

experimenta



A Science Center in a New Dimension

avedition

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When Inquiry Leads to Learning-by-doing

Answers to the great challenges facing our time such as digitization, mobility, climate change, the transition to renewable energy, and health determine the future viability of our region, the country, and the people who live here. Education and science are decisive factors in this process of finding solutions and shaping and securing our future.

Learning and the acquisition of knowledge are often demanding, arduous, and challenging, not just at school or during vocational training or university studies, but also throughout our lives—for all of us. Albert Einstein once said that “joy in looking and comprehending is nature’s most beautiful gift.” Children learn many things seemingly just “incidentally” as they experience and explore their surroundings. Learning is a like game and exploring is fun and enjoyable.

It is precisely this childlike joy of seeing and literally grasping things that experimenta makes possible—for young and old alike. Its interactive offerings inspire visitors, awakening a joy in experimentation and promoting a thirst for knowledge. Children and teens in particular are encouraged to delve deeper into technology and the natural sciences. They are given a sense of accomplishment when things succeed and when they are able to grasp and understand things through playful discovery. experimenta thus does its part to ensure that learning is experienced as something positive.

That this has succeeded is also due to experimenta’s architecture. The new building itself is both unusual and experimental in its impact: an upward spiral joins the spacious and bright foyers that provide ever-changing panorama views of the city and the surroundings. It also takes visitors to the studios where creativity is given free rein as well as to four large exhibition levels where experimenta’s diverse offerings and knowledge formats are presented to visitors.

Through this interaction a place has been created in which people of all ages can experience knowledge and science as fun and joyful. Like many other activities of the Dieter Schwarz Foundation, experimenta as a science center is thus an investment in the future which contributes in the long term to mastering the current and future challenges facing our society.

We wish experimenta many enthusiastic visitors.

Dieter and Franziska Schwarz
Heilbronn, May 2021



←
Maker
Space

WISSEN
KRAFT
ZUSAMMEN

WISSEN
KRAFT
ZUSAMMEN



Forum

DU BIST WISSENSCHAFT





The Architecture of the New Building

Only a few years after opening its doors, experimenta's immense success led to thoughts of an expansion. Comprehensive reflections on the museum's structure and offerings laid the foundations for an architectural competition, which was decided in 2013 in favor of the design by Sauerbruch Hutton. Planning began in January 2014. Sauerbruch Hutton coordinated an interdisciplinary planning team consisting of Schlaich Bergermann Partner (support structure), Drees & Sommer Advanced Building Technology (TGA, structural physics, façade planning), Hager and Partner (landscape partner), and other specialists. Accompanying the planning, a process of tendering and contracting led by Drees & Sommer made it possible to begin construction already in March 2016. The planning was carried out on the basis of a three-dimensional model of the building (digital planning method BIM), to support the efficient collaboration of all those involved and to facilitate decision-making. Based on the model, information was combined and linked together so that the ongoing coordination and integration of geometry, quality, costs, time, and environment could be monitored by all participants in real time.

experimenta had stipulated a very clear program of use and accompanied the design in all its phases; the builders were involved in all important decisions. The building is thus the result of a very close collaboration.

Architectural Concept

experimenta's new building was conceived to form a pair of complementary building sculptures together with the renovated Hagenbucher storehouse, which were juxtaposed like large objects on the Kraneninsel island in the Neckar River. Between the two experimenta buildings runs a foot and bicycle path leading to the city center and the main train station area. A spacious square situated directly on the water invites visitors to linger. This public space is carried over inside the building—not only in the form of a foyer on the ground floor but it also “flows” further—both downwards into an expanded foyer and events space on the lower level, and upwards into a continuously opening area that runs through the entire building in the form of an ascending space spiral ending at the roof terrace.







A Science Center in a New Dimension

Introduction

In 2017, John W. Jacobsen, president of White Oak Associates, published a compendium for museum managers.⁵⁵ For over forty years, Jacobsen had concerned himself with the analysis, planning, and direction of museums. His book exemplifies a large number of publications concerned with museum history, construction, planning and design, content, educational theory, operational organization including personnel, and ancillary offerings such as food services and shops. Similarly, the future and role of museums in the twenty-first century is increasingly the subject of conferences and specialist articles.^{8,91,101} The number of publications specifically dedicated to science centers has also markedly increased.^{12,14,32,34,80,81} But at least in the German-speaking areas, no overview addressing all these themes exists specifically for the science center.

What follows will attempt to describe the development, characteristic features, intentions, and ambition of this type of institution within the educational offerings of a modern society, based on the concrete example of experimenta Heilbronn. While many aspects can be generalized and are applicable to numerous science centers, due to its complex, interdisciplinary offerings, experimenta is also an example of the forward-looking development or reinterpretation of this kind of institution. The essays in this book describing the contents, the brand, and the architecture complement and complete this picture.

As a science center, experimenta grew out of the idea to conceptually and thematically modernize the already extant, Naturhistorisches Museum—at the time Heilbronn's most tradition-steeped museum—and thus position it more suitably within an economically robust region with numerous global technological leaders.⁴¹ In this, parallels exist to the Technorama science center in Winterthur, Switzerland, which was preceded until 1990 by a museum of technology. In Heilbronn this entailed a redesign of its museum landscape, beginning in 2008.^{5,39,41}

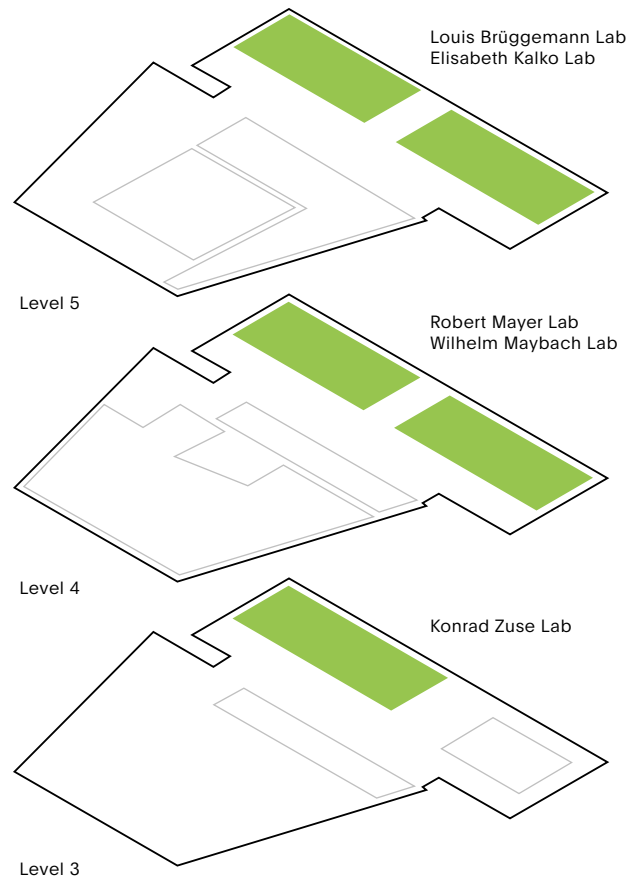


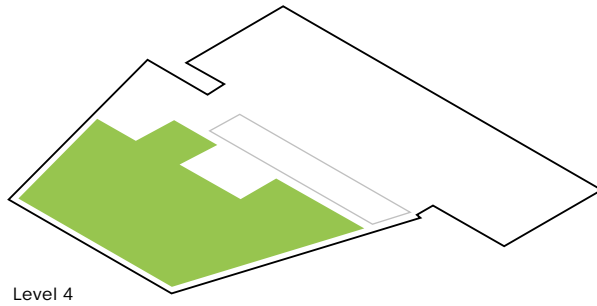


The Research Worlds

Getting to know the ways of the world means more than accumulating knowledge. This is why the experimental Research Worlds focus on guided explorative learning. In the process, visitors grapple with theories, test them using various methods, and in this way find answers to their questions on their own. This facilitates the comprehensive examination of a topic, the grasping of interrelationships, and confidence in one's own creativity in finding solutions to problems. During explorative learning, students also learn how to learn.

Laboratory Facilities for the Secondary School Level p. 108



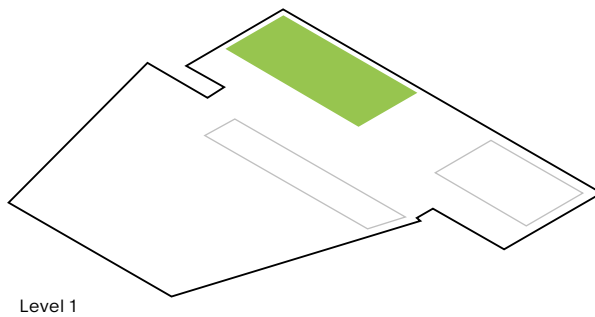
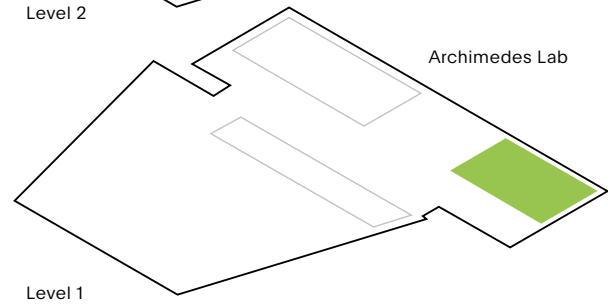
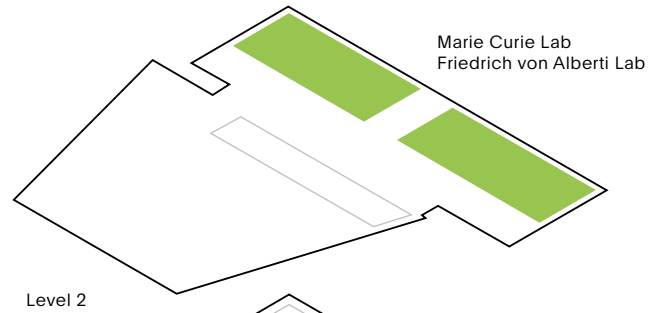


The Student Research Center sfz Nordwürttemberg

p. 110

The labs for elementary and middle-school levels

p. 104

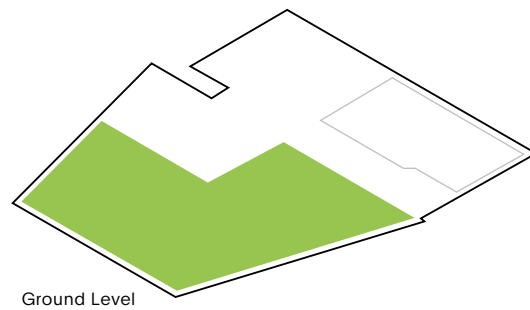


The Carl-Heinrich Knorr Test Kitchen

p. 106

The Maker Space

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The Student Research Center



In the 400 m² area on level four of the renovated original building, the Student Research Center sfz gives young people the opportunity to work on scientific and technical research and development projects on their own or in small groups over a longer period of time and free of charge. The results are submitted to competitions like Jugend Forscht or presented at student conferences.

In addition to providing vocational orientation and career guidance in the STEM sector, the aim is to support interested young people in acquiring further skills: a capacity for empathy, creative and critical thinking, problem-solving and decision-making skills, interpersonal relationship skills, the ability to work on a team, stress management, and resilience. Granting students general autonomy offers them a framework within which they can acquire competence in a self-determined manner and can experience self-efficacy. A large support team

is available to them: experimental scientific staff, instructors, volunteers (e.g. retired professors), and student assistants. Experienced sfz students are also hired as part-time staff for mentoring within the framework of peer education and Learning by Teaching.

To be able to offer authentic vocational orientation and career guidance and to make "exploratory learning" attractive, the sfz has labs equipped to a standard comparable to university labs. The sfz has over eight twenty-five-m² rooms: two each of chemistry, biology, physics, and technical labs. The biology labs are designed for genetic engineering research at safety level 1. The labs have a wide range of instruments and equipment such as fluorescence and depth-of-field microscopes, safety cabinets, CO₂ incubator, PCR, gel documentation system, gas chromatograph, infrared spectrometer, atomic force microscope, optical tweezers, medical ultrasound measurement devices, drones, as well as actuators and sensors for building robots.

The central common area with its kitchenette is ideal for gathering and social interaction. There are other functional rooms nearby. The equipment and rooms of the secondary-school-level labs can also be used outside of course hours.





Science Dome

In the Experience Worlds, the Science Dome is the central location for facilitating immersive learning. It was designed as a combination of domed hall and theater stage to offer unique forms of use.

Beneath the 726 m² projection dome is a state-of-the-art full-dome planetarium. Equipped with a ZEISS star projector, the planetarium follows the tradition of the star theater. With Walther Bauersfeld's invention of the projection planetarium known as the "Wonder of Jena," the first presentations of the artificial night sky began at the Deutsches Museum in Munich. Over the next decades, planetariums became educational institutions for astronomy in which technologically automated presentations with slide projections and recorded lectures were played by a sound system. The first 360° projections were produced as all sky or panorama projection using six or twelve slide projectors and for the first time provided an immersive experience that went beyond the natural starry sky. The emergence of giant screen and IMAX theaters with spectacular documentaries on subjects in technology, natural science, or space flight led to a merging of the two media formats and an opening of the content presented in planetariums to include other topics.

Further developments in video projection and computer technology culminated in the opening of the first digital fulldome planetarium at the American Museum of Natural History in New York in early 2000.

The Science Dome follows this tradition, but is a unique fulldome theater. While the first planetariums had an omnidirectional seating

orientation so that visitors saw different sections of sky displayed in front of them, many fulldome planetariums today like the Science Dome are unidirectional in orientation and are thus capable of directing the visitor's gaze to a specific section of sky during fulldome presentations. The rising angle of the auditorium with a projection dome angled at 15 degrees gives the whole audience an unobstructed view of the entire projection area, providing an immersive experience. The projection is not shown in one area at the rear of the planetarium because of the steep angle of the dome. A complete theater stage and back-of-house area have been placed there.

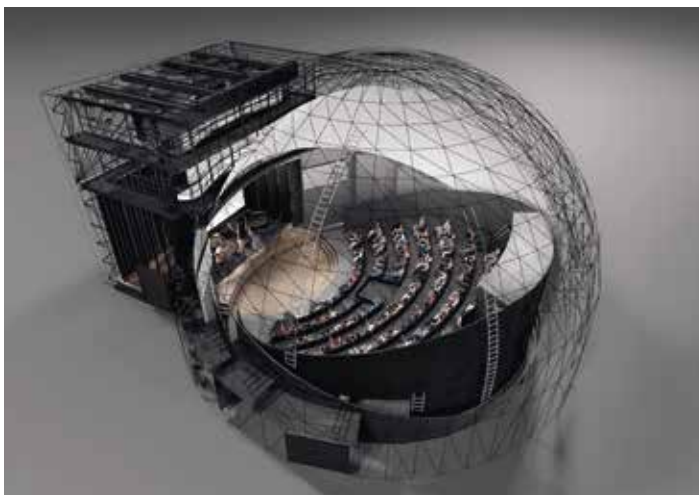
To use the Science Dome both as a fulldome planetarium and a theater, the circular auditorium has been placed on a rotating platform twenty-one meters in diameter. Thanks to a circular track, the auditorium can rotate 180° in just sixty-five seconds while the audience remains comfortably in their seats. The back-of-house area with its 180 m² stage and proscenium of six meters is equipped with rigging, media lifts, and a sophisticated light and sound system. It meets the standards of a state-of-the-art theater. Additional equipment also allows the stage to be used for experimental shows. Metal mesh on walls, ceiling and floor of the stage create a Faraday cage for a high voltage demonstration in which four Tesla coils shoot up to three-meter bolts of lightning at 1.2 million volts into the air. The side stage is also fully equipped as a lab to prepare chemical experiments and furnished with a mobile fume hood that can also be used on stage.

Another special feature is the water curtain: microscopically small drops are sprayed into the back-of-house area and produce a ten-meter-wide curtain onto which video or laser shows can be projected.

Next to it a big screen covering the entire stage opening turns the Science Dome into a science theater with a brilliant 4-K video projection.

The visual full-immersion impression is complemented acoustically by a 3-D audio system. Over thirty high-end loudspeakers are situated in several rings on the cupola of the Science Dome. Virtual sound sources in space can be simulated using the 3-D sound system so that visitors can locate the motion of the sound sources in the room. In interaction with the visual 360 (Grad-Zeichen)-3D-technology, for example, an airplane can be moved visually and acoustically through the Science dome and intensify the emotional experience.

The laser show system with its six projectors, many mirrors, and effects like theatrical smoke and fog make it possible to produce a depth effect. Laser beams are thus not only on stage, but extend out through the auditorium, visible through the theatrical smoke and fog, and tempting enough to want to reach out and touch.



Thanks to a rotating auditorium, presentations in the Science Dome are possible in stage- (left) and dome-mode (right).



Substantive Objective

With its extraordinary immersion experience, spectacular effects, and the personal interaction between the edutainer and visitors, the Science Dome presents an opportunity to arouse curiosity about the world.

By eliciting an emotional response, it is possible to teach scientific content in a different way in a full-dome planetarium and to inspire questions about science and technology. Complemented by the forms of presentation of the theater, the Science Dome is a facility for communicating content with a wide range of different formats. The Science Dome's thematic aim is the teaching of science and technology and is thus not limited to individual fields such as that of astronomy or space travel. Instead, its aim is to follow an interdisciplinary approach.

It is hoped that visitors leave the Science Dome with a better awareness of the world around them and the issues of the present day and the future and that they are encouraged to ask questions and—in keeping with the Explor-

atorium's motto: "...to ask questions, question answers...."

With its appeal as a special event location, the Science Dome attracts new visitor groups. The Science Dome's technological image and broad-based offerings can attract the attention of target groups less likely to be drawn to a Science Center. The formats range from laser shows to a broad range of films. Classic full-dome films such as "We are Stars—3D", "Dream To Fly—3D", or "Das Licht der Nacht" use the immersion of 360° projection and communicate a scientific picture of the universe and the heavens and the corresponding history of science. In 360° animated films like "Polaris" or "Limbradur" produced specifically for children, the young audience can more easily immerse themselves in history through characters in a story, and scientific content is presented vividly and in a way children can understand.

In order to have more say in the selection of topics, experimenta decided to film its first in-house production in 2018. Producing a full-dome film is a highly technical feat since the resolution of almost 64,000,000 pixels in a

Authors



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Kenan Bromann

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Dr. rer. nat. habil. Wolfgang Hansch

Studied Geology. Academic career / work residencies at: Universität Greifswald, Bergakademie Freiberg (Saxony), Museum für Naturkunde Berlin, University of Leicester (UK), Museum of Natural History London. Private lecturer. Numerous research trips / studies as part of academic projects (until 1999), among other places in the USA, Australia, European countries. As of 1994 Head of the Naturhistorischen Museums Heilbronn. Supervision of over 20 major exhibition projects on topics in nature, technology and culture. As of 2005 scientific director of the "Science Center Project Heilbronn", since March 2007 executive director of der experimenta gGmbH with sole power of representation. Editor, author and co-author of over 90 scientific and popular science publications.

Functions under mandate and in associations, currently incl. Chairman of the State Association for Science and Technology Youth Education in Baden-Württemberg, Member of the University Council of Heilbronn University.



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Studied German Language and Literature, History and Auxiliary Sciences of History at the Universities of Tübingen and Vienna. Many years of work in publishing, most recently as program manager. 2003–2006 Hochschule der Medien, Stuttgart; on-the-job doctoral studies at LMU Munich. 2006–2016 Professor for Service Management / Media and Communications at Baden-Württemberg Cooperative State University (DHBW) Stuttgart. 2009–2016 Member of the (Founding) Board of the DHBW. 2011–2016 Director of Communications DHBW. Since 2017 Director of Communications and Administration (Brand Management, PR, Event Management, School Communications, Personnel, Visitor Services) at experimenta gGmbH.

Numbers mandated functions, incl. Member of the Broadcasting and Administrative Council of SWR (2015–2020).



Prof. Dipl.-Ing. Architekt, Hon. FAIA
Matthias Sauerbruch

Studied at the College of Fine Arts Berlin and der Architectural Association School of Architecture in London, subsequently project manager and until 1988 Partner at OMA Office for Metropolitan Architecture. 1989 established offices as managing director in London together with Louisa Hutton. Since 2001 Sauerbruch Hutton in Berlin, since 2020 responsibility for the offices is shared by 19 partners and 10 associates.

Professor, e.g. at AA London, the TU Berlin as well as the Stuttgart State Academy of Art and Design (ABK Stuttgart); guest professorships at the University of Virginia in Charlottesville (2006), at the Harvard Graduate School of Design (2005–2009) and at the College of Fine Arts Berlin (2012–2014).

Founding member of the German Sustainable Building Council (DGNB e.V.), Member of the Urban Design Commission for the city of Munich and of the Board of the KW Institute for Contemporary Art Berlin. Honorary Fellow of the American Institute of Architects and Member and currently Director of the Architecture section of the Akademie der Künste in Berlin



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1997–1999 Project management at the Vienna Museum of Science and Technology for the Section "Nature & Knowledge". 2003–2009 Curator for Physics, Geophysics & Geodesy at the Deutsches Museum in Munich. Since 2009 Director of the Section Discovery Worlds (Exhibition, Special Exhibitions, Forum) at experimenta gGmbH.

Author of various (popular science) publications on the history of science and physics education. Direction and co-development of numerous exhibitions on the history of science and interactive exhibitions.



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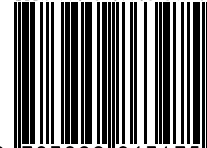
Studied biology at the University of Heidelberg with majors in Bioinformatics and Molecular Biology. Doctorate studies at the European Molecular Biology Laboratory (EMBL), Heidelberg. 1998–2003 Research Associate at Florida State University in Tallahassee/Florida and at EMBL Heidelberg. 2003–2009 Project Director of the student lab at ExploHeidelberg in Heidelberg. Since 2009 Director of the Section Research Worlds (Labs, Student Research Center, Maker Space) at experimenta in Heilbronn.

Research stays in Great Britain, France, USA. Author of numerous academic and scientific peer-reviewed publications as well as organizer of international scientific and pedagogic-didactical conferences and seminars.

This book about Germany's largest science center explains experimenta's origins in the context of science centers, planetariums, and student labs as institutions of education. It also vividly documents the innovative offerings available as well as its unique didactic concept. The richly illustrated volume is accompanied by remarks on the architectural design concepts of both experimenta buildings: the repurposed historical Hagenbucher storehouse and the spectacular new glass and steel structure designed by Sauerbruch Hutton.



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