

Assignment Discovery Online Curriculum

Lesson title:

The Human Genome Project

Grade level:

9-12

Subject Area:

Biology

Duration:

Two class periods

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

Materials:

- 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
 - The long-term goal of the project is to locate the estimated 30,000 or more human genes on all the chromosomes and determine their sequence along each strand of DNA.
 - 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:

<<http://www.ornl.gov/hgmis/project/info.html>>. (Classroom sources on the subject may also be very useful.)

3. 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:

http://www.ornl.gov/TechResources/Human_Genome/hg5yp/hlight.html

<http://www.nhgri.nih.gov/HGP/>

4. 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:

Group 1: Scientific findings. The number of genes discovered and their sequence, as well as definitions of key scientific terms such as *chromosome*, *DNA*, *gene*, and *protein*

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

5. Tell students that the Web sites below have information relevant to their research:

Group 1: Scientific findings

http://www.ornl.gov/TechResources/Human_Genome/hg5yp/hlight.html

http://www.nhgri.nih.gov/NEWS/Finish_sequencing_early/twenty_questions_about_DNA.html

<http://www.ornl.gov/hgmis/project/info.html>

Group 2: Potential applications

http://www.nhgri.nih.gov/Policy_and_public_affairs/Communications/Publications/Maps_to_medicine

<http://www.ornl.gov/hgmis/project/info.html>

Group 3: Ethical implications

<http://www.ncbi.nlm.nih.gov>

<http://www.accessexcellence.org/AB/IE>

<http://www.mcw.edu/bioethics>
<http://www.bioethics.net>

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 potential to save lives?

Discussion Questions:

1. Suppose a genetic disease runs in your family. Scientists have just identified the gene responsible for the disease and have developed a way to test for it. Would you have the test done to see whether you carry that gene? Consider both the advantages and disadvantages of having this information.
2. Describe how the treatment for serious diseases will improve as a result of information from the HGP. For example, think about how drug therapy might improve and how gene therapy could be used. (*For example, drugs could be developed to target a specific disease, and possibly the genes could be modified.*)
3. Do you think that most people are in favor of the Human Genome Project? If so, explain why. If not, identify who might be opposed to it and explain why.

Evaluation:

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:

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 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.

Extension:

Extracting DNA from Dried Split Peas

DNA contains the genetic instructions for everything a particular cell does, and all living things contain DNA. It is possible to separate DNA from split peas and other vegetables. Have students conduct this experiment to see, feel, and smell DNA.

1. Measure $\frac{2}{3}$ cup of dried split peas. Add about $\frac{1}{8}$ teaspoon of salt and $1\frac{1}{3}$ cups of cold water. Mix the ingredients in a blender on high speed for 15 seconds.
2. Pour the pea mixture through a strainer into another container. Add about 2 tablespoons of liquid detergent to the mixture. Let it sit for 5 to 10 minutes.
3. Pour the mixture into three test tubes or smaller containers so that each is one-third full. Then add a pinch of meat tenderizer to each container and stir gently.
4. Tilt each test tube and slowly pour rubbing alcohol (70-95 percent isopropyl or ethyl alcohol) down the inside wall of the tube so that it forms a layer on top of the mixture. Keep pouring in alcohol until the tube contains about the same amount of alcohol as it does pea mixture.
5. In a few minutes, the DNA will rise into the alcohol layer from the pea mixture layer. You can use a toothpick to pull the DNA out.

Have students describe what the DNA looks like. What is its texture? Does it have an odor? Does it look different from what they expected?

Suggested Reading:

Genetic Engineering

Clarice Swisher. Lucent Books, 1996.

Illustrated with cartoons and black-and-white photographs, this book explains how genetic engineering has affected many fields, from agriculture to veterinary medicine, industry to medicine. A final chapter discusses how genetic engineering will affect our future in these diverse fields. A glossary and list of organizations to contact provide valuable resources.

The Science of Jurassic Park and the Lost World, or How to Build a Dinosaur

Rob DeSalle and David Lindley. BasicBooks, 1997.

Science fiction is quick to embellish on current scientific achievements, pushing beyond what's currently possible. In the case of DNA, Michael Crichton had a great time imagining what would happen if dinosaur DNA could be cloned. In *The Science of Jurassic Park and the Lost World*, the authors compare the events in the movie *Jurassic Park* to the reality of finding ancient DNA and the difficulties as well as the ethical issues of this kind of reproduction. Although this book focuses on dinosaurs, the implications for human life are clear.

Vocabulary:

chromosome

Definition: A physically separate molecule that is made up of DNA.

Context: DNA in the human genome is arranged into 24 **chromosomes**.

deoxyribonucleic acid (DNA)

Definition: The chemical inside the nucleus of a cell that carries the instructions for everything that cell does; made up of four chemical subunits referred to as bases.

Context: The human genome contains 600,000 pairs of **DNA**.

gene

Definition: The functional and physical unit of heredity passed from parent to offspring.

Context: Scientists estimate that human beings each have between 30,000 and 35,000 **genes**.

human genome

Definition: The complete set of DNA in each human being.

Context: Researchers completed a rough draft of a map of the **human genome** in June 2000.

Academic Standards:

This lesson adheres to the National Science Education Standards for students in grades 9-12:

1. Life Science
2. Science as Inquiry

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This lesson was created in consultation with Mark Herzog, science coordinator, Harford County, Maryland.

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