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CRITICAL MASS

WOMEN IN SCIENCE

A 26 minute video with curriculum support

This video and curriculum were designed for delivery to middle school and high school science classes. Viewing and lesson plan require one full period of classtime, however, teachers are encouraged to prepare students in advance of viewing as well as provide additional content for motivated students.

The video is an interesting and fast-paced overview of women scientists and middle and high school girls talking about their jobs, experiences and attitudes toward science. Rock and rap music are interwoven throughout the video, providing an up-beat soundtrack for holding students' interest. The scientists are from Los Alamos National Laboratory, The University of New Mexico, Sandia National Laboratories; the teachers and students are from Albuquerque High School, Taft Middle School, and The University of New Mexico.

This video raises issues of gender equity, an issue that is not often discussed in middle and high schools. It is imperative that teachers provide context to any discussion by explaining how gender stereotypes can lead to discrimination.

We welcome any feedback from you and your classes regarding the video and the curriculum support. Please contact us at:

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MASTER

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LESSON PLAN

Teacher : _____ Period : _____

Lesson Topic : Women in Science Date : _____

OBJECTIVES: The learner will be able to discuss gendered stereotypes of scientists, understand the concept of equity in education and job recruitment/training. Female learners will be motivated to consider science as a career option; both male and female learners will understand that girls face social stereotypes that can limit their opportunities.

MOTIVATION: (Written on the board before class or given as a handout at beginning of class) :

Although men and women are equally capable of becoming scientists, the scientific fields are dominated by men.

Write your reaction to this statement on a piece of paper and hold on to it.

PRETEST: (Given as handout or read aloud - see next page for pretest)

VIDEO PREP: Explain to class that the video was produced to address the problem of girls being discouraged to go into science careers because of stereotypes. Explain the concept of equity in educational opportunity; boys and girls must have equal access to educational opportunities that lead to rewarding careers that maximize each person's potential. If possible, discuss gender stereotypes/discriminations and how it limits a person's opportunities, e.g., females in major league sports, males in nursing, females in firefighting, males in elementary education.

SHOW VIDEO

INVITE REACTIONS / RESPONSES TO VIDEO

DISCUSS WRITTEN RESPONSES TO OPENING STATEMENT

GO OVER ANSWERS TO PRETEST

PRETEST TO VIDEO

1. What are some things that scientists have in common?

Curiosity, problem-solving, scientific method, data, e.g.

2. Name three things or activities you encounter daily that are related to science.

Automobiles, plumbing, electricity, computers, cooking, etc.

3. Name at least one famous woman scientist.

Sally Ride, astronaut; Marie Curie, discovered radium; Dian Fossey, primatologist; Jane Goodall, primatologist, etc.

4. Guess how many women scientists have received the Nobel Peace Prize,

Eight. Marie Curie received two. (See Fact Sheet for complete list.)

5. What is the average salary of scientists?

\$39,000. (1992)

6. Of all the scientists in the U.S., what percent are women?

Of the 5,285,300 scientists and engineers in the U.S. , only 16% are women. Women, however, comprise 45% of the workforce.

7. During the period between first and eighth grade, boys and girls score equally on math aptitude tests.

True or false?

True. At age 13 , girls start to fall slightly behind.

WOMEN SCIENTISTS THROUGHOUT HISTORY

Science as a discipline began in the 16th century. Prior to this time, very few men and fewer women could even read. In spite of these limitations, several women found ways to study and create new knowledge. The following are brief profiles of women throughout history who have made significant contributions to scientific knowledge.

HYPATIA (370 - 415) is generally known as the first woman scientist. She was one of the great mathematicians of her time and yet she was murdered by a mob of people who did not accept her studying math.

ST. HILDEGARD OF BINGEN (1098 - 1179) studied both the physical and spiritual world. She wrote and published a nine-volume study of plants, animals and metals in medicine.

JANE COLDEN (1724 - 1766) was known as America's most famous woman scientist for 100 years. She studied plants and catalogued more than 300 types of plants.

CAROLINE HERSCHEL (1750 - 1848) was an astronomer and discovered five comets and published a catalog of stars. Her work was instrumental in the accepted theories of her famous brother, Sir William Herschel.

EMILIE DI BRETEUIL, MARQUISE DE CHATELET (1706 - 1749) was privately tutored in mathematics and she was the first to provide a French translation of Sir Isaac Newton's work. She also published a physics textbook.

FLORENCE BASCOM (1862 - 1945) was the first woman and first geologist to receive a Ph.D. from Johns Hopkins University. She pioneered microscopic study of minerals and rocks.

ELIZABETH KNIGHT BRITTEN (1858 - 1934) published over 300 articles on mosses and was the only woman charter member of the Botanical Society of America.

ELLEN RICHARDS (1842 - 1911) started the first sanitation lab in the U.S. at MIT. She founded the study of nutrition and food chemistry, which she called home economics so as to enable women scientists to study in the field.

ANNIE JUMP CANNON (1836 -1941) classified over 350,000 stars with a system she invented that is still used by astronomers today.

FLORENCE REBA SABIN (1871 - 1953) was the first woman to be elected to the National Academy of Sciences for helping medical science understand the deadly disease tuberculosis.

LISA MEITNER (1878 - 1968) was one of the greatest physicists of the 20th century and the first to understand nuclear chain reactions. She discovered four radioactive elements.

EDITH HINCKLEY QUIMBY (1891 - 1982) discovered a radiation treatment for cancer and taught hundreds of physicians about radiation treatment.

KATHERINE BURR BLODGET (1898 - 1979) was a physicist and inventor and was responsible for inventing the glass used in camera lenses.

ROSALIND FRANKLIN (1920 - 1958) was the first scientist to study the microscopic structure of coal. She is the unacknowledged scientist in the discovery of DNA, having worked side by side with her male colleagues Watson and Crick.

GRACY MURRAY HOOPER (1906 -) , a Yale mathematician who helped develop the first electronic computer at Harvard, the Mark I. She helped develop COBOL, the standard computer language used in business. She was also an admiral in the Navy.

JANE GOODALL (1934 -) , a primatologist who studied chimpanzees in their natural environments and discovered that they make and use tools. Her research led us to understand that non-human primates are toolmakers.

SUGGESTED READINGS AND MATERIALS ON WOMEN IN SCIENCE

Available from National Women's History Project, 7738 Bell Road, Windsor, CA 95492:

Outstanding Women in Mathematics and Science. A display set featuring 23 women scientists in a range of fields—full-page black and white photos with biographies.

Women in Science: Antiquity Through the Nineteenth Century. A biographical dictionary of 186 women in science over 2500 years.

Women of Science: Righting the Record. G. Kass-Simon and Patricia Farnes, eds.

Portraits for Classroom Bulletin Boards: Women Mathematicians.
Full-page line drawings and bios of 15 math pioneers.

OTHER MATERIALS:

Breaking the Barriers, Clewell, Anderson and Thorpe, eds. Jossey-Bass, San Francisco, 1992.

How To Encourage Girls in Math & Science, Skolnick, Langbort and Day, eds. Prentice-Hall, New Jersey, 1982.

Spaces : Solving Problems of Access to Careers in Engineering and Science. Lawrence Hall of Science, University of California, Berkeley, California, 1982.

How High the Sky? How Far the Moon? by Sharon Menard, 1979.

Activities for a variety of grade levels, information on science careers and a good bibliography of fiction and non-fiction science-related books for students. Available from Education Development Center, 55 Chapel Street, Suite 268, Newton, Massachusetts, 02160.

Encouraging Girls in Math and Science. A four-pamphlet set that reflects the most recent research on effective math and science education for girls: "Working Together, Making Changes;" "Math, Science, and Your Daughter;" "Nothing Can Stop Us Now;" and "What Works and What Doesn't." Available from Education Development Suite, 55 Chapel Street, Suite 268, Newton, Massachusetts, 02160, 1-800-225-3088 to order.

3-2-1 Contact. A children's science magazine for ages 8-14 with puzzles, games and posters that make science interesting and fun. Available in bulk to schools from Children's Television Workshop, P.O. Box 2933, Boulder, Colorado, 80322.

SUPPLEMENT TO PRE-TEST:

Women in Science and Their Accomplishments

Science is for everyone ! The history of science is filled with women who made major breakthroughs in math, astronomy, chemistry, physics, geology, biology, and medicine, to name a few.

What do the inventors of the following have in common?

Terramycin, rabies vaccination, radium, nuclear fission, COBOL, meningitis serum, apgar score, radioactivity, parity violation, small pox inoculation.

THEY WERE ALL WOMEN !

Who invented the ice cream freezer? Dolly Madison, wife of President James Madison.

Who invented the folding bed? African American Sarah Goode, in 1885.

Who invented cosmetics? African American Sarah Walker, known as Madame C.J. Walker who made a fortune in cosmetics.

Who invented the disposable diaper? Marion Donovan in 1951.

What started Pepperidge Farm, the famous cookie and bread company ? Margaret Rudkin's recipe for whole-grain bread.

Who invented the chocolate chip cookie? Ruth Wakefield, in 1920, chopped up a chocolate bar in cookie dough and began serving the cookies at the restaurant she and her husband owned in Massachusetts, The Toll House.

Source : " Women in Science ", The Philadelphia Daily News , November 24 , 1986

Eight women have received the Nobel Prize for Science and Medicine

Marie Curie, 1903 for physics (shared with her husband) for discovery of radioactivity and 1911 for chemistry for discovery of the element radium.

Irene Joliot-Curie (Marie's daughter) shared the 1935 Prize for chemistry with her husband; they discovered that radioactivity could be artificially produced which was an essential step in the development of the atomic bomb.

Gerty Cori shared the 1947 Prize for physiology/medicine with her husband. They worked on carbohydrate metabolism and discovered a new enzyme, phosphorylase.

Maria Mayer received the 1964 Prize for physics along with her colleagues Hans Jensen and Eugene Wigner, for their research on the structure of atomic nuclei.

Dorothy Mary Crowfoot Hodgkin discovered the biochemical structures of penicillin and vitamin B-12, receiving the 1964 Prize for chemistry.

Rosalyn Yalow received the 1977 Prize in medicine for development of radioimmunoassay, a test of body tissues used to measure concentrations of hormones, viruses, vitamins, enzymes and drugs. She shared the prize with her colleagues, Roger Guillemin and Andrew Schally.

Barbara McClintock studies the genetics of corn for 30 years; her work was largely dismissed by the scientific community until the 80s in which her groundbreaking research on DNA and gene transposition was accepted. She received the 1983 Prize for Medicine for work accomplished without a collaborator.

Rita Levi-Montalcini received the 1986 Prize for medicine for her work on nerve fibers, along with her colleague Dr. Stanley Cohen. Her research on nerve growth contributed greatly to understanding cancer cells and the development of cures for some cancers.

SCIENTIFIC EXPERIMENT

An Enrichment Activity

Primary Objective: Use science skills to identify problems and answer the question:

Why are girls not choosing science careers as often as boys?

Secondary Objective: Demonstrate to students that girls and boys use science to effectively solve problems.

Review Scientific Method

scientific method : activities used to solve problems and gather data

data : information

hypothesis : suggested answer to a problem

As a class or in small groups :

Step 1 Identify and State the Problem

Girls don't choose science careers as often as boys.

Step 2 Study Existing Facts

Give class the Fact Sheet on women in science, highlighting the statistics.

Step 3 State Hypothesis

There might be several—ask for suggestions and select one or two to explore as a class, e.g., girls don't like science, girls don't do well in science, girls want to be mothers-not scientists, boys like science more than girls, etc.

Step 4 Design an Experiment

Example: Take a survey of girls in class in response to the statement "*girls don't like science.*"

Note: Be sure to discuss the limitations of such a small sample size and emphasize the need for a much larger survey.

Step 5 Gather Data

Survey the girls with questions.

Step 6 Analyze the Data

Compute the percentages of responses.

Step 7 State a Conclusion

State whether data supports the hypothesis, e.g., 65% of the girls in this class like science, therefore this sample disproves the hypothesis that girls don't like science.

FACT SHEET ON U.S. WOMEN IN SCIENCE

Use these statistics in Step 2 of the scientific method to provide background for the class on this question.

Women, and minorities are underrepresented in science, particularly in physical science fields. Underrepresentaion is based upon the fact that women make up 45% of all workers in the U.S.

Only 16% of all scientists and engineers are women.

Female scientists average 75% of male scientists' salaries.

Female college professors of science average 79% of male professors' salaries.

Girls and boys score equally on math aptitude tests until age 13, when girls start to fall behind. Research indicates that girls can lose confidence at this age, particularly in subjects that are stereotyped as masculine.

CRITICAL MASS

WOMEN IN SCIENCE

**A television documentary on
KNME-TV Channel 5
Tuesday, September 7th at 7:30 pm**

Cool science and hot rock combine in **Critical Mass : Women in Science** to encourage young women in science and engineering, which airs on KNME-TV Channel 5 at 7:30 pm on Tuesday, September 7th. Studies indicate that women are twice as likely as men to drop out of science. Women make up only 16% of the scientists and engineers in the United States. Minority women face even greater roadblocks.

Targeting girls in the 5th through 10th grades, this MTV style documentary captures the voices and concerns of girls from Taft Middle School and Albuquerque High to explore the emotional and social reasons why young women do not continue their studies in science and mathematics. Role models Astronaut Susan Helms and women scientists from Los Alamos National Laboratory and The University of New Mexico also share their experiences and lives.

Critical Mass : Women in Science is a part of a comprehensive educational effort by Los Alamos National Laboratory to improve the opportunities for women and minorities in the sciences. A ten-page curriculum has been developed to help both male and female students better understand gender issues in science. Copies of the video and the curriculum will be distributed free of charge to middle schools and high schools in the Albuquerque / Los Alamos corridor.

Teachers making their own copies of the program can obtain copies of the curriculum at cost from the Office of Research Administration, Scholes Hall, The University of New Mexico, Albuquerque NM 87131, (505) 277-2256. Major funding was provided by Los Alamos National Laboratory with additional support by KNME-TV and The University of New Mexico.