juelich_horizons

Supporting Young Talent at Forschungszentrum Jülich
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Dear Readers,

I take pleasure in introducing this brochure as the topic is one that is particularly important here at Forschungszentrum Jülich: supporting young talent. We aim to awaken scientific interest at all stages of education. By establishing the concept of “juelich_horizons”, Forschungszentrum Jülich has made a wide variety of options available: from projects for school students to vocational training at a later stage, right up to programmes for doctoral researchers and postdocs.

Our employees across all institutes and the administration stand behind the concept: Scientists explain their research to school students, teach vocational trainees how to work in the laboratory, and create programmes for doctoral researchers. Qualified personnel in administration ensure that the framework conditions are attractive and also offer vocational training in certain professions. In many cases, such commitment demands a lot of time and often goes beyond normal working hours.

For this reason, we can be even prouder of the statistics: some 4,500 children and young adults come to Forschungszentrum Jülich every year; around 350 trainees in more than 20 different occupations; more than 900 doctoral researchers; and around 300 postdocs – an excellent foundation for future expansion.

I hope you enjoy reading about all that Jülich has to offer!

W. Clauser
Chairman of the Board of Directors, Forschungszentrum Jülich
juelich_horizons

With juelich_horizons, Forschungszentrum Jülich offers diverse opportunities at all stages of education. The aim is to ensure excellence at all stages of education and career, as well as to compete internationally in attracting the brightest minds. As a multiprogrammatic research establishment, Forschungszentrum Jülich benefits from unique dynamics at the multifaceted interface to partners in science, industry, and funding organizations. And budding young scientists also benefit from this.

A range of activities fosters and encourages young talent. Jülich’s umbrella concept encompasses four areas: juelich_impulse targets children and young people, from kindergarten children to all types of schools; juelich_tracks is aimed at young adults during vocational training and at the beginning of their careers; juelich_chances addresses students and graduates; and juelich_heads is intended for early-career scientists at postdoc level.
Arousing enthusiasm for science in children and young people:
Every year, about 4,500 children and teenagers visit Forschungszentrum Jülich. With their school classes, they experience the fascination of science in the institutes or at Jülich’s Schools Laboratory, JuLab.

On top of this, every year another 320 school students get their first taste of working life on campus, coming to Forschungszentrum Jülich’s institutes and infrastructure divisions for work experience. Different initiatives like Girls’ Day and the collaboration with the local girls’ secondary school aim to interest girls in the STEM subjects – science, technology, engineering, and mathematics.

Forschungszentrum Jülich also hosts the regional heat of the annual “Jugend forscht” competition for young researchers and runs programmes during the school holidays for talented children and teenagers.

In future, Jülich intends to offer more for children in kindergarten and primary school. Even at their very young age, toddlers and preschool children are developing mathematical and scientific competences that should be encouraged right from the beginning.

For this reason, the planned childcare centre is being designed as a module in Jülich’s educational concept. It will draw upon the educational and didactic concept of the “Haus der kleinen Forscher” Foundation.

Another important period in young people’s education is the time when they choose a career. With the aim of “identifying talents and supporting career decisions”, Forschungszentrum Jülich has initiated several projects to assist young people in their career choices. School students in grades 8 to 10, as well as those in grades 10 to 12/13, with a keen interest in STEM subjects benefit from these projects.

JuLab, the Vocational Training Centre, and the institutes work together to familiarize these young people with the subject matter of scientific professions and their relevance. Jülich recently introduced a new career-choice concept involving flexible work placements (“JuBoP”). These work placements can last from a few days to several weeks and can be structured to take place in parallel with school lessons or in one stretch. They provide insights into professional life in general as well into a specific professional field. Regardless of which form of work experience is chosen, all work placements involve career counselling and training in applying for jobs (preparation for aptitude tests and tips for interviews).
Experiments for school students

Younger children learn about a topic using their senses; older school students solve specific problems

Forschungszentrum Jülich offers something special for children, teenagers, and even teachers: the JuLab Schools Laboratory. The facility has state-of-the-art equipment designed for experiments in physics, engineering, chemistry, and biology. JuLab is for school children of almost all ages, from primary school right up to those in their final year. The activities are rooted in the research conducted at Jülich.

“At just before taking off in a plane, you will now receive some safety instructions from me. These are important so that we can work well together, and do so safely.” Marcel Weckbecker, head of the biology laboratory at JuLab, instructs a group of senior school students from a secondary school in nearby Heinsberg. He and his team will supervise the students throughout this day of experiments. Adhering to the safety and protection measures is part of the day, just like recording the various phases during the experiments. In this way, the students will obtain an authentic impression of scientific work in a STEM laboratory. Today’s biology course is concerned with the questions of how much ethanol yeast can produce from different kinds of sugar, and what, at the end of the day, is the most economically attractive production method. Experiments have been set up on several benches, around which groups of four gather. Materials for the experiments have also been placed on the benches: sugar, yeast, equipment. The different groups have different types of sugar: glucose, fructose, and sucrose. The adolescents set to work with a will. They handle the equipment with ease; it’s obvious that they’re not working in the laboratory for the first time. Their school has an ongoing cooperation with Julab, and they are regular visitors here.

The experimental phases take up quite a bit of time and the students record them in between the attractively presented experimental procedures. This way,
“You wish it could be like that at school.”

the students can take their own laboratory logbooks home with them and later reconstruct the experiments and results from the documentation.

When all the groups are finished, they compare their results. It quickly becomes clear with which sugar the yeast produces the most ethanol: it is glucose. From an economical point of view, however, it is sucrose – ordinary table sugar – which is the favourite. This example shows the students how questions are approached in bioeconomy – an issue which they also discussed with the scientists during a guided tour of an institute they were given today.

Activities for all ages

Most activities at JuLab are visits from school classes who spend a whole day conducting research on one of Jülich’s topics. But another focus is cooperation with schools: several schools in the region regularly send selected students to the schools laboratory. Other events include research activities and blocks of work experience during the school holidays as well as training for preschool and primary school teachers, probationary teachers, and secondary school teachers.

All in all, JuLab has days of experiments for children at primary school level right up to students at senior secondary school level. The scientific topics are didactically prepared. “A good example is soil. Simple experiments help young children learn about soil using their senses,” says Karl Sobotta, head of JuLab. “They investigate what soil is made of, for example, what it smells like, and how much water it can store. Older children, in contrast, focus on a particular aspect of soil and try to answer questions such as the impact of acid rain on iron in soil.” The answer here is that acid rain is critical

Types of schools

In 2015, 4,500 school students came to JuLab. This comprised approx. 55 % girls and 45 % boys. They attended the following types of schools:

<table>
<thead>
<tr>
<th>Secondary school</th>
<th>145</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary school</td>
<td>19</td>
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Formats

<table>
<thead>
<tr>
<th>Experimental Lab Days</th>
<th>164</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer Schools</td>
<td>8</td>
</tr>
<tr>
<td>Special events</td>
<td>11</td>
</tr>
</tbody>
</table>
“The aims of our childcare centre include introducing children to science and technology through their play. We want them to learn to ask questions and then to discover how they can get the answers. From time to time, we invite researchers – generally, the parents of our children – to think up experiments for us. Project weeks provide an opportunity to deal more intensively with topics. One example is the course on water. The children are concerned with various questions: Where does water come from? Where does it go? What do we need it for? They then learn, for instance, that rain seeps into the soil and is taken up by plants. One experiment is measuring how much rain falls on one particular day. Another experiment shows how plants drink. The children colour water, pour it into a glass, and place a tulip in the glass. The stem of the flower then turns colour.”

Petra Jerrentrup, Purchasing and Materials Department, Forschungszentrum Jülich, chair of the association Kleine Füchse e. V.

students are generally not afraid of tackling things hands-on and getting to grips with state-of-the-art lab equipment. They turn the instruments on and test them.”

Florian Herff worked at JuLab for three years as a student assistant: together with the rest of the JuLab team he instructed student groups in the laboratory. He was studying biology and chemistry at RWTH Aachen University with the aim of becoming a teacher. He has learnt a lot from his work at JuLab. “I have learnt about interdisciplinarity and how important it is. Our experiments cover different aspects of a topic: biological, chemical, and physical. This reflects nature better than splitting things into separate topics.” In his future career as a teacher, he hopes to draw on his experience at the Schools Laboratory: “At JuLab, experiments can take several days, whereas in school they are often limited to 45 minutes. I believe that more project work should be undertaken in school. To focus on the same topic for a week is completely dif-
ferent to chemistry lessons once or twice a week. When you see how the kids here work – how independently and professionally – you wish it could be like that at school.”

The students from the secondary school in Heinsberg come to JuLab with their biology, chemistry, and maths teacher Marion Maybaum. Maybaum is impressed by JuLab: “The students enjoy it here; at the beginning of the school year, they always ask when the next trip to Jülich is.” Every year, around 56 school students (14 each from seventh to tenth grade) come to Forschungszentrum Jülich. “We select our top students because they benefit more from JuLab and this is the best way for us to encourage them. It’s also easier for these students to catch up on the work they’ve missed,” says Maybaum. “There are always more kids interested than we can actually send. For each grade, we have four dates per year.” For Maybaum, one of the main advantages is that school students can learn in a prac-

The activities offered by JuLab attract school students from all over Germany although most of them come from North Rhine-Westphalia, amongst others from the following towns and cities

<table>
<thead>
<tr>
<th>Aachen</th>
<th>Leverkusen</th>
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<tbody>
<tr>
<td>Bad Honnef</td>
<td>Mönchengladbach</td>
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<tr>
<td>Bonn</td>
<td>Monheim</td>
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<tr>
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<td>Grevenbroich</td>
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<td>Wiehl</td>
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<td>Willich</td>
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<td>Hilchenbach</td>
<td>Wuppertal</td>
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<td>Jülich</td>
<td>Zülpich</td>
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<td>Kamp-Lintfort</td>
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In JuLab Schools Laboratory, the basic concept is that young people find their own solutions by experimenting.
“Soldering, tightening screws and nuts – that’s what I enjoyed. I first came to Jülich on a career orientation placement and then after leaving school I came on other placements. The experience I gained helped me decide to take physics as an advanced course. My school had a cooperation with JuLab so we were often at Forschungszentrum Jülich with our class. We came to Jülich four times every two months. We all always looked forward to coming here. Our final project was to build a radio. We constructed the casing ourselves. We actually designed the printed circuit board on the computer, but then we were given a ready-made board. Soldering this component by hand would have involved too great a risk of error. Finally, we wired up the whole thing. I managed to locate a Dutch radio station!”

Selina Granderath-Miegel, physics student at RWTH Aachen University and student assistant at JuLab

Activities during school holidays

In addition to programmes for schools, Forschungszentrum Jülich also runs activities during the school holidays, with a dedicated programme for employees’ children. During the summer holidays, a programme is offered for children between the ages of five and twelve. The topic varies. One example is “energy detectives”. Kids learn, for example, about nature’s energy cycles and look at where energy comes from and the environmental impact of different energy conversion technologies.

One of the more recent school holiday programmes also involved planting apple trees. Six-year-old Lean­der loved every minute: “A hole was already there and we dug a bit more,” he says. “The hole mustn’t be too wide or too deep. If it’s too deep, the tree will be smaller than me! And if it’s too wide, then there won’t be enough grass around the tree.” The young boy understood the energy exchange between plants and humans well: “Apple trees need energy. They use carbon dioxide and then make air. We breathe in this air and make carbon dioxide. The trees breathe this in, and it keeps on going like this. And then we can eat the energy from the apple.”

A very different but just as exciting adventure for kids was a visit to the waste incineration plant. Here, they learnt how recycling saves energy. The group was even allowed into the main control area to watch what happens to waste. “There’s a machine and two men controlling it. The rubbish is dumped into a hole and then the arms of the machine pick it up and put it in the incinerator. If you were in there when the arms came and picked you up, you’d have a problem,” says Lean­der and shudders at the thought. “There are three
incinerators: the rubbish from hospitals goes into one flap; rubbish from industry goes into another; and the last one is for normal rubbish. I saw plastic bags from Netto and Kaufland, and a banana skin.”

Choosing a career

Even though the JuLab Schools Laboratory’s main remit is to teach children about working as a scientist, there are several overlaps with other fields of work. For example, JuLab runs career-choice programmes for 15- and 16-year-olds on topics like mobility. Working on a general research question, the teenagers immerse themselves in various professions: that of an engineer, a mechanic, or an electrician. They are given a half-finished model fuel cell car. They then have to build the bumpers and the lights. Input is needed from a range of experts who provide the school students with insights into their work as they complete the fabrication of the model car.

So far, schools from the following European countries have also come to JuLab:

- Italy
- The Netherlands
- Belgium
- Austria
- Switzerland
- France

In-service courses for teachers

A total of 784 teachers have taken part in training courses at JuLab.
“You learn by doing!”

Interview with Dr. Norbert Drewes, head of Corporate Development and father of two children aged 9 and 7. Both boys went to the “Kleine Füchse” daycare centre based in Forschungszentrum Jülich.

What age were your children when they conducted their first experiments?

Norbert Drewes: Our sons were in the toddlers’ group! For example, they made their own little compass. A paper clip was placed on a sheet of paper that was floating in a bowl of water. The paper clip then turns until it points north-south. Although the kids may not understand why this happens, they can see that something happens without any external influence. This arouses their curiosity and they wonder why this happens.

Have your children already been to JuLab?

Dr. Norbert Drewes: Our children visited JuLab with their kindergarten group. They soldered a clover leaf with four LEDs and a battery. It flashed on and off. Both of them thought this was marvellous – they took the clover leaves to bed with them! As a family, we also went to the daycare centre’s open day. My wife is a chemist, and she made gherkin batteries with the kids who were interested. You need tinfoil, a pickled gherkin, a copper coin, and headphones. A slice is cut from
the gherkin and placed on the tinfoil. A 5 cent coin is placed on top. Then, you put the headphones on and place the jack beside the gherkin slice on the tinfoil. If you move the coin until it comes into contact with the headphones jack, you can hear crackling through the headphones. When the two metals meet, electrons flow from the tinfoil through the gherkin, which functions as an electrolyte, to the copper. This flow of current is heard as cracking. You shouldn’t eat the gherkin slice afterwards though! Other parents also performed experiments with the kids; they loved it!

Children don’t understand the physical principles at that age. What do they learn from the experiments?

Dr. Norbert Drewes: They think it’s exciting to make something that has some sort of effect. When they soldered their clover leaf, for example, it was exciting being allowed to use tools themselves. It’s important that children have the confidence to try out things and learn what works and what doesn’t. At home, we always say: you learn by doing!
Vocational training and dual study programmes with prospects:
Forschungszentrum Jülich is a key, well-connected partner in the region when it comes to vocational training. Since it was established, Forschungszentrum Jülich has trained more than 4,600 young people and laid the foundation for their personal development and professional future. At the same time, this enables Jülich to satisfy its own need for motivated and highly specialized skilled employees.

At present, Jülich has around 350 trainees in 20 different occupations, most of whom are in the scientific and technical field. A special feature is the opportunity to take a joint training programme for electronics technicians for devices and systems, organized by RWTH Aachen University and Forschungszentrum Jülich as part of JARA, the Jülich Aachen Research Alliance.

In some cases, vocational training can be combined with university studies. Practical training takes place at Jülich and the academic part at a university. Currently, dual study programmes are offered in six fields: scientific programming, applied chemistry, physical, mechanical, and electrical engineering, and business administration. In cooperation with a Dutch university of applied sciences in Heerlen, trained biological and chemical laboratory technicians have the opportunity to pursue a part-time, fast-track bachelor’s degree.

There have been more training places than applicants in Germany since 2011. For Forschungszentrum Jülich, this means that it will have to intensify its efforts to attract trainees from all over Germany and abroad, and to use proactive recruitment and marketing strategies to find suitable candidates and maintain its excellent training standards. The regional training network in the Euregio, which facilitates exchange programmes with other institutions or participation in international competitions, for example, plays an important part in these endeavours. One crucial aspect for the quality of vocational training is also the continuing professional development of the instructors and supervisors. Specialized programmes aim at presenting new methods of teaching, refreshing knowledge, and developing leadership skills. Work is also in progress on developing an online course system. This will facilitate time- and location-independent learning as well as individual support.
Excellent prospects

Skilled workers trained at Forschungszentrum Jülich are much sought after

Forschungszentrum Jülich regularly employs about 350 trainees; about one third of them women. Roughly 30% of the trainees are enrolled in dual study programmes at a university. Forschungszentrum Jülich also cooperates with businesses and universities in the region in the form of training networks and contract training.

"Young people who train with us have excellent opportunities. The demand for specialists has never been so great, at least not in our region. There is a particularly great demand for specialists in electrical engineering, mechanical engineering, and information technology," says Ulrich Ivens, Head of the Vocational Training Centre at Forschungszentrum Jülich. "The labour market is changing, which is why it is increasingly difficult to find suitable trainees. Companies used to be able to pick and choose – now in many cases it’s the other way round".

A maximum of 115 new trainees are accepted each year at Jülich – from a total of about 2000 applicants. The occupations available at Jülich range from biological, physical, and chemical laboratory technicians to industrial mechanics and electronics engineers as well as office professionals and catering experts.

Trends: More heterogeneity, flat hierarchies

The trends that Ivens has observed over the years include a greater diversity of applicants. "On the one hand, there are more older applicants, but on the other hand also increasingly younger entrants who are under 18. There is also a great demand for part-time training, retraining, and entry-level work placements. The latter are placements subsidized by the Federal Employment Agency to make it easier for weaker candidates to obtain an apprenticeship. We get applica-
tions from university dropouts or people aged between 25 and 45 who want to retrain,” Ivens explains. The educational background of the candidates has also changed in the course of time. “Young people are definitely not more stupid, but they have different competence fields. They are for example very computer literate, but some of them have difficulties with communication and manners. In general, trainees now expect to be treated as equals, which is quite different from my own apprenticeship, when my instructor could be very harsh.”

Today, relations between trainees and instructors tend to be characterized by a flat hierarchy. “Our training is quite relaxed. If somebody does something wrong nobody tears a strip off them. They are just shown again how to do it properly,” says Laura Becker, a trainee electronics technician for devices and systems. The trade she is learning requires technical understanding and manual skill. Electronics technicians for devices and systems construct, maintain, and repair small devices. “One of our jobs is troubleshooting. If a device isn’t working we have to check everything. I have already looked for faults in power supply units. A power supply unit converts the mains voltage from the power socket into the voltage required by the device – for example, a laptop or a beamer. The more often you make such checks, the easier it is to detect faults. That’s pretty cool,” says Becker. The aspiring technician likes working at Jülich. “The working atmosphere is super. I’d like to stay here.”

“Demand has never been so great”

<table>
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<th>Year</th>
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<tr>
<td>2011</td>
<td>21</td>
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<td>2012</td>
<td>34</td>
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<td>2013</td>
<td>33</td>
</tr>
<tr>
<td>2014</td>
<td>31</td>
</tr>
<tr>
<td>2015</td>
<td>21</td>
</tr>
</tbody>
</table>
“During the holidays, I spent four days on a placement at Forschungszentrum Jülich. I got to know various fields of work: metal working, glass blowing, and the section for plastics and ceramics. I spent the first day in the workshop for industrial mechanics. I was given a drawing as a model and had to file a piece of metal accordingly. Then I had to blow glass balls for a Christmas tree. I was allowed to take them home, although there were a bit misshapen. Finally, in the plastics and ceramics section, I labelled plates with plastic. I enjoyed all of it, but most of all filing the metal. I will be taking my school leaving certificate next year and then I intend to apply to Jülich to train as an industrial mechanic.”

Leonie Etzel, 18 years old, school student at Gymnasium Hückelhoven

Dual study programmes

About one third of the trainees are also taking a dual study programme. In parallel to their training at Forschungszentrum Jülich, they are enrolled on a university course. At the end of the programme, they will not only have a vocational qualification but also a bachelor’s degree. Jülich is involved in a total of six dual study programmes.

One of these programmes is mathematical-technical software developer/bachelor of science in scientific programming, offered together with Aachen University of Applied Sciences, Campus Jülich. Vocational training and university studies are closely coordinated. “Every week we have lectures and the professors come to us at Jülich,” says Andreas Müller, who is enrolled in the programme. “We spend the rest of the time on practical projects in our institutes.” Trainees learn how to apply mathematical methods to scientific problems and to implement them in operating systems. “I wanted to do something maths-related but I didn’t just want to study something theoretically and soak it up like at school. Then I came across this dual study programme. In this way, I can apply in practice what I have learnt in the lectures.” Müller’s present project is part of a collaboration between the Jülich Supercomputing Centre and the scientists at the Institute of Neuroscience and Medicine. “The project is concerned with modelling the nerve fibres of a post mortem brain. My job is to calculate the angle of inclination of nerve fibres in brain slices.” Müller is already in his third year and still very enthusiastic. “I am completely satisfied. The environment here at Jülich is
### Overview of current dual study programmes:

<table>
<thead>
<tr>
<th>Programme Description</th>
<th>Total duration</th>
<th>IHK examination</th>
<th>Bachelor’s degree</th>
<th>Partner university</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor of Scientific Programming + mathematical and technical software developer (MATSE), IHK</td>
<td>3 years</td>
<td>after 3 years</td>
<td>after 6 semesters</td>
<td>Aachen University of Applied Sciences, Campus Jülich</td>
</tr>
<tr>
<td>Bachelor of Science + chemical laboratory technician, IHK</td>
<td>4 years</td>
<td>after 3 years</td>
<td>after 8 semesters</td>
<td>Aachen University of Applied Sciences, Campus Jülich</td>
</tr>
<tr>
<td>Bachelor of Engineering Physics + physical laboratory technician, IHK</td>
<td>4.5 years</td>
<td>after 3.5 years</td>
<td>after 9 semesters</td>
<td>Aachen University of Applied Sciences, Campus Jülich</td>
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<tr>
<td>Bachelor of Mechanical Engineering + industrial mechanic, IHK</td>
<td>4 years</td>
<td>after 2.5 years</td>
<td>after 6 semesters</td>
<td>Aachen University of Applied Sciences, Campus Jülich</td>
</tr>
<tr>
<td>Bachelor of Electrical Engineering + electronics technician for industrial engineering, IHK</td>
<td>4 years</td>
<td>after 2.5 years</td>
<td>after 6 semesters</td>
<td>Aachen University of Applied Sciences, Campus Jülich</td>
</tr>
<tr>
<td>Bachelor of Arts in Business Administration + office communications specialist, IHK</td>
<td>3.5 years ¹)</td>
<td>after 3 years</td>
<td>after 7 semesters</td>
<td>FOM University of Applied Sciences, Campus Cologne/Leverkusen</td>
</tr>
<tr>
<td>Bachelor of Applied Sciences, after IHK examination as biological laboratory technician</td>
<td>2 years ²)</td>
<td>2 years parallel to employment, after completion of vocational training</td>
<td></td>
<td>Hogeschool Zuyd, Campus Heerlen, Netherlands</td>
</tr>
<tr>
<td>Bachelor of Applied Sciences, after IHK examination as chemical laboratory technician</td>
<td>2 years ²)</td>
<td>2 years parallel to employment, after completion of vocational training</td>
<td></td>
<td>Hogeschool Zuyd, Campus Heerlen, Netherlands</td>
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</tbody>
</table>

¹) parallel to training, ²) parallel to employment

Vocational training as a chemical laboratory technician can be combined with studies at Aachen University of Applied Sciences, Campus Jülich.
“I am currently training part-time as an office communications specialist, that is to say 30 hours a week. I got the idea from the TEP project for part-time training, starting a career, and opening up prospects organized by a local non-profit association (Verein für Allgemeine und Berufliche Weiterbildung e. V. Alsdorf). The idea is to help parents who want to combine vocational training and looking after their family. My children are now seven and twelve years old and I would like to work in order to provide a role model for them. At 33, I’m not too old to start training. Altogether, I sent 69 applications. Getting this place at Jülich was like winning the lottery. The working time arrangements that Forschungszentrum Jülich offers me are ideal for me and the children. My friends ask me if it’s not strange going back to school. But it’s not like that at all. I’m really enjoying it.”

Melanie Plum, part-time trainee office communications specialist

The job of an industrial mechanic is to construct and service devices and apparatus. In the training workshops, the trainees first practise different machining methods such as drilling, milling, and turning on various materials. “We instruct them in a number of skills in our training project on the Stirling engine. The trainees construct the engine themselves. The manual skills they learn will stand them in good stead for the rest of their working lives,” says Turobin. “Furthermore, it is important that they first learn how to do such work by hand even if later the job is taken over by machines. They get a better understanding of the
whole process.” In the second and third year, their training includes welding, brazing, and pneumatics. The special feature of the dual study programme is that training is provided in collaboration with various commercial companies. Trainees on the programme from Forschungszentrum Jülich and from the commercial enterprises attend the same courses and each institution provides different content. For example, one company demonstrates assembly processes while another offers pneumatics courses. “In this way, they get to know everyday working life in different companies. This is the best thing that can happen to them,” Turobin adds.

In general, it can be said that: “The overriding goal is to make sure that the trainees are qualified in such a way that they can work in different fields and are capable of undertaking complex jobs,” Ivens explains. Specialists trained at Forschungszentrum Jülich can easily fulfil the demands made by industry. “Some companies even ring us up and ask whether we have any trainees that we will not be able to take on after their training. In order to accommodate this demand, we continue to train more skilled personnel than we actually need. Some local companies are our suppliers so that we are always interested in making sure there are good specialists in the region.” Forschungszentrum Jülich also offers training units for companies who do not have sufficient capacity of their own. “Small companies need their machines for production and cannot have them tied up for training purposes. This is why they send their trainees to us,” explains Ivens. “We more or less perform contract training for some companies. For example, we work with one very small company in Jülich which is a world leader in a certain segment of measuring technology and needs physics laboratory technicians and mathematical-technical software developers.”

In addition to the large proportion of former trainees who are offered employment at Forschungszentrum Jülich, the quality of the vocational training is also demonstrated in regional and national competitions. Trainees from Forschungszentrum Jülich regularly receive prizes from the various Chambers of Industry and Trade, and Chambers of Commerce. Jülich has already produced several national winners and its trainees regularly receive recognition as regional winners.
“My professional experience is characterized by my mistakes and my successes”

Thomas Muckenheim, part-time instructor for biological laboratory technicians, explains in an interview the significance of soft skills such as the ability to accept criticism and to work in a team, as well as intercultural competence.

In addition to the actual course content, soft skills also need to be imparted. What is particularly important here?

Thomas Muckenheim: It is particularly important to be well organized in the laboratory and to work conscientiously. This includes the ability to openly admit mistakes. If you make mistakes in the laboratory you must communicate this and accept criticism. If you cover up mistakes this could lead to failure of the whole project. You can cultivate the ability to accept criticism if instructors do not overreact in such situations but offer constructive assistance. It helps if you remind yourself that mistakes add to the sum total of your own experience. My professional experience is characterized by my mistakes and my successes.

What other soft skills play a part?

Thomas Muckenheim: We attach great significance to topics such as teamwork and flexibility in your field of work. Laboratory technicians usually work in teams, and in their training they are confronted with a wide range of topics in the different institutes ranging from animal experiments and molecular biology to botanical work. Furthermore, we want to provide our trainees with a comprehensive understanding of biology and also contribute to their general knowledge. The idea that modern biologists can only recognize organisms by their genetic code is not what we communicate. In practical terms, this means that we make excursions to extreme environments in which we have to function as a team and at the same time get to know the ecosystem of extreme habitats.
know special ecosystems. For example, we spend a week on the Atlantic coast of France. We go on excursions in the tidal flats, a rocky plateau where at low tide the water remains behind in little rock pools. You can find interesting organisms there such as starfish, shrimps, sea anemones, and lumpfish. The subject areas we cover on such excursions include ornithology, botany, and Atlantic ecosystems. The trainees prepare talks on these subjects and then present them to the group. We stay in a self-catering holiday cottage where we look after ourselves. We all take turns cooking and cleaning. Those on kitchen duty go shopping together and then prepare typical local meals such as mussels and mackerel. This encourages a team spirit as well as flexibility. A second similarly organized excursion takes us to the mountains of the High Tatras in Poland.

Intercultural competence is one of the other soft skills required in international teams. What projects encourage this competence?

Thomas Muckenheim: Together with the vocational college in Stolberg, we organize a stay at the marine biology research station of the University of Gothenburg: the Sven Lovén Centre Kristineberg in Sweden. This gives our trainees the opportunity to gain experience in international teams and to work on various marine biology topics. They sail out into the fjord on the research vessel and collect organisms such as jellyfish, starfish, and crustaceans, which are then kept in aquariums and studied. These topics include regeneration biology, the influence of environmental parameters, and the impacts of climate change. Our trainees live and work at the research station together with the international team of scientists. In order to prepare for their stay they attend a course on the topic including intercultural competence and they also receive foreign language instruction.

How many young people are offered employment at Forschungszentrum Jülich after completing their training?

Thomas Muckenheim: Currently, we are able to employ about 80% of the qualified trainees. The remaining 20% leave Forschungszentrum Jülich and go to other research institutions or commercial companies. A small proportion enrol in full-time university courses. After their training, the majority of the young specialists join a part-time course at Hogeschool Zuyd in Heerlen, the Netherlands. Their previous training counts as credits for the course and they are able to complete their bachelor’s degree in two years. They then have the opportunity to take up a scientific career.
University degrees and doctoral theses as a career springboard:
At Jülich, bachelor’s and master’s students and doctoral researchers are given the opportunity to work on interesting research projects at an early stage. Numerous institutes supervise students – for example as part of work placements or longer-term projects, such as the practical part of bachelor’s and master’s dissertations. Funding programmes offer international university students the opportunity to come to Jülich. Within the China Scholarship Council (CSC) programme, for example, ten to fifteen doctoral researchers or post-docs come to Forschungszentrum Jülich annually.

Every year, the RISE programme of the German Academic Exchange Service (DAAD) gives about ten students from the United States, Canada, and the United Kingdom the opportunity to come to one of Jülich’s institutes for up to three months. Courses such as the IFF Spring School, which has been running for more than 45 years, consolidate cooperations with research institutions and enable personal contacts to be established. Many of the participants return to Jülich later on in their careers.

Forschungszentrum Jülich works closely with universities in training and supervising doctoral researchers. During 2015, 908 doctoral researchers were active at Forschungszentrum Jülich, about 37 % of them women. Almost one third of all graduates are early-career scientists from abroad.

Thanks to reliable framework conditions and well-structured training programmes, the majority of the students complete their doctorate within the scheduled period. These early-career scientists benefit not only from the fact that experts in the institutes provide intensive supervision, but also that the Doctoral Committee closely monitors their research project. Graduate colleges and schools also offer subject-specific training as well as training in soft skills.

Almost all doctoral researchers at Jülich working in the field of energy and environment are enrolled in the programme of the Helmholtz graduate school HITEC – Helmholtz Interdisciplinary Doctoral Training in Energy and Climate Research. The school provides both scientific training and also workshops, for example, on presentation techniques and writing scientific texts.

The international Helmholtz Research School of Biophysics and Soft Matter (BioSoft), on the other hand, provides excellent opportunities for doctoral theses in fields where biology, chemistry, and physics intersect.
Structured graduate training

Graduate schools, further training, institute seminars: doctoral researchers are intensively supervised

Many paths lead from university to Forschungszentrum Jülich. Students find opportunities for coming to Jülich via placements, summer schools, practical semesters, as well as projects for bachelor’s or master’s dissertations; positions as doctoral researchers are available for graduates. The spectrum of disciplines is very broad and ranges from engineering and science to economics and the social sciences. Jülich’s careers portal usually offers about 60 to 80 opportunities for students and about 30 to 40 vacancies for doctoral researchers. Establishing direct contact with the institutes is also a promising approach.

“I decided to work on my master’s dissertation at Forschungszentrum Jülich because I am interested in applications of physics in medicine and there is a broad range of opportunities here. I contacted various working group leaders by email in order to introduce myself and gain further information. They all answered promptly, which was a very positive surprise,” says Miriam Menzel, who studies physics at RWTH Aachen University and wrote her master’s dissertation at Jülich’s Institute of Neuroscience and Medicine – Structural and Functional Organization of the Brain. “I then spent several days at Jülich talking with the scientists about their research and looking at the instruments. Finally, I decided on the group working on fibre tract architecture.” In this group, scientists are concerned with the imaging technique of polarized light imaging, which makes it possible to visualize the spatial course of nerve fibres in the human brain. “My job is to perform calculations and to develop simulations...”
in order to improve the reconstruction of the directions of the nerve fibres. I am the only theoretical physicist in the group and what I am doing is breaking new ground. Since I enjoyed research in this field so much I have now started work on my doctorate."

Supervision for doctoral researchers

Of the 908 doctoral researchers at Jülich, about 85 % have contracts with Jülich. The remainder are scholarship holders or external doctoral researchers who use the equipment and facilities at Jülich for their projects. Since heads of institute at Jülich are always also university professors, there are particularly close links with universities in North Rhine-Westphalia. The majority of doctoral researchers are therefore enrolled at universities in the region. Most of them (about 439 in 2015) are at RWTH Aachen University followed by the universities of Düsseldorf (145), Cologne (67), and Bonn (50). Altogether, in 2015 the doctoral researchers were enrolled at a total of 45 universities in Germany, and about 4 % of them were abroad.

“I consider that supervising doctoral researchers is one of the most important tasks at Forschungszentrum Jülich,” says Prof. Dr. Uwe Rau, director of the Institute of Energy and Climate Research – Photovoltaics, and scientific director of the Helmholtz graduate school HITEC – Helmholtz Interdisciplinary Doctoral Training in Energy and Climate Research. "Furthermore, Forschungszentrum Jülich is a very good place

University conferring doctorate

The 908 doctoral researchers supervised at Jülich in 2015 were enrolled at 45 universities, 96 % of all doctoral researchers are enrolled in Germany.

The majority of the doctoral researchers were enrolled at the following six universities:

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“From my point of view, it’s important not to regard doctoral researchers as university students but as grown-up people and university graduates who are working on a scientific project. If we continue the trend at universities towards regimentation on to the next level of education then this would not increase the competitiveness of doctoral researchers. Although, of course, it is appropriate to offer additional qualifications. I consider seminars in the fields of good scientific practice and project management to be particularly relevant and they have already been introduced at our institute. Amongst other things, good scientific practice means ensuring the reproducibility of one’s own scientific results. Data should be properly processed and saved, which is, however, a question of resources. Courses in project management, on the other hand, focus attention on working in complex situations. As a rule, doctoral researchers at Jülich are part of a team working on a larger project with various collaboration partners, often at different sites. We must pay attention to skills such as effective regular communication, sufficient documentation, and the establishment of a good approach to error management.”

Prof. Dr. Markus Diesmann, director at the Institute of Neuroscience and Medicine – Computational and Systems Neuroscience, Forschungszentrum Jülich; Professor of Computational and Systems Neuroscience at RWTH Aachen University; Chair of the Doctoral Committee of Forschungszentrum Jülich

for doctoral projects. We have the infrastructure to pursue research at the highest level and we need early-career scientists. Doctoral researchers contribute their good training and we give them the opportunity to further develop their skills in relevant and sophisticated projects.” In order to provide structural support for the doctoral researchers and to ensure uniform framework conditions, a special committee has been established at Jülich, the Doctoral Committee, of which Rau has been the chair for several years. “A doctoral project represents a unique opportunity for young scientists to explore a scientific problem in depth and, moreover, also to test and develop their own abilities. Each doctoral project is therefore a very individual endeavour, but at the same time also based on general scientific standards. The Doctoral Committee intends to cater to both aspects by creating a common basis for all Jülich doctoral researchers.” Rau regards the commitment shown by the scientific supervisors at the institute level, who provide intensive support for their doctoral researchers, as a special service.

Marco Prill preparing specimens: the glove box prevents the materials becoming contaminated and protects the operator against contact with toxic substances.
In 2015, a total of 908 doctoral researchers (573 from Germany and 335 from abroad) from 57 countries were supervised by Forschungszentrum Jülich. The majority of foreign doctoral researchers came from China (114) followed by Italy (29) and India and Russia (19).

Graduate schools

Forschungszentrum Jülich offers various training courses accompanying actual work on the students’ doctoral projects. These include seminars at the institutes as well as courses offered for all doctoral researchers at Jülich. Furthermore, Forschungszentrum Jülich is involved in a total of 20 collaborations with local universities in various graduate schools. Forschungszentrum Jülich itself is responsible for two of them: HITEC (Helmholtz Interdisciplinary Doctoral Training in Energy and Climate Research) and BioSoft (International Helmholtz Research School of Biophysics and Soft Matter).

“The great thing about HITEC is the close contact with doctoral researchers from other institutes. In this way, you get to know other perspectives on energy research, for example economic approaches or topics concerned with materials processing,” says Marco Prill, who is working on a doctorate in the field of battery materials at the Institute of Energy and Climate Research – Microstructure and Properties of Materials. Prill particularly appreciates the mentoring programme at the graduate school. “I chose my mentors because they have experience in industry and I later intend to work in the field of industrial research and development.” Prill regards Jülich as a very good place for his doctoral project. “Firstly, there is an excellent

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Hailey Williamson, doctoral researcher in physics at Jülich Centre for Neutron Science and at RWTH Aachen University

“For my doctoral project I look at a certain class of magnetic materials called ‘multiferroics’ that have great potential for applications in information technology. My research often takes me to experiments at large-scale facilities all over the world. Working at the Jülich Centre for Neutron Science is a great privilege as I can actually conduct a majority of my research in-house, from synthesis to characterization, as well as using internal beamtime at our outstation in Munich, the Heinz Maier-Leibnitz Zentrum. My future? I would like to work on a space programme. I want to be the first scientist on Mars. Mars could well hold secrets on naturally occurring multiferroic compounds based on its iron abundance. After finishing my doctorate I will start to scout out projects in this area as well as postdoc opportunities on neutron instruments. Eventually my dream is to work with NASA or the European Space Agency. In any case I will always be a scientist.”

Hailey Williamson, doctoral researcher in physics at Jülich Centre for Neutron Science and at RWTH Aachen University

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environment here because the institute has been working on materials, including types of steel, for decades. And secondly, the equipment is outstanding. I regularly use the glass workshop, for example. The Central Institute of Engineering, Electronics and Analytics is also a very interesting part of the infrastructure where they perform chemical analyses. In general, I have never had any difficulty in obtaining materials or instruments. I feel that my time at Jülich has equipped me well for a career in industry.”

In addition to his doctoral studies, Prill is also active in DocTeam, an initiative organized by Jülich doctoral researchers concerned with the interests of those working on a doctorate. In addition to representing doctoral researchers on the relevant committees at Jülich, DocTeam promotes contacts between the students and also organizes lectures.

One job that traditionally falls to doctoral researchers at Jülich is that of tour guide, known to insiders as a bear leader. These guides accompany groups of visitors on campus and provide information on instruments, facilities, and research priorities. “I believe it is important to educate the public about research. That’s why I was glad to guide visitors,” says David Minossi, who worked as a bear leader for several years.

“The German Research School for Simulation Sciences is very well organized by both the outstanding RWTH Aachen University and the prominent research centre Forschungszentrum Jülich. Simulation is always such an exciting subject that through computers we discover and predict new phenomena. The lectures I like most are Quantum Mechanics and Parallel Computing. In the future I would like to do research involving high-performance computing and physics. I hope I can apply what I have learned to make interesting and powerful applications.”

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years. "It was also a chance to expand my own horizons and get to know other institutes." Minossi first worked on his diploma dissertation at Jülich’s Nuclear Physics Institute and then continued with a doctoral degree. His doctoral thesis in the field of theoretical physics required a large number of calculations, which meant he also needed access to Jülich’s supercomputers. He found working conditions at Jülich very good. “I was able to ask my supervisors questions at any time, which was excellent. You couldn’t wish for anything better.” During the final phase of his doctoral degree, Minossi had already decided to go into industry and get to know another field outside research at Jülich. “I now work for a consulting firm. We provide services for banks, specifically risk assessment and modelling. This requires the basics skills of a physicist: experience with all types of calculations and troubleshooting abilities.”

Qualified candidates required

What qualifications do prospective doctoral researchers require when they apply for a position at Jülich? “A good command of English is important since we have international working groups and we are looking for people who can work in an interdisciplinary environment. Our institute also requires knowledge of neuroscience. In particular, if someone has already worked with imaging techniques then he or she has good chances,” explains Prof. Dr. Peter Weiss-Blankenhorn, who heads the motor cognition group at the Institute of Neuroscience and Medicine – Cognitive Neuroscience, and is professor of cognitive neurology at the University of Cologne. He is also on the Jülich Doctoral Committee. His institute actively tries to attract young scientists by advertisements on online job markets and mailing lists at the universities. Weiss-Blankenhorn has noticed that it is getting more difficult to find good candidates. “It’s not that the training has deteriorated but rather the number of vacancies in our field have increased so much that people can stay where they are. It is generally possible to obtain follow-up funding at university. Mobility is no longer a necessity, but has become an option.” In order to provide even more support for early-career scientists, the institute is also considering what additional courses could be of interest. For example, as Weiss-Blankenhorn says, courses improving the students’ methodological skills, whether in statistics or programming, could be beneficial.

Overall, in coming years it is planned to expand the level of supervision offered to bachelor’s, master’s, and doctoral researchers at Forschungszentrum Jülich. Collaborations with universities are to be further developed and support for early-career scientists expanded.
“We believe in reviews from an early stage”

Prof. Dr. Uwe Rascher heads the research field of ecosystem dynamics at the Institute of Bio- and Geosciences – Plant Sciences, and is at the same time professor of the quantitative physiology of crop plants at the University of Bonn. At his institute, he is also responsible for the doctoral researchers. In an interview, he discusses his supervision concept.

What is the difference between working on a doctoral degree in your institute and at a university?

Prof. Dr. Uwe Rascher: With us, doctoral researchers have more time and a suitable environment so that they can concentrate completely on their research project. The topics are more focused – we know where we want to go. But, on the other hand, we don’t have the wide range of lectures that you have at a university. Another difference is the working hours. Most people start work between 07:30 and 09:00 and finish at about 18:00. Some people like this rhythm; others think it’s dreadful. A lot of the doctoral researchers first start working in their old rhythm from uni – they come in at 10:30 and continue open end, until they notice that it’s a lot easier to work when, for example, the people in charge of the greenhouses are there as well.

What are the conditions for undertaking a doctoral project at your institute?

Prof. Dr. Uwe Rascher: We assign a team to the doctoral researchers consisting of one main supervisor and two co-supervisors. They provide support with all issues starting with developing a research, time, and work plan. In addition, they advise the doctoral re-
searchers on all decisions regarding his or her further training: Which graduate school or which additional courses would be of interest? Where and at what stage of the project would a stay abroad be beneficial?

How long does it take to complete a doctoral degree on average?

Prof. Dr. Uwe Rascher: Our aim is that all doctoral researchers submit their thesis to their university in three years. About half make the deadline. The others need a few months more. In general, we believe in reviews from an early stage. We have set up several milestones for this purpose. For instance, after the first year, we undertake a joint but critical evaluation of whether doctoral researchers are on the right track with their projects. It may be the case that a technique which we first thought was promising turns out to be unsuitable. Perhaps a method that always worked with maize doesn’t function with barley. We then have to take another tack. Another topic is advance planning especially for outdoor projects. Modern high-performance cereals, for example, shoot up within a few months. Starting in February, I talk until I’m blue in the face telling people they have to get their measuring instruments ready and prepare the measurement protocols. Only about 80% believe me. Then, in the field 20% discover that something is wrong with their instrument. If they miss these relatively short main growth phases they may have a problem and they then need a good team of advisers.

What sort of solutions can the team of advisers offer if students miss the growth phases?

Prof. Dr. Uwe Rascher: The solution is different for each individual project. We once sent a doctoral researcher to Chile where he was able to repeat his outdoor experiment. They have similar growing conditions to us in Chile, but five months later.

Is it easy to attract good early-career scientists?

Prof. Dr. Uwe Rascher: It’s still not easy but we are getting more and more applications from highly qualified candidates, many from very good universities. There is a rising trend.
Career opportunities for high achievers, supporting mobility:
Early-career scientists in their postdoc phase receive personalized support in close cooperation between the institutes at Jülich and the universities. The centrally coordinated support programmes subsumed under “juelich_heads” assist them in actively planning their careers.

There were a total of 341 postdocs at Forschungszentrum Jülich on 31 December 2015, including 105 women. Various postdoc programmes provide individual funding for two or three years to further encourage individual research approaches after a promising doctoral thesis. Special encouragement is given to international exchange, which often forms the basis for further rungs on the career ladder.

One example of the opportunities for early-career scientists is the Helmholtz postdoc programme. In 2014, all four proposals submitted by Jülich were successful.

At Jülich, internationally outstanding postdocs are given the opportunity to establish their own young investigators groups. The process begins with a highly competitive multistage selection procedure. At the end of 2015, there were 18 young investigators groups at Forschungszentrum Jülich, and seven of their heads were junior professors. Seven of the young investigators groups were headed by women. Forschungszentrum Jülich supports these early-career scientists with a range of services, from info lunches to training courses and individual support measures.

Collaborations with universities, such as the Jülich Aachen Research Alliance (JARA), play an important part in supporting early-career scientists. This way of promoting partnership in training young scientists must be energetically pursued providing young people with the best of both worlds – university and non-university.

In future, partners from outside science will be increasingly sought after in order to develop joint programmes. The aim is to identify other career options and to promote mobility into and out of other science-related fields in a structured manner.

An example of the transfer of research results to industry is the project by Jülich researchers Dr. Stephan Binder and Dr. Georg Schumann from the Institute of Bio- and Geosciences – Biotechnology. The two scientists were one of seven winning teams in spring 2014 to receive an award from the Federal Ministry of Education and Research (BMBF) in the GO-Bio funding competition for the foundation of new biotechnology companies. They developed a system for a targeted search for highly productive microorganisms that they are now planning to bring to market maturity. BMBF is providing about € 2.5 million for Binder and Schumann to implement this project and for their spin-off company SenseUp Biotechnology, which is planned for 2017.
Getting the best results

At the start of their careers, postdocs receive support from various programmes

About 341 postdocs work at Jülich, almost a third of them women. Various instruments are in place to support them. The Helmholtz Association offers young researchers the opportunity to apply for three years of funding as part of the postdoc programme. Scientists who completed their doctoral degree at an earlier date can attract funds to set up a young investigators group, of which there are currently 18 at Jülich. These groups are financed by the Helmholtz Association, Forschungszentrum Jülich, and other funding bodies.

“The situation at Forschungszentrum Jülich is extremely good for heads of young investigators groups, in fact almost optimal. With the starter pack that I get here, I am certainly well equipped for the job market” explains Prof. Dr. Julia Frunzke, head of the young investigators group on population heterogeneity in industrial microorganisms at the Institute of Bio- and Geosciences – Biotechnology and junior professor at the University of Düsseldorf. “We have the opportunity to undertake teaching duties and we also have enough time for our own research. The financial resources are excellent – especially because the funds can be used flexibly. If an outstanding application lands on my desk then I can react quickly and hire the candidate. A decisive point for me was undoubtedly the tenure-track option. Without this long-term prospect, I would have already moved to industry.”

Julia Frunzke’s field of research is applied microbiology. Her initial question is: “How can I use bacteria to produce interesting products such as amino acids?” She is particularly interested in the phenotypic structure of
microbial populations. “In the case of a production strain, for example, this can lead to considerable differences in productivity: some populations produce the desired product while others just consume the culture medium and don’t produce anything at all. This means that different phenotypes develop from the same genotype. We want to find out how that happens.”

The biologist receives € 250,000 per year to establish her Helmholtz young investigators group: 50 % from the Helmholtz Association and 50 % from Forschungszentrum Jülich. There are currently 12 such Helmholtz young investigators groups at Jülich. A further six young investigators groups are funded by Forschungszentrum Jülich itself or by funding bodies such as the Federal Ministry of Education and Research (BMBF) and the German Research Foundation (DFG).

**Science management as a challenge**

For young scientists, this phase of their career after completing their doctorate often overlaps with their desire to start a family. This was the case with Julia Frunzke: “I had my first child while I was setting up the working group. During this period, I came to the institute once a week with my son to keep an eye on things. Otherwise, I kept in contact by email and telephone,” says the scientist. “This meant that the doctoral researchers in my group became more independent. It didn’t lead to any lack of motivation.” The topic of personnel management is one of the challenges which young group leaders are first faced with. “Beforehand I was not aware of how great the differences between individual personalities in a team could be,” says Frunzke. “But that’s what makes it interesting. The aim is to

### “The situation is almost optimal”

As head of a young investigators group, Prof. Dr. Julia Frunzke has to cope with a wide range of management tasks in addition to her own research.
“We analyse functional materials. We can only put forward new ideas for the next generation of materials when we have understood existing materials. Functional materials are characterized by the fact that a certain reaction can be triggered in them by means of a signal. This may, for example, be a storage function or a switching function. Areas of application can be found in information technology and energy technology. At the Jülich Centre for Neutron Science, I attracted funding for a Helmholtz Young Investigators Group focusing on the research area of thermoelectric materials. These are materials that can be used to convert heat into electricity. Now the funding period is over, the activities are financed by other third-party funds. I have had no trouble with organizational aspects of heading a group. There is no problem in attracting employees because we receive an enormous number of applications. It is, however, striking that in response to advertisements for positions abroad we get few, if any, applications from Germany, perhaps because German doctoral researchers get good offers from their own universities.”

Prof. Dr. Raphael Hermann, Jülich Centre for Neutron Science – Scattering Methods, Forschungszentrum Jülich, now at Oak Ridge National Laboratory, USA

encourage everybody to give their best and to help them develop as optimally as possible.”

Prof. Dr. Moritz Helias, head of the young investigators group on the theory of multiscale neural networks at the Institute of Neuroscience and Medicine – Computational and Systems Neuroscience, and junior professor at RWTH Aachen University can confirm this experience: “You have to encourage quite different people to work in the same direction. But it is particularly this diversity, such as cultural background, which can open up new perspectives. For example, I have found that the Japanese put forward criticism in a much politer and more constructive manner, which can be a real benefit in heated discussions.” He draws a positive conclusion. “I now have a lot more freedom because I can choose my own research direction. At the same time, I have considerable support from Forschungszentrum Jülich with organizational aspects. This applies to financial calculations and also the recruitment process.”

Helias’s group investigates the mechanisms that determine activities in neural networks. The researchers study different orders of magnitude: from the level of individual cells and synapses up to the interaction of whole brain regions. Particular attention is paid to the
interaction between the various levels. In this way, they can determine the properties of networks which would not be recognized by a fragmented consideration on the individual scales. The research approach is interdisciplinary. “We apply theories and methods from physics in order to understand and describe these activities,” explains Helias. “This means we use existing knowledge and transfer it to other fields.”

**Postdoc programme**

The young investigators groups consist of doctoral researchers and postdocs, who are recruited in different ways. “I met the head of my research group at a conference,” says Dr. Michael Owen, who works as a postdoc in a young investigators group on the multiscale modelling of protein-protein interactions funded by Forschungszentrum Jülich at the Institute of Complex Systems – Structural Biochemistry. “She gave a lecture on Alzheimer’s research that was very interesting for me because my doctoral thesis was concerned with a related topic.”

Owen, who comes from Canada and took his doctorate in Hungary, succeeded in acquiring funding from the Helmholtz postdoc programme. He thus receives up to € 100,000 annually for two to three years from the Helmholtz Association and Forschungszentrum Jülich. Apart from his own position, he can use these
"My aim is to simulate the microcirculation of blood. By microcirculation, we mean the flow of blood in the capillaries, that is to say networks of extremely fine vessels – smaller than a human hair. We study how the individual cells are distributed, how they move, and when they touch the walls of the vessels. It is very important to know what happens in blood. This knowledge would, for example, help to improve cancer treatment. At the moment, it is the case that many drugs only have a limited effect since the blood that transports the drugs flows in a different way in tumours than in healthy tissue. My special field is applied mathematics. I studied in Novosibirsk and then took my doctorate in the USA. I came to Jülich because there are good conditions here for my research, including the supercomputer that we need for the simulations. My impression is that science in Germany is just as strong as in the USA. Working conditions for postdocs are also good. In any case, the best postdoc is one who can work on his or her own."

Dr. Dmitry A. Fedosov, winner of the Sofja Kovalevskaja Award of the Alexander von Humboldt Foundation and head of a young investigators group at the Institute of Complex Systems – Theoretical Soft Matter and Biophysics, Forschungszentrum Jülich

"funds for a technical assistant and for business travel and a stay abroad. "The aim of our work is to understand the origins of Alzheimer’s disease in order to identify a promising approach for treatment," the researcher explains. "We apply a wide range of techniques for this purpose. We use computer simulations and quantum calculations to understand molecular structures and their interactions." In the case of Alzheimer’s, amyloid beta protein fragments are deposited in the brain and then damage the nerve cells. Amongst other things, Owen is interested in the part played by free radicals in this context. Free radicals are short-lived, aggressive, oxygen-containing compounds which disturb certain processes in cells. Even if his investigations are not yet complete, Owen has already drawn his own conclusions. "I eat more raw fruit and vegetables, in as untreated a form as possible. The antioxidants contained in them bind free radicals and thus protect the organism."

Owen greatly appreciates working conditions at Forschungszentrum Jülich. "We are very well equipped with research resources, both with respect to hardware and software. I can therefore work with large systems – with a resolution down to the atomic range – which I was previously unable to do. The simple fact that I can formulate a research proposal here and then receive support in implementing it is very beneficial for innovative developments. My expectations – and also my previous experience – have been wildly exceeded." He has no plans to return to Canada in the immediate future. "As long as I have ideas and the opportunity to implement them I would like to continue working in research, preferably in Germany. The country invests a lot in research – which is a very noble way of investing in the future."
Owen likes living in Europe. "It’s a good place to live and work. Conditions are good, you can have an interesting job and still have time for your family and for travel. Part of what makes a researcher tick is curiosity. This includes the desire to discover how things work in other cultures and societies, and there are ideal conditions for that here."

**Summer schools, laboratory and compact courses in 2015 (selection)**

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You founded a company on the basis of your work at Forschungszentrum Jülich. What is your experience of the move from research to industry?

Dr. Markus Boner: As a young scientist, I was first fascinated by what you can do. I didn’t ask where the money came from. The case is exactly opposite in industry. You first ask about the money and then you think about what you can do. The most important thing is keeping the business running. What I had to learn very quickly was how to make far-reaching financial decisions. I had sleepless nights at the beginning. But the longer you’re in business, the easier it gets. Naturally, I made the same mistake ten times, but the eleventh time I got it right.

What aspects were essential for the success of your new company?

Dr. Markus Boner: It was very helpful that we had a controller right from the start. He took off some of the heat and warned against wrong decisions. Furthermore, we didn’t start off on our own. We followed the advice of Jülich’s Technology Transfer and looked for a partner to market our products on a commission basis. You might have the best idea in the world, but without advertising it’s no use at all. However, the very best assistance was given by Prof. Treusch, who was Chairman of the Board of Directors until 2006. He took us out of institute operations and gave us a budget for a year so that we could manage our own affairs independently of the institute hierarchy.

What mistakes did you make?

Dr. Markus Boner: You always make decisions depending on prevailing conditions, which is why I would not
call them mistakes but rather experiences. A mistake is if the company goes bankrupt. As long as the business keeps going not too many mistakes have been made. If I could turn back the clock, I would always try to keep a majority of shares right from the beginning. At that time, I couldn’t find the capital on my own and the bank didn’t want to give me a loan without security so I had to look for partners. These partners did not want to invest without a say in developments. This meant that I had to give up my independence right at the beginning.

Spin-offs by scientists are encouraged. Why do you think there aren’t more of them?

Dr. Markus Boner: No bridges are built. Why should scientists establish spin-offs if they have to take a risk that they cannot manage? We need new concepts for funding innovation. It should, for example, be possible to obtain venture capital without – as in my case – your parents having to stand security. The security required by the banks could be obtained in a different way, for example by means of an advisory model. In this way, in the early stages a company founder would be provided with a team of advisers whose decisions he would abide by. This team should include a controller, a good tax consultant, and a legal adviser, who would explain the pitfalls in contracts.

Are there other obstacles, perhaps inherent to the system?

Dr. Markus Boner: An obstacle may also be that the head of the institute responsible for the field in which the idea originated tries to slow down the spin-off. A professor would never give up his job in order to found a company. Instead, he would try to operate the company on a small scale in his spare time. You can only really build up a company if you’re willing to take a risk and give up your day job. Solutions must be developed for such cases, for example, that people intending to establish a company should be taken out of the institute hierarchy. In general, I think it is important that the positive aspects of this path should be communicated even more: the high level of independence and the chance to realize your own abilities. If you found a company you can make things happen. A company is always the best way for people who want to roll up their sleeves and get stuck in.

Isotope analysis determines the proportion of certain stable isotopes, in other words non-radioactive isotopes, of different elements, such as oxygen, nitrogen, carbon, and sulfur. Since the isotopic composition of plants and organisms differs from place to place, this method can be used to determine the region from which a product originates. Amongst other things, this technique is used to uncover fraudulent labelling in the food industry.