

## Model Organisms: the genes we share

### Description of Activity

The *Model Organisms* activity provides students with the opportunity to compare short DNA sequences of different organisms. Students are asked to explore the similarities and differences between the human genome and the genome of other organisms and relate these to the study of genetic disorders.

### Learning Outcomes

Students will:

1. explain the importance of using model organisms to assist in human genetics research.
2. observe genetic relationships between humans and model organisms.
3. use the National Center for Biotechnology Information (NCBI) web site to compare DNA sequences of a model organism and a human.
4. research Huntington disease, a debilitating late-onset genetic disorder.
5. understand the pros and cons of using model organisms.

### Assumptions of Prior Knowledge

The following concepts should be covered prior to the instruction of this lesson:

There are rules of heredity (Mendel's Laws).

DNA has a defined structure.

There is a genetic code common to all living things.

There is a flow of information from genetic code to characteristics (transcription and translation).

Determining protein structure is important to understanding its biological function.

Mutations - changes in DNA - may cause genetic disorders.

### Misconceptions

Model organisms (or any nonhuman organisms) are not genetically related to humans.

Sequencing a model organism's genome is not relevant to human medicine.

Genes from one organism will not function in a different organism.

If the same gene is present in both humans and specific model organisms, it is expressed the same way.

*Possible misconception question: Why can model organisms be used to study the effect of drugs in humans?*

### Implementing the Lesson

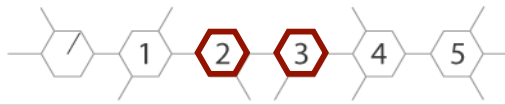
#### **Before class:**

Become familiar with the *DNA Interactive (DNAi)* and *Your Genes, Your Health* web sites and how to navigate through them. Provide students with information about navigating the sites, and how to play animations and video clips. For this exercise, you should also become familiar with the page ([www.ncbi.nlm.nih.gov/HomoloGene](http://www.ncbi.nlm.nih.gov/HomoloGene)).

Assign students the pre-class activity on Huntington disease for homework.

Make copies of the student worksheets for each student in the class.

For background information about the Human Genome Project, visit [www.dnai.org/c](http://www.dnai.org/c).

**During class:**

Provide students with background information about the National Center for Biotechnology Information (NCBI) from their introduction

<http://www.ncbi.nlm.nih.gov/About/index.html>.

Introduce the concepts of model organisms and cooperative genetic databases or "gene banks."

Some examples are *Drosophila melanogaster*, the fruit fly; *Caenorhabditis elegans*, the nematode worm; *Arabidopsis thaliana*, the mustard plant; *Danio rerio*, the zebra fish; *Mus musculus*, the mouse. Ask the students to think of reasons why model organisms are useful in genetic research.

Give each student an activity sheet and have him or her work in cooperative learning groups of between two and three students to fill in their sheets.

**Further Explorations***Exploring web tools*

Students may wish to locate genes in model organisms that are homologous to genes for other human genetic disorders. Examples might include cystic fibrosis, ALS, Fragile X, and Marfan syndrome.

To make students more familiar with the NCBI site and find more information on a genetic disorder, have the students go to Locus Link and enter the genetic disorder. All of the databases with information on that disorder will be accessible from the NCBI home page, such as Genes and Disease [www.ncbi.nih.gov/books/bv.fcgi?call=bv.View..ShowSection&rid=gnd](http://www.ncbi.nih.gov/books/bv.fcgi?call=bv.View..ShowSection&rid=gnd) and OMIM (Online Mendelian Inheritance in Man) at [www.ncbi.nih.gov/entrez/query.fcgi?db=OMIM](http://www.ncbi.nih.gov/entrez/query.fcgi?db=OMIM).

Students will find that the phenotype for Huntington disease and other genetic disorders can have more than one genotype, making it difficult to develop one genetic test for a disorder.

*Reading*

Scroll down in the NCBI Homologene web site to "Further Reading" and read the abstract by Nasir, J. et al. What effects are seen in mice that are heterozygous for the gene?

*Debate*

Have a student panel discuss the pros and cons of using model organisms for drug development.

**Glossary**

Genome

Homolog

Phenotype

Genotype

Ortholog

NCBI

Model organism

Huntington disease

**Resources**

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

National Center for Biotechnology Information (NCBI) [www.ncbi.nlm.nih.gov/](http://www.ncbi.nlm.nih.gov/)

NCBI's mouse genome resources [www.ncbi.nlm.nih.gov/genome/guide/mouse/](http://www.ncbi.nlm.nih.gov/genome/guide/mouse/)

NCBI's "Homologene" page [www.ncbi.nlm.nih.gov/HomoloGene/](http://www.ncbi.nlm.nih.gov/HomoloGene/)

**Activity Pages Include:**

Student worksheets: pre-class activity (HD); and model organisms.

Answer sheets: pre-class activity (HD); and model organisms.