DLR at a Glance

DLR is the national aeronautics and space research centre of the Federal Republic of Germany. Its extensive research and development work in aeronautics, space, energy, transport and security is integrated into national and international cooperative ventures. In addition to its own research, as Germany's space agency, DLR has been given responsibility by the federal government for the planning and implementation of the German space programme. DLR is also the umbrella organisation for the nation's largest project management agency.

DLR has approximately 8000 employees at 16 locations in Germany: Cologne (headquarters), Augsburg, Berlin, Bonn, Braunschweig, Bremen, Goettingen, Hamburg, Juelich, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Stade, Stuttgart, Trauen, and Weilheim. DLR also has offices in Brussels, Paris, Tokyo and Washington D.C.

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DLR_School_Labs GB-4/15

The DLR_School_Labs

Out of the classroom—
into the lab!

DLR_School_Lab

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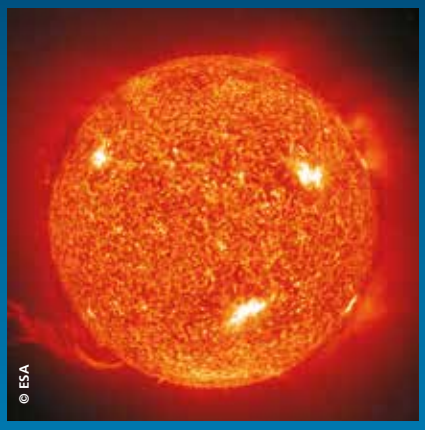

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Out of the classroom— into the lab!

The German Aerospace Center (DLR) invites students and their teachers to visit its high-tech student laboratories, the DLR_School_Labs. This is where young people and students have an opportunity to actively discover the fascinating world of research and technology. The special feature of our concept: in the authentic environment of a research institution the students themselves can carry out experiments which are specifically related to ongoing projects in the fields of aeronautics, space, transportation and energy. And so they experience how exciting the natural sciences and research can be.

Visiting a DLR_School_Lab also gives teachers important support for planning modern and interesting courses. By making accessible sophisticated equipment and facilities not usually available to schools and by pointing out practical applications for research results, their classroom instruction can be meaningfully augmented. Students are thus able to understand the purpose behind what they are being taught, in what kinds of jobs they can use their knowledge, and the advantages of applied research.

The topics covered by DLR_School_Labs in the form of "hands-on" experiments suitable for the age level of the participants reflect the entire range of DLR activities, from remote sensing of the "blue planet" Earth to new technologies like low-emission aircraft engines or environmentally-friendly and solar power plants to concepts for the mobile society of the future. In this way links are forged which connect all the "STEM" subjects (science, technology, engineering, mathematics) and are useful for follow-up activities at school. At the same time the young people and students become acquainted with research and technology methodologies—and learn that scientists not only "think" but sometimes have to "think ahead" on a scale of decades in order to work out approaches for tackling the socially rele-vant issues emerging on both near and distant horizons.

The didactic concept behind the DLR_School_Labs is to awaken the enthusiasm of young people already at an early age and then to deepen the interest of older students, as well as motivate them to choose a relevant course of studies or career. Special attention is given to attracting girls and young women. Although the DLR_School_Lab routine is designed for broad appeal, there are also special programmes for highly gifted young people—often carried out in cooperation with prominent partners such as "Jugend forscht" and other foundations.

The first DLR_School_Lab began operations in 2000 in Göttingen. Since that time, a total of twelve DLR_School_Labs based at various DLR locations or partner universities welcome and coach over 36,000 students every year.

DLR_School_Labs contribute to the wider-ranging DLR_Campus programme, which comprises all DLR activities addressing the younger generation, including summer schools, student workshops, and an ambitious training programme for doctoral candidates, the DLR_Graduate_Program. In this context, DLR_School_Labs are also in charge of other measures which DLR carries out expressly for schools: from Girls'Day to arranging for student traineeships at DLR institutes to children's universities and other events.

The following DLR_School_Labs offer programmes for visits of one or several days to secondary school classes—and in some cases also elementary school classes:

- DLR_School_Lab Berlin
- DLR_School_Lab Braunschweig
- DLR_School_Lab Bremen
- DLR_School_Lab Göttingen
- DLR_School_Lab Köln
- DLR_School_Lab Lampoldshausen/Stuttgart
- DLR_School_Lab Neustrelitz
- DLR_School_Lab Oberpfaffenhofen
- DLR_School_Lab RWTH Aachen
- DLR_School_Lab TU Dortmund
- DLR_School_Lab TU Dresden
- DLR_School_Lab TU Hamburg-Harburg

„Walking“ on Mars

DLR_School_Lab Berlin

Discovering fascinating natural science phenomena, interpreting and assessing the results of “hands-on” experiments, finding answers and discussing emerging issues—young visitors can expect all of this at DLR_School_Lab Berlin. Here are some of the subjects being offered:

- Camera and sensor technology: see the invisible with infrared cameras and stereometry.
- Solar energy: find out how efficient solar cells are and how to power vehicles with fuel cells,
- Traffic jams: learn with the help of simulations how the traffic situation can be improved anywhere in Berlin.

DLR_School_Lab Berlin offers a particular highlight: equipped with stereo eyeglasses, students can explore Mars as if they were walking over the surface of our mysterious neighbouring planet. Subjects are craters, dried out streambeds and other geological formations found on the Martian surface, and of course whether there was ever life on the “red planet,” or whether it could still be there. As at all the DLR_School_Labs, scientists and research assistants are available to help the young people and students carry out the experiments, and they can also share information about training and study courses.

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Experiments relevant for transportation

DLR_School_Lab Braunschweig

DLR_School_Lab Braunschweig focuses on topics related to transportation—in the air, on streets and rails. What are all the things that an air traffic controller has to pay attention to, and how does a pilot announce himself to the tower? How can road traffic be made even safer? And how are the thousands of trains involved in everyday rail traffic regulated? Other experiments deal with the following subjects:

- Sound research: sources of unwanted resonances and how to prevent them,
- Safety: identifying material faults that are invisible to the naked eye,
- Wind tunnels and numeric simulation: complementary aerodynamic investiga-tions of an aircraft wing,
- Rotor test stand: influencing the lift produced by helicopter rotor blades by modifying their shape,
- Catapult facility: constructing model aircraft and the discovery of flight mechanics.

By experimenting on their own, young people can informally figure out and understand physical processes and at the same time find out whether or not being a pilot is really their dream job, and what other exciting career perspectives exist in the world of research.

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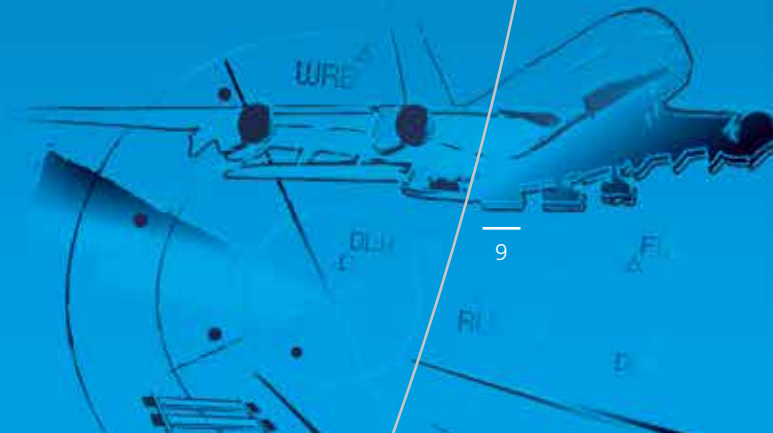

Teamwork on a voyage through space

DLR_School_Lab Bremen

At DLR_School_Lab Bremen the focus is on aerospace: how can people and technology be put into space and what conditions have to be taken into account there? How can Earth be monitored from space and how can distant planets, moons and asteroids be investigated? At the DLR Institute of Space Systems in Bremen, following a comprehensive and systematic approach is crucial. Working in teams on such an integrated undertaking, students at DLR_School_Lab can even carry out a complete Mars mission—from launch and descent onto the Red Planet to robot control and analysis of sand samples. They also discover how mission success depends on the smooth interaction of all systems.

Taken together, the hands-on experiments offered at Bremen encompass three subjects:

- Extremes and dangers in space,
- Satellite technology and remote sensing,
- Mission to Mars.

The students study vacuum conditions, microgravity, and space weather. They carry out experiments on propulsion technology, landing navigation, robotics, and sensor systems.

These intriguing hands-on experiments acquaint students with ongoing research projects at the German Aerospace Center and lead to fascinating insights into the world of natural science and technology.

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The mystery of flight

DLR_School_Lab Göttingen

Aviation is at the heart of DLR_School_Lab Göttingen. School classes conduct experiments on the physics of flight and related issues with the help of various high-tech instruments—like high performance cameras, computer-aided particle trackers and wind tunnels. Among other topics the experiments deal with questions like:

- How can airplanes and helicopters actually take off and fly?
- How can the flow and turbulence on a wing be made visible?
- How can extremely fast processes like the bursting of a balloon be recorded with high-speed cameras, and what is this equipment used for in research?

In the student workshop young visitors can also produce airplane models—from simple gliders to remotely controlled miniature airplanes—and then test whether they can fly. Students also even have a chance to experience the blast of the wind and the forces which develop inside a large wind tunnel. DLR_School_Lab Göttingen additionally offers schools help with follow-up projects.

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Artificial comets in the centrifuge hall

DLR_School_Lab Köln

DLR_School_Lab Köln makes available to school classes various types of equipment related to current DLR, such as a unique comet simulation facility, a small-scale wind tunnel for sound research and a miniature drop tower. Topics from the fields of biology and medicine can also be investigated.

The experiments are suitably adapted for the age group of the visitors and include such topics as:

- How can an "artificial comet" be produced, and what happens if the "sun" is then turned on? What is the reason for comet research, also as far as the earth is concerned?
- What exactly is weightlessness? Students can experiment with a miniature drop tower and with the help of a camera installed inside see how water and air are distributed in surprising ways during the weightless phase.
- How can little organisms like paramecia distinguish between up and down? And where would they swim under micro-gravity conditions when there is no "up" or "down"?

DLR_School_Lab Köln is located in the large centrifuge hall—where many astronauts trained for their flights into space—thus offering young visitors a rather special environment.

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Rockets: the most powerful machines on earth

DLR_School_Lab Lampoldshausen/Stuttgart

At DLR_School_Lab Lampoldshausen/Stuttgart students can design model rockets and even launch them themselves. We provide the simulation software they need to design and optimise their rockets before they test them in practice. Other facilities available to them are a vacuum chamber to create outer space conditions, an electric bus which is being tested on a dynamometer—and much more. There is even a virtual trip at the speed of light on the programme.

The experiments include the following topics, among others:

- Vacuum technology: space flight,
- Materials: lightweight, stable and extremely robust,
- Combustion technology: looking inside a flame,
- Alternative propulsion concepts: energy and a healthy environment.

At DLR in Lampoldshausen, where the DLR_School_Lab is next to large rocket testing facilities, the focus is naturally on the subject of propulsion for rockets, the most powerful machines on earth.

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Research projects for daily life

DLR_School_Lab Neustrelitz

Why is a rainbow never visible in the summer around noontime? Such intriguing questions from the natural sciences and technology are intended to convey to students at DLR_School_Lab Neustrelitz how enjoyable research can be. The well-designed experiments relate both to the students' daily life as well as to current DLR projects and cover these and other topics:

- What do satellites see? Our magic eyes in space,
- Light does not always equal light! What radio and microwaves have to do with light,
- Why are we interested in the extent of solar activity? Ionosphere & Co.,
- Compass, GPS, Galileo or what? Navigation yesterday and today.

The DLR_School_Lab is located at DLR in Neustrelitz, where data from various satellites are being received with large antennas and then processed. School groups can also gain stimulating insights into the reception of video images from a small satellite.

Additionally, there is a DLR_Project_Lab in Neustrelitz which offers nearby schools an opportunity for longer term cooperation in the form of courses and project work.

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Robots near the Space Operations Center

DLR_School_Lab Oberpfaffenhofen

DLR_School_Lab Oberpfaffenhofen is right next to the German Space Operations Center, which directs the work being carried out inside the European Columbus module of the International Space Station ISS and which can be toured as part of a visit to DLR_School_Lab.

School classes are offered numerous exciting and informative experiments on the following topics:

- Infrared measurement technology,
- Laser technology,
- Radar measurement technology,
- Environmental spectroscopy,
- Weather and climate,
- Satellite image analysis,
- Satellite navigation,
- Robotics,
- Virtual mechanics,
- Flight team simulator,
- Mobile rocket base.

We make our expertise and sophisticated technology available—sensors, robots, a satellite data archive, a professional workplace for meteorologists, and much more. The robotics experiment is quite special: students can themselves control the movements of a small rover through an artificial Mars landscape. The mini-robot vehicle transmits video images during its trip and reacts to control commands.

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High-tech Robotic Experiments

DLR_School_Lab RWTH Aachen

The hands-on experiments at DLR_School_Lab RWTH Aachen focus on robotics and artificial intelligence. Robotics is an especially fascinating field for young people. Visitors to DLR_School_Lab RWTH Aachen can look forward to the following experiments:

- Smart city: What is involved in supplying society with renewable energy, and how can the provisioning be intelligently managed?
- Helping hands: Learn how an industrial robot works and how to program it.
- Quadrocopter: How can an autonomous aircraft be designed so it can be controlled as "intuitively" as possible, and what is intuition, anyway?
- Driving simulator: How do "intelligent" cars sense their highly dynamic surroundings, and how can they get us safely to our goal?
- Humanoid robots: to what extent are "humanoid" robots like us, and what can they accomplish? The purpose of the experiment is to make students aware of the complexity of human motion and to apply the insights gained about their own sense of balance to the humanoid robot NAO.

The experiment „A Walk on Mars" is something special. Using the "holodeck" of an institute cluster at RWTH Aachen, students set off for a virtual tour on our neighbouring planet. Participants follow the tracks of former Mars missions and investigate the climate, geology and topography of the "Red Planet".

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Sensing virtual objects and the structure of materials

DLR_School_Lab TU Dortmund

DLR_School_Lab TU Dortmund investigates many stimulating questions from a wide variety of disciplines: how does a robot have to be programmed to independently find the right route? Or: how do solar cells really function? Other key words are:

- Chaos in the solar system,
- Future motor vehicles,
- Microgravity,
- New materials.

Other fascinating investigations deal with virtual objects that cannot only be visualised on a monitor but even actually "felt" through interactive feedback, or use the famous double slit experiment to aid understanding of the structure of materials.

DLR_School_Lab is right on the campus of TU Dortmund—giving young participants the chance to become ac-quainted with a university. Depending on scheduling, visitors to DLR_School_Lab TU Dortmund also have an opportunity to see the electron accelerator Delta, an impressive research facility.

The DLR_School_Lab came into being in 2008 as a joint project of DLR and Dortmund Technical University—supported by the North Rhine-Westphalia Ministry of Innovation, Science, Research and Technology.

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The future subjects Energy and Mobility

DLR_School_Lab TU Dresden

At DLR_School_Lab TU Dresden students learn about current challenges in the areas of energy and mobility. While undertaking their own experiments they acquaint themselves with relevant projects at DLR and TU Dresden – and also discover the importance of this research for tomorrow's society.

- What could make solar cells cheaper and more powerful?
- Can hydrogen be produced with less energy than at present?
- How do new materials have to be designed to make them lightweight as well as sturdy and versatile?

At DLR_School_Lab TU Dresden students turn into promising young scientists and perform actual research assignments tailored to their age level. They plan the experiments, carry them out themselves, present their results, and discuss them with their schoolmates. Modern equipment for the experiments and many demonstration objects are available in our lab at Technische Sammlungen Dresden. Advanced students from TU Dresden provide any assistance needed and share information about university life and studies.

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Why birds flap their wings—while airplanes shouldn't

DLR_School_Lab TU Hamburg-Harburg

A bird flaps its wings in order to fly. But for an airplane flapping could have di-sastrous consequences. Why is that the case? And how can it be prevented? How can an airplane fly anyway? What forces keep even heavy machines up in the air?

At DLR_School_Lab TU Hamburg-Harburg young people and students have an op-portunity to themselves carry out science experiments. It becomes immediately evident that technology is fascinating, and it is fun to find out why certain things happen and what conclusions can be drawn. What has been learnt in school suddenly appears in an entirely new light. And possibly one or the other visitor may discover that this is a field worth considering as a future career.

The experiments at DLR_School_Lab TU Hamburg-Harburg focus on two main areas with many research and development topics in common, such as flow technology:

- Aviation: Hamburg is the third largest location worldwide for the civil aviation industry,
- Shipping: Hamburg is also one of Europe's largest harbour cities.

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