

Grade Level: 9-12

Overview	The students will learn how to organize their online sources they find about the Human Genome Project by using Zotero!
Objectives	Students will do the following:
1.	Learn about the goals of the Human Genome Project (HGP)
2.	Discuss the scientific and ethical implications of the project 3. Students will learn how to organize their sources using Zotero
Materials	The class will need the following:
•	Internet access
•	Newspaper and magazine articles and other current resources about the Human Genome Project
•	Poster board
Procedures	
1.	Begin the lesson by asking students what they know about genes. Explain to students that genes are made up of double strands of deoxyribonucleic acid, or DNA. The DNA provides the genetic instructions for everything a cell does. In particular, the sequence of the subunits of DNA, called bases, plays a part in determining whether a person will get sick and how well that person will respond to medication. To understand how the body works as well as diseases and treatments, scientists must understand the human genome, or the complete set of genetic instructions. To do so, they are mapping these instructions in the Human Genome Project, or HGP.
2.	Share the following information about the HGP with the students <ul style="list-style-type: none">• The long-term goal of the project is to locate the estimated 30,000 or more human genes on all

	<p>the chromosomes and determine their sequence along each strand of DNA.</p> <ul style="list-style-type: none"> • In June 2000, scientists were able to complete a rough draft of the human genome a year ahead of schedule. Scientists use this information to understand how genes function, how genetic material varies among people, and how some genetic variations predispose people to disease. • The HGP also invests in studying the ethical, legal, and social implications of these findings. For additional information about genes, students may want to consult the following Web site before proceeding with the activity: The Science Behind the Human Genome Project. (Classroom sources on the subject may also be very useful.)
<p>3.</p>	<p>Tell students that the HGP is a complex project and has scientific, ethical, and medical ramifications. During this lesson, students will work in small groups to research the project. Before students divide into groups, provide them with an overview of the HGP. The following Web sites will be useful in describing its goals and current status: New 5-Year Plan for the U.S. Human Genome Project Division of Extramural Research (DER): HGP</p>
<p>4.</p>	<p>Divide the class into three groups to research different facets of the HGP. Have them use the Web sites listed below to research the following areas:</p> <ul style="list-style-type: none"> *Group 1: Scientific findings. The number of genes discovered and their sequence, as well as definitions of key scientific terms such as <i>chromosome</i>, <i>DNA</i>, <i>gene</i>, and <i>protein</i> *Group 2: Potential applications. The tools used to detect genes carrying disease and how this information can be applied to individual treatment plans *Group 3: Ethical implications. The ethical issues involved with screening adults and fetuses for genetic diseases, using new technology to treat diseases, and other issues associated with mapping the human genome
<p>5.</p>	<p>Tell students that the Web sites below have information relevant to their research:</p> <ul style="list-style-type: none"> Group 1: Scientific findings Human Genome Project 5-Year Plan Twenty Questions About DNA Sequencing Human Genome Project Science Group 2: Potential applications The Human Genome Project: From Maps to Medicine From the Genome to the Proteome Group 3: Ethical implications National Center for Biotechnology Information Issues and Bioethics Center for the Study of Bioethics

	The American Journal of Bioethics
6.	Give students time in class to work on their research. Students can record their findings on the computer or in notebooks. Tell students that they can use illustrations to depict some of their findings, such as the structure of DNA or the shape of a chromosome.
7.	Give each group an opportunity to present its findings. Then create a display of each group's presentation. The scientific findings display could include a labeled diagram showing the relationships among DNA, genes, chromosomes, and proteins. The potential applications display could present a case study showing how the genes responsible for an illness were identified and how that information was used to develop treatment. The ethical implications display could present a list of issues that have emerged from this new knowledge.
8.	Place the displays on a several large pieces of poster board. Use the displays to discuss the complexity of the project.
9.	Conclude the lesson by discussing students' overall reaction to the Human Genome Project. Do students think that the advantages of the project outweigh the challenges? Do they think this information has the

Evaluation	
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<p>Use the following three-point rubric to evaluate how well students conduct their research, compile their findings, present them to the class, and participate in class discussions on complex issues:</p> <ul style="list-style-type: none"> • *Three points:*exhibited strong research skills; showed above-average ability to compile findings and present them to the class; demonstrated the ability to share keen insights and ideas during class discussions. • *Two points:*exhibited on-grade research skills; showed average ability to compile findings and present them to the class; demonstrated on-grade ability to share insights and ideas during class discussions. • *One point:*exhibited slightly 			
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<p>below-average research skills; had some problems in compiling findings and presenting them to the class; demonstrated difficulty sharing insights and ideas during class discussions.</p>				
<p>Standards</p>	<p>This lesson adheres to the National Science Education Standards for students in grades 9-12:</p> <ol style="list-style-type: none"> 1. Life Science 2. Science as Inquiry 			

<http://school.discoveryeducation.com/lessonplans/programs/humangenome/>