Teacher Guide: Positions, Beliefs and Values

ACTIVITY OVERVIEW

Abstract:
Students review statements about gene therapy and determine how strongly they agree or disagree with each one. Students also write out the personal belief that leads them to their position for each statement.

Module:
Gene Therapy: Molecular Bandage?

Prior Knowledge Needed:
Germline gene therapy

Key Concepts:
Beliefs and values influence one's position on gene therapy use, access and control.

Materials:
Student Handouts

Appropriate For:
Ages: 12 - 18
USA grades: 7 - 12

Prep Time:
15 minutes

Class Time:
20 minutes

Activity Overview Web Address:
http://gslc.genetics.utah.edu/teachers/tindex/
overview.cfm?id=gtbeliefs

Other activities in the *Gene Therapy: Molecular Bandage?* module can be found at:

http://gslc.genetics.utah.edu/teachers/tindex/

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I. PEDAGOGY

A. Learning Objectives
• Students will state their own opinion about who should have access to gene therapies, how gene therapies should be used, and to what extent the government should regulate gene therapies.
• Students will examine and state the personal beliefs that shape their opinions about the various aspects of gene therapy.
• Students will determine the values that underlie their personal beliefs about gene therapy.

B. Background Information
The basic idea behind gene therapy is to add a normally functioning copy of a gene to cells of the affected tissue. This is often done using an engineered virus as a vector. Gene therapy will only work if the normal gene is delivered to a large number of correct cells –several million in fact. Once the gene reaches its destination, it must be activated ("turned on") to produce the protein encoded by the gene. Due to this complexity, gene therapy poses one of the greatest technical challenges in modern medicine.

Below is a list of issues surrounding gene therapy that are pertinent to this activity and/or may add to classroom discussion.

• **Germline gene therapy**
  Germline gene therapy aims to permanently add the desired gene to the reproductive cells that ultimately produce egg or sperm cells. This would ensure that offspring inherit the desired gene. In some cases, this could happen unintentionally and have a negative effect.

• **Activating an immune response**
  Using viral vectors in gene therapy puts the patient at risk for an immune response. Serious illness or death can result.

• **Disrupting important genes in target cells**
  Incorporation into the genome is crucial to the success of gene therapy. However, there is a risk that the gene will incorporate itself into an inappropriate place in the genome, disrupting the function of another gene.

  For more information and examples of the challenges above see: *Gene Therapy: Molecular Bandage?* - Challenges in Gene Therapy (http://gslc.genetics.utah.edu/units/genetherapy/gtchallenges/)

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- **Government regulation**
  Currently, gene therapy research trials are subject to approval by regulatory agencies such as the FDA. The FDA also must approve any gene therapy product sold currently and in the future. See the FDA's website for more information.

- **The cost of gene therapy**
  The high cost of financing gene therapy research or treatment has given rise to a host of financial questions such as: Who will pay for the expensive gene therapy trials? Will health insurance cover gene therapy treatments? Will only those able to pay have priority in receiving treatment?

- **Gene therapy and enhancement**
  Some worry that once gene therapy techniques have been established to treat disease, those same techniques could be used to change other traits. Many are discussing the ethical implications of using gene therapy techniques for genetic enhancement.

C. Teaching Strategies
1. Timeline

- One day before activity:
    - Make copies of student pages S-1– S-3, one set per student

- Day of activity:
    - Hand out student pages S-1 through S-3
    - Provide time for students to complete the activity
    - Discuss students' responses to the statements

2. Classroom Implementation

- Begin class by reviewing basic information about gene therapy such as:
    ◦ the general idea behind gene therapy
    ◦ how gene therapies are delivered (in general)
    ◦ the risks associated with gene therapy
    ◦ the difference between somatic cell and germline gene therapies
    ◦ the aspects of gene therapy that are potentially time-consuming and costly

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- Distribute the student handouts (pages S-1 – S-3)
  Instruct students to:
  - Check the box beneath each statement on page S-1 that most closely corresponds to how much they agree or disagree with it.
  - Write the personal belief that leads to the ranking they chose.
  - Look at the Values and Descriptors handout (pages S-2– S-3). Choose the value or values on which their belief is based and list it for each statement.
- When the students are finished, poll the class to determine their answers for each statement. Discuss the statements for which there were a variety of rankings or a strong similarity in ranking among the class.

  See *Adaptations* below for an activity to do before or after students have completed the handout.

3. Adaptations

- Designate an area of the room to form a linear "agreement gradient" (for example, the east wall represents "strongly agree" and the west wall represents "strongly disagree") along which students can stand. Read each statement aloud and ask students to stand along the imaginary "agreement gradient" indicating their ranking for each statement (for example, a neutral student would stand in the middle of the linear gradient, whereas a student who strongly agrees with the statement will stand at the east wall). Discuss students' distributions where appropriate. This activity can be done before, after, or in place of the *Positions, Beliefs and Values* worksheet (page S-1)

4. Common Misconceptions

- It is commonly thought that gene therapies, and many other techniques in genetics for that matter, are easy to do and enjoy a high success rate. Although these techniques may make sense theoretically, they are still very difficult to carry out in the laboratory. There are many factors that affect the success of gene therapies, some of which can be controlled and others that can not.
- Students may have the misconception that changes made to the somatic cell genome are incorporated throughout the body and can be passed on to offspring. One of the biggest challenges of gene therapy is delivering the desired gene to an adequate number of the right kind of cells in the body to make a difference. Also, only changes made to the germline (sex) cells can be passed to offspring.

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II. ADDITIONAL RESOURCES

A. Activity Resources linked from the online Activity Overview at:
http://gslc.genetics.utah.edu/teachers/tindex/overview.cfm?id=gtbeliefs

- Website: Gene Therapy: Molecular Bandage? - animations and information about the basic idea behind gene therapy, the different types of vectors used, delivery methods, and the risks and challenges associated with gene therapy.

- Website: Human Gene Therapy and the Role of the Food and Drug Administration - information on FDA regulation of gene therapy trials and products.

- Website: Clinical Trials - for general information about clinical trials and current gene therapy clinical trials.

III. MATERIALS

A. Detailed Materials List

- Copies of *Positions Beliefs and Values*, (page S-1) , one per student
- Copies of *Values and Descriptors*, (page S-1 - S-2), one per student

IV. STANDARDS

A. U.S. National Science Education Standards

Grades 5-8:
- Content Standard C: Life Science - Reproduction and Heredity; hereditary information is contained in genes, located in the chromosomes of each cell; an inherited trait of an individual can be determined by one or by many genes; a single gene can influence more than one trait.

- Content Standard E: Science and Technology - Abilities of Technological Design; Identify Appropriate Problems for Technological Design; students should develop their abilities by identifying a specific need, considering its various aspects, and talking to different potential users or beneficiaries.

Grades 9-12:
- Content Standard C: Life Science - The Molecular Basis of Heredity; in all organisms, the instructions for specifying the characteristics of the organism are carried in DNA.

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B. AAAS Benchmarks for Science Literacy

Grades 9-12:
- The Living Environment: Heredity - genes are segments of DNA molecules; inserting, deleting, or substituting DNA segments can alter genes; an altered gene may be passed on to every cell that develops from it; the resulting features may help, harm, or have little or no effect on the offspring's success in its environment.
- The Human Organism: Physical Health - faulty genes can cause body parts or systems to work poorly.
- The Designed World: Health Technology - knowledge of genetics is opening whole new fields of health care.

C. Utah Secondary Science Core Curriculum

Intended Learning Outcomes for Biology
Students will be able to:
2. Manifest Scientific Attitudes and Interests
    c. Maintain an open and questioning mind toward ideas and alternative points of view.
    d. Accept responsibility for actively helping to resolve social, ethical and ecological problems related to science and technology.

Biology (9-12)
Standard 4: Students will understand that genetic information coded in DNA is passed from parents to offspring by sexual and asexual reproduction. The basic structure of DNA is the same in all living things. Changes in DNA may alter genetic expression.
Objective 3: Explain how the structure and replication of DNA are essential to heredity and protein synthesis.
    - Research, report, and debate genetic technologies that may improve the quality of life (e.g., genetic engineering, cloning, gene splicing).

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V. CREDITS

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Positions, Beliefs and Values

Directions
   a. Review each statement. Decide if you agree or disagree with it and to what degree.
   b. Explain what belief led you to that position.
   c. Refer to Values and Descriptors. List one or more values involved in your belief.

1. If gene therapy can cure a disease, all people that have the disease should be treated no matter what the cost.

   ☐ Strongly agree   ☐ Agree   ☐ Neutral   ☐ Disagree   ☐ Strongly disagree

   Belief _____   Value _____
           _____   _____
           _____   _____

2. Germline gene therapy should be used to treat any genetic disorder so that a person will not pass the disorder on to their children.

   ☐ Strongly agree   ☐ Agree   ☐ Neutral   ☐ Disagree   ☐ Strongly disagree

   Belief _____   Value _____
           _____   _____
           _____   _____

3. Government regulations should restrict gene therapy until its success is proven.

   ☐ Strongly agree   ☐ Agree   ☐ Neutral   ☐ Disagree   ☐ Strongly disagree

   Belief _____   Value _____
           _____   _____
           _____   _____

4. It is acceptable to use gene therapy for genetic enhancement of traits.

   ☐ Strongly agree   ☐ Agree   ☐ Neutral   ☐ Disagree   ☐ Strongly disagree

   Belief _____   Value _____
           _____   _____
           _____   _____

5. The government should decide which gene therapies are treatments and which are enhancements. Then, it should restrict the use of gene therapy for treatment only.

   ☐ Strongly agree   ☐ Agree   ☐ Neutral   ☐ Disagree   ☐ Strongly disagree

   Belief _____   Value _____
           _____   _____
           _____   _____

Values and Descriptors

Read through each of the following values and its definition. Cross out values that are not meaningful for you and add others that do have meaning for you. Be sure to define any values that you add.

ACHIEVEMENT: Accomplishment; a result brought about by hard work to attain a desired goal.

AESTHETICS: The appreciation and enjoyment of beauty for beauty's sake.

ALTRUISM: Concern for the interests of others.

AUTONOMY: Self-directed, capable of existing alone; acting without aid of others.

BEING LIKED: Being held in favor or regard by others.

COOPERATION: Working together for a mutual benefit.

CREATIVITY: Initiating new and innovative ideas and designs.

EDUCATION: The process of gaining knowledge and skills while developing reason, judgment and intellectual maturity.

EMPATHY: The ability to share in someone else's feelings.

EMOTIONAL WELL-BEING: Freedom from overwhelming anxieties and barriers; a peace of mind; inner security.

EQUALITY/RIGHTS: Correspondence in quality, degree, value, rank or ability.

FAMILY/BELONGING: Related by blood or marriage.

FRIENDSHIP: The state of one person being attached to another by feelings of affection or personal regard.

HEALTH: The soundness of one's body.

HONESTY: Fairness or straightforwardness of conduct; integrity; uprightness of character or action.

HUMAN DIGNITY: Holding all humans in high esteem regardless of age, race, or creed.

INTERDEPENDENCE: The mutual need for support, aid, comfort, etc.

INTIMACY: A close, familiar, and usually affectionate or loving personal relationship.

JUSTICE: The quality of being impartial; to treat others fairly or adequately.

KNOWLEDGE: The seeking of truth, information, or principles for the satisfaction of curiosity, for use, or for the power of knowing.

LOVE: Affection based on admiration or benevolence; unselfish devotion.

LOYALTY: Maintaining allegiance to a person, group, institution, or political entity.

MORALITY: The moral values held by an individual or society.

OWNERSHIP: To have or hold material objects or to acknowledge specific ideas as being part of your ideology.

PERSONAL HEALTH: The condition of being sound in body; freedom from physical disease or pain; the general condition of the body; well-being.

PHYSICAL APPEARANCE: Concern for the beauty of one's own body.

PLEASURE: The agreeable emotion accompanying the possession or expectation of what is good or greatly desired; a state of gratification.

PRESTIGE: Holding a position of high value relative to society's standards.

POWER: Possession of control, authority, or influence over others.

RECOGNITION: Being made to feel significant and important; given special notice or attention.

RELIGIOUS BELIEFS: One's convictions or opinions about religion, faith, devotion, etc.

SELF-CONTROL: Restraint of oneself or one's actions, feelings, etc.

SELF-PRESERVATION: Looking out for your own welfare.

SELF-WORTH: A feeling of being useful and/or held in high esteem by others.

SKILL: The ability to use one's knowledge effectively and readily in execution or performance; technical expertise.

SOLITUDE: The state of being removed from society; a quiet life.

TRUTH: An ideal abstraction conforming to a universal or generalized reality.

WEALTH: Abundance or valuable material possession or resources; affluence.

WISDOM: The ability to discern inner qualities and relationships; insights, good sense, judgment.

WORK/LABOR: Exertion or effort directed to produce or accomplish something; toil, effort.