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Meeting the grand challenge for future carbon management engineers and scientists: stimulating workforce capacity through teacher professional development

Hilary Clement Olson^{ab*}, Jon E. Olson^b, Steven L. Bryant^b, Larry W. Lake^b, Paul Bommer^b, Katherine Romanak^c, Susan D. Hovorka^c, Rebecca C. Smyth^c, Iona Williams^b

^a*Institute for Geophysics, 10100 Burnet Rd., The University of Texas at Austin, Austin, Texas, 78758, U.S.A.*

^b*Department of Petroleum and Geosystems Engineering, 200 E. Dean Keeton St., The University of Texas at Austin, 78712, U.S.A.*

^c*Bureau of Economic Geology, 10100 Burnet Rd., The University of Texas at Austin, Austin, Texas, 78758, U.S.A.*

Abstract

In 2008 the National Academy of Engineering (NAE) announced a list of fourteen Grand Challenges for Engineering in the 21st Century that includes the challenge to “Develop carbon sequestration methods”. The NAE highlighted the importance of creating an awareness of and involvement in the Grand Challenges for the pre-university community in order to (1) strengthen the technical workforce pipeline, (2) develop technical literacy and motivation needed for the global society to address these challenges, and (3) educate the general public on engineering and its role in addressing these challenges and improving the quality of life. In 2009, we initiated a program funded by the United States Department of Energy to increase workforce capacity for the geological carbon storage (GCS) industry. As part of this initiative, we have forged alliances to bring high-quality curriculum related to GCS to pre-university classrooms, and to provide teachers an opportunity to introduce curriculum on one of the Grand Challenges for Engineering into their classroom.

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1. Introduction

In 2008 the National Academy of Engineering (NAE), a government-created non-profit institution in the United States, announced a list of fourteen Grand Challenges for Engineering in the 21st Century [1]. The list of challenges was created by an international committee of technological leaders, with input from

* Corresponding author. Tel.: +1-512-653-8356
E-mail address: holson@austin.utexas.edu.

both the public and external experts. “Develop carbon sequestration methods” is one of these fourteen Grand Challenges (Table 1). As one of the Grand Challenges, carbon sequestration is highlighted as a good, short-term engineering solution to a global societal problem. The NAE highlighted the importance of creating an awareness of and involvement in the Grand Challenges for the pre-university community to (1) strengthen the science, technology, engineering and math workforce pipeline, (2) develop the technical literacy and motivation needed for the global society to address these challenges, and (3) educate the general public on engineering and its role in addressing these challenges and improving the quality of life.

Table 1. The Grand Challenges for Engineering in the 21st Century as put forward by the National Academy of Engineering [1].

<i>National Academy of Engineering: Grand Challenges for Engineering</i>	
1. Make solar energy economical	8. Engineer better medicines
2. Provide energy from fusion	9. Reverse-engineer the brain
3. Develop carbon sequestration methods	10. Prevent nuclear terror
4. Manage the nitrogen cycle	11. Secure cyberspace
5. Provide access to clean water	12. Enhance virtual reality
6. Restore and improve urban infrastructure	13. Advance personalized learning
7. Advance health informatics	14. Engineer the tools of scientific discovery

In 2009, a group of scientists and engineers involved in carbon capture and storage at The University of Texas funded by the U.S. Department of Energy, established the STORE (Sequestration Training, Outreach, Research and Education) alliance to carry out the mission of developing a future workforce to support the commercial deployment of carbon sequestration technologies. As part of this workforce initiative, we forged alliances with teacher networks, teacher associations, teacher professional development programs, outreach programs, industry and professional societies to bring high-quality curriculum related to geological carbon storage (GCS) to the middle- and high-school classroom (students typically ranging from 10 to 18 years of age). These inquiry-based activities, although focused on the topic of carbon storage, satisfy many state (Texas) and national (U.S.) education requirements for teaching science, technology, engineering and math. By bringing GCS activities into the pre-university educational environment, we provide teachers an opportunity to expose their students to one of the Grand Challenges for Engineering in the 21st Century.

2. Creating Alliances

By establishing broad alliances, STORE has been able to leverage resources for content, expertise, materials, opportunities and teachers to create a successful model for education and outreach across the large culturally and geographically diverse area of Texas (~700,000 km²) that has almost 26 million residents, the second largest state in the U.S. Through the authors' involvement with various teacher development programs in Texas over the last decade, we are aware that working through an alliance is an excellent way to multiply the effectiveness of our efforts.

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