

**STEM PROGRAMS  
ROUTES TO SUCCESS  
IN SCIENCE AND TECHNOLOGY**



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# **STEM PROGRAMS**

## **ROUTES TO SUCCESS**

## **IN SCIENCE AND TECHNOLOGY**

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# SECURING FRAUNHOFER'S FUTURE BY INSPIRING ENTHUSIASM FOR STEM TODAY

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The success of the Fraunhofer-Gesellschaft depends on its employees. However, there will soon be a shortage of skilled employees in STEM (science, technology, engineering and mathematics) fields – Fraunhofer is already preparing for this fact.

*“Through their professional, commercial and social skills, the employees of the Fraunhofer-Gesellschaft play a major role in determining the organization’s performance.”*

(Principles of the Fraunhofer-Gesellschaft)

Various studies confirm that Fraunhofer is perceived as an attractive employer. However, the competition for talented personnel and trained engineers and scientists is increasing. For many years, industrial companies have also been advertising with keywords such as “innovation,” “research,” and “doctorate.” Fraunhofer is meeting this challenge on two levels:

## 1 Clear positioning

Fraunhofer highlights its advantages as an employer – also in comparison to other organizations – in order to secure young talent. The organization-wide YES campaign conveys the highly practical nature of applied research: where others throw up their hands, Fraunhofer forges ahead; where others say “not possible,” Fraunhofer says “yes, we can.”

With this campaign, Fraunhofer sets itself apart from the competition and is perceived by talented people as an attractive employer.

## 2 Early and continuous appeal to target group

The Fraunhofer-Gesellschaft is fulfilling its social responsibility and promoting the study of STEM subjects. It awakens the curiosity of children and teens for science, technology, engineering and mathematics, provides them with exciting experiences in the fascinating world of STEM through special programs and inspires them to take up careers in science and technology.

*“The role of the Fraunhofer-Gesellschaft is to translate scientific findings into practical innovations. By doing this, it makes a contribution to macroeconomic growth, structural change and employment.”* (Principles of the Fraunhofer-Gesellschaft)

Fraunhofer’s STEM programs start with kindergarten-age children and accompany them throughout their education and into college. In each phase, the programs are age-appropriate and in line with the children’s existing knowledge.



## Youth programs throughout the education system

### Kindergarten

- "kids kreativ!" ("Kids get creative!") creativity competition for day care centers



### Elementary school

- "Der Entdeckercampus" ("Explorer Campus") / online game
- "Romy, Julian und der Superverstärker" ("Romy, Julian and the super amplifier") / book
- "Forsche(r) Kids" ("Research kids")



### Secondary school stage 1

- Junior Academy
- Junior Engineering Academy
- Girls' Day
- "Jugend forscht" youth science competition
- "BoGy/BoRs" career guidance



### Secondary school stage 2

- Fraunhofer Talent School
- European Talent Academy
- Talent Take Off
- "Jugend forscht" youth science competition
- "MINT-EC" program for STEM talent



"myTalent" portal





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## FROM KINDERGARTEN THROUGH TO COLLEGE

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Children are curious by nature. They want to explore the world and learn by experience what works and what doesn't. Kindling and strengthening this curiosity through age-appropriate experiences is the goal of Fraunhofer's STEM programs at all stages of education. These programs seek to motivate today's knowledge-thirsty children to be tomorrow's innovative researchers.

Because a solid foundation in STEM subjects also gives young people good career prospects, the Fraunhofer programs deliberately foster talent at both basic and cutting-edge levels.

Fraunhofer's early childhood education program starts in kindergartens; additional projects accompany children through elementary school and high school until they decide what they want to study and begin their university studies. In this way, promising youth repeatedly learn about various subjects that are important to Fraunhofer over the course of their school education. They experience exciting research fields in practical exercises and they learn all about the opportunities Fraunhofer offers them as an employer.

*Can you turn the world upside down and still understand it? YES. Our "kids kreativ!" competition gives kids a passion for research through creative games. (Fraunhofer YES campaign)*

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## PROGRAM FOR KINDERGARTEN CHILDREN

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### "kids kreativ!"

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Researching, inventing, painting, doing arts and crafts, filming, building and designing – kindergarten groups taking part in the "kids kreativ!" competition can give free reign to their curiosity and creativity. While solving an everyday problem together with their teacher, they proceed just like grown-up development engineers: recognizing problems, collecting ideas about how to resolve them, exercising their imagination, discussing, agreeing on one idea – and then starting out on implementation.

To give an example: a kindergarten from the German village of Hausen am Andelsbach won the competition by inventing an "herb grab-wash-cut machine" to simplify production of their self-baked herb bread rolls. To do this, they drew up a plan and a list of materials, they built the machine and finally they carried out practical tests. Each child was able to contribute with their own strengths and abilities, and the end result was the product of teamwork.

Below is a sample of some of the categories from which kindergarten groups can choose their project:

- How robots can help people in practical ways
- Clever clothing designed by children for children
- Too little room on Earth? A hotel in space?
- Why does  $1 + 1 = 2$ ? A world full of numbers in everyday kindergarten life
- Let there be light! – When there is a blackout in the kindergarten
- Making it new – How to make new toys from garbage

The prizes are goods vouchers and material prizes with a research theme.





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## CHILDREN'S PROGRAMS AGES 6–10

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### **"Romy, Julian und der Superverstärker"** Fraunhofer children's book

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Children are most likely to catch the "research bug" if science comes packaged in an exciting story. For this reason, Fraunhofer published the children's book "Romy, Julian und der Superverstärker" ("Romy, Julian and the super-amplifier") with the assistance of many researchers at Fraunhofer. Packed with exciting puzzles, games and experiments and aimed at the 5–11 age bracket, the book is suitable for reading aloud or for children to read by themselves.

#### Synopsis:

Romy's parents are scientists and are working on a new research project. Now the family has moved to a house on the institute's campus. In the house, everything is super-modern and filled with state-of-the-art gadgetry, but Romy does not like it. That changes only when she meets Julian from next door. Together with caretaker Kyrill and the little robot Roberta, they are soon on the trail of a thief and discover what the deal is with super-amplifiers.

In the course of their adventure, Romy and Julian encounter many questions from research and technology:

Can a fridge order juice by itself? Can cars run on fruit?

How does a solar cell work? These and other questions are

answered in Romy and Julian's info archive by Fraunhofer

scientists in the form of e-mails. In addition, there are illustrations and suggestions for experiments to do at home.

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### **"Der Entdeckercampus" Fraunhofer children's website**

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Based on "Romy, Julian und der Superverstärker," Fraunhofer has created the children's website "Der Entdeckercampus" – <http://entdeckercampus.fraunhofer.de> – as a hidden object game. The topics come from the research world of children aged 5–11. Together with Romy and Julian, the players collect individual parts of a robot blueprint that was stolen by a fake scientist and distributed around the Explorer Campus. As they progress, the players learn through interactive mini-games, animations and videos about topics such as how a solar plant works, what a smart home does, and how far electric car technology has developed.

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### **“Forsche(r) Kids” initiative for teachers of grades 3 and 4**

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Whether a teacher can get elementary school children excited about scientific phenomena depends on how well the subject is prepared in class. In collaboration with experts in teacher training, Fraunhofer has developed material that can be downloaded for free that helps elementary school teachers prepare a science lesson for kids. Videos and other lesson materials are available for preparing other lessons.

To date, the following modules have been prepared:

- From milk to whey; or how do I find the protein in milk?
- The effect of heat and cold on materials; or is it all just hot air?
- The colors of light; or the secret of the rainbow
- How sugar and salt dissolve; or the mysterious disappearance of sugar
- Steam as driving force; or ship ahoy!
- Air takes up space; or air is not nothing!
- Current flows; or the lemon battery

New subjects are continuously being added to the lesson materials.

*Can you really get kids passionate about research during school?*

*YES. “Forsche(r) Kids” supports elementary school teachers by providing materials for science lessons.*

*(Fraunhofer YES campaign)*

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## **YOUTH PROGRAMS AGES 10–15**

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### **Girls’ Day**

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Some 900 young women take part in Fraunhofer Institute Girls’ Day events every year in April and visit laboratories, offices and workshops. They are invited to experience the world of research for a day. Fraunhofer scientists give insights into their areas of expertise, describe their projects and carry out small-scale experiments to illustrate working life at a research institution.

For many former Girls’ Day participants, this experience prompted them to use additional Fraunhofer programs for young talent.

For more info, see: [www.fraunhofer.de/girlsday2014](http://www.fraunhofer.de/girlsday2014)



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### **Career guidance internships for high school students and other internships for schoolchildren**

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The “BoGy” career guidance program is a compulsory one-week internship at academic high schools in the German state of Baden-Wuerttemberg for all students in grades 9, 10 or 11 (depending on the school). Despite the time researchers have to spend looking after the interns, Fraunhofer places value on providing sufficient BoGy places so that young people can see what the everyday working life of researchers is like. The same applies to the “BoRs” career guidance program for Realschule secondary school students and to other internships for schoolchildren. Below is a sample of just some of the topics covered:

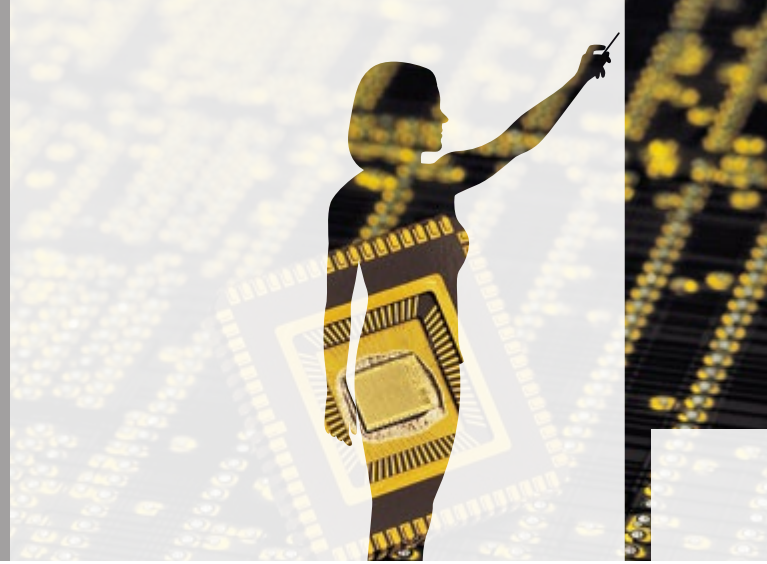
- Technology management
- HR management
- Information and communication technologies
- Acoustics and noise (vehicle test rig)
- New building materials and components
- Institute’s library
- Environmental biotechnology and bioprocess engineering
- Molecular biotechnology
- Working with cell systems
- Surface analytics

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### **“Jugend forscht” competition for budding researchers**

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Many winners of the all-Germany “Jugend forscht” competitions began experimenting – and submitting their results – together with teachers or friends when they were still very young. The younger they start, the more experience they bring with them to subsequent projects. Accordingly, Fraunhofer also supports youth under the age of 14, endows prizes in mathematics and IT across Germany and organizes creative workshops for the predecessor competition for schoolchildren “Schüler experimentieren.” Moreover, winners at state level are offered special terms for taking part in Fraunhofer programs.



## YOUTH PROGRAMS AGES 15–19

### Fraunhofer Talent School

*Is it possible to start out as a researcher while still in school? YES. At our Talent School, you can experience applied research up close in practical projects. (Fraunhofer YES campaign)*

Turning interest into enthusiasm: Fraunhofer created its Talent School for teens aged 16–19 who are interested in STEM subjects. In these workshops, talented young people work in teams for three days to develop solutions for various challenges taken from modern research. Scientists from the Fraunhofer-Gesellschaft teach the workshops. The program also contains exercises to induce participants to critically reflect on their own ways of thinking and perceiving things, so that they can get to know themselves better and develop as individuals. In the evening, the young adults then have the opportunity to talk to Fraunhofer managers and gain insights into the everyday working life of researchers and into the national and international scientific community.

Currently, eleven different Talent Schools take place every year and are visited by some 400 participants. Examples from the approximately 30 different workshops are:

- Building blocks of life – biological analysis of proteins
- Holding the world together – chemistry and physics of adhesives
- Humanoid robots – analyzing and transferring human behavior
- Web TV – interactive concepts for modern television production
- Self-driving cars

The complete program with many further exciting workshops is available at:  
[www.fraunhofer.de/talentschool](http://www.fraunhofer.de/talentschool)

*“We also want to convey to young people that science is not cast in concrete. Ideally, they will come out thinking: there’s so much still to explore, maybe it’s just waiting for me to come along and make the discovery!” (Beate Brede, responsible for Talent School concept and implementation at Fraunhofer IFAM, Bremen)*

The Talent School provides an ideal basis for the students to pursue their interest at school and university. Many former participants have used further Fraunhofer programs for young talent to help them with the transition from school to university and to their working life.



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## YOUTH PROGRAMS AGES 16–20

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### “Talent Take Off” From school to university

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As their schooldays draw to a close, students are faced with a big decision. Many teenagers who are enthusiastic about STEM subjects feel overwhelmed by the plethora of different science and engineering courses out there and their various emphases. On top of that, they have to prepare for the transition from school to university life and deal with the pressure of forging a definite plan for their future as soon as possible. To help students in this phase of life, Fraunhofer has collaborated with Femtec GmbH to develop a three-stage orientation program called “Talent Take Off – Getting Your Studies off the Ground.” It offers practical help and guidance to prospective students. During the program, Fraunhofer presents scientific topics in workshops and lectures while also presenting itself as a modern, attractive employer.

### Module 1: “Getting started”

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This six-day course helps the teens choose the right university course and career in a STEM subject and offers concrete guidance. At the Technical University of Berlin, the young people carry out technology workshops and laboratory experiments and they go on excursions to Fraunhofer Institutes and learn about their fields of research. In addition, they take part in training courses on their interests, strengths and goals as well as on team building and communication. Discussions with STEM students from higher semesters and with practicing engineers from industry and research give the young adults a realistic perspective on their studies and careers.

The goal of the module is to show talented youth a broad range of scientific disciplines and research opportunities at Fraunhofer. This helps them to gain a clear picture of their prospective studies, thereby making it less likely that they will drop out of university because they had a false conception of what their studies would really be like.

### Module 2: “Getting going”

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They’ve made their decision and started their studies. Now the bright young talents are faced with new questions: In what capacity will I be able to use this knowledge later? How can I make best use of it? Fraunhofer answers these questions in the four-day “Getting going” module as part of the “Talent Take Off” program. The module takes place at a Fraunhofer Institute, where participants get to learn about the work of scientists and engineers engaged in application-oriented research, about their everyday working lives split between the lab and customer acquisition, and between fastidious data collection and evaluation on the one hand and easy-to-grasp presentations for customers on the other. They also learn about what entry-level job opportunities exist for dedicated students even during their bachelor studies. In addition, the students are taught important skills relating to time management, presentation and optimized learning as well as taking a course in rhetoric.

*“Now I know how research really works.”  
(Participant in Talent Take Off – Getting going)*

The goal of this module is to increase the motivation of talented youth by giving them a realistic picture of everyday working life as a Fraunhofer researcher, introducing them to genuine role models and improving their methodological competencies right at the start of their studies.



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### Module 3: “Networking”

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The studies are going well, and now it's time for further career planning: How do other people go about it? Who can help me? What do successful research team members recommend? The four-day “Networking” module is all about building up and expanding a personal network that will sustain them through their future career. And for school students, “Talent Take Off – Networking” is also really exciting – after all, what could be better preparation for their university studies than talking to researchers who have made it? For this reason, the Fraunhofer mentorship program also kicks off during the “Networking” module. In this program, students mentor their younger charges for several months, helping and advising them with all questions related to university studies. In addition, the participants encounter numerous other people who are talented in a range of STEM subjects from all over Germany; and on top of this, they meet career experts and prominent Fraunhofer researchers, who together form the basis of a new network. Exciting expert presentations and workshops on study, job and career planning round off the program.

*“I learned more about current research here than in all the past few months combined. And I also got to know people who want similar things from life that I do.” (Participant in Talent Take Off – Networking)*

The goal of module 3 is to teach talented youth about the advantages of smart networking and invite them to form their own community, thereby also bringing them closer to the Fraunhofer community.

Further information about all modules is available at:  
[www.fraunhofer.de/talenttakeoff](http://www.fraunhofer.de/talenttakeoff)



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## INTERNATIONAL YOUTH PROGRAM AGES 15–18

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### European Talent Academy in Lindau

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A program with a more international orientation that inspires and attracts outstanding STEM talent – that is the concept of the European Talent Academy in Lindau. Since 2005, this annual two-week summer academy sponsored by Fraunhofer has offered 60 gifted, motivated teenagers with a wide range of interests from Germany, Austria, Italy and Switzerland the opportunity to work together in project-based courses, exchange scientific insights across national borders and reflect on their perspectives, strength and goals.

Since it began, over 500 high school students have now taken part in the European Talent Academy in Lindau, creating a lasting network with each other in the process. The program's partners are the Free State of Bavaria; the Association of Alpine States (*Arbeitsgemeinschaft Alpenländer*); the Bavarian State Ministry of Education and Cultural Affairs, Science and the Arts; Swiss agencies responsible for middle schools; state school inspectors and teacher training colleges in Austria; the German education authority in Bolzano; and the education board (*Dipartimento Istruzione*) in Trentino.

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### “Fraunhofer MINT-EC Talents”

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Because top research requires outstanding talent, Fraunhofer has joined forces with the “MINT-EC” association to create a program that fosters the talent of particularly gifted school students: “Fraunhofer MINT-EC Talents”. (“MINT” is the German equivalent of “STEM” and “EC” stands for excellence centers.) In a selection process, the best school students are picked from 147 participating academic high schools throughout Germany.

This program nurtures the participants' talent for three years until they complete high school diploma exams and supervises their participation in the “Jugend forscht” research competition. For the workshops, participants are divided into two groups: chemistry and mathematics. The Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM in Bremen is responsible for the chemistry group, while the Fraunhofer Institute for Industrial Mathematics ITWM in Kaiserslautern is responsible for the mathematics group. Four specialist workshops and a soft skills training course make up the program.

The “Fraunhofer MINT-EC Talents” program is an effective way of attracting the “best of the best” at an early age and of supervising their development with expert training over three years – with an eye to those students subsequently choosing to do their doctorate at Fraunhofer.







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## “MYTALENT” PORTAL: MEETING PLACE FOR “FRAUNHOFER TALENTS” ONLINE

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In addition to the various programs for fostering talent, Fraunhofer also maintains continuous contact with all the talented people who have attended one of the workshops and communicates with them through the Fraunhofer “myTalent” portal.

*Is it possible to be in touch with cutting-edge science while still in high school?*

*YES. In our internet portal, we always keep you up to date on the latest developments in STEM subjects. (Fraunhofer YES campaign)*

Members of the “myTalent” portal form individual communities based on the program or workshop they participated in. They find an up-to-date jobs page with advertisements for Fraunhofer internships and opportunities for writing the final paper. Also, in the mentorship program, experienced students offer their support to students in lower semesters. In forums, the members discuss issues relating to STEM subjects and careers. The science news section reveals in which areas of research breakthroughs have been made. Meanwhile, the campus and job news sections report on current topics in universities and job markets. Exciting portraits of researchers provide inspiration for unusual and original career paths. And coaching articles give practical advice on how students can make their university life easier and plan their future with clearly defined objectives.





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## TESTIMONIALS BY FORMER PARTICIPANTS

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“I stumbled across Fraunhofer while searching for info about science subjects. First, I took part in ‘Talent Take Off – Getting started’ and then in the ‘Talent School’ in Bremen. As a result of the conversations I had at Fraunhofer, I’ve shifted my focus. Originally, I wanted to do something in engineering. Now I’m leaning toward physics, because I’m interested in what lies behind the surface of things.”

“What I found most interesting here at ‘Talent Take Off – Networking’ were the conversations I had with the students. And it’s exciting that we can even get to know institute directors here.”

“At Fraunhofer, what I like most of all is the close connection between theory and practice – and that also applies to the Talent programs. Each time, the mix is just right: I learn a lot about new topics, meet people who took part in previous events and get to know new people. The group dynamics are always good. I found the bits about how to start a career at Fraunhofer especially interesting this time – as were the tips on how to boost creativity.”

“Getting ideas for what career I might pursue is really motivating. And at events like these, I can concentrate and think about all the various possibilities, something I don’t get round to doing when I’m at home. That’s why I already attended Fraunhofer events such as ‘Talent School,’ ‘Junior Academy’ and ‘Talent Take Off – Networking’ last year. Next, I’d like to do an internship at a Fraunhofer Institute to get a taste of what it’s like.”

"I think the Fraunhofer programs are very impressive, so I've registered as a mentor. At every event I've been to in the past, I've got to know new scientists, learned about new fields of research and met nice people. Now I'm trying to pass on some of these things to others. When I was in high school, I would have really benefited from someone coming to our class and telling us how they decided what to study at a university and how they managed when they got there."

"I've already taken part in a few Fraunhofer programs. This time, the highlight for me was the entrepreneurship workshop with the design thinking method. There we followed up ideas that we would have ordinarily discarded right away – a good experience! I've also now signed up to be a mentor and am glad to pass on my experiences to others. The questions that arise because of this have forced me to think and reflect, which can only be good. And my network continues to grow. I think networking is extremely important nowadays; it's one of the main reasons why I keep coming back to Fraunhofer: it's so easy to meet people here who are on the exact same wavelength as me."

Conclusion:

"We've now developed programs that reach from kindergarten to university and introduce exciting research topics to children and teenagers at every step along the way – this fulfills an important condition for Germany to secure a new generation of science and engineering talent."

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