

Application and production
- Analytical chemist in a quality control laboratory
- Laboratory-scale production of molecules or preparations for diagnostic tests or research purposes

Engineering and manufacturing
- Developing analyses for quality control
- Research into parameters of chemical reactions or processes for upscaling

Commerce and customer service
- Safety and environmental consultant
- Sales engineer

National programme profile

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

** Students can choose to raise the level of these competences by making certain choices in their range of subjects, internship and graduation project during the last two years of their course.

Chemistry

KNOWLEDGE

- **Analytical chemistry:** spectroscopy, chromatography
- **Basic chemistry:** atomic and molecular structure, reactions in water, chemical balance
- **Biochemistry:** biomolecules, protein and enzyme chemistry
- **Physical chemistry** (e.g. electrochemistry, phase theory, colloid chemistry)
- **Information technology** (e.g. chemometrics, experimental design, simulation and design programs)
- **Physical applications** (e.g. optics, electronics)
- **Organic chemistry:** synthesising functional groups, reaction mechanisms
- **Polymer chemistry and materials science**
- **Statistics:** data processing, normal distribution, confidence intervals, testing
- **Thermodynamics and kinetics**
- **Health, safety and environment**
- **Mathematics:** chemical calculations, functions, differential and integral calculus

SKILLS

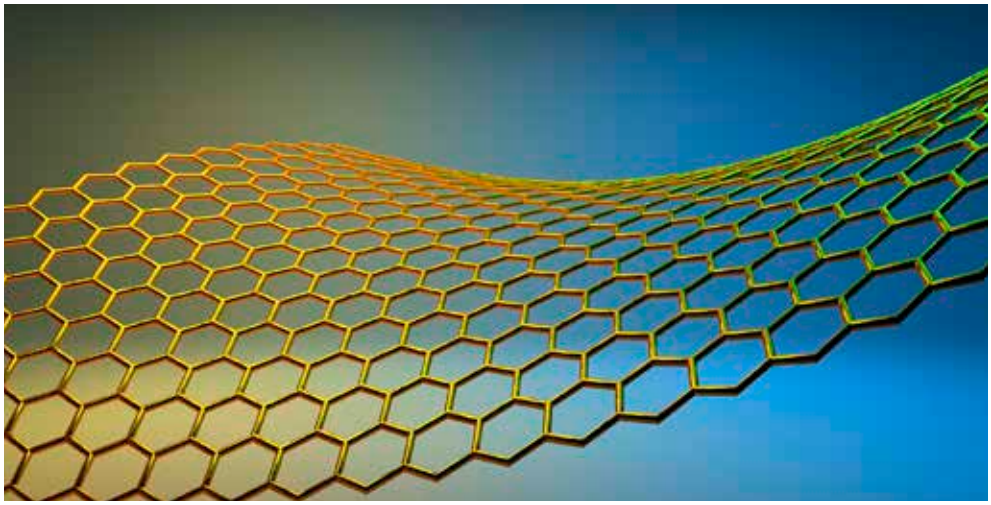
- **General laboratory skills:** weighing, pipetting, making solutions (buffers), keeping a lab journal, chemical calculations
- **Chemical analysis methods:** spectrometry (e.g. UV/VIS, IR, AAS, NMR, ICP), chromatography (e.g. GC, GC-MS, HPLC) and other methods such as titrimetry, electrochemistry, enzyme analysis, bonding analysis
- **Computer skills:** word processing, spreadsheets, chemical drawing programs, presentation techniques
- **Research skills and systematic approach to problems:** problem analysis, preparing research questions, desk research, research planning and implementation
- **Social and communication skills:** collaborating, meetings, written reporting (lab journal, research report), oral presentation, project-based work
- **Safe working in the laboratory in accordance with HSE rules**
- **Using standard laboratory equipment:** pH meter, spectrophotometer, centrifuge, power sources, electrophoretic equipment
- **Using setups for organic synthesis:** reflux, distillation, extraction, evaporators

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.

TYPICAL TEXTBOOKS

- *Chemistry*, J.E. McMurry. R.C. Fay e.a.
- *Campbell Biology*, L.A. Urry, M.L. Cain e.a.
- Elements of Physical Chemistry, P. Atkins, J. de Paula
- *Organic Chemistry*, P.Y. Bruice
- *Quantitative Chemical Analysis*, D. C. Harris
- *From Polymers to Plastics*, A.K. van der Vegt
- *Principles of Instrumental Analysis*, D.A. Skoog, F.J. Holler e.a.
- *Statistics and Chemometrics for Analytical Chemistry*, J. Miller, J.C. Miller
- *Exact communiceren*, R. van der Laan
- *Wiskunde voor hoger onderwijs*, S. Kemme e.a.

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.



Support staff member Diane te Brake:

‘A lot of freedom requires self-management’

Name: Diane te Brake
Age: 21
Course of study: Chemistry
Place of employment: Wageningen University
Job: Support staff member in two Chair Groups

‘I chose this course because I had always been interested in natural sciences, especially chemistry. I also believed that chemistry was a course that devoted a lot of attention to research, with a good chance of a job at the end of it. Did the course ultimately meet my expectations? Yes and no. Attending Open Days and Orientation Days does give you a reasonable picture of what the programme involves in advance. But when I actually started on my chemistry programme, I had not been expecting it to contain so many different subjects within it. To that extent, it was a surprise. That’s the time when you really notice how much you still have to learn and how many directions you can go in. I eventually started specialising in nanotechnology because it was a challenging and relatively new subject involving a multidisciplinary approach. Then you’re no longer just a chemist – as a nanotechnologist, you also learn to communicate and cooperate with other disciplines and have to start working with biologists and physicists, for example. That’s why I also chose nanotechnology for my graduation project.

I now work at Wageningen University and have a support role in the two Chair Groups, Physical Chemistry and Colloid Science and Bio-device NanoTechnology. My work is extremely varied. The support I provide is mainly in the area of organic syntheses. Another important task for me is assisting in the first year practical education programme. Of course, I didn’t have much teaching experience in the beginning but I fortunately managed to pick it up quickly. I also feel that the programme and my job fit seamlessly together. Aspects such as setting up experiments and carrying out desk research frequently came up during the programme.

Growth

When I look back on the competences I learned from my programme, I can say that – because of the great diversity of my work – several competences are relevant to me. This applies in particular to the competences of **self-management** and **instruction**. Self-management because I have a lot of freedom in scheduling work and instruction because I use this competence to provide explanations to a group of students.
I see a lot of opportunities for growth in my current job. I can also take courses within the university, which organises a lot of lectures; I also find group discussions with debates very instructive.’ ■

Chemical analyst Rudy van Eekelen:
‘Real learning begins at work’

‘At secondary school, I had most fun in chemistry. I didn’t know exactly what I wanted to do, so I just chose my strongest subject. I did a higher professional course in chemistry which, in retrospect, was a good decision. Fortunately, I still had a number of demanding teachers on that course as I’m afraid that standards are slipping at secondary level and therefore also at higher professional level.
My choice of graduation project was mostly dictated by the fact that I wanted to learn something new and use technologies that I hadn’t seen at school. At Philips I was given the opportunity to set up **liquid XRF** at the Materials & Analysis lab in Eindhoven.

I was taken on by Philips to carry out wet chemical analyses, especially titrimetric and ICP determinations. Because the workload was too low for me, I got myself transferred to another group in the department. I now do XRF, micro XRF and glass property determinations. I am responsible for and specialise in the micro XRF system that was purchased a year and a half ago.

New technologies
I think a chemistry programme provides you with a relatively small foundation of knowledge. Because real learning only begins when you start work. In my case, the programme did not fit so well with the job that I eventually did, because most of the technologies I needed for my work did not feature in the programme. That’s understandable, as it’s just too expensive for a higher professional establishment to maintain technologies such as ICP (due to the high cost of argon consumption. However, learning how to write reports and network has actually been very useful in the professional field.

‘Competences’ are hardly ever used in my job. I do of course do a lot of **research** and **experimentation**, especially with establishing new measurement methodologies on the new micro XRF system. I am, to a great extent, allowed to decide for myself the working methods to use. I get help from colleagues who have a wealth of experience of the department’s commonly used working methods.

So long as I can continue to grow and learn, I am doing really well in my current job. I have agreed with my manager that the intention is for me to move on to a new and/or more senior job within six years. I’ve set my sights high!’ ■

Name: Rudy van Eekelen
Age: 24
Course of study: Chemistry
Place of employment: Philips
Job: Chemical analyst

XRF is a non-destructive, rapid quantitative analysis method for all the elements in the periodic table, from boron to uranium.