



Information Sheet: Gender Differences in Science Achievement



"What is turning girls off is the image of an engineer. They don't see engineering in relation to its impact on the world, on society, on the human condition." (Larrondo-Petrie, M. as quoted in Green, 2009)

More women than men pursue a postsecondary degree in the U.S., however fewer females pursue an undergraduate degree in science and therefore do not enter into science, technology, engineering, and math (STEM) related careers at the same rate as males. Females have demonstrated that they are equally capable as their male counterparts of learning and mastering science concepts and knowledge (Ingels & Dalton, 2008). Views that females hold in relation to science and its application to solve real-world problems; courses that females are advised to enroll in during high school; and support from parents, teachers, and other role models related to pursuing a career in STEM disciplines are factors that provide additional insight into gender differences in science achievement (Green, 2009; Ingels & Dalton, 2008; National Science Foundation, 2005).

This information sheet provides a summary of salient points related to statistical trends in gender differences in science achievement and how this research can be applied for use by instructional professionals in K-16 with focus on STEM disciplines. Gender differences in science achievement are discussed in more detail in the Gender Differences in Science Achievement Literature Overview.

Brief Overview of Statistical Trends:

- This document and related literature overview uses the term science to focus on trends related to the fields of chemistry, physics, engineering, biology, and/or psychology, or a composite of any or all areas of related scientific knowledge. Science achievement is measured by mean scores on nationally administered standardized assessment tools as well as the number and level of science courses students enroll in and the grade point average attained while enrolled in those courses. At the undergraduate level, science achievement is measured by the number and percentage of science degrees earned.
- Recent studies point to few significant differences remaining with regard to the gender gap in science achievement, however males continue to perform at higher rates with regard to science achievement, particularly in high school:
 - A longitudinal study conducted by the National Center for Education Statistics reveals females are enrolling in more science courses in high school and are enrolling in advanced science courses at higher rates than males (i.e., Chemistry II, Physics II, and Advanced Biology) (Ingels & Dalton, 2008). The mean number of credits earned in science increased for both males and females during this time period as well (Dalton, Ingels, Downing, & Bozick, 2007).
 - The National Assessment of Educational Progress (NAEP) regularly conducts a national assessment of students' achievement in science in grades 4, 8, and 12. Analysis of the 2005 results reveals that males continue to outperform females in science achievement at all three grade levels for the third year in a row. Females at all levels have made relatively little gains in their average science achievement scores since 1996. Further analysis of the 2005 science results demonstrates the importance of coursework in relation to science

achievement. Twelfth-graders who took biology, chemistry, and physics scored higher than students who took biology and chemistry, and both groups scored higher than those who took just biology or other science courses (NAEP, 2005). When looking at the course completion rates among the graduating class of 2005, females studied biology and chemistry at higher rates, whereas males studied physics, engineering, and engineering/science technologies at higher rates (National Science Foundation, 2008). Males' propensity to enroll in physics has been attributed to their higher performance on science achievement tests and subsequent interest in STEM careers (Hazari, Tai, & Saddler, 2007).

- The Trends in International Mathematics and Science Study documents international trends related to science achievement among 46 countries. Among U.S. fourth graders in 2007, males continued to outperform females in science, however differences were not significant. Among eighth-graders, males scored significantly higher overall than females in science (Mullis, Martin, & Foy, 2008).
- In 2007, male high school students continued to take science Advanced Placement subject tests in larger percentages than female students and tended to score higher.
- During 2007, fewer females demonstrated readiness for college-level science coursework than males as measured by the American College Test (ACT) *ACT High School Profile Report: HS Graduating Class* (2007).
- Males continue to surpass females in the number of undergraduate degrees awarded in science and engineering fields. In particular, computer science, physical science, and engineering show the greatest differences with males attaining more baccalaureate degrees in these fields while females attain degrees in biology and psychology at rates equal to or greater than male peers (National Science Foundation, 2005).

Impact and Application of Research for Practitioners

- Elements that are part of the educational experience have been identified to contribute to differences in science achievement between males and females. While some of these factors such as stereotype threat and group work issues are discussed in more detail in other AWE resources, following is a brief overview of considerations for K-16 professionals when designing programmatic interventions to address gender differences in science achievement:
 - Females tend to perform better on areas of standardized science assessments that address the human application of science such as life sciences. In addition, females tend to enroll in advanced coursework and pursue degrees in science fields that have a direct application to improving the human condition (Ingels & Dalton, 2008; NAEP, 2005). These trends suggest that females may be turned off from studying STEM subject matter and pursuing careers in STEM fields due to stereotypes that such fields have little or no impact on the human condition (Green, 2009).
 - Courses students enroll in during high school, particularly whether students successfully complete a physics course, are strongly predictive of further science achievement (Hazari, Tai, & Saddler, 200; Madigan, 1997). K-12 educators should monitor the participation and successful completion rates of females in physics coursework.
 - Parent's perceptions of their children's ability and expectations for STEM education and STEM careers may be related to science achievement (Wang, 2007; Trenor, 2007). Parents should be made aware of how influential their views are in shaping their child's future aspirations related to STEM fields. Recruitment initiatives should take into

- consideration parents' viewpoints and inform both parents and students about career opportunities for females in STEM.
- Classroom climates may be geared towards facilitating the science achievement of males. Teacher's attitudes, behaviors, and pedagogical strategies should be examined for gender bias (Sandler, Silverberg, & Hall, 1996). Instructional experiences should consider how to build confidence among females with regard to science achievement through constructive criticism that includes positive reinforcement (Brainard & Carlin, 1998). In addition, the types of questions on in-class tests, homework assignments, and projects done in class can be designed in a way to address multiple learning styles successfully (Clewell & Campbell, 2002) and improve science achievement among students (Schroeder, Scott, Tolson, Huang, & Lee, 2007).
 - Schools that devoted resources to science education have seen favorable results with regard to science achievement among females (Clewell & Campbell, 2002; Wang, 2007). Instructional professionals should consider the financial support provided to STEM disciplines and whether classes offered to students are adequately funded.
 - Professionals should consider creating instructional environments that integrate math and science preparation. Doing so may help address gender gaps in science achievement given the manner in which academic preparation in the two fields is needed for attainment of undergraduate degrees. Attention to the number of females enrolling in and completing physics courses at the high school level is also important as studies have linked degree attainment in STEM fields to successful completion of physics coursework (Clewell & Campbell, 2002; Trenor, 2007).
 - Stereotypes that science is a male dominated field may exist as well as confusion over how work is accomplished and what scientists and engineers do for a living (Cunningham, 2007). These views are reinforced further by lack of female role models in STEM disciplines, affecting persistence among female undergraduates who do pursue degrees in these areas (Clewell & Campbell, 2002; Trenor, 2007). Initiatives designed to target female involvement in STEM should educate high school teachers, counselors, and parents as well as the students themselves with regard to the careers available, academic preparation needed to be successful, and address stereotypes females entering STEM disciplines may face (Clewell & Campbell, 2002; Trenor, 2007).
 - Community support among female undergraduates in the form of living-learning communities or programmatic interventions such as mentoring may help relieve feelings of isolation and encourage attainment of degrees (Clewell & Campbell, 2002; Trenor, 2007). Universities should consider making discipline-specific living-learning communities an integral part of the undergraduate experience for declared majors in STEM fields and offer mentoring programs that pair female undergraduates with successful male and female mentors in the field.
 - Assessments used to measure science achievement at the national level as well as in classrooms should be examined for gender bias given the fact female enrollment in advanced science coursework has increased and females report a higher GPA in such courses than their male counterparts. Questions and content included on tests may be more geared to learning styles and interests that are typically associated with male students.

Recommendations for Action

- Information about formal learning experiences such as science coursework completed by gender and its relation to science achievement among students has been collected. While informal learning experiences such as participation in science competitions or learning through science-related field trips has shown to have promising results related to females' science achievement and interest in engineering, the area could benefit from additional research, focusing on gender differences (Cunningham, 2007).
- Teacher preparation in STEM disciplines, including what subjects aspiring teachers study as part of their undergraduate coursework and whether inclusive pedagogical practices are discussed in teacher preparation classes and subsequent student achievement by gender would also provide useful information. Studies could look specifically at whether teachers who learn how to convey subjects studied in science courses so that the humanitarian application of coursework is emphasized have male and female students who subsequently pursue advanced science coursework at equal rates.
- At the postsecondary level, examining the undergraduate experience and whether courses address the different interests of males and females in relation to STEM subject matter may prove useful to understanding why females do not enter into STEM careers at the same rate as male peers. In addition, interaction with faculty has been shown to have positive results in terms of student persistence, but the degree to which these experiences encourage female interest and long-term involvement in STEM careers is not clear and would benefit from additional research.

Citations:

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