Introduction: Science performance in American public schools is “uninspiring at best,” according to William Schmidt, a leading science curriculum expert at Michigan State University’s Education Policy Center and the author of a new study on a Chicago-based science teacher professional development program. Research suggests that one reason for subpar performance in both U.S. and international science tests is that many middle-grades teachers lack a background in science or science teaching. Moreover, Schmidt believes, many professional development programs targeting elementary and middle-school science teachers provide “little consistency in their purpose, scope or content” with many of them covering a “large number of topics at a relatively superficial level.”

The Institute for Quality Science Teaching: The Museum of Science and Industry, Chicago (MSI) formed the Institute for Quality Science Teaching (IQST) with the goal of improving the science achievement of 4th-8th grade students in the Chicago area by creating a series of courses for teachers who lack the background in science or science teaching to teach effectively. Four different courses have been offered on a rotating basis since October 2006, reaching more than 800 teachers. The courses aim to improve content knowledge, use of hands-on and inquiry-based strategies in the classroom, and use of external resources. IQST focuses on teachers with limited or no science backgrounds in mostly public, high-need, low socio-economic schools. The museum commits considerable resources; courses are offered at no cost, and the museum provides instructional staff, lesson plans, lab materials, as well as substitutes during training sessions. Teachers who take the IQST courses can also earn credit hours towards a middle-grades science endorsement or a Master’s of Science Education.

The Study: Schmidt designed a study to evaluate teachers’ increased content knowledge in one IQST course, Get Re-Energized (GRE), which focuses on energy topics. He also assessed the impact on student learning. Approximately 85 teachers participated in the study, two-thirds in the treatment group and one-third in the control group. In order to effectively measure the impact of the IQST professional development, teachers were tested in advance and at the end of
the course and students were tested at the end of the course, including a measure of students’
applied knowledge in the context of a museum field trip experience.

**Results for Teachers:** The mean performance of GRE teachers was 8 percent higher than that
of the control teachers. The estimated effect size was two-thirds of a standard deviation, which,
Schmidt says, “is typically considered to be quite large in education.” For all grades except
grade six, GRE teachers did better on the post-test than did the control group teachers. The
largest difference was evident among those teaching seventh or eighth grade where the estimated
difference controlling for the pretest is 18 percent. Schmidt concludes, “There are important
differences in teacher knowledge related to energy between those teachers who received the
yearlong GRE course and those who did not. Given the random assignment of the teachers to the
two groups we can interpret this causally, that it was the GRE course that produced the rather
large effect size of two-thirds of a standard deviation.”

**Results for Students:** While the goal of the GRE course and similar efforts is to increase the
professional knowledge and competence of teachers, the ultimate goal is to improve student
science learning. On the energy-specific test items, the GRE teacher’s students did better than
those of the control teachers by a statistically significant amount of 5 percentage points. Schmidt
further points out that “the effect of the GRE program on the performance of the students is truly
remarkable in that it occurred within the same year in which the teachers were themselves GRE
students, suggesting that it was related to the practice of giving the teachers in the program
instructionally related materials they can use in their classroom instruction immediately
following a GRE session.”

**Applied Knowledge Test:** One of the most innovative aspects of this research study was the
incorporation in the design of a museum-based test to measure applied science knowledge
related to energy. The study looked at whether students can identify and understand important
energy concepts as they operate in applied, real world situations such as in the machines, cars,
inclined planes, etc. found in the museum. The results indicate that the difference in mean
performance on the applied test of knowledge between the students whose teachers were in the
GRE program and those students whose teachers were in the control group was five percentage
points. Schmidt concludes: “Not only does the GRE program have a direct effect on teacher
knowledge, but the program also influenced student performance on both the formal and applied
tests.”

**Encouraging Scientific Inquiry:** Finally, Schmidt highlights the effect of GRE on the time
teachers spent teaching energy with respect to scientific inquiry – an underlying theme of the
GRE program. The study reveals a significant effect on the amount of time teachers spent on this
topic during the fall term. More specifically, GRE teachers spent nearly three-fourths of a
standard deviation more time covering this empirical aspect of science than did the control
teachers. Here again, Schmidt concludes: “The GRE capacity-building course benefited not only
the participating teachers but their students as well.”

**The Role of Museums:** Museums can play a critical role in helping teachers make science
education much more engaging for students, offering both professional development
opportunities for teachers and out of school activities to inspire and motivate students. MSI
hopes the Michigan State University study prompts a national discussion on the importance of
STEM education and the role that museums can play in improving the way science is taught. The Museum’s goal is to work with 1,000 teachers over the next five years.

Authors: William Schmidt, Ph.D., is a University Distinguished Professor, director of the Center for the Study of Curriculum and co-director of the Education Policy Center at Michigan State University. His current writing and research concerns issues of academic content in K-12 schooling, teacher preparation and the effects of curriculum on academic achievement. He is also concerned with educational policy related to mathematics, science and testing in general. He is a member of the National Academy of Education and a fellow of the American Educational Research Association (AERA). Leland S. Cogan, Ph.D., is a Senior Researcher at the Center for the Study of Curriculum.