

## 3

## Exploring Genetic Testing: A Case Study

### Introduction

In this lesson, students engage in a case study about a family with a history of breast cancer. Students consider ethical issues surrounding genetic testing as they decide whether family members should get tested for *BRCA1* or *BRCA2* mutations. Students then evaluate the case through the principles-based bioethics concepts of: **Respect for Persons**, **Maximize Benefits/Minimize Harms**, and **Justice**. Students apply the principles to help them reason through their decision as they participate in a Structured Academic Controversy. In *Lesson Three*, students learn how **genetic counselors** might use bioinformatics tools in their careers.

### Learning Objectives

At the end of this lesson, students will know that:

- Genetic testing involves screening a patient's DNA for the presence of mutations that may cause diseases such as cancer.
- Genetic testing can have implications for family members of the patient, as they share some of the same genetic material.
- Bioinformatics tools are used by people in many careers, including genetic counselors.
- In the case of *BRCA1* and breast cancer, no treatment is 100% effective, and the test is not 100% predictive about whether the patient will develop cancer.

At the end of this lesson, students will be able to:

- Identify ethical issues involved in genetic testing.
- Apply their understanding of bioethical principles to a case study.
- Explain why someone would or would not choose to have the genetic test for *BRCA1* mutations.
- Consider alternative perspectives and engage in discussion and decision making during a Structured Academic Controversy.

### Key Concepts

- Genetic testing involves screening individuals for the presence or absence of mutations that can cause cancer (i.e., cancer-associated alleles).
- A mutation in a particular gene does not mean that the person carrying that allele will definitely get cancer.
- Knowledge of ethical principles can provide a structure for making complex decisions. The bioethical principles introduced are:
  - o **Respect for Persons:** Respecting the inherent worth of an individual and his or her **autonomy**.
  - o **Maximize Benefits/Minimize Harm: Beneficence/nonmaleficence.**
  - o **Justice:** Being fair.

### Class Time

- One homework assignment before class.
- One class period (50 minutes) for the Structured Academic Controversy.

### Prior Knowledge Needed

- Understanding of the Central Dogma of Molecular Biology.

### Common Misconceptions

- Only women can get breast cancer.  
*Fact: 1 in 1,000 men will contract breast cancer in their lifetime.*
- Not everyone has *BRCA* genes.  
*Fact: Everyone has *BRCA* genes. Some of the mutant or altered forms (alleles) can cause cancer.*

- In the case of *BRCA1* and breast cancer, no treatment is 100% effective.
- Bioinformatics tools are used by people in many careers, including genetic counselors

## Materials

Materials	Quantity
Copies of Student Handout— <i>Careers in the Spotlight</i> (handed out in <i>Lesson One</i> )	1 per student
Class set of Student Handout— <i>Case Study: A BRCA Genetic Testing Dilemma</i>	1 per student (class set)
Class set of Student Handout— <i>Focus on the Principles</i>	1 per student (class set)
Copies of Student Handout— <i>Structured Academic Controversy Worksheet</i>	1 per student
Class set of Student Handout— <i>Structured Academic Controversy FOR Position Statement</i>	1 per every 2 students (half of class) (class set)
Class set of Student Handout— <i>Structured Academic Controversy AGAINST Position Statement</i>	1 per every 2 students (half of class) (class set)
Teacher Answer Key— <i>Focus on the Principles</i>	1
Teacher Answer Key— <i>Structured Academic Controversy Worksheet</i>	1

Computer Equipment, Files, Software, and Media
Computer with internet access and projector to display PowerPoint slides.
<b>Alternative:</b> Print PowerPoint slides onto transparencies and display with overhead projector.
<i>Lesson Three</i> PowerPoint Slides— <i>Exploring Genetic Testing: A Case Study</i> . Available for download at: <a href="http://www.nwabr.org/curriculum/introductory-bioinformatics-genetic-testing">http://www.nwabr.org/curriculum/introductory-bioinformatics-genetic-testing</a> .
A student version of lesson materials (minus teacher answer keys) is available from NWABR's Student Resource Center at: <a href="http://www.nwabr.org/students/student-resource-center/instructional-materials/introductory-bioinformatics-genetic-testing">http://www.nwabr.org/students/student-resource-center/instructional-materials/introductory-bioinformatics-genetic-testing</a> .
Computer lab with internet access for students.

## Teacher Preparation

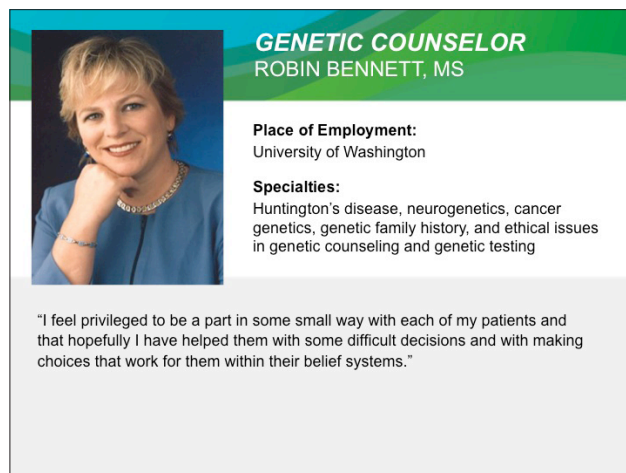
- Load the classroom computer with the *Lesson Three* PowerPoint slides.
- Make copies of the Student Handouts, one per student. The following handouts are designed to be used as class sets: Student Handout—*Case Study: A BRCA Genetic Testing Dilemma*; Student Handout—*Focus on the Principles*; Student Handout—*Structured Academic Controversy FOR Position Statements*; and Student Handout—*Structured Academic Controversy AGAINST Position Statement*.
- Student Handout—*Case Study: A BRCA Genetic Testing Dilemma* should be assigned as homework before the lesson.

[**Note:** Half of the students will receive copies of Student Handout—*Structured Academic Controversy FOR Position Statements* and half of the students will receive copies of Student Handout—*Structured Academic Controversy AGAINST Position Statements*.]

## Procedure

### WARM UP

1. As students enter the classroom, display PowerPoint **Slide #1**. This slide highlights genetic counselor Robin Bennett.



Exploring Genetic Testing: **Slide #1**

2. Have students retrieve Student Handout—*Careers in the Spotlight* from Lesson One.
3. Students should think about, and write down, what kind of work a genetic counselor might do (Genetic Counselor Question #1). This will be revisited at the end of the lesson, including how a genetic counselor might use bioinformatics in his or her job.
4. Tell students to keep their *Careers in the Spotlight* handout available for future lessons.

### PART I: Applying Bioethical Principles to a Case Study

5. Explain to students the **aim of this lesson**.

#### Lesson Aim:

- To understand the ethical issues involved in genetic testing.

Some teachers may find it useful to write the lesson aim on the board.

Teachers may also wish to discuss the *Learning Objectives* of the lesson, which are listed at the beginning of this lesson plan.

6. Ensure that everyone has read the case study. To participate in the discussion and the following Structured Academic Controversy, it is very important that every student has read the case study. If the case study was not assigned previously for homework, provide time in class for students to read the case study found on Student Handout—*Case Study: A BRCA Genetic Testing Dilemma*.
7. Pass out Student Handout—*Focus on the Principles*.
8. Show **Slide #2**. Tell students that they may already be familiar with the important concepts behind the bioethical principles found on Student Handout—*Focus on the Principles*, which include concepts such as **fairness**, **doing good**, and **respect**. Bioethicists use a number of different ethical

perspectives to help defend their position. In this unit, we will focus on the principles **Respect for Persons**, **Maximize Benefits and Minimize Harms**, and **Justice**.

Exploring Genetic Testing: **Slide #2**

BIOETHICAL PRINCIPLES

**Respect for Persons**

- Respecting the inherent worth of an individual and his or her autonomy

**Maximize Benefits/Minimize Harm**

- Beneficence/Nonmaleficence
- The most good for the most people

**Justice**

- Being fair; giving what is “owed” or “due”
- Distributing benefits/burdens equitably across a group of individuals

- Encourage students to engage in a Think-Pair-Share. First, using their answers to the case study questions found on Student Handout—*Case Study: A BRCA Genetic Testing Dilemma*, have students use a separate sheet of paper to respond to the prompts on Student Handout—*Focus on the Principles* as best they can individually.
- After about five minutes, have individual students come together in pairs to compare answers to Student Handout—*Focus on the Principles*. Students can revise their written responses as needed.
- After a few minutes, have two pairs of students meet as a group of four. Again, students can compare answers and revise their written responses.
- Bring the class together to share students’ answers and thoughts on Student Handout—*Focus on the Principles*. During the class discussion, draw out how the bioethical principles relate to Deb Lawler and her decision to have, or not to have, genetic testing for mutations in the BRCA genes. Teacher Answer Key—*Focus on the Principles* can be used as a guide for this discussion.
- Point out that the principles can be used to support either a ‘yes’ or a ‘no’ answer to the ethical question. The **reasoning** behind the decision is more important than the decision itself for these purposes.

## PART II: Structured Academic Controversy

- Show **Slide #3**. Tell students about the framework of a Structured Academic Controversy. The basic framework is:
  - A group of four subdivides into two pairs of students.
  - Two students are assigned (or choose) the FOR position; two argue the AGAINST position.
  - Each pair reads background material on their position and prepares their argument.
  - Pair FOR presents while Pair AGAINST listens.

[**Note:** Structured Academic Controversy is a text-based, small group deliberation model where students learn about both sides of an issue before examining their own personal views. Active listening is an important part of the process. The ethical question the students will be considering is: “Should Deb Lawler have BRCA genetic testing?”]

- Pair AGAINST asks clarifying questions **only**.
- Pair AGAINST paraphrases FOR.
- Pair AGAINST presents while Pair FOR listens.
- Pair FOR asks clarifying questions **only**.
- Pair FOR paraphrases AGAINST.
- Students drop their assigned roles and discuss possible solutions.
- Students take turns stating their own positions.
- Students clarify areas of agreement and disagreement.

**STRUCTURED ACADEMIC CONTROVERSY**

**Should Deb Lawler have BRCA genetics testing?**

- Read background position statements
- Pair "FOR" presents, Pair "AGAINST" listens
- Pair "AGAINST" asks CLARIFYING questions **only**
- Pair "AGAINST" paraphrases "FOR"
- Pair "AGAINST" presents, Pair "FOR" listens
- Pair "FOR" asks CLARIFYING questions **only**
- Pair "FOR" paraphrases "AGAINST"
- Students drop their assigned roles and discuss possible solutions.
- Students take turns stating their own positions.
- Students clarify areas of agreement and disagreement.

Exploring Genetic Testing: **Slide #3**

15. Remind students of the classroom norms. For example, students should speak one at a time, hear all sides equally, listen well enough to respond, and back up their opinions with clear reasons.
16. Show **Slide #4**, which begins to walk students through the steps of the Structured Academic Controversy. Students should already be in groups of four from completing *Part I* of the lesson. Have them further subdivide into two pairs.

**STRUCTURED ACADEMIC CONTROVERSY**

**Should Deb Lawler have BRCA genetics testing?**

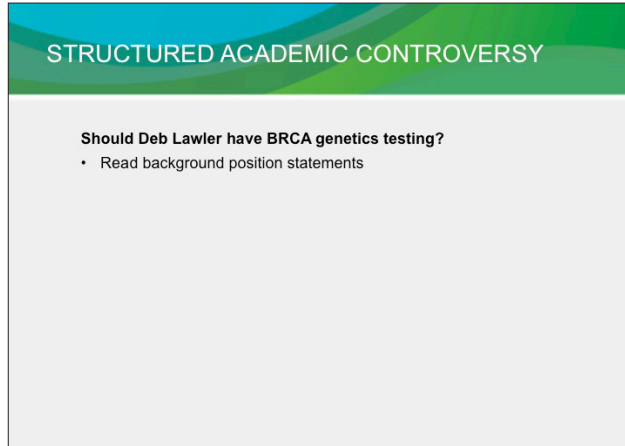
- Groups of four students subdivide into two groups of two
- Two students are "FOR" and two students are "AGAINST"

Exploring Genetic Testing: **Slide #4**

17. Pass out Student Handout—*Structured Academic Controversy Worksheet*. In their pairs, have students fill out the *Relevant facts and Stakeholders* sections using the case study (Student Handout—*Case Study: A BRCA Genetic Testing Dilemma*).

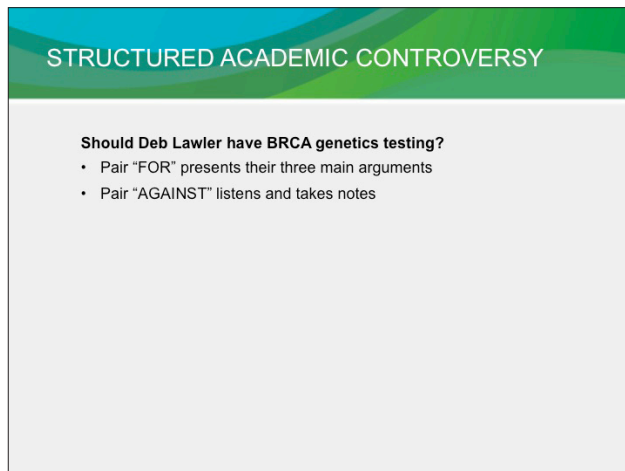
18. Pass out Student Handout—*Structured Academic Controversy FOR Position Statements* to half of the students (the FOR groups) and Student Handout—*Structured Academic Controversy AGAINST Position Statements* to half of the students (the AGAINST groups). Two students are assigned (or choose) the FOR position; two are assigned (or choose) the AGAINST position.
19. Show **Slide #5**. Each pair reads the background information supporting their position (about five minutes). Together, each pair plans a presentation of their position and arguments. Students should focus on their **three most important arguments**.

Exploring Genetic Testing: **Slide #5**

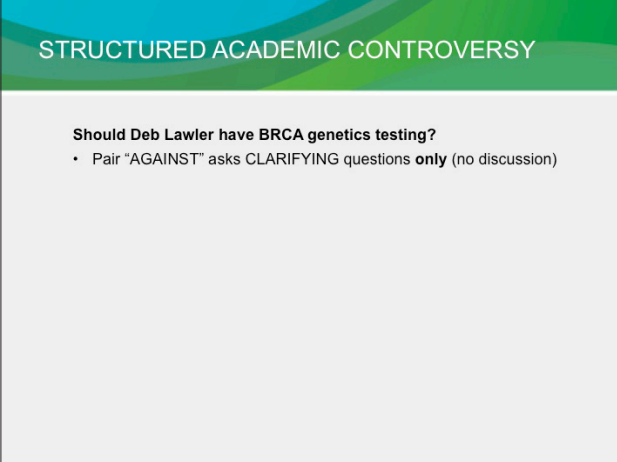


20. Show **Slide #6**. One side presents, the other side listens and takes notes. One side presents their three important arguments to the other side. The other side needs to listen carefully and take notes. The presenters should be satisfied that their position has been heard and understood.

Exploring Genetic Testing: **Slide #6**



21. Show **Slide #7**. To be sure that Pair AGAINST understands the arguments, they may ask clarifying questions as necessary. Emphasize that there is no discussion at this point.




**STRUCTURED ACADEMIC CONTROVERSY**

**Should Deb Lawler have BRCA genetics testing?**

- Pair "AGAINST" asks CLARIFYING questions **only** (no discussion)

Exploring Genetic Testing: **Slide #7**

22. Show **Slide #8**. Pair AGAINST paraphrases the three main arguments from Pair FOR (members of Pair AGAINST take turns restating the main points back). Pair FOR corrects any misunderstandings.



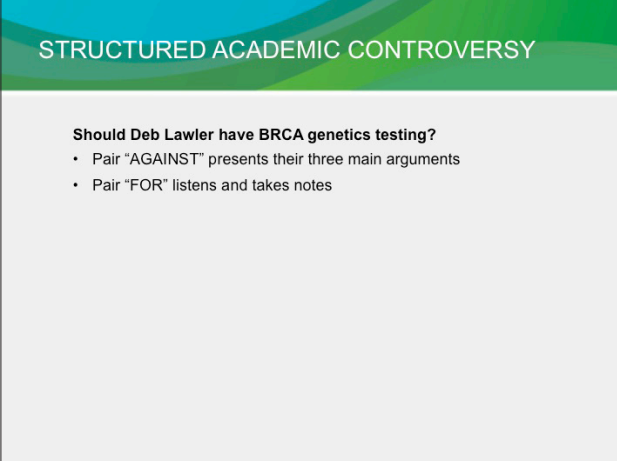
**STRUCTURED ACADEMIC CONTROVERSY**

**Should Deb Lawler have BRCA genetics testing?**

- Pair "AGAINST" paraphrases "FOR" (members of Pair "AGAINST" take turns restating the main points back)
- Pair "FOR" corrects any misunderstandings

Exploring Genetic Testing: **Slide #8**

23. Show **Slide #9**. **The pairs switch** and the process is repeated, with Pair AGAINST presenting their three main arguments, while Pair FOR listens and takes notes.



**STRUCTURED ACADEMIC CONTROVERSY**

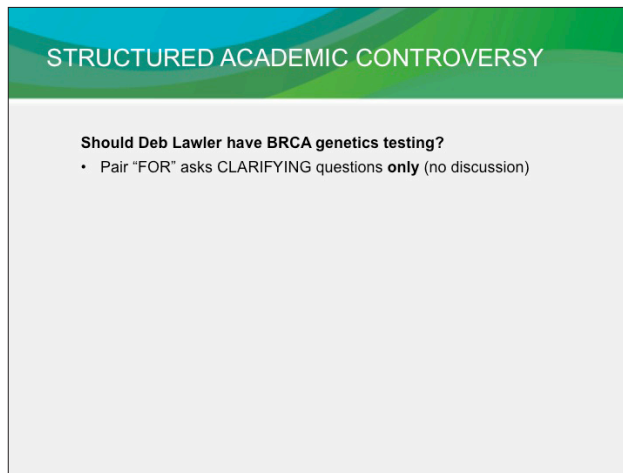
**Should Deb Lawler have BRCA genetics testing?**

- Pair "AGAINST" presents their three main arguments
- Pair "FOR" listens and takes notes

Exploring Genetic Testing: **Slide #9**

24. Show **Slide #10**. To be sure that Pair FOR understands the arguments, they may ask clarifying questions as necessary. Emphasize that there is no discussion at this point.

Exploring Genetic Testing: **Slide #10**



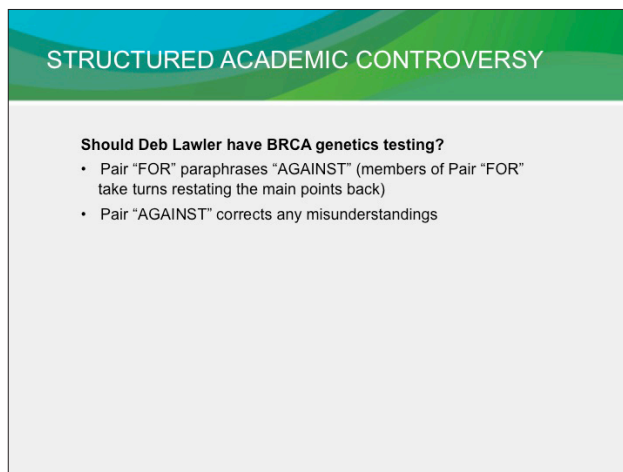
**STRUCTURED ACADEMIC CONTROVERSY**

**Should Deb Lawler have BRCA genetics testing?**

- Pair "FOR" asks CLARIFYING questions **only** (no discussion)

25. Show **Slide #11**. Pair FOR paraphrases the three main arguments from Pair AGAINST (members of Pair FOR take turns restating the main points back). Pair AGAINST corrects any misunderstandings.

Exploring Genetic Testing: **Slide #11**



**STRUCTURED ACADEMIC CONTROVERSY**

**Should Deb Lawler have BRCA genetics testing?**

- Pair "FOR" paraphrases "AGAINST" (members of Pair "FOR" take turns restating the main points back)
- Pair "AGAINST" corrects any misunderstandings

26. Show **Slide #12**. Students drop their roles. Students proceed as their own individual selves, using information from their own experiences as well as the background readings. **Prompt: See if you can clarify areas of agreement and disagreement. Feel free to change your mind.**



Exploring Genetic Testing: **Slide #12**

**STRUCTURED ACADEMIC CONTROVERSY**

**Should Deb Lawler have BRCA genetics testing?**

- Students drop their assigned roles and discuss possible solutions.
- Students take turns stating their own positions.
- Students clarify areas of agreement and disagreement.

27. While working through the Structured Academic Controversy, students should continue to fill out Student Handout—*Structured Academic Controversy Worksheet*.


### Closure: Careers in the Spotlight

28. Convey this to students: “Today, we’ve taken a close look at a personal decision about whether to have genetic testing for mutations in the BRCA genes. Tomorrow we’ll learn more about the tools that make genetic testing possible, using sequences from the Nucleotide and Protein databases at the NCBI to compare with sequences from members of the Lawler family to find out if each person has a mutation in his or her *BRCA1* gene.”

29. Return to the picture of the genetic counselor from Student Handout—*Careers in the Spotlight*, **Slide #13**.

Exploring Genetic Testing: **Slide #13**

**GENETIC COUNSELOR**  
ROBIN BENNETT, MS



**Place of Employment:**  
University of Washington

**Specialties:**  
Huntington's disease, neurogenetics, cancer genetics, genetic family history, and ethical issues in genetic counseling and genetic testing

“I feel privileged to be a part in some small way with each of my patients and that hopefully I have helped them with some difficult decisions and with making choices that work for them within their belief systems.”

30. Show **Slide #14**, which provides job information for a genetic counselor. Review this information with students.

Exploring Genetic Testing: **Slide #14**

CAREERS IN SPOTLIGHT:  
**GENETIC COUNSELOR**

**What do they do?**

- Review a patient's medical and family history.
- Advise patients and their families about the benefits and consequences of genetic testing, and about the nature of genetic disorders.
- Offer counseling consistent with the patient's belief system.

**What kind of training is involved?**  
 Bachelor's degree and a two to three year Master's degree.

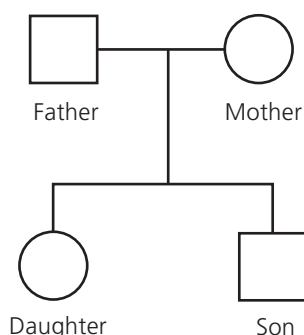
**What is a typical salary for a Research Scientist?**  
 Start at \$60,000/year (\$29/hour), and may make up to \$120,000/year (\$58/hour).

31. Ask students, "How does a genetic counselor fit into today's stories?" Point out that:
- Genetic counselors provide support and guidance to help families identify risks, interpret genetic information, and analyze how conditions are inherited.
  - Recent advances in bioinformatics have revolutionized the field of genetic counseling by dramatically increasing the amount of information to which genetic counselors have access.
  - The tools of bioinformatics are used to compare genetic sequences (as students will see tomorrow) which is the basis for the genetic tests genetic counselors help interpret.
32. Ask students to answer Genetic Counselor Question #2 on their *Careers in the Spotlight* handout, which has students explain how this lesson has changed their understanding of the kind of work a genetic counselor does.
33. Ask students to also answer Genetic Counselor Question #3 on their *Careers in the Spotlight* handout, which has students explain how a genetic counselor might use bioinformatics in his or her work.

## Homework

The following are suggested homework activities to follow this lesson. It is highly recommended that Student Handout—*Lawler Family Pedigree* be provided as homework to allow more time for class discussion in *Lesson Four*.

- A. Students should complete Student Handout—*Lawler Family Pedigree* for homework (from *Lesson Four*). If students are not familiar with pedigrees, draw a simple pedigree chart for a nuclear family with two children, such as:



Explain the relationships detailed in the pedigree. For homework, students will be asked to fill in the Lawler family pedigree by coloring in the square or circle if that person has had breast cancer (**phenotype**). Tell students that they can't know a person's genetic component (**genotype**) until the individual has been tested. As such, it is impossible to know carrier status, and no circles or squares should be partially colored in.

If students are unfamiliar with how to use a Punnett Square, page three of Student Handout—*Lawler Family Pedigree* (from Lesson Four) should not be assigned.

- B. Teachers may also wish to include a reflective homework assignment. Ask students to write about the activities they did in Lesson Three in their lab notebooks, on another sheet of paper, or in a word processing program like Microsoft Word® or Google Docs which they then provide to the teacher as a printout or via email. This can serve as an entry ticket for the following class. Have them complete these prompts:

- Today I learned that...
- An important idea to think about is...
- Something that I don't completely understand yet is...
- Something that I'm really confident that I understand is...

- C. Teachers may find it helpful to add a reflective paragraph for homework in lieu of the reflective questions listed above. Encourage students to share their specific thoughts about genetic testing, especially if students did not have sufficient time to explore and discuss their thoughts and feelings at the end of the Structured Academic Controversy. This assignment could take the form of a Supreme Court decision, with students writing the "Majority Decision" based on their own feelings and beliefs either "FOR" or "AGAINST" genetic testing, while acknowledging the merits of the opposite view in the "Minority Decision."

[**Note:** Suggested scoring for reflection: +5 points if all 4 prompts are complete.]

## Extension

- Students can use Student Handout—*Focus on the Principles* to consider some additional ethical scenarios. The italicized ethical question can go in the center of the worksheet, and students can view each scenario through the lens of the bioethical principles. A generic copy of Student Handout—*Focus on the Principles* can be found in the *Appendix*.
  - a. Matt's grandfather died of Huntington's Disease at the age of 53. It is a genetic disease for which there is no cure. Matt is 15 and would like to be tested for the disease, but his mother doesn't want him to get tested. She thinks Matt should live his life without the burden of knowing, at least until he is older. ***Should he take the genetic test now?***
  - b. Through genetic testing, Gabriella has found out that she is a carrier for Duchenne muscular dystrophy, an X-linked disorder that can be passed on to boys. ***Should her insurance company pay for in vitro fertilization techniques to ensure that her next baby is a girl?***
  - c. For his last birthday, Anthony's wife bought him a full genetic screening package from a direct-to-consumer genetic testing business. The results showed that Anthony has familial hypercholesterolemia, a condition which puts him a much higher than average risk of having an early heart attack. Anthony is an airline pilot and fears that passenger safety might be at risk. ***What should he do?***
- Information about the Genetic Information Nondiscrimination Act of 2008 (GINA), a new federal law that prohibits discrimination in health coverage and employment based on genetic information, can be found in the *Appendix*. This reading may be assigned to students as an extension activity. Students may use this information to write a reflective piece about how GINA would impact their answers to Questions #3 and 4 on Student Handout—*Case Study: A BRCA Genetic Testing Dilemma*.
- *Pretty is What Changes: Impossible Choices, The Breast Cancer Gene, and How I Defied My Destiny*, by *The Gilmore Girls* TV writer Jessica Queller, is a compelling novel about one woman's struggle with *BRCA1* and a **prophylactic** double **mastectomy** at age 35. This book was recommended by a Bio-ITEST field test teacher, and may be assigned as an extension activity or recommended to students who wish to read more about this material.

## Teacher Background

**The rest of the story:** This case study is based on a true story published by Amy Harmon in the *New York Times* on September 16, 2007 entitled “The DNA Age: Cancer Free at 33 but Weighing a Mastectomy.” In the original article, Deb Lindner decides in favor of getting the BRCA genetic test. Students will have to wait until the end of *Lesson Four* to find out the results of the test. The name Lindner has been changed to Lawler in this curriculum.

## Assessment Suggestions

The extension to the lesson (described above) could also be used to assess students’ ability to apply the bioethical principles to a short scenario.

## Glossary

**Autonomy:** Related to the bioethical principle of **respect for persons**, autonomy is independence or freedom to choose one’s own actions.

**Beneficence/nonmaleficence:** Bioethical principles in which decisions are based on doing the most good for the most people. Sometimes referred to as **maximize benefits/minimize harms**.

**Chemoprevention:** Regular doses of drugs that block estrogen and help prevent the development of breast cancer, but induce a form of menopause.

**Justice:** An ethical principle often referred to as “being fair.”

**Mammogram:** An X-ray of the breast, often used to detect breast cancer.

**Mastectomy:** Surgical removal of the breast.

**Maximize benefits/minimize harms:** Bioethical principles in which decisions are based on doing the most good or the least amount of harm for the most people. Sometimes referred to as **beneficence/nonmaleficence**.

**Prophylactic:** A preventative measure. For example, a prophylactic mastectomy is the removal of the breast(s) before cancer develops.

**Respect for persons:** Respecting the inherent worth of an individual and his or her autonomy.

## Resources

The Genetic Information Nondiscrimination Act of 2008 (GINA) is a federal law that prohibits discrimination in health coverage and employment based on genetic information. A handout prepared by the Department of Health and Human Services (HHS) with information about GINA for researchers and health care professionals is provided in the *Appendix*. This handout is designed to provide a brief overview of what legal protections are now in place regarding genetic testing, genetic privacy, and genetic discrimination.

Background on ethical theories can be found in the *Appendix*.

For additional information and activities, NWABR’s *Ethics Primer and Bioethics 101* are helpful resources. These can be downloaded free of charge at: <http://nwabr.org/education/ethicslessons.html>.

Queller, Jessica. 2008. *Pretty Is What Changes: Impossible Choices, The Breast Cancer Gene, and How I Defied My Destiny*. New York, New York: Spiegel & Grau.

## Credit

Bennett, Robin. Personal Interview. 18 March 2010.

Couch F.J., DeShano M.L., Blackwood M.A. et al. *BRCA1* mutations in women attending clinics that evaluate the risk of breast cancer. *New England Journal of Medicine*. 1997; 336: 1409–15.

Easton D.F., Steele L., Fields P. et al. Cancer risks in two large breast cancer families linked to *BRCA2* on chromosome 13q12–13. *American Journal of Human Genetics*. 1997; 61: 120–8.

Ford D., Easton D.F., Stratton M. et al. Genetic heterogeneity and penetrance analysis of the *BRCA1* and *BRCA2* genes in breast cancer families. *American Journal of Human Genetics*. 1998; 62: 676–89.

Harmon, Amy. "The DNA Age: Cancer Free at 33 but Weighing a Mastectomy." *The New York Times*. September 16, 2007. Print.

Struwing J.P., Hartge P., Wacholder S. et al. The risk of cancer associated with specific mutations of *BRCA1* and *BRCA2* among Ashkenazi Jews. *New England Journal of Medicine*. 1997; 336: 1401–8.

# 3 A Case Study: A BRCA Genetic Testing Dilemma

*Adapted from a true story.*

It was the decision of a lifetime.

Her latest doctor visit showed nothing was wrong. But Deborah Lawler, age 33, was tired of constantly looking for the lump in her breast. Ever since she had learned about the DNA test that could help predict her risk of developing breast cancer, Deb had agonized over whether to have the test, and what to do about the results.

Deb didn't want history to keep repeating itself: Deb's mother had fought breast cancer when Deb was in high school, and Deb's maternal grandmother died from the disease before Deb was born. Deb's uncle Bob, her mother's only brother, had been diagnosed just after his 50th birthday. One of Deb's first cousins, Katherine, had detected breast cancer at the age of 33. The coincidences were too much to ignore.

"It could be growing inside of me right now," she told her mother on the phone in February, pacing in the living room of her Chicago apartment. "We could find it any time." Waiting for an encouraging word, she added, "I could take the test this week." Her mother, not sure what to say, remained silent.

Deb was referring to the breast cancer susceptibility tests—the BRCA tests. Doctors would isolate DNA from Deb's blood and sequence the Breast Cancer Susceptibility 1 and 2 genes to determine whether known cancer-causing mutations are present. *BRCA1* and *BRCA2* mutations account for about 5% of all breast cancer. The remaining cases are caused by mutations in other genes, environmental exposures, and other unknown factors.

Factors such as excess weight, lack of exercise, having her first period at a young age, and not having children can increase the risk of breast cancer in all women. If the test finds that Deb carries a cancer-causing mutation in her BRCA genes, her risk of breast cancer would increase dramatically – from 12% (the average lifetime risk for all women) to anywhere between 50-85%. A mutation would also increase her risk of ovarian cancer from the average of 2% to between 16-60%.

Few things in biology are 100%.

If she tested positive for the mutations known to be associated with cancer, she could have both of her ovaries surgically removed before cancer could strike. This would reduce her risk of cancer substantially, but not completely. She could also have her breasts surgically removed through a procedure known as a mastectomy, but even after a mastectomy, there would still be a 10% chance that tiny cancer cells might be hiding in her otherwise healthy tissue. She could try regular doses of drugs that block estrogen and help prevent the development of breast cancer, but these drugs induce a form of menopause. She and her doctors could practice increased surveillance to try to catch the cancer early by using twice-yearly **mammograms** (x-rays of the breast to detect breast cancer), breast self-exams, and blood tests, and at least yearly physical exams with her doctor and other tests to detect potential ovarian cancer.

For every **1,000** women...

**120** (12%) will get breast cancer.

**6** of them inherited mutations in *BRCA1* or *BRCA2* (5% of all cases of breast cancer).

This may seem like a small number, but for a woman who inherits a cancer-causing *BRCA1* or *BRCA2* mutation, her **risk of developing breast cancer is up to 85%**.

As they seek to avoid the potentially lethal consequences of a mutant gene, many people turn to relatives who may share the burden of having such a gene. But at a moment when a genetic test can make family ties even more tangible, they are often most strained. Parents who fought cancer might not understand the choices that confront their children, and guilt over giving their children a harmful allele might color their advice. Siblings and cousins who may carry the risky allele might try to persuade others to confront the problem just as they do, while those relatives who inherited functional forms of the genes may seem unqualified to judge those who did not.

Even as she searched for her own answer, Deb, a doctor, found herself navigating her family's strong and conflicting opinions on the imperfect options lying before her. Her father, who once feared he would lose his wife to cancer, encouraged her and her siblings to have the test. Her brother John felt ambivalent about the knowledge the test would bring, even though the risk of breast cancer in men carrying BRCA mutations is also high. Her sister Lori was also undecided, though she thought that the results may benefit her two young children some day. Deb's Aunt Sue said she hated to see her niece embrace a course of action that was "upsetting the whole family for her own personal gain." Another cousin, Katherine's sister Lynn, declined even to talk about the DNA test—she did not have health insurance and the test was too costly to pay for out-of-pocket, so why even consider it? But for Deb, even with her family's mixed reactions, it was her mother's blessing that she most eagerly sought.

"I have the potential of this amazing gift, of knowing my risk," Deborah told her mother over the phone that winter night. "How can I not do anything about that?"

But biology is rarely a simple thing, and her risk of cancer, even should she test positive for cancer-causing mutations, was far from certain. Should Deborah take the test?

**Credit:** Adapted from Harmon, Amy. "The DNA Age: Cancer Free at 33 but Weighing a Mastectomy." *The New York Times*. September 16, 2007. Print.



**Homework Questions:** Answer these questions in your lab notebook or on a separate sheet of paper.

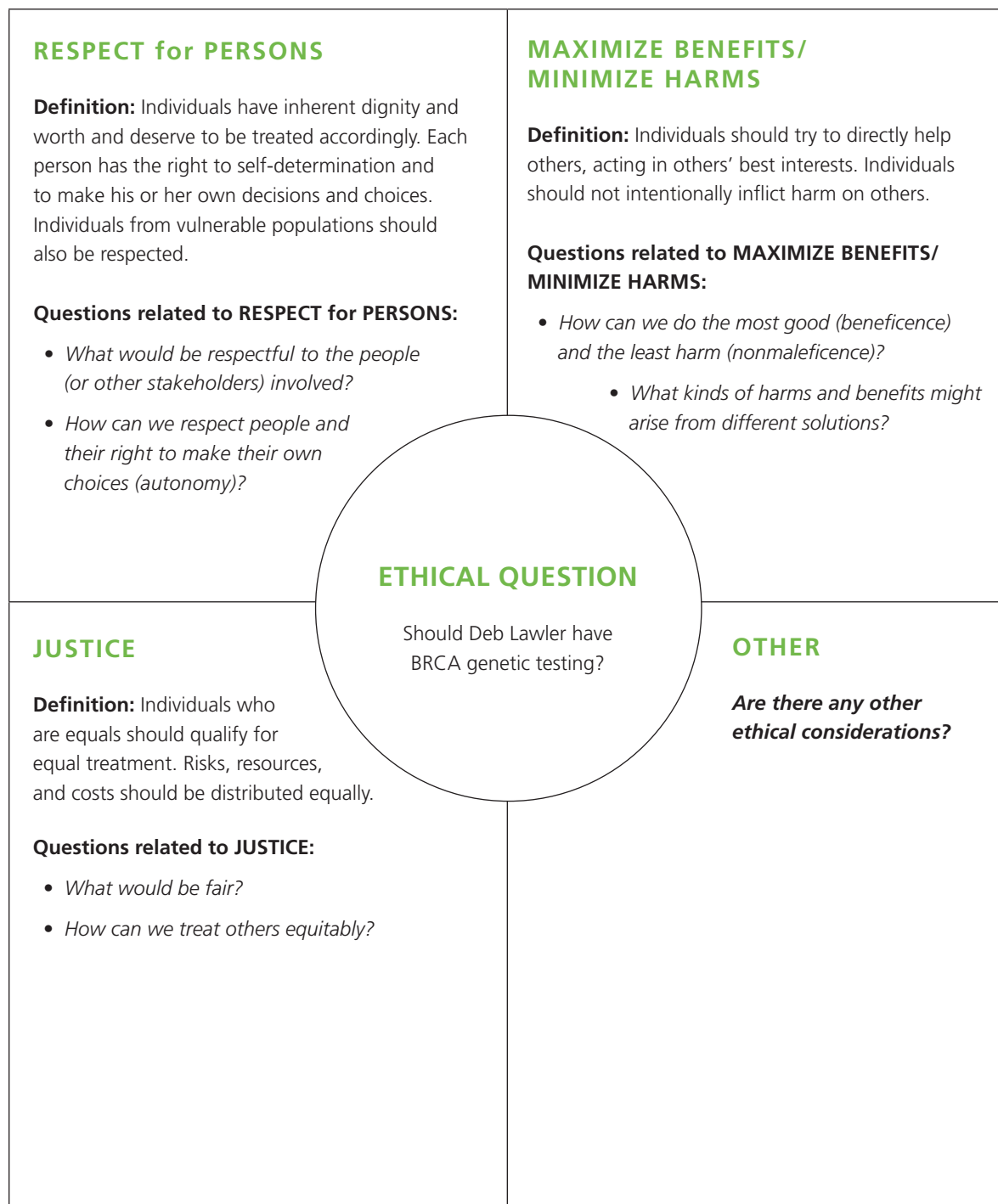
1. One important principle of ethics is **Respect**. Part of Respect acknowledges a person's right to make choices, hold views, and to take actions based on personal values and beliefs. Describe one way that the principle of Respect applies to this case study.
2. Another principle of ethics is **Maximize Benefits/Minimize Harms**, which states that there is an obligation not to inflict harm, to provide benefits to persons, and to contribute to their welfare. Describe one way that the principle of Maximize Benefits/Minimize Harms applies to this case study.
3. Would you ever consider having a genetic test done? Why or why not?
4. Under what circumstances would you not want to have a genetic test done?



# 3 Focus on the Principles



**Do these principles apply?** In your lab notebook or on a separate sheet of paper, discuss how each of these bioethical principles applies to the ethical question, “Should Deb Lawler have BRCA genetic testing?” You may use the questions below each principle to guide your answers. Some principles may apply more than others for a particular situation.



# LESSON 3

## CLASS SET

Name \_\_\_\_\_ Date \_\_\_\_\_ Period \_\_\_\_\_

# 3

## Structured Academic Controversy Worksheet



**This Issue:** *Should Deb Lawler have BRCA genetic testing?*

Team Members **FOR**

1. \_\_\_\_\_

2. \_\_\_\_\_

Team Members **AGAINST**

1. \_\_\_\_\_

2. \_\_\_\_\_

Relevant facts:

Individuals or groups who have a stake in the outcome ("stakeholders") and their concerns:  
(Who is affected by Deb's decision? Why do they care?)

# LESSON 3

## HANDOUT

<p>Main arguments <b>FOR</b>:</p> <p>1.</p>   <p>2.</p>   <p>3.</p>	<p>Main arguments <b>AGAINST</b>:</p> <p>1.</p>   <p>2.</p>   <p>3.</p>
<p>List of possible solutions:</p>          	
<p>Areas of agreement:</p>          	<p>Areas of disagreement:</p>          

# 3

## Structured Academic Controversy FOR Position Statement

**FOR Arguments:** (Deb *should* proceed with BRCA genetic testing).

If Deb takes the test and the result is negative (meaning she does not have a mutation in her *BRCA1* or *BRCA2* genes that would increase her risk of breast and ovarian cancer), she will likely feel relieved and be less anxious about her future. She will also not have to worry about passing the mutation on to future children.

If Deb takes the test and the result is positive (meaning she does have a mutation in her *BRCA1* or *BRCA2* genes that would increase her risk of breast and ovarian cancer), she can begin to make some lifestyle and behavioral changes to reduce her risk, such as:

- Having physical exams more frequently to try to detect breast or ovarian cancer early.
- Increasing her number of medical screenings, such as mammograms (x-rays of the breast used to find cancer).
- Beginning **chemoprevention** medications, which are drugs that are taken regularly to help prevent cancer from developing.

She could also reduce her risk by having surgery to remove her breasts and/or ovaries.

### Ethical Arguments Supporting the FOR Side Include:

#### Respect for Persons

Deb has the right and responsibility to make decisions and take action based on her values and beliefs. She appears to value the knowledge that would come from the test results. Deb is a competent adult, fully able to understand the results and take action on those results. Whether or not her mother supports her decision to take the test, Deb can make her own autonomous decision about her own health and care. It is her body and her decision.

#### Maximize Benefits and Minimize Harms

The benefits that come from knowing her BRCA status outweigh the harms that may result.

If the test is negative, the benefits (relief, less anxiety) far outweigh any harms that come from the knowledge.

If the test is positive, Deb will benefit by being able to be proactive about her health care. Being able to take action (see the bullets above) will outweigh the anxiety that may result from a positive test result.

# 3 Structured Academic Controversy AGAINST Position Statement

**AGAINST Arguments:** (Deb **should not** proceed with BRCA genetic testing).

- Not all people with a mutated *BRCA1* or *BRCA2* gene will develop breast or ovarian cancer as a result.
- Inherited mutations in *BRCA1* or *BRCA2* genes only account for about 5% of breast cancer.
- Not all family members may want to know the results of this test. A positive or negative result for Deb also informs family members who have a similar genetic makeup.
- There is a possibility that testing results may not remain entirely private.
- There is a possibility of discrimination from insurance companies based on results.
- While there are some behavioral changes Deb could make, there is really no “cure” and treatment options are limited.

## Ethical Arguments Supporting the AGAINST Side Include:

### Respect for Persons

While Deb has the right to make her own decisions and choices about her health, her test results also affect her family. A positive result for Deb identifies her mother as also having the mutation. This information has strong implications for both of Deb’s siblings and her maternal cousins. If a family member does not want to know his or her BRCA status, that individual’s right to make his or her own choices may be violated by Deb’s test results.

### Maximize Benefits and Minimize Harms

The harms that come from knowing her BRCA status outweigh the benefits that may result.

Nothing in biology is 100%, and knowing that her chances of breast/ovarian cancer are increased does not mean that Deb will develop the disease. Acting on positive test results (meaning she does have a BRCA mutation that would increase her risk of breast and ovarian cancer), Deb may choose to have her breasts and/or ovaries removed. While there might be some unknowable benefit to this procedure, she would be intentionally inflicting harm on herself in the pursuit of health.

Many of the lifestyle changes that reduce the risk of breast cancer in all women (such as keeping a healthy diet, exercising regularly, and maintaining a healthy weight) have widespread benefits, regardless of BRCA status. Deb does not need to take the genetic test to benefit from embracing these health and lifestyle choices.

## 3

## Focus on the Principles

### Teacher Answer Key

[**Note:** Suggested point values are included after the sample answers and are intended to provide general guidelines for the weight each question could be given. Using these suggested point values, the total value for this worksheet is **10 or more points**.]

**Do these principles apply?** In your lab notebook or on a separate sheet of paper, discuss how each of these bioethical principles applies to the ethical question, “Should Deb Lawler have BRCA genetic testing?” You may use the questions below each principle to guide your answers. Some principles may apply more than others for a particular situation.

### RESPECT for PERSONS

**Definition:** Individuals have inherent dignity and worth and deserve to be treated accordingly. Each person has the right to self-determination and to make his or her own decisions and choices. Individuals from vulnerable populations should also be respected.

#### Questions related to RESPECT for PERSONS:

- What would be respectful to the people (or other stakeholders) involved?
- How can we respect people and their right to make their own choices (autonomy)?

Deb has the right to make decisions and take action based on her values and beliefs; she appears to value the knowledge that would come from the test results. She is fully able to understand the results and take action. The test results, however, also affect her family. A positive result has strong implications for both of Deb’s siblings and her cousin. The family members’ right to know (and make his or her own choices) is affected by Deb’s choices. If Deb gets the genetic test, will her information remain private?

(+4 total, +2 points per reasonable application of principle to question.)

### MAXIMIZE BENEFITS/MINIMIZE HARMS

**Definition:** Individuals should try to directly help others, acting in others’ best interests. Individuals should not intentionally inflict harm on others.

#### Questions related to MAXIMIZE BENEFITS/MINIMIZE HARMS:

- How can we do the most good (beneficence) and the least harm (nonmaleficence)?
- What kinds of harms and benefits might arise from different solutions?

If the test is negative, Deb (and her family members) will benefit by feeling relieved. If the test is positive, Deb can be proactive about her health care. However, a positive result does not mean that Deb will certainly develop breast or ovarian cancer. The knowledge that she could (but may not) develop cancer may cause her anxiety over time. A positive test may cause harm (such as psychological harm) to her family members.

(+4 total, +2 points per reasonable application of principle to question.)

**JUSTICE**

**Definition:** Individuals who are equals should qualify for equal treatment. Risks, resources, and costs should be distributed equally.

**Questions related to JUSTICE:**

- What would be fair?
- How can we treat others equitably?

Is it fair to Deb's siblings that they know more about their genetic predisposition to cancer because Deb gets tested, even if they choose not to know? Will Deb's insurance company pay for the testing? Should it? Should Deb's cousin have access to the test, even though she does not have health insurance? If the test is positive, can a future insurance company decline her coverage due to her preexisting risk of developing breast cancer? Does everybody have equal access to medical resources (clinics or hospitals that perform the test; genetic counselors and doctors who can help to interpret the risks)?

(+2 for at least one reasonable application of principle to ethical question.)

**OTHER**

Are there any other ethical considerations?

Students may come up with other answers or issues which do not neatly fit one category or the other.

(Additional points may be given to other considerations.)



## 3

# Structured Academic Controversy Worksheet

## Teacher Answer Key

[**Note:** Suggested point values are included after each question, and are intended to provide general guidelines for the weight each question could be given. Using these suggested point values, the total value for this worksheet is **20 points**.]

**This Issue:** Should Deb Lawler have BRCA genetic testing?

Relevant facts:

- Deb is a doctor and understands the risks of mastectomy and cancer treatment.
  - Deb's mother, grandmother, and cousin all had breast cancer, suggesting a strong inherited (i.e., genetic) risk.
  - Deb's cousin Lynn has no health insurance.
  - *BRCA1* and *BRCA2* mutations are associated with a high risk of breast cancer.
  - Deb is still young enough that genetic testing could reveal risk before she gets sick (i.e., develops cancer), allowing her to make lifestyle choices (i.e., mastectomy or not, healthy diet, exercise).
  - There are a number of "controllable" factors that affect breast cancer risk, including getting enough exercise, eating a healthy diet, and maintaining a healthy weight.
  - Deb has health insurance, and can pay for the genetic test and cancer treatment.
  - The *BRCA1* and *BRCA2* genetic tests are not 100% predictive about whether or not Deb will get cancer, even if she inherited cancer-causing mutations.
  - Preventive treatment options like prophylactic or preventive mastectomies are not 100% effective.
- (+1 for each relevant fact, listed up to +4.)

Individuals or groups who have a stake in the outcome ("stakeholders") and their concerns: (Who is affected by Deb's decision? Why do they care?)

- Deb wants to know her cancer risk.
  - Deb's family shares some of her genetic information (brother, sister, mother, father, cousin, etc.), so if Deb tests positive for cancer-causing *BRCA1* or *BRCA2* mutations, her family is more likely to carry those mutations as well. Similarly, any children (i.e., Deb's nieces and nephews, or Deb's future children) could also be impacted, because they do (or will) share genetic material with Deb, too.
  - Deb's sister and brother are not sure if they want to know the test results, or if they want to be tested themselves.
- (+0.5 for each stakeholder and +0.5 for concerns, up to +3.)

Main arguments **FOR**:

1. A negative test result would relieve some worry for Deb about the increased risk of breast cancer, or passing mutations on to her children.
  2. A positive test result would allow or motivate Deb to make changes to her lifestyle that could impact her risk (i.e., healthy diet, exercising).
  3. If Deb tests positive, she could take medical action to minimize her risk (i.e., surgery, medication, increased screening).
  4. Deb has a right to know about her own health and health risks.
- (+1 for each main argument listed, up to +3.)

Please see Student Handout—*Structured Academic Controversy FOR Position Statement* for more information and additional possible answers.

Main arguments **AGAINST**:

1. A positive test does not mean that Deb will definitely get breast cancer.
  2. A negative test does not mean that Deb won't get breast cancer.
  3. Some of Deb's family members don't want to know if they carry cancer-causing mutations.
  4. No lifestyle changes are 100% effective at preventing cancer.
  5. No medical interventions are 100% effective at preventing cancer.
- (+1 for each main argument listed, up to +3.)

Please see Student Handout—*Structured Academic Controversy AGAINST Position Statement* for more information and additional possible answers.

List of possible solutions:

- Deb could get tested for *BRCA1* and *BRCA2* mutations and not tell her family the results.
- Deb could get tested and tell only those family members who wish to know her results.
- Deb could choose not to get tested but continue her medical testing and increased cancer surveillance with her doctor.
- There are other possible solutions students may arrive at.
- (+1 for each possible solution listed, up to +3.)

Areas of agreement:

- Deb and her family have a right to make their own decisions.
- (+1 for each area of agreement, up to +2.)

Areas of disagreement:

- Whether Deb or her family members want to know their genetic risk for breast cancer.
- (+1 for each area of disagreement, up to +2.)