

## Teacher Guide: Gene Therapy Patient Education

### ACTIVITY OVERVIEW

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**Abstract:**

Students create an educational brochure or poster that explains gene therapy in detail and summarizes the associated risks and challenges.

**Module:**

Gene Therapy: Molecular Bandage?

**Prior Knowledge Needed:**

Genes code for the production of proteins; the absence or abundance of a particular protein may lead to disease; the different types of gene therapy vectors; *in vivo* and *ex vivo* gene therapy delivery methods; ligand binding

**Appropriate For:**

Ages: 12 - 18

USA grades: 7 - 12

**Key Concepts:**

Basic description of gene therapy; how gene therapies are delivered; some diseases are better candidates than others for gene therapy; the risks and challenges associated with gene therapy.

**Materials:**

Paper or poster board and art supplies; computers with Internet access for research (optional)

**Prep Time:**

10-15 minutes

**Class Time:**

Varies

**Activity Overview Web Address:**

<http://gslc.genetics.utah.edu/teachers/tindex/overview.cfm?id=gtbrochure>

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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 demonstrate that they understand how gene therapy works, the tools and techniques used to deliver gene therapies, disease candidates for gene therapy, and associated risks and challenges.

#### B. Background Information

This activity is designed as an assessment of what students have learned about gene therapy. Information from classroom activities, as well as online research, can be used to complete this assessment. Ideally, this assignment would follow or be used in conjunction with the Gene Therapy module listed in *Additional Resources* (page 3).

Assigning students to produce an informational brochure or poster that a genetic counselor could give or show to patients considering gene therapy will help them determine the appropriate level of detail for the assignment. Students will need to present balanced and complete information covering all aspects of gene therapy in this context. Student brochures or posters should include the following information:

- The basic idea behind gene therapy
- The types of vectors that are commonly used
- The features of each vector that make it more suitable for some therapies than others
- Definitions or examples of *in-vivo* and *ex-vivo* delivery methods
- Basic challenges involved in gene therapy
- Risks associated with gene therapy
- Diseases that could and could not be addressed with gene therapy.

See the *Assessment Rubric* (page S-2) for more detailed requirements.

For background information on gene therapy see the *Gene Therapy: Molecular Bandage?* module.

#### C. Teaching Strategies

##### 1. Timeline

- One day before activity:
  - Make copies of Student Page S-1 and the optional Assessment Rubric (page S-2), one copy of each per student

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- Day of activity:
  - Hand out copies of Student Page S-1 and Assessment Rubric (page S-2)
  - Discuss assignment requirements
  - Provide class time and computers (if available) for students to work on the assignment

### **2. Classroom Implementation**

- Hand out copies of the assignment requirements (page S-1) and Assessment Rubric (page S-2).
- Discuss the assignment requirements and due date with the class.
- Provide class time to work on the assignment, including time to use computers, if they are available.

### **3. Extensions**

- Pick up materials from a Genetic Counselor's office for student to browse through to get an idea of the appropriate level of detail.
- Have students interview a Genetic Counselor.
- Provide class time to showcase the completed brochures or posters so students can see the work of their classmates. You may want to have students vote to determine the top three brochures or posters in the class.

### **4. Adaptations**

- Students may work individually or in groups on this project.
- This assignment may be given at the beginning of a unit on gene therapy to serve as a guide for studying this topic.

### **5. Assessment Suggestions**

- Use the brochure or poster as an assessment. See the *Assessment Rubric* (page S-2).
- Conduct a peer review of the brochures or posters by placing them around the classroom and having other students review them. Peer reviewers may use the Assessment Rubric (page S-2) or the Peer Review Rubric (page S-3).

### **6. Common Misconceptions**

- It is important to remind students that gene therapies are very much in the trial stages at this point in time (2003).
- A common misconception is that gene therapy replaces disease-causing with normally functioning genes. In fact, a normally functioning version of the gene is *added* to the genome - the malfunctioning form of the gene is not removed.

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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=gtbrochure>

- Website: *Gene Therapy: Molecular Bandage?* - Animations and information about the basic idea behind gene therapy, the different types of vectors used and their delivery methods, as well as the risks and challenges associated with gene therapy.
- Activity: *Treatment, Enhancement or Both?* - Students consider applications of gene therapy and determine if they are enhancements or treatments. General background information about gene therapy is provided in the Teacher Guide for this activity.

### III. MATERIALS

#### A. Detailed Materials List

- Copies of Student Pages S-1, S-2 and S-3 - one per student
- Paper, posters, art supplies (such as markers, colored pencils, tape, glue and scissors)
- Computers with Internet access for research (optional)

### 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 Seventh and Eighth Grade Integrated Science*

Students will be able to:

4. Communicate Effectively Using Science Language and Reasoning
  - a. Provide relevant data to support their inferences and conclusions.

#### *Intended Learning Outcomes for Biology*

Students will be able to:

4. Communicate Effectively Using Science Language and Reasoning
  - a. Provide relevant data to support their inferences and conclusions.

#### 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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# Gene Therapy

## Patient Education



You work in the patient education office of a genetic counseling facility. Your task is to create an informational flyer or poster designed to help patients better understand gene therapy and why they may want to consider it as an option. Your final product should address each of the following aspects of gene therapy:

- An explanation of what gene therapy is.
- How gene therapy works. (include information about vector types and delivery methods)
- The types of disorders gene therapy can and cannot treat.
- An example of gene therapy for a specific disorder, including basic information about the disorder.
- Some of the risks or challenges a gene therapy patient may face.
- Why a patient would want to receive gene therapy.
- A list of disorders that gene therapy may be able to treat in the future.

Be creative! You need to make your brochure or poster visually appealing so a patient would want to read it. Your final product should include at least 5 graphics. Please remember to cite the source of graphics that are not your original work.



## Gene Therapy Patient Education: Assessment Rubric

CATEGORY	4	3	2	1
<b>Content Accuracy</b>	All facts are accurate.	99-90% of the facts are accurate.	89-80% of the facts are accurate.	Fewer than 80% of the facts are accurate.
<b>Information Included</b>	All 7 items are addressed.	6 of the 7 items are addressed.	4-5 of the 7 items are addressed.	2-3 of the 7 items addressed.
<b>Graphics/ Pictures</b>	Graphics appropriately match the text and there is a good mix of text and graphics.	Graphics appropriately match the text, but there are so many that they distract from the text.	Graphics appropriately match the text, but there are too few and the brochure seems "text-heavy".	Graphics do not match the accompanying text or appear to be randomly chosen.
<b>Attractiveness &amp; Organization</b>	The brochure or poster has exceptionally attractive formatting and well-organized information.	The brochure or poster has attractive formatting and well-organized information.	The brochure or poster has well-organized information.	The brochure or poster's formatting and organization of material are confusing to the reader.

## Gene Therapy Patient Education: Peer Review Rubric

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Rate this brochure or poster on a scale of one to four (four being the best) in the categories below:

CATEGORY	
<b>Content Accuracy</b>	All facts are accurate.
<b>Information Included</b>	All 7 items are addressed.
<b>Graphics/ Pictures</b>	Graphics appropriately match the text and there is a good mix of text and graphics.
<b>Attractiveness &amp; Organization</b>	The brochure or poster has exceptionally attractive formatting and well-organized information.

Comments: