Lesson Plan: Genetic Testing and Hereditary Cancer

OVERVIEW
This lesson plan is designed to be used with the film **In the Family,** which explores issues related to genetic testing and the difficult decisions some must face when they learn they are at high risk for certain forms of cancer.

P.O.V. documentaries can be recorded off the air and used for educational purposes for up to one year from the initial broadcast. In addition, P.O.V. offers a lending library of DVD's and VHS tapes that you can borrow anytime during the school year — FOR FREE! (Note: This film includes some frank and sensitive discussions about how the prevention and treatment of breast and ovarian cancer may affect one's quality of life and relationships with loved ones. In addition, there are images of women's breasts that have undergone mastectomy and/or reconstructive procedures. Please review prior to using the entire film in the classroom.)

Please visit our Film Library at **http://www.amdoc.org/outreach_filmlibrary.php** to find other films suitable for classroom use or to make this film a part of your school's permanent collection.

OBJECTIVES
By the end of this lesson, students will:
- Use viewing skills to understand and interpret a number of video clips.
- Discuss issues related to genetic testing and the knowledge that comes with the test results.
- Write an opinion paper on if or how genetic testing should be used to inform people of high risks for cancer.

GRADE LEVELS
11 and 12

SUBJECTS
Health, Biology, U.S. History, Current Events, Language Arts, Civics

MATERIALS NEEDED
- Method (varies by school) of showing the class online video clips
- Computers with access to the Internet

ESTIMATED TIME OF COMPLETION
One 50-minute class period, plus some homework time for students to complete their papers

SUGGESTED CLIPS
Clip 1: Gene Mutation Animation (length 1:35)
The clip begins at 23:16 with the quote "All cancer is genetic …" and ends at 24:51 with the quote "… because the first mutation is already present."

Clip 2: Support Group (length 1:42)
The clip begins at 13:47 with a scene of women greeting one another at the front door and ends at 15:29 with the quote "… finished treatment on Friday."

Clip 3: Hanke Family Test Results (length 3:45)
The clip begins at 36:04 with the Hankes riding in the car and ends at 39:49 with the quote "You now have control of the situation for the rest of your lives."

BACKGROUND
The film **In the Family** looks at the use of genetic testing to determine the possibility of future illness based on inherited genes. Alterations in the BRCA1 and BRCA2 (short for breast cancer 1 and breast cancer 2) genes are involved in many cases of hereditary breast and ovarian cancer, and both men and women can carry them. Testing for mutations is recommended for families with a history of being diagnosed with these cancers before the age of 50. The cost for the test is currently $3,000 and is exclusively performed by the company Myriad Genetics, which holds the patents for the BRCA genes.

Test results can come back positive ("positive for a deleterious mutation"), negative ("no mutation detected") or undetermined ("variant of uncertain significance"). Women who test positive for these mutations have a 36 to 85 percent lifetime risk for breast cancer and a 16 to 60 percent risk for ovarian cancer. In the general population, the lifetime risk for breast cancer is 12 percent and the lifetime risk for ovarian cancer is 1.8 percent.

If a woman tests positive for a mutation, she can seek advice from genetic counselors and other health professionals. Generally speaking, women who test positive should avoid environmental factors that can increase their risk for cancer, such as smoking. Individuals can also consider a number of preventive medical procedures, including frequent clinical monitoring (ultrasounds, mammograms, blood tests, etc.) to catch a disease at an early stage, prophylactic surgery (removal of healthy breasts with preventive mastectomy and removal of healthy ovaries and fallopian tubes with preventive salpingo-oophorectomy) and drug therapy (chemoprevention, though its effectiveness is unclear, and birth control pills, which can decrease the risk of ovarian cancer). For more information, please see the "Resources" section below.

ACTIVITY

1. Ask students if they would want to know if they had a strong likelihood of getting certain types of cancer and to explain why or why not? Discuss as a class what they see as the benefits and drawbacks of knowing this information. List these points on the board.

2. Explain that geneticists have learned that a mutation in two specific genes have been linked to a high risk of breast and ovarian cancer. These genes are called BRCA1 and BRCA2, short for breast cancer 1 and breast cancer 2.

3. Show Clip 1, "Gene Mutation Animation," to give students a basic explanation of how a gene mutation can raise someone's risk for disease. (Classes with a strong background on DNA concepts can skip this step.) How do genetic and environmental factors influence a person's health?

4. Tell students that genetic testing can reveal if someone has the BRCA1 or BRCA2 mutation. Draw from the "Background" section to provide details on the possible results of this testing, cancer risk statistics and the preventive treatment options available for those who test positive. Explain that currently, the most effective way to lower the cancer risk for a person who tests positive for BRCA1 or BRCA2 is prophylactic surgery.

5. Show Clip 2, "Support Group," to provide students with information about the medical treatment choices and consequences of a number of women who tested positive for this mutation. Discuss treatment choices students would make if they were in that situation. How would access to affordable health care influence those choices?

6. Explain that genetic testing can greatly impact families. Show Clip 3, "Hanke Family Test Results." Tell the class that the video shows what happens when three daughters of a woman who carries the BRCA mutation are tested and go in together to hear the results.

7. After the clip, talk about how the lives of each daughter will change as a result of the knowledge gained through genetic testing. Discuss factors (e.g., age, marital status, family history) might influence a person's decisions about genetic testing. What might happen if genetic testing for this mutation were not available?

8. Conclude the activity by having students write an opinion paper on if or how genetic testing should be used to inform people of their being at high risk for cancer. Students can refer to the benefits and drawbacks list from Step 1, class discussion notes and the P.O.V. website resource "Hereditary Cancer: What Do I Need to Know?" to develop their ideas.

ASSESSMENT SUGGESTIONS

Students can be assessed on:

- Contributions to class discussions.
- How well their opinion papers effectively apply language conventions and demonstrate their understanding of the information, ideas and concepts addressed in the lesson activity.

EXTENSIONS AND ADAPTATIONS

- Debate this question: Should the government allow genes to be patented? First, divide the class into groups that will argue for or against patenting genes. Explain that a company called Myriad Genetics found the exact location of the BRCA1 and BRCA2 genes and then patented them. They now control all commercial testing in the United States and use testing fees to reimburse their original research investment. Students can then prepare their arguments using the Genetics and Patenting Page (**http://www.ornl.gov/sci/techresources/Human_Genome/elsi/patents.shtml**) from the Human Genome Project Information site and points from the July 2000 *NewsHour* interview, "Patenting Genes" (**http://www.pbs.org/newshour/bb/health/july-dec00/genome_7-6.html**).

- Simulate a press conference that announces the May 2008 signing of the Genetic Information Nondiscrimination Act (GINA). Assign students the roles of various members of Congress, the president and the press. Give time for

students to prepare an opening statement and ask or answer questions related to their role. For example, the president may make a statement about signing GINA. Members of the press might ask why it took 13 years for the bill to pass and how it will affect people's lives. Students can find the legislative history of this law (**http://www.genome.gov/24519851**) at the site for the National Human Genome Research Institute. Students may also find it helpful to access news stories on GINA from Online NewsHour (**http://www.pbs.org/newshour/extra/features/us/jan-june08/dna_5-05.html**) and Reuters (**http://www.reuters.com/article/politicsNews/idUSN2143439320080521**). After the press conference, ask students to write a news article about the new law.

- Help students create a family health history that will help them and members of their families take action to prevent serious medical disorders. Use the My Health Family Portrait tool (**http://www.hhs.gov/familyhistory/**) provided by the U.S. Department of Health and Human Services to research and organize family health information and print out a graphical report that can be shared with health professionals and family members. Then have students research which medical screenings and lifestyle behaviors will help reduce their risks of getting these diseases.

- Explore the issues behind the statistics that show black women are more likely to die of breast cancer than white women. Read the ChicagoMag.com article "The Deadly Difference" (**http://www.chicagomag.com/Chicago-Magazine/October-2007/The-Deadly-Difference/**), which features Martha Haley from **In the Family.** Outline the obstacles that black women often face when managing their health and brainstorm possible solutions.

RESOURCES

Frequently Asked Questions About Genetic Testing
http://www.genome.gov/19516567
The National Human Genome Research Institute provides information about how genetic tests are done, the information the tests provide, and details to guide decisions about whether or not to get tested.

Genetic Testing for Breast Cancer: What the Results Mean
http://www.mayoclinic.com/health/genetic-testing/BR00014
The Mayo Clinic outlines the risk-reducing options available to those with BRCA mutations.

STANDARDS

These standards are drawn from "Content Knowledge," a compilation of content standards and benchmarks for K-12 curriculum by McRel (Mid-continent Research for Education and Learning) at **http://www.mcrel.org/standards-benchmarks/**.

Civics

Standard 14: Understands issues concerning the disparities between ideals and reality in American political and social life.

Standard 21: Understands the formation and implementation of public policy.

Standard 27: Understands how certain character traits enhance citizens' ability to fulfill personal and civic responsibilities.

Health
Standard 1: Knows the availability and effective use of health services, products and information.

Standard 3: Knows the relationship of family health to individual health.

Standard 8: Knows essential concepts about the prevention and control of disease.

Language Arts
Standard 1: Uses the general skills and strategies of the writing process.

Standard 9: Uses viewing skills and strategies to understand and interpret visual media.

Science
Standard 4: Understands the principles of heredity and related concepts.

U.S. History
Standard 31: Understands economic, social and cultural developments in the contemporary United States.

ABOUT THE AUTHOR
Cari Ladd, M.Ed., is an educational writer with a background in broadcast journalism, secondary education and media development. Previously, she served as director of education of PBS Interactive, overseeing the development of curricular resources tied to PBS programs, the PBS TeacherSource website (now PBS Teachers) and online teacher professional development services. She has also taught in Maryland and northern Virginia.

Background Sources
"Genetic Testing for BRCA1 and BRCA2: It's Your Choice," National Cancer Institute, **http://www.cancer.gov/cancertopics/factsheet/risk/brca**; "Genetic Testing for Breast Cancer," The Mayo Clinic, **http://www.mayoclinic.com/health/genetic-testing/BR00014**; **In the Family,** Joanna Rudnick.