



Genome: a tour and genetic disorder brochure

Description of Activity

Students tour the human genome by listening to a young scientist who was actively involved in the mapping and sequencing of the human genome. They are then given a close-up view of chromosome structure that highlights key components of each human chromosome. Students will then select a genetic disorder and create a brochure by conducting further research.

Learning Outcomes

Students will:

1. tour the human genome.
2. analyze the structure and key features of human chromosomes.
3. investigate a genetic disorder using a variety of resources and create a brochure.
4. share their brochure with other students in the class.

Assumptions of Prior Knowledge

This lesson should follow a unit on genetics. Students should be aware of the transmission of traits from parent to offspring and the types of mutations that cause genetic disorders.

Misconceptions

Students may believe that all diseases are contagious or that if someone in a family has a genetic disorder then a child will always inherit that disorder.

Students may also believe that genetic disorders are all inherited in the same way and that they must appear at birth.

Possible misconception question: if you are sitting next to a person who has cystic fibrosis, should you move away to protect yourself from catching it?

Implementing the Lesson

Become familiar with the *DNA Interactive (DNAi)* web site (www.dnai.org) and how to navigate through it. Provide students with information about navigating the site, and how to play animations and video clips.

Before class:

Visit the *Genome* section of the *DNAi* web site www.dnai.org > **Genome** > **Tour**. Become familiar with the four sections: *flyover*, *chromosome close-up*, *genome FISHing*, and *genome spots*.

A list of genetic disorders has been included for the students to work with. Review the list and decide on a process by which to have the students either select or be assigned a disorder.

During class:

This lesson can be done in the computer lab or as an at-home assignment.

Activity 1.

Begin the lesson by having students take the **Tour**. Have them listen to Ewan Birney as he describes the genome in *chromosome close-up*: Parts 1, 2 and 3. Then have students view the *flyover* sequence as they look at a section of Chromosome 11.

Next, students should return to the *chromosome close-up* animation, "chromosome coiling," so that they can see how the DNA in



their chromosomes is packaged to fit in the nucleus of their cells. They can then take a closer look at a single chromosome in the animation called "Zooming in: examining the X."

In *genome FISHing* each chromosome can be studied in more detail. For example, centromeres, telomeres and variations in individual nucleotides can be viewed.

Finally, in *genome spots*, individual genes associated with certain genetic diseases can be identified. By clicking on a spot, students can learn more about that individual gene.

At this point, students should then either choose or be assigned a genetic disorder to research. Some of these may not appear in *genome spots* on the web site.

The students should be asked to do research on their particular genetic disorder and follow a "rubric" supplied on the following page. They will create a tri-fold brochure by following specific directions.

There are several computer programs such as Microsoft Publisher that can help them create the actual brochure so that it looks professional.

A list of genetic disorders is included. If there is a disorder that does not appear on the list but is of interest to a student, they should have the option to choose the disease.

It is suggested that the students present their brochures to the class.

Activity 2

A second version of the brochure activity is to have students create a poster made of individual 8.5 x 11 inch sheets of paper attached together. Each sheet should contain one specific category of information. For example, one page could provide testing information; another could show the chromosome with the locus of the gene pinpointed, and so on.

Further Exploration

Model Building

Create models to represent chromosome coiling.

Writing

1. After a lesson on chromosome wrapping, ask students to view the animation and write a paragraph explaining what they see. Their description should include the following terms: histone proteins, nucleosomes, 30nm fibers, looped domains, and metaphase chromosomes. They should include the purpose of chromosome coiling and its role in gene expression.
2. Make a picture book explaining a genetic disease.
3. Give students a literary metaphor for the human genome:
 - Genome = genetic autobiography or your genealogy;
 - Chromosome = chapters;
 - Genes = sentences;
 - Codons = words; and
 - Nucleotides = letters.

Then ask the students to write a different metaphor for the terms *genome*, *chromosome*, *gene*, and *nucleus*.

Writing

Tell students to imagine that they are taking a ride at an amusement park touring the human genome. They wait patiently in line until they reach the starting point. They get into their transport vehicle and are reminded to buckle their seatbelts. The ride begins in a cell in the human body. As the vehicle moves, students might recognize some typical cell structures. "Oh look! There is the . . ."



Students should write a narration for their ride to include the following:

1. at least three cell structures seen before reaching the nucleus, with a brief description of each.
2. a brief descriptive overview of the human genome.
3. a detailed view of a chromosome
 - describing and explaining the function of the centromeres and telomeres.
 - explaining the source of individual variation observed in this chromosome.
 - naming some of the specific genes located on the chromosome.
 - include a drawing of the chromosome along with the descriptions.

Glossary

Centromere

Telomere

Sex-linked trait

Translocation

Autosomal recessive

Autosomal dominant

Point mutation

Genome

SNP: single nucleotide polymorphism

Resources

Web

Cold Spring Harbor Laboratory (2002). *DNA From the Beginning: an animated primer on the basics of DNA, genes, and heredity*, www.dnafb.org

Cold Spring Harbor Laboratory (2002). *Your Genes, Your Health: a multimedia guide to genetic disorders*, www.ygyh.org

Human Genome Management Information System (2003). *DOEgenomes.org: genome programs of the U.S. Department of Energy Office of Science*, doegenomes.org

DVD

DNA Interactive (2003). NTSC version produced by Cold Spring Harbor Laboratory and Red Green & Blue Company; funded by Howard Hughes Medical Institute. Available at www.dnai.org

Books

Micklos, David A., Freyer, Greg A., and Crotty, David A. (2003). *DNA Science: A First Course, (2nd Edition)*, Cold Spring Harbor Laboratory Press, New York.

Ridley, Matt (2000). *Genome: An Autobiography of a Species in 23 Chapters*, HarperCollins, New York.

Watson, James D., with Berry, Andrew (2003). *DNA: The Secret of Life*, Alfred A. Knopf, New York.

Activity Pages Include:

Student worksheets with scoring rubric.

Correlation with U.S. National Science Education Standards.