

# FORWARD MOMENTUM 2025

## THE STRATEGIC PLAN FOR SANFORD UNDERGROUND RESEARCH FACILITY





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# A MESSAGE FROM THE BOARD

It is our pleasure to present FORWARD MOMENTUM 2025, a strategic plan designed to lead the South Dakota Science and Technology Authority (SDSTA) and the Sanford Underground Research Facility (Sanford Lab) into a bold future. The goals and objectives outlined in this plan were developed with thoughtful input by the SDSTA staff, senior science researchers, and national laboratory partners directly involved with Sanford Lab's current efforts and future plans.

The future of Sanford Lab has never been brighter. The SDSTA and its partners have developed the deepest underground science research facility in the United States—nearly a mile underground. The researchers working at Sanford Lab today are world leaders in their respective disciplines, striving to solve some of today's most compelling science questions. The experiments include studies to understand dark matter—a substance that makes up more than 80 percent of matter in the universe, but never has been directly measured—and how neutrinos can help us understand the imbalance of matter and anti-matter in the universe. Sanford Lab also supports a broad base of science activities in biology, geology, chemistry, and engineering.

The vision outlined in this strategic plan will prepare Sanford Lab to successfully host future generations of our current experiments and one of the largest proposed international megascience experiments to ever occur on U.S. soil called the Deep Underground Neutrino Experiment (DUNE) and its supporting facility, the Long-Baseline Neutrino Facility (LBNF). Led by Fermi National Accelerator Laboratory (Fermilab), LBNF and DUNE seek to unlock the mysteries surrounding the fundamental properties of neutrinos and how they oscillate from one type to another as they travel through the universe. They also hope to achieve a better understanding of the matter and antimatter imbalance stemming from the Big Bang.

It is clear that Sanford Lab's future will be exciting and will advance the facility's role on the world stage of premier science laboratories. The SDSTA's overarching objective is for Sanford Lab to be a premier location for underground science research for decades to come. As we move forward, we must respect and recognize the core beliefs embodied in our mission and our values, which have helped us reach this point in our success. Our values provide the guiding principles on how we work and how we treat our team members, partners, and visitors with the highest level of dignity, integrity, and respect, while maintaining our commitment to diversity. Our mission continues to be two-fold: to advance compelling underground, multidisciplinary research in a safe work environment and to inspire and educate through science, technology, and engineering. For this plan to be successful, it must go far beyond this document. It must be a central part of the daily activities that drive Sanford Lab's operations. We must embrace these goals with a sense of urgency and follow through with the action plans needed to make them and our future a reality.

We would like to express our deepest appreciation to those who have come before us in making Sanford Lab a reality and to those who have invested their time in developing this strategic plan to guide us in creating and realizing an exciting vision for the future of Sanford Lab and the SDSTA.

**Mr. Mike Headley**  
Executive Director,  
SDSTA



**Mr. Casey Peterson**  
Chairman, SDSTA Board  
of Directors



# OUR HISTORY

Sanford Lab is located at the former Homestake gold mine in Lead, S.D. Until its closure in 2002, Homestake was the largest and deepest gold mine in North America, producing approximately 41 million ounces of gold in its lifetime. Following the mine's closure, Barrick Gold Corporation, which owned the mine, agreed to continue dewatering as negotiations to develop a deep underground science laboratory proceeded. But as progress slowed and dewatering and maintenance costs increased, Barrick turned off the pumps.

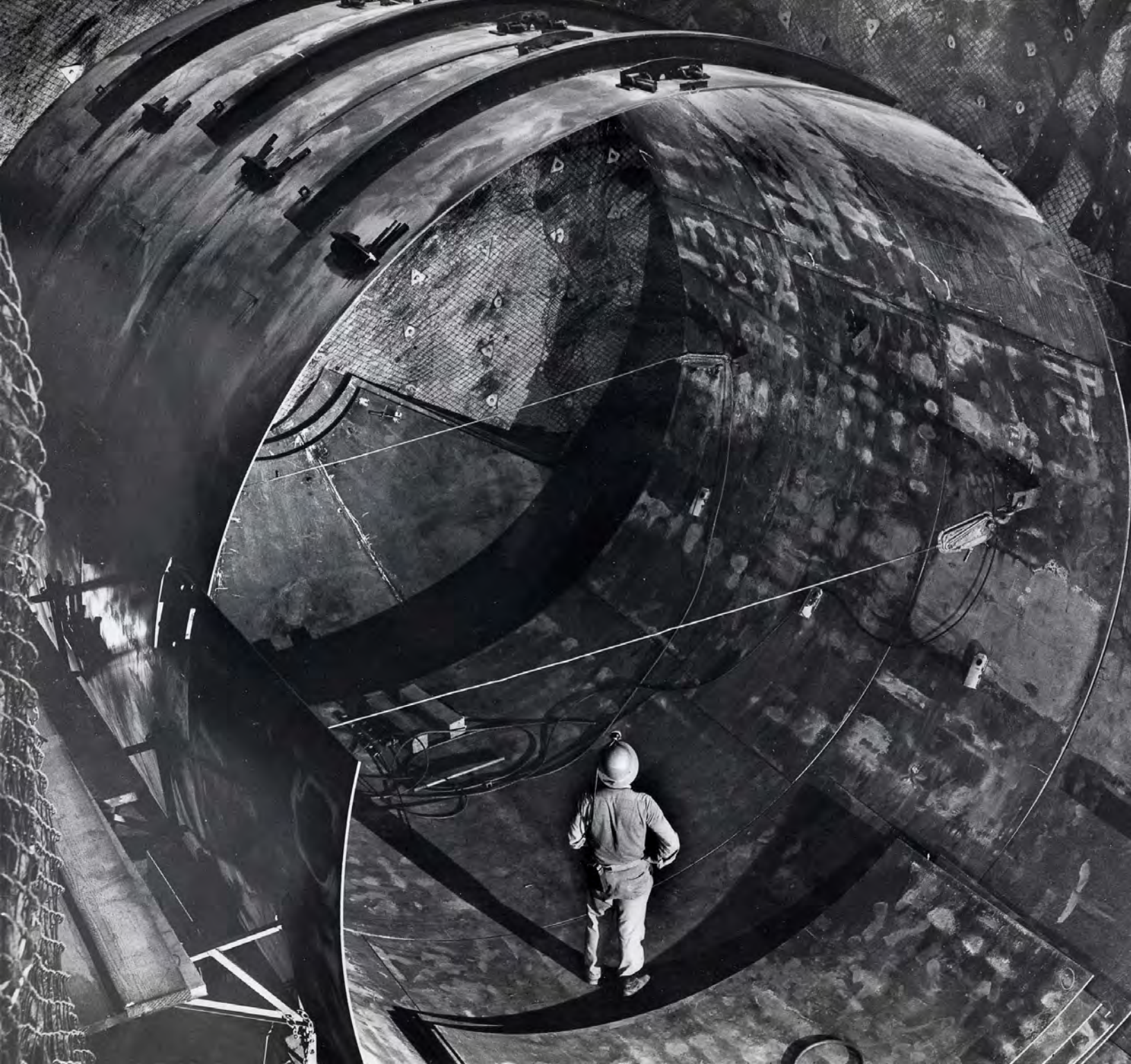
**EARLY PHYSICS RESEARCH.** The idea of housing physics research at Sanford Lab came long before its official conversion to a research facility. The first physics experiment came to Homestake Mine in the mid-1960s when Dr. Ray Davis, a chemist from Brookhaven National Lab, began building his solar neutrino experiment on the 4850 Level. Despite nearly three decades of counting neutrinos, Davis consistently found only one-third of the number predicted. This became known as the solar neutrino problem. Eventually the problem was solved through new understandings in neutrino physics. By the time Ray Davis received the Nobel Prize in Physics in 2002, the deep caverns of the mine were coveted for continued particle physics research.

**BUILT ON PARTNERSHIPS.** Advocates for underground science continued working on developing a deep underground laboratory, and in 2006 Barrick donated the property to the State of South Dakota for use as an underground laboratory. T. Denny Sanford, for whom the facility is named, donated \$70 million to the project, while the state

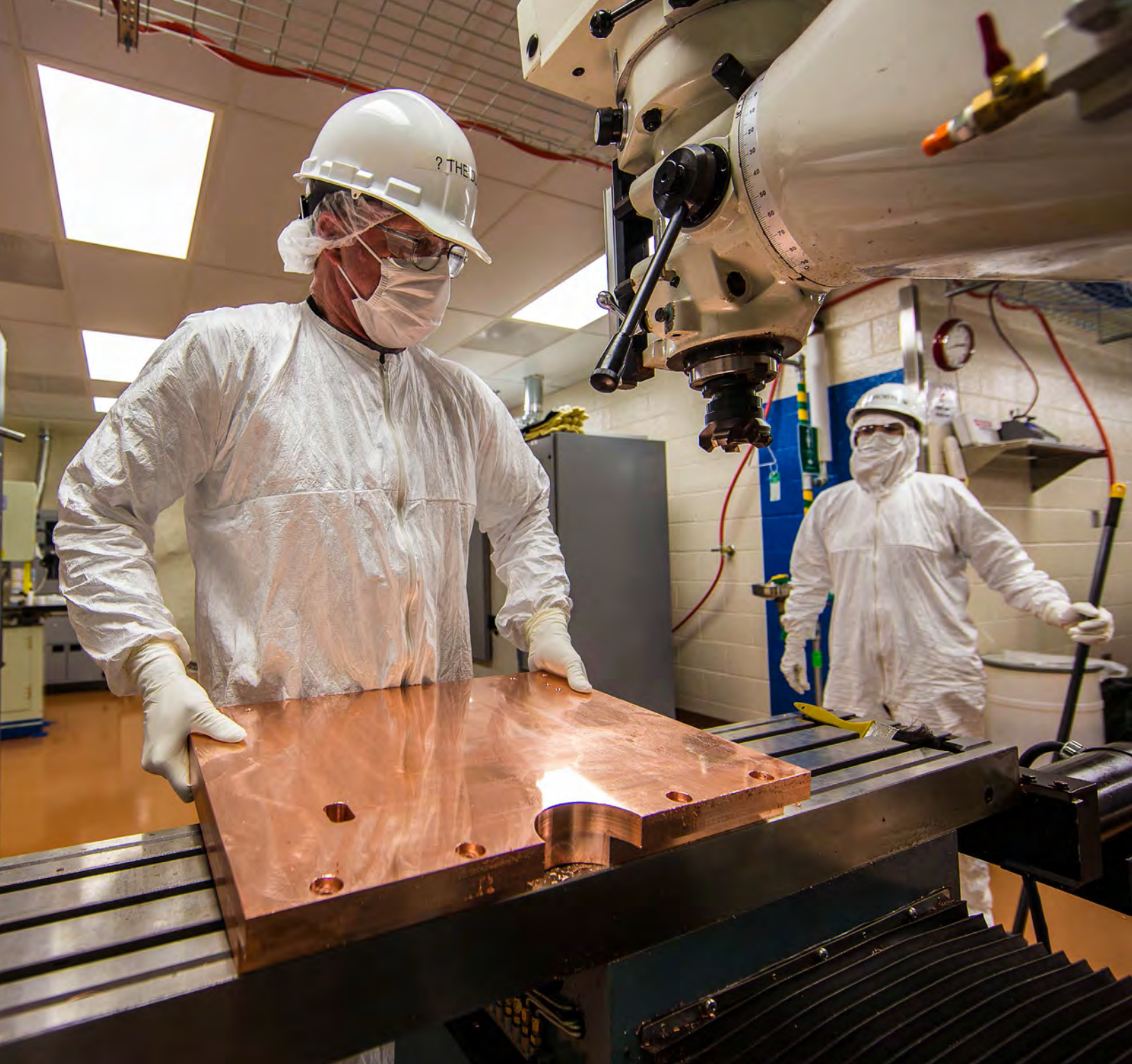
committed \$40 million and created the South Dakota Science and Technology Authority (SDSTA) to run the site. On July 10, 2007, the mine was selected by the National Science Foundation as the location for the Deep Underground Science and Engineering Laboratory (DUSEL), winning out over several other sites. Homestake's selection paved the way for the SDSTA to begin reopening the mine. Since 2003, however, the mine had slowly been filling with water. Before the work of building a physics laboratory could begin, the water needed to be pumped out. An additional \$10 million in grants allowed refurbishing to begin.

**CHANGE IN DIRECTION.** In December 2010, the National Science Board decided not to fund further design of DUSEL. However, in 2011 the Department of Energy, through the Lawrence Berkeley National Laboratory, agreed to support science operations at the lab. The first two major physics experiments located on the 4850 Level were the Large Underground Xenon (LUX) experiment and the MAJORANA DEMONSTRATOR experiment. LUX is housed in the same cavern that was excavated for Ray Davis's experiment in the 1960s. In October 2013, after an initial run of 80 days, LUX was determined to be the most sensitive dark matter detector in the world. The MAJORANA experiment is searching for a rare type of radioactive decay called "neutrinoless double-beta decay." If this phenomenon were detected, it could confirm that neutrinos are their own antiparticles and provide clues as to why matter prevailed over antimatter.









# OUR FUTURE

In addition to LUX and MAJORANA, Sanford Lab hosts other experiments, including CASPAR (Compact Accelerator System for Performing Astrophysical Research), which hopes to reproduce and study the complex processes that occur in stars. Sanford Lab is proud to partner with Fermilab on the Long-Baseline Neutrino Facility and associated Deep Underground Neutrino Experiment (LBNF/DUNE). Fermilab is leading a collaboration of 800 researchers from 26 countries. Called “the next frontier of particle physics,” LBNF/DUNE will follow neutrinos as they travel 800 miles through the earth from Fermilab in Batavia, Ill., to Sanford Lab in Lead, S.D. Other experiments in geology, microbiology, and engineering also take advantage of the unique underground environment. Further, Sanford Lab will host the next generation dark matter detector, LZ (LUX-ZEPLIN), and MAJORANA hopes to develop a much larger version of its experiment.

Education is integral to the SDSTA’s mission and Sanford Lab is focused on inspiring K-12 students to consider careers in science and engineering. Pilot education programs have reached thousands of students and teachers across South Dakota. Through generous funding provided by T. Denny Sanford, the Sanford Science Education Center will provide education and research opportunities for decades to come. We will continue to pursue transformational education and outreach programs for South Dakota teachers and students, with an eye to creating model programs that can be used in regional, national, and international schools. Sanford Lab also partners with the Sanford Lab Homestake Visitor Center to offer educational programming to the general public.

We aim to:

- **Position Sanford Lab as a globally competitive laboratory.** We seek to exceed the expectations of our researchers and scientists in their work at Sanford Lab in all aspects, ranging from science support to safety to hospitality.
- **Align our processes and procedures with those used in national and underground laboratories.** As the location of several world-leading experiments in physics, we hope to become the preferred location for underground science experiments from around the world. We strive to adapt the best national laboratory policies in the areas of environment, safety, and health, as well as project management to provide seamless integration with researchers and hosted experiments.
- **Support our dedicated workforce through enhanced organizational capacities and professional development opportunities.**
- **Build upon the incredible support we received from the State of South Dakota.** The State’s strong financial commitment has given us a competitive advantage over other potential research sites. More importantly, our Legislature, workforce, and communities across South Dakota recognize the value of Sanford Lab to science around the world and to education at all levels. South Dakotans are proud to have such a facility in their state.







# OUR MISSION AND VALUES

## MISSION STATEMENT

To advance compelling underground, multidisciplinary research in a safe work environment and to inspire and educate through science, technology, and engineering.



## OUR SHARED VALUES

At Sanford Lab, values drive our culture. Values guide how we treat each other, our partners, and our visitors. Values dictate how we manage operations and projects, and influence our decisions. We are proud to be part of the Sanford Lab team and it shows in how we demonstrate our values.

**SAFETY** – We value human life and health above all else. We are personally accountable for our own safety and collectively responsible for each other's safety. In meeting our goals for quality, cost, and scheduling within all of our operations, we do not compromise safety.

**PROFESSIONALISM** – We understand that every team member represents Sanford Lab. We show professionalism through our language and behavior.

**DIVERSITY** – We acknowledge and honor the fundamental value and dignity of all individuals. We pledge ourselves to create and maintain an environment that respects diverse tradition, heritage, and experience.

**INTEGRITY** – We deliver what we promise. We are honest and loyal to each other and our partners.

**RESPECT** – We treat one another, our partners, and our visitors with respect. We show respect by listening first, acknowledging different positions, and recognizing everyone's contributions.

**CUSTOMER SERVICE** – We are dedicated to providing seamless, intuitive, and hassle-free support. We embrace a culture of continuous improvement.

**TEAMWORK** – We depend on each other and achieve more as a team than as individuals.







Develop underground and surface infrastructures that will support underground laboratories.

## OBJECTIVES

1. Develop a facility master plan.
2. Develop an access utilization coordination plan.
3. Complete underground infrastructure projects in line with the facility master plan.
4. Complete surface infrastructure projects in line with the facility master plan.
5. Establish additional science space underground to host future experiments and ensure Sanford Lab's longevity.

## INFRASTRUCTURE

We will:

- Provide safe, reliable underground access through the completion of the Ross Shaft rehabilitation and the Yates Shaft maintenance activities.
- Forecast underground access and surface needs of the facility and respond to those needs with a workable plan that enables research to occur while allowing time for upkeep and maintenance.
- Create and deploy a facility master plan that is responsive to current needs yet mindful of future growth opportunities.
- Create new spaces to house underground multi-disciplinary research.
- Bolster the existing infrastructure such that backup systems are online and necessary upgrades are achieved.





**Provide quality resource and technology support to research groups, which will distinguish the Sanford Underground Research Facility among other global underground laboratories.**

## **OBJECTIVES**

1. Develop a staffing plan for science support that provides optimum resources for research groups, and serves as a point of distinction between Sanford Lab and other underground laboratories around the world.
2. Coordinate a consistent and well-defined process for the implementation and support of science experiments, including a clear way to discern best use of our resources and a communication plan to ensure transparent dialogue between operations, science, and the experiments.
3. Engage universities to facilitate opportunities for undergraduate and graduate learning and advance faculty involvement in underground research.
4. Provide efficient, integrated service to research groups; evaluate performance via an annual customer service survey that gathers input from stakeholders, including Sanford Lab researchers.
5. In collaboration with research groups, define requirements for the proposed scope of work, reliability of systems, and other supports.
6. Facilitate streamlining and integration of access controls with safety systems and tools.
7. Leverage survey instruments to gain customer service feedback on all aspects of science support. Make timely interventions based on feedback.
8. Establish an ongoing process to engage the wider scientific community and create strategic partnerships.
9. Develop venues to interface with researchers so they will consider and choose to conduct research at Sanford Lab.

## **SCIENCE SUPPORT**

We will:

- Improve our communication with research groups through a single point of contact that can address questions and facilitate dialogue with other business units at Sanford Lab.
- Provide a facility support model that ensures exceptional customer service.
- Continue to seek new and innovative ways to integrate safety considerations into research processes.
- Work together to ensure we are exceeding expectations, closing gaps as identified, and seeking feedback from our science groups so as to continuously improve our quality of service.
- Define a science implementation process so scope of work and requirements are uniformly gathered and communicated.







**Maintain a strong culture around Environment, Safety and Health, resulting in a continuous and sustainable reduction of injuries, accidents, and incidences.**

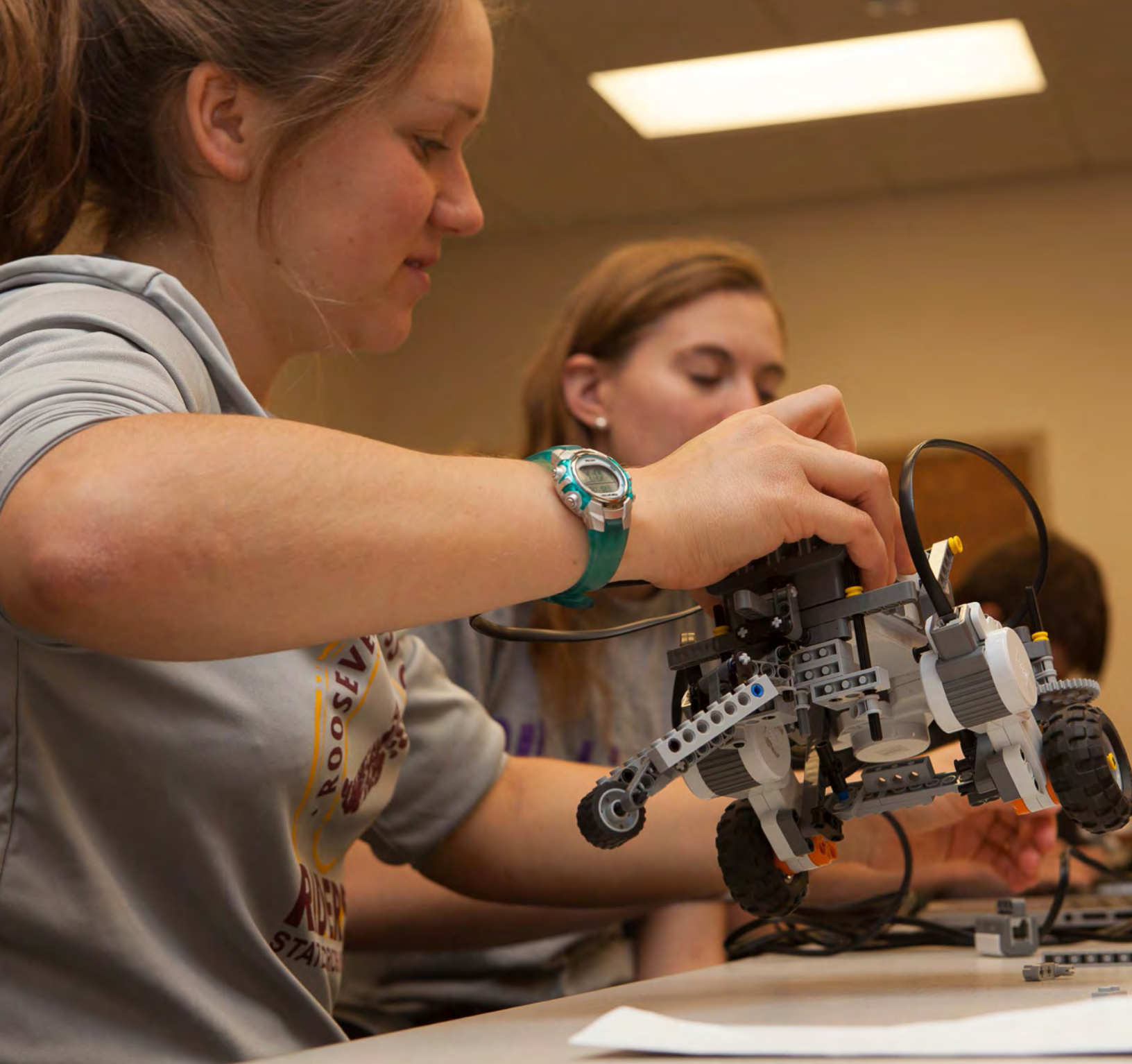
## **OBJECTIVES**

1. Create and leverage safety management systems that are regularly evaluated in line with the South Dakota Office of Risk Management reviews.
2. Protect against or reduce harmful effects of hazards throughout the entire organization.
3. Improve Sanford Lab's ability to effectively respond to operational issues through defining and achieving continued evaluations.
4. Enhance Environment, Safety and Health training for employees, contractors, research groups, and visitors.
5. Enhance communication of the emergency management plan sitewide. Review and update an emergency management plan that allows Sanford Lab to effectively respond to operational and/or safety incidents; conduct drills on a quarterly basis.

## **ENVIRONMENT, SAFETY & HEALTH**

We will:

- Continually analyze best practices in industry and across similar work settings so as to adopt or adapt policies that address concerns or close gaps.
- Identify potential environmental hazards underground and on the surface, and partner with internal and external stakeholders to prevent and mitigate those hazards.
- Create an online platform for researcher and visitor safety training, providing access to modules that are designed with the specific safety considerations of Sanford Lab in mind.
- Regularly conduct drills to increase staff preparedness for potential operational and/or safety incidents.





**Increase science awareness and create a STEM student pipeline by developing and providing education and outreach to K-12 students.**

## **OBJECTIVES**

1. Secure funding for the education and outreach enterprise.
2. Develop six units of study at each grade band (elementary, middle, and high school) that can be used by teachers in South Dakota, throughout the country, and around the globe. Lead a network of educators to share teaching practices and further refine curriculum of best use in the classroom and provide support in person, through technology and at annual teacher workshops.
3. Educate our children about the science at Sanford Lab through student assemblies on a yearly basis, target 20 percent of school districts beginning in 2017, and rotate through remaining districts on an annual basis until 90 percent of districts are reached. Continue programming on an ongoing basis. Use what we learn to create programs that can be deployed nationally and internationally.
4. Develop and implement an online presence for education and outreach. Initially market to South Dakota school districts and educators to encourage utilization of resources made available online, with an eye toward educators throughout the world.
5. Optimize facilitation of surface tours to student groups.
6. Facilitate educational experiences that bridge the transition from K-12 to undergraduate education.

## **EDUCATION & OUTREACH**

We will:

- Create a centralized online warehouse of science education content for teachers and students.
- Make educational modules available to K-12 schools to increase their STEM awareness and knowledge.
- Present at assemblies across the state.
- Identify, procure, and leverage external funding and other partnerships to advance the objectives of education and outreach at Sanford Lab.
- Use program evaluation and demonstrated efficacy to show value to partners and sponsors, and leverage that knowledge for additional support.
- Oversee and ensure funding for scholars programming.





Increase global and national awareness of Sanford Lab through targeted messages. Facilitate internal communication to ensure all team members receive constant and up-to-date information.

## OBJECTIVES

1. Create and implement a communications plan that encompasses all internal and external communication processes and materials.
2. Facilitate tours to groups that will increase the awareness of Sanford Lab.
3. Target external communication messaging to enhance national and international awareness and further the reputation of Sanford Lab using a variety of traditional and creative communication vehicles.
4. Target internal communication messaging to ensure our team members can effectively collaborate and feel encouraged to share ideas and information.

## COMMUNICATIONS

We will:

- Create a clear internal communications plan that serves as a forum for our team members to generate ideas and share information.
- Develop identity standards and branding for use in media, and ensure our messages are of one voice and represent Sanford Lab well in all audiences.
- Increase the awareness of Sanford Lab through targeted contact and engagement with the sciences underground.
- Create a dynamic, user-friendly website that reflects Sanford Lab's status as a world-leading research facility and provides information to target audiences.
- Use social media platforms to leverage creative messages that spark interest and bolster engagement in learning.





**Increase organizational capacity to seamlessly execute processes while maintaining high customer and employee satisfaction.**

## OBJECTIVES

1. Institutionalize project management processes. Continually improve processes based on project management best practices and expectations of contracting agencies.
2. Establish training and mentorship programs to strengthen organizational capacity.
3. Develop performance management systems that bring out the best in our staff and improve leadership skills.
4. Improve document storage, access, and sharing.
5. Adopt and integrate a quality management program.
6. Develop a program for board development that leverages the collective experiences of board members while defining individual board member roles to best lead the organization.
7. Through the leadership of our Cultural and Diversity Coordinator and Cultural Advisory Committee, Sanford Lab will develop a diversity plan to further demonstrate its commitment to diversity in its workforce and outreach efforts.

## ORGANIZATIONAL CAPACITY

We will:

- Define and utilize project management processes that will allow us to communicate effectively with both internal and external stakeholders, and that align with those utilized by our peer laboratories at the national scale.
- Embrace a culture of time and resource management to ensure we can deliver what we promise, on time and on budget.
- Bolster our team with mentorship and cross-training opportunities to ensure sustainability and knowledge transfer in all we do.
- Validate our team's contributions through recognition, reward, feedback, and coaching.





**Develop and execute a sustainable business model to support capital and operational requirements at Sanford Lab.**

## **OBJECTIVES**

1. Conduct a facility and organizational assessment to identify capital and operational requirements for Sanford Lab and quantify financial resources to support those requirements. Draft and implement a short-term (5-year) operational plan.
2. Increase federal government funding to support required capital infrastructure needs.
3. Maintain State of South Dakota support and identify new areas of potential partnership.
4. Identify and pursue strategic partnerships in order to accomplish the necessary facility and organizational goals of Sanford Lab. Leverage those partnerships to ensure financial sustainability.

## **BUSINESS MODEL**

We will:

- Develop a comprehensive case statement for Sanford Lab that clearly articulates the business function, its critical role in science research today, and its plans for future development.
- Engage with our legislators at a state and national level to ensure they are fully aware of Sanford Lab's contributions, its importance to South Dakota, and its opportunities for continued impact.
- Create and deploy a development plan that can be used to identify, procure, cultivate, and solicit key sponsorships and program support for the mission of Sanford Lab.

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