

GIRLS CAN SUCCEED IN SCIENCE!

Antidotes for Science Phobia
in Boys and Girls



Linda S. Samuels

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My Dana Hall Colleagues and Students, 1972 to 1999

My Husband, Martin

My children, Marilyn and Charles

My parents, Esther and Robert Garber and Jean and Sydney Samuels



CORWIN
PRESS

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Preface

Over the past 25 years as a science instructor at the Dana Hall School, I have developed a clear teaching philosophy and effective strategies for teaching science. These are designed to counter misconceptions about science and gender that students have learned from various sources, including parents, other teachers, and popular culture, before entering their first junior high or middle school science courses. I have taken this approach because far too often, by the time girls reach my 7th, 10th, and 12th grade classes, they have already “learned” that they are “not good at science.” Often, lack of confidence precipitates poor performance, which, in turn, convinces students that their initial self-doubts were justified. Bolstering self-confidence in these students is the crucial first step for parents and teachers.

A considerable body of evidence suggests that some young women actually fear science and mathematics. There are myriad reasons for this fear: American culture teaches young women that they should be well-mannered, quiet, and passive (Gleason & Snow, 1991). Girls are told both explicitly and implicitly that by being assertive (even by being and acting intelligent), they will scare boys away (Sadker & Sadker, 1994). Both peers and adults discourage feminine assertiveness, calling it by the negative terms “pushiness” or “nagging.” Instead, girls are encouraged to be passive, supportive, and irrational, and to avoid competition (dumb down) in favor of personal relationships. Obviously, these stereotyped traits directly conflict with the rationality, perseverance, and competitive demeanor expected of scientists.

Likewise, images from TV, movies, magazines, and even textbooks imply that women need men to explain scientific, mathematical, or technical concepts. Although women have made major scientific contributions, the icons we use to represent “the scientist” remain male: Edison, Einstein, Salk, even Frankenstein. Only a few short years have passed since TV medical dramas began to showcase female doctors. Even more disturbing, in a study conducted at American University, students had difficulty naming 20 famous women in American history who weren’t athletes, entertainers, or Presidents’ wives (Sadker & Sadker, 1994). Women still grace magazine covers more often in bikinis than in business

suits or lab coats. Unfortunately, the preponderance of these gender stereotypes influences the way young women perceive themselves and damages their self-esteem.

Nevertheless, things have changed, and they continue to change. The politically correct 1990s have called serious attention to the persistence of sexism in the United States. Although the feminism of the 1970s helped to eliminate, in large part, explicit discrimination, women of the 1990s continue to grapple with countless implicit inequalities. Major victories have been won in employment, education, and the mass media. However, in the struggle for gender equality, educators have sometimes been overlooked as valuable resources.

Educators have a special opportunity, even an obligation, to counteract expectations of failure and to nurture self-confidence in their female students. A teacher can be an important role model for students, offering a constant source of support and guidance. Through encouragement and supportive relationships with teachers, girls can develop the skills necessary to be competent and successful in any scientific endeavor. Furthermore, by encouraging independent, creative thinking, teachers can inspire female students to greater intellectual heights and even change the courses of their lives. For these reasons, it is critical for science instructors to help young women learn that they can succeed in science.

Girls Can Succeed in Science! illustrates effective teaching strategies that really work! Although my teaching methods were developed to help young women who are apprehensive about science, they will benefit students of both genders. In addition, students who already enjoy science will find the approach and the activities interesting and engaging.

The book is divided into three parts. Part 1 presents an overview of the factors that discourage many young women from studying science and details the roles of students, parents, and most important, teachers in helping young women recognize their unique potentials as individuals. It defines the problem and details my new philosophy for confronting these issues. Part 2, "Specific Tactics for Classroom Success," combines the current literature on science for girls and my own successful experience. I discuss the tools needed to build a classroom that teaches boys and girls to love science. I introduce a general approach to course design and classroom atmosphere and describe the specific classroom procedures and activities that make the philosophy work. The specific techniques and strategies outlined provide successful ways to elevate self-esteem and promote student competence.

Creative activities tailored for classes in life science, biology, and advanced biology follow in Part 3. Some activities are also integrated into the text. My innovative class activities and laboratory exercises demonstrate how to implement the new philosophy of science education to create independent, self-assured problem solvers! This book is designed to help students, parents, and teachers eradicate the obstacles young women face in science education by changing the methods we use to teach. It does *not* advocate teaching a watered-down quasi-science for girls and requires no significant change in the subject matter. My hope is

that, with consistent implementation of the techniques and strategies outlined here, many students will not only perform well in class but will develop a passion for scientific inquiry.

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For their editing help, I am grateful to Jason Overdorf, Elizabeth Tua, Tanya Rubins, Jeannie Wang, Emily Chin, and Liz Howar.

About the Author



Linda S. Samuels is known for her passion for science and her dedication in teaching girls to stretch beyond academic and societal limits and pressures to claim their own places in the science field. For 25 years at Dana Hall School for Girls in Wellesley, Massachusetts, Linda has faithfully encouraged her students through process, not memorization.

In 1994, she was nationally recognized as the Outstanding Biology Teacher in Massachusetts by the National Association of Biology Teachers and awarded Norfolk County Science Teacher of the Year by the Massachusetts Association of Science Teachers. In 1996, she was awarded the Distinguished Alumni Award from the University of Cincinnati; in 1996-1997, she was named a fellow at the Wright Center at Tufts University. In 1997, she received the Award for Excellence in Encouraging Equity (sponsored by the National Association of Biology Teachers); and she is President for 1998 of the Massachusetts Association of Biology Teachers.

She continues to expand her love of learning by taking courses or attending workshops and symposia at Tufts, Harvard, MIT, Wellesley, Boston College, Boston University, and Syracuse. Her undergraduate degree was in biology-zoology and her master of science degree was in population genetics, both at the University of Cincinnati.

She is married and has two college-age children.

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Part 1

Identifying and Overcoming Barriers to Success

[If we, as parents, teachers, and members of society,] stop trying to change girls and . . . let a feminine approach to science inform our pedagogy, we may see some exciting results for boys and girls and for science and technology.

—A. Pollina (1995, p. 33)

Catherine Joyce
Kathryn Whelan
Dana Hall students



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Jordana Kosow
Lia Lopez
Dana Hall students



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Barriers to Success in Science

The underrepresentation of girls in science and science-related fields has been seen primarily as a “girl problem” (Campbell, 1993, p. 3). That is to say, educational systems have blamed women for the difficulties they have had with science. Experts have even gone so far as to speculate that women are genetically encoded for scientific incompetence! Because we have defined the problem this way, most of our solutions have been designed to make girls “more compatible” with science (Campbell, 1993) and have largely ignored the many environmental factors that affect the way women view themselves and even the way their personalities develop. Before we can do anything, we must realize that young women face many obstacles, both inside and outside the classroom, that may discourage them from excelling in science: These include stereotyping, low self-esteem, and poor preparation.

Young women face many obstacles, both inside and outside the classroom, that may discourage them from excelling in science.

Stereotypes

Stereotypes and metastereotypes say science is a “male” endeavor. Current stereotypes about science and science-related professions are particularly discouraging to young women (Wolfson, 1993). Many of these stereotypes suggest that science is a “masculine” discipline and, therefore, unsuitable for women. Stereotypes and folk history also suggest that scientists, like virtuoso violinists or tennis greats, are so-called geniuses or prodigies and must be discovered early in life. Perhaps even more discouraging to young women, conventional wisdom asserts that scientists must be rigid and analytical, never creative or open.

One of the most common scientific stereotypes—Doctors are male and nurses, female. This stereotype has been well-entrenched by many long-running television drama series.

Stereotypes in Movies and TV

From the science fiction movies of the 1950s onward, scientists have been portrayed as men in white coats. Women have been screamers.

Stereotypes in Magazines

As Naomi Wolf (1991) points out in her book *The Beauty Myth*, take a look at any magazine rack and you’ll see women in bikinis and men in business suits. The

contrast suggests to young women that they will be valued for their physical attributes, whereas men will be recognized for their abilities.

Role Models

Too few teachers and textbooks call attention to successful women in the sciences.

Peer Pressure

Junior high and high school is the time of “the great leveling,” when to be different is to be wrong. It’s not cool to be smart, particularly for girls, particularly in science. Many girls believe that being smart is in conflict with being popular (Sadker & Sadker, 1994).

Low Self-Esteem

When was the last time a woman made a magazine cover for her achievements?

Low self-esteem predicts failure. In adolescence, boys begin to base self-esteem on their accomplishments, whereas girls base self-esteem on beauty (American Association of University Women [AAUW], 1991). Because you’re either born beautiful or you’re not, girls “begin to attribute their success to luck and not to skill,” particularly in math and science (Skolnick, Langbort, & Day 1982, p. 21).

Poor Preparation

Few elementary school teachers teach science effectively. Science receives less emphasis among the so-called basics of reading, writing, and arithmetic. Few elementary school teachers have science training. As a result, some students enter middle school with no science background!