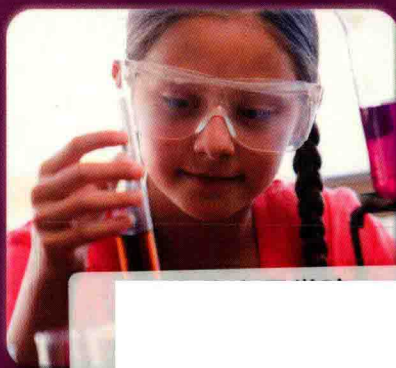


TEACHING the FEMALE Brain

How Girls
Learn Math
and Science



Abigail Norfleet James

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Learn Math
and Science**

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TEACHING
the
FEMALE
Brain

*In memory of the wonderful women
who opened the worlds of
science and math
to many students (including the author):*

*Nancy Lee Young
Jessie Y. Carpenter Goulding*

Foreword

In the spring, when schedules are set for the following school year, I am never surprised when a handful of girls line up at the head of upper school's office door. These students are concerned because calculus, advanced-placement (AP) physics, or AP chemistry appears on their class schedules. They are sure that someone has made a mistake. Despite many years spent in a single-sex school that actively promotes girls' achievements in the disciplines of science, technology, engineering, and math (STEM), many girls still doubt their ability to excel in these academic areas.

Why does this happen year after year? How can these girls develop confidence in their ability? Why does this anxiety affect some girls and not others? What is the difference between test anxiety and math anxiety? Educators and parents have spent years searching for answers.

Fortunately, researchers have some answers and are working toward many more. An ever-increasing body of research is enhancing our knowledge about the complex relationship between gender and cognition. Researchers have focused on the similar and different ways girls' and boys' brains process information.

Their findings, though varied in scope, support the conclusion that girls' brains differ in several key ways from boys' brains and that the resulting differences influence how girls and boys learn. Most recently, scientific research has expanded to include the use of magnetic resonance imaging (MRI) to understand better neurological growth and connections. Additionally, studies in educational psychology and sociology continue to make important contributions to this field of research. With this expanding body of knowledge, synthesis and real-world application are needed to realize its benefits.

Teaching the Female Brain serves these purposes and builds on the key concepts established in Dr. Abigail Norfleet James's first book, *Teaching the Male Brain* (2007), which outlines the cognitive, sensory, physical, social, and emotional differences between genders. Following each area of her synthesis of the latest research, overview of brain functions, and explanation of learning modalities—which includes learning differences—Dr. James

provides many practical strategies for using this information. Her chapter on stress, test anxiety, math anxiety, and the typically overlooked topic of self-handicapping is particularly helpful not only to teachers but also to parents and students. Her real-world examples are insightful and will resonate with all her readers.

Taking the position that both biology and environment influence how girls learn, Dr. James focuses on making sure that teachers recognize and understand the cognitive gender differences and social influences that affect how girls learn. As teachers, parents, policymakers, and students themselves become aware of these differences and develop strategies to accommodate all students, the likelihood that girls *and* boys will have more positive learning experiences is greatly enhanced.

A psychologist and an experienced math and science teacher with years of service in all-girls', all-boys', and coeducational classrooms, Dr. James delivers practical strategies for every teacher and parent, providing age-appropriate activities and exercises. These accommodations have the potential to change the framework for educating girls in the classroom and at the school, county, and state levels.

It is a critical time for girls; the numbers of women in the STEM areas are increasing only gradually—and even declining, in terms of the number of women who earn undergraduate degrees in mathematics and computer and information science. *Teaching the Female Brain* is an invaluable resource for parents, teachers, educational policymakers, and other adults who work closely with young women and men.

Dr. James establishes a broad understanding of gender differences and an awareness of the many ways to influence positively girls' confidence in math and science. This self-assurance is essential to the success of girls in our modern, technological world as well as to their overall ability to reach their potential and to contribute to our collective future: a future where all girls embrace science, technology, engineering, and technology with enthusiasm and confidence.

—Monica M. Gillespie, PhD

Monica M. Gillespie, Head of School of St. Paul's School for Girls, holds BA, MEd, and PhD degrees from the University of Virginia. She is a former visiting-assistant professor at the Jepson School of Leadership Studies at the University of Richmond, a former assistant professor at the Curry School of Education at the University of Virginia, and an author and coauthor of research papers and articles on women in leadership and educational design.

Acknowledgments

A number of people are responsible for what is in this book. As I have grown as a teacher, I realized that I would not have become a science and math teacher if it were not for the two teachers to whom the book is dedicated. They were my middle school teachers, and I can remember both of them as if I had been in their classes yesterday. In the almost fifty years since then, few teachers have made as strong an impression on me. Role models are very important for girls, and these two women provided me with stellar examples of what scientists and mathematicians could look like.

You may have read an earlier book I wrote about teaching the male brain. Many of my acquaintances are surprised that I have taught girls as well. Roberta C. McBride gave me my first teaching job, which was at an all-girls' school. I will never forget the call from her about a week before the start of school asking me if I would mind teaching a math class along with the science classes that I was contracted for. I assumed that I would be teaching pre-algebra or Algebra I at the most only to discover that I was assigned a class of Algebra II/trigonometry students. It quickly became apparent that everyone in the class was terrified of math and was only there because they all needed a third credit in math to get into competitive universities. A true baptism by fire, but those girls made the most amazing progress, and as I wrote this book, I tried to put myself in those two classes to try to remember what it was we did. Later, I taught science and math at a different girls' school, and I thank Patrick F. Bassett for making me accept the position. I wasn't sure that I could do it, but those experiences, together with those from my earlier school, laid the groundwork for what you will find in the following pages.

After I obtained my doctorate, I took an adjunct position with Germanna Community College where I came across David Fama, who taught math. David and I had many discussions about the material in my first book about teaching boys before remarking that his problem was with his female students, not his male students. I agreed that was probably so, but what I knew about gender differences would help his students as well. Those discussions were so interesting to both of us and helped me realize

that I actually knew quite a bit about how girls learn. David was responsible for arranging for me to speak at the Virginia Mathematical Association of Two-Year Colleges (VaMATYC) annual meeting. That talk was so well received, resulting in several other organizations asking for similar material, that I realized that there probably was a book in it. Without David's probing questions, I might not have gotten this information formatted as clearly.

I thank David McCrae and Ben Hale who allowed me to teach developmental math in summer school at Woodberry Forest. True, Woodberry is a boys' school, but the summer sessions included girls, and while almost all of my summer students were boys, the girls I taught helped me see what had been missing in their past math and science training. Some of the strategies that are included in this book were tried out then.

Lori Howard has been my true friend by pointing out to me where I was going seriously astray in this manuscript and helping me figure out what I actually wanted to say. She is one of the world's great teachers, and I am lucky to have had her willing help.

Others who have helped along the way are Sandra Allison, Samuels Real Estate, Robert and Catherine Gillespie, Monica M. Gillespie, Cathe Kervan, Duane Berger, St. Catherine's School, and all the schools who asked me to speak about teaching girls. Carol Collins has let me bend her ear and then set me gently on the correct path—what a good editor should do. She, her assistant Brett Ory, and Corwin have supported me in this endeavor.

My family continues to be the best of all. My son is so pleased that he supplied only one example in this book after having served as the chief example in the boy book. My husband, my best friend of all, has taken to finding me books on the brain that I would never have found, so he is now a research assistant as well as the nicest man in the world.

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About the Author



Abigail Norfleet James taught for many years in single-sex schools and consults on the subject of gendered teaching to school systems, colleges, and universities. Her area of expertise is developmental and educational psychology as applied to the gendered classroom. Prior to obtaining her doctorate from the University of Virginia, Curry School of Education, she taught science, biology, and psychology in both boys' and girls' secondary schools.

Previous publications include reports of research comparing the educational attitudes of male graduates of coed schools to male graduates of single-sex schools and research describing the effects of gendered basic-skills instruction. In addition, she has written on differentiated instruction at the elementary school level and on using cognitive gender differences to teach boys. She has presented workshops and papers at many educational conferences and works with teachers and parent groups in interpreting the world of gendered education.

Her professional affiliations include the American Educational Research Association, the American Psychological Association, the Association for Supervision and Curriculum Development, the Gender and Education Association, the International Boys' School Coalition, and the National Association for Single-Sex Public Education (advisory board member).



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Introduction



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At the end of my junior year in high school, I had a conversation with my counselor about what I was going to take in my senior year. The year before, the girls' school that I attended had made an arrangement with the nearby boys' school to allow students at each school to attend the other school if their own school did not offer a course they wanted. I was excited as it meant that, in my senior year, I would be able to take upper-level math and science courses not available at my school. When I raised this possibility with my guidance counselor, she patted my hand and said, and I remember her words exactly, "My dear, what possible use are you *ever* going to have for calculus and physics?" I was upset, but without anyone to contradict her, I accepted her decision and took analytical algebra and biology at my own school instead.

In retrospect, I do see her point of view. After all, at that point in my life, I had decided to attend nursing school, and if that is all that I had ever done, she might have been right. However, given the changes in the profession of nursing since that time, especially with the advent of nurse practitioners, I would have had plenty of use for advanced math and science.

In the years since that time, I became a teacher of math and science and had to take calculus and physics in college, not an easy task since all of my classmates had taken the courses first in high school. I taught math and science in girls' schools and pressed each of those institutions to offer upper-level courses even if there were only a few students who expressed an interest. I was delighted to see my students enjoying these subjects and was thrilled when some of my students majored in science and math in college.

When I was in high school, it was accepted that math and science were not subjects in which most girls were going to do well. Since that time, the world has changed its perspective and now the idea is that girls should have the chance to do math and science if they want to. However, from working with young women, I have noticed that many girls believe they are probably not going to do well in math or science or, at the very least, will not be interested in those subjects, and it appears that this belief is pervasive and widespread.

Is there any evidence that math and science are not subjects for girls? See if you know the answers to the following questions.

Hint: All the individuals are women.

QUIZ

1. Who was the first person to win two Nobel Prizes?
2. Who was the first child of a Nobel Prize winner to also win a Nobel not shared with the parent?
3. Who was the inventor of the computer language COBOL?