CREATE for STEM is a Michigan State University-sponsored research institute with a broad mandate to improve teaching and learning in the STEM disciplines for students from grades K-16, regardless of their backgrounds. We work across disciplines and with partners across the country and around the world to create innovative reform in STEM education. Through the collaborative efforts of our diverse community of researchers and educators, we are making a difference in fostering a generation of STEM-literate citizens.

Join Our Community
@create4stem
www.create4stem.msu.edu

ABOUT THE DIRECTOR
Professor Joseph Krajcik is the Lappan-Phillips Chair of Science Education at Michigan State University and the director of CREATE for STEM Institute. A former high school chemistry and physical science teacher, Krajcik has focused on working with science teachers to reform science teaching practices to promote student engagement and learning. He chaired the Physical Science Design Team for the Next Generation Science Standards.

Krajcik received the 2014 George G. Mallinson Award from the Michigan Science Teachers Association for overall excellence of contributions to science education over a significant period of time.
CREATE projects build upon several big ideas related to the Next Generation Science Standards, which have been adopted as the Michigan Science Standards. 3-dimensional learning (3DL) is the idea that students learn better when disciplinary core ideas, scientific and engineering practices, and crosscutting concepts are integrated into how they experience science. Project-based learning (PBL) engages students in reading, listening, speaking, and writing in science by having them ask questions, work together to investigate, and draw conclusions or develop solutions to problems.

Making sure that students can recognize and understand phenomena using 3DL and PBL is a crucial part of our work because it leads to developing the ideas and skills that allow them to solve complex problems.

Students develop and refine these skills and ideas over time through learning progressions (LPs), which help scaffold student learning over a school year and across grades. LPs allow CREATE designers to bring coherence to curriculum materials by providing alignment between standards, instructional tasks, and assessments across grades and grade bands.

CREATE’s goal is to improve STEM education for all students, especially those who have been traditionally underrepresented in STEM careers due to their race, gender, or socioeconomic background. Making STEM education more readily available through the use of innovative digital platforms and materials will help all students gain useable STEM knowledge and skills and see themselves in STEM-related professions.

Our work focuses on increasing student engagement in the classroom and fostering a sense of self-efficacy in students. Learning improves when students are attentive, curious, and passionate. Being engaged in learning can involve being invested at an intellectual, emotional, behavioral, physical, social, or cultural level. This style of active, participatory learning also encourages self-efficacy. When students are constantly practicing using their knowledge and skills in class, their belief in their ability to solve problems or accomplish tasks grows. Students who believe in their abilities to succeed in STEM learning are more likely to continue their education and pursue careers in STEM.
CREATE is a hub for research-based innovation and development.

**Collaboration** is at the heart of our work:
- across subject matters
- between organizations
- among researchers and practitioners.

Our **Big Ideas** of project-based learning and 3-dimensional learning guide our work in five focus areas.

CREATE is committed to working to improve STEM teaching and learning for **ALL** students, especially those traditionally underrepresented in STEM fields.

Our innovative materials and methods are developed and designed to work in every classroom with minimal additional resources.
K-12 Education

CREATE is at the forefront of efforts to improve the teaching and learning of STEM at the K-12 level. Our projects are strongly aligned with the Next Generation Science Standards, and all of them tie back to the big ideas that guide our work. Innovative new curriculum materials, professional development, and research methods are being developed across twelve projects directed at elementary, middle, and high school students.

Two of our projects focus on grades K-5. One is professional development for elementary teachers. It helps them integrate NGSS into their lesson plans while also encouraging them to bring their classes outdoors when possible. Another project for grades 3-4 is creating curricular units that help students build language literacy and mathematical skills as they develop usable science knowledge. This instructional approach also creates access to and ownership of science learning for diverse learners.

There are seven middle school projects working on a variety of subject matters. One project is both supporting students in learning engineering design and also in recognizing that they belong in engineering. Another project builds upon the highly successful Connected Math Project. It is developing an online platform that allows students to record and share their mathematical explorations digitally. The Energy project is working with international partners to develop innovative curriculum and assessments that help students build a robust understanding of energy over time. A project focused on genomics education is designing new digital curriculum materials and creating informal science education activities by partnering with community organizations. Two projects are designing assessments that align with NGSS for both physical and life sciences.

There are three projects working at the high school level. The Interactions project has designed a physical science course that integrates computer-generated simulations with in-class activities to teach students about intermolecular forces. Another project is exploring how best to support students in building models that explain and predict phenomena across a range of disciplines; CREATE has developed a digital modeling tool and accompanying instructional materials to accomplish this. Our newest K-12 science project is a collaboration with partners in Finland to increase student engagement in physical science classrooms by promoting engaging activities and testing new forms of science instruction based on NGSS.

Learn more about our projects at http://create4stem.msu.edu/project/list.
Higher Education

CREATE has two projects that are working to improve introductory STEM courses at Michigan State University. These courses serve as gateways to continued studies in STEM and can often be determining factors when students choose to pursue different majors. To increase STEM retention, improve student learning, and raise student engagement, we are working to transform these introductory courses so that they emphasize core scientific and mathematical ideas and practices that are common across different disciplines. In doing so, we will also be changing the institutional culture of MSU to focus even more on STEM learning and success.

Another CREATE project uses computational modeling to teach students about core physics concepts while also engaging them in the practices of doing science. Contrary to traditional teaching techniques in introductory mechanics courses, the project focuses on creating a community-based learning environment. Another project, TEAM, is a collaboration between the Math and Teacher Education programs to improve remedial mathematics education at MSU while giving pre-service mathematics teachers authentic teaching opportunities. There is also a project working to revolutionize assessments for large enrollment undergraduate STEM courses. Researchers on this project have created a computer program that can score students’ written responses with over 90% accuracy. This approach to assessment can provide insight into student use of analogical thinking, a fundamental part of scientific modeling.

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