

## Mi-STAR Curricular Themes

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### Introduction

Currently in Michigan, and in many of the nation's schools, STEM instruction consists of a series of seemingly unrelated courses that require students to memorize large numbers of facts, often fail to engage students in the practice of doing science, and rarely connect to topics related to students' lives. Mi-STAR will remedy this by focusing on a set of themes that will be used to develop an innovative middle school curriculum in which students will explore science content and methods integrated across traditional disciplinary boundaries. The themes that will be used emphasize important societal concerns that can naturally be used to connect state and national standards to real-world STEM questions and engage students in topics that are relevant to their own lives and communities.

### The Mi-STAR Themes

The themes selected for use in the Mi-STAR curriculum are based on the topics identified by the National Research Council and several professional societies as being of particular importance to society in the 21<sup>st</sup> century (figure 1).



Figure 1: Documents reviewed for identification of themes for Mi-STAR curriculum. These documents are the result of activities of the American Chemical Society, American Geosciences Institute, American Physical Society, Federation of American Scientists, Intergovernmental Panel on Climate Change, National Academy of Engineering, National Academy of Science and National Research Council's Committee on Grand Challenges in Environmental Sciences and Committee on a New Biology for the 21st Century.

Remarkably, each of the documents reviewed cited similar topics of interest. For example, each document identified aspects related to energy resources as indicated in table 1. Based on the

Suggested citation: Mi-STAR Committee on Theme Development (2015). *Mi-STAR Curricular Themes*. E. E. Gochis, J. E. Huntoon and A. L. Guth (Eds.). Available online at: <http://mi-star.mtu.edu/resources/publications-and-presentations/>, 3 pp.

overlap among the documents, the themes identified for use in development of the Mi-STAR curriculum are: **water resources; energy & earth resources; sustainable environment; earth and space systems; food and agriculture; human and public health; and the built environment.** The complete table with the all themes and their corresponding topics is available on the [Mi-STAR Theme Alignment](#) webpage.

*Table 1: Example of topics that align with the Mi-STAR theme of “Energy Resources” and their source.*

<i>Topics Aligned with Energy Resources Theme</i>	<i>Sources</i>
<ul style="list-style-type: none"> <li>• Developing new sources of energy; biofuels and fuels from ice, water and sunshine</li> </ul>	American Chemical Society, <i>Global Challenges/Chemistry Solutions</i>
<ul style="list-style-type: none"> <li>• Ensure reliable energy supplies in an increasingly carbon-constrained world</li> </ul>	American Geosciences Institute, <i>Critical Needs for the Twenty First Century: The Role of the Geosciences</i>
<ul style="list-style-type: none"> <li>• Reduce emissions of greenhouse gases</li> <li>• Develop renewable and nuclear energy sources and adopt new methods of using fossil fuels</li> </ul>	American Physical Society, <i>Issues</i>
<ul style="list-style-type: none"> <li>• Nanotechnology for energy production</li> </ul>	Federation of American Scientists, C.K.N. Patel & I. Jarudi, <i>21st Century Physics: Grand Challenges</i>
<ul style="list-style-type: none"> <li>• Decarbonize electricity generation</li> </ul>	Intergovernmental Panel on Climate Change, <i>Climate change 2014: Impacts, Adaptation, and Vulnerability</i>
<ul style="list-style-type: none"> <li>• Provide energy from fusion</li> <li>• Engineer the tools of scientific discovery (fuels)</li> </ul>	National Academy of Engineering, <i>Grand Challenges for Engineering</i>
<ul style="list-style-type: none"> <li>• Energy Efficiency</li> <li>• Energy Generation</li> </ul>	National Academy of Science, <i>America’s Energy Future</i>
<ul style="list-style-type: none"> <li>• Understand the interactions between social institutions and resource use</li> <li>• Document &amp; monitor current actions and develop predictive models to guide fossil fuel and energy policies</li> </ul>	National Research Council’s Committee on Grand Challenges in Environmental Sciences, <i>Grand Challenges in Environmental Sciences</i>
<ul style="list-style-type: none"> <li>• Expand sustainable alternatives to fossil fuels</li> </ul>	National Research Council’s Committee on a New Biology for the 21st Century, <i>A new biology for the 21st century: ensuring the United States leads the coming biology revolution</i>

## **Implementation**

The Mi-STAR network is now developing a three year Mi-STAR curriculum based on the themes. The curriculum is designed to allow students to investigate different aspects of the seven themes in 6<sup>th</sup>, 7<sup>th</sup>, and 8<sup>th</sup> grade through Michigan-centric and locally relevant, scaffolded units that progressively build learners’ depth of understanding. The units include performance-based challenges that allow students to explore real-world examples that naturally blend disciplinary core ideas, cross-cutting concepts and scientific and engineering practices in a holistic manner. Together, the units will give students the opportunity to use science and engineering practices to investigate phenomena and propose innovative solutions to contemporary problems. Comprehensive teacher professional development will accompany the implementation of the Mi-

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STAR integrated science curriculum to provide long-term support for educators and to ensure the curriculum is successfully integrated into their middle school classrooms.

Over the next year, teams consisting of experienced middle school teachers, science education specialists, and university science and engineering faculty will collaboratively develop the Mi-STAR integrated science curriculum. The theme-based units will then be reviewed and pilot tested in several school districts across Michigan.

## References:

- American Chemical Society (2009). Global Challenges/Chemistry Solutions. Retrieved from <http://www.cendigital.org/acsgccs/2009#pg1>
- American Geosciences Institute (2012). Critical Needs for the Twenty First Century: The Role of the Geosciences. Retrieved from <http://www.agiweb.org/gap/criticalneeds/>
- American Physical Society. "Issues." 2015, Retrieved from <http://www.aps.org/policy/issues/>
- Field, C. B., V. R. Barros, et al. (2014). "IPCC: Climate change 2014: Impacts, adaptation, and vulnerability." Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Retrieved from [http://ipcc-wg2.gov/AR5/images/uploads/WG2AR5\\_SPM\\_FINAL.pdf](http://ipcc-wg2.gov/AR5/images/uploads/WG2AR5_SPM_FINAL.pdf)
- National Academy of Engineering (2008). Grand challenges for engineering. Washington, DC. Retrieved from <http://www.engineeringchallenges.org/Object.File/Master/11/574/Grand%20Challenges%20final%20book.pdf>
- National Academy of Sciences. "America's Energy Future." 2015, Retrieved from [http://sites.nationalacademies.org/Energy/Energy\\_080036](http://sites.nationalacademies.org/Energy/Energy_080036), [http://sites.nationalacademies.org/Energy/Energy\\_080037](http://sites.nationalacademies.org/Energy/Energy_080037), [http://sites.nationalacademies.org/Energy/Energy\\_087534](http://sites.nationalacademies.org/Energy/Energy_087534).
- National Research Council . Committee on Grand Challenges in Environmental Sciences (2001). Grand challenges in environmental sciences, National Academy Press.
- National Research Council Committee on a New Biology for the 21st Century (2009). A new biology for the 21st century: ensuring the United States leads the coming biology revolution, National Academies Press (US). Retrieved from [http://www.nap.edu/openbook.php?record\\_id=12764](http://www.nap.edu/openbook.php?record_id=12764)
- Patel, C. K. N. and I. Jarudi (2003). "21st Century Physics: Grand Challenges." Federation of American Scientists 56(2). Retrieved from <http://fas.org/faspir/2003/v56n2/v56n2.pdf>