

Discover Magazine: Genetics: Teacher's Guide

Grade Level: 6-8

Curriculum Focus: Human Body

Lesson Duration: Two class periods

Program Description

What is DNA, and how much of our life is predetermined by genes? In this episode, explore the complex and controversial field of genetics, and get the straight story on the twisted world of genes. This program includes four short segments:

- Double Take (7 min.)
 - The Riddle of Life (7 min.)
 - Fly Science (11 min.)
 - Mapping the Human Genome (8 min.)
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Onscreen Questions

- How do genes affect the way we look and act?
 - What role do genes play in memory?
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Lesson Plan

Student Objectives

- Discover that physical traits are determined by genetics but some personality traits may be determined by events in a person's life.
- Understand that because they have the same genetic makeup, identical twins raised separately are ideal subjects for experiments on the effects of genes versus environment.
- Design an experiment to test nature vs. nurture.

Materials

- *Discover Magazine: Genetics* video and VCR, or DVD and DVD player
- Paper and pencils

Procedures

1. Begin a conversation with your students by asking, "Which is a more important factor in how personality develops: nature or nurture?" Explain that "nature" is a person's hereditary, genetic makeup and "nurture" is the events in a person's life, including treatment by parents, peers, community, and society. Let students know that nature vs. nurture is also known as heredity vs. environment. Encourage students to express their views and give reasons to support them.
2. Ask students to think of a way to conduct a scientifically valid experiment that will shed light on the issue of nature vs. nurture. Guide the discussion toward studies of identical twins who have been raised separately.
3. Ask students to explain why identical twins raised apart would be ideal subjects for an experiment. Make sure students understand that identical twins have the same genetic makeup, so all inherited physical traits are exactly the same. When raised separately, these twins have different environmental influences.
4. Divide the class into groups, and have each group brainstorm an experiment designed to cast light on nature vs. nurture. Students' experiments should involve a set of identical twins raised separately.
5. Before groups meet, review the requirements for a scientifically valid experiment:
 - The experiment should begin with a question. (Example: Is musical ability determined by nature or nurture?)
 - The experiment should include a hypothesis, or educated guess, based on knowledge or experience. (Example: Musical ability is determined by nature.)
 - The experiment should be set up with one variable only; all conditions must be the same except for the variable being tested. (In the case of twins, we know that each twin has the exact same genetic makeup, so the only variable is environment.)
 - The experiment should have a control. (In the case of a twin study, the experiment might be a musically gifted twin who was raised by musical parents; the control might be the twin raised by parents who have no musical talent.)
6. Tell the class that the results of one experiment are rarely considered sufficient. An experiment must be repeated many times before the results can be taken seriously.
7. Allow sufficient class time for groups to design their experiments.
8. Have each group present its experiment to the class.
9. Invite class members to critique each experiment, considering the scientific validity of its design.

Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- **3 points:** Students met all requirements of a scientifically valid experiment that tests nature vs. nurture; wrote a clear, well-organized, grammatical, and error-free description.



- **2 points:** Students met most of the requirements of a scientifically valid experiment that tests nature vs. nurture; wrote an adequate, organized description with several grammatical errors.
- **1 point:** Students did not meet the requirements of a scientifically valid experiment that tests nature vs. nurture; produced a disorganized description with numerous grammatical errors.

Vocabulary

gene

Definition: A specific sequence of nucleotides that makes up a piece of DNA on a chromosome and that controls a specific trait

Context: The gene that can give a fly a photographic memory may one day provide a therapy for people with Alzheimer's disease.

genetic

Definition: Relating to, or produced by, the genes

Context: Cystic fibrosis is a genetic disease; a defective gene produces thick mucus that clogs the lungs.

genetic engineering

Definition: The artificial manipulation of one gene or a group of genes in order to change genetic processes

Context: Genetic engineering has been used to create insect-resistant plants and to change how animals grow.

homeosis

Definition: The process by which one body part grows in place of another; homeosis can be caused by environmental factors or genetic mutation.

Context: Homeosis led to the growth of a second pair of wings where the legs should be.

identical twins

Definition: Two persons produced from a single fertilized egg who have identical DNA

Context: It's often difficult to distinguish physical characteristics of identical twins.

Academic Standards

National Academy of Sciences

The National Science Education Standards provide guidelines for teaching science as well as a coherent vision of what it means to be scientifically literate for students in grades K-12. To view the standards, visit <http://books.nap.edu>.



This lesson plan addresses the following science standards:

- Life Science: Reproduction and heredity; Diversity and adaptations of organisms
- Science as Inquiry: Abilities necessary to do scientific inquiry

Mid-continent Research for Education and Learning (McREL)

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit <http://www.mcrel.org/>.

This lesson plan addresses the following national standards:

- Science – Life Sciences: Understands the principles of heredity and related concepts
 - Language Arts – Viewing: Uses viewing skills and strategies to understand and interpret visual media
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Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- <http://school.discovery.com/teachingtools/teachingtools.html>
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DVD Content

This program is available in an interactive DVD format. The following information and activities are specific to the DVD version.

How To Use the DVD

The DVD starting screen has the following options:

Play Video – This plays the video from start to finish. There are no programmed stops, except by using a remote control. With a computer, depending on the particular software player, a pause button is included with the other video controls.

Video Index – Here the video is divided into four parts (see below), indicated by video thumbnail icons. Watching all parts in sequence is similar to watching the video from start to finish. Brief descriptions and total running times are noted for each part. To play a particular segment, press Enter on the remote for TV playback; on a computer, click once to highlight a thumbnail and read the accompanying text description and click again to start the video.



Curriculum Units – These are specially edited video segments pulled from different sections of the video (see below). These nonlinear segments align with key ideas in the unit of instruction. They include onscreen pre- and post-viewing questions, reproduced below in this Teacher's Guide. Total running times for these segments are noted. To play a particular segment, press Enter on the TV remote or click once on the Curriculum Unit title on a computer.

Standards Link – Selecting this option displays a single screen that lists the national academic standards the video addresses.

Teacher Resources – This screen gives the technical support number and Web site address.

Video Index

I. Double Take (7 min.)

Do environmental factors or genetics have more influence in our lives? Learn about twins and a university study that is using them to examine the nature vs. nurture debate.

II. The Riddle of Life (7 min.)

Each human being is programmed with a unique genetic code. Visit the Rich Lab at MIT to learn about DNA, the genetic code that makes us all individuals.

III. Fly Science (11 min.)

Think houseflies are just nuisances? Think again! Through experiments with flies, scientists are hoping to learn more about the genetic structure of humans.

IV. Mapping the Human Genome (8 min.)

For more than a decade, scientists all over the world participated in the Human Genome Project. Learn about this enormous project and the implications its completion holds for our future.

Curriculum Units

1. Identical and Fraternal Twins

Pre-viewing question

Q: What traits do you share with your siblings?

A: Answers will vary.

Post-viewing question

Q: What is the difference between fraternal and identical twins?

A: Identical twins are created when a fertilized egg splits in two; the twins have identical genes. Fraternal twins occur when two separate eggs are fertilized; the twins do not have identical genes.

2. Nature vs. Nurture

Pre-viewing question

Q: Are people shaped by genetics or by the environments in which they were raised?

A: Answers will vary.



Post-viewing question

Q: Do you agree with findings that non-biological traits could be genetically influenced?

A: Answers will vary.

3. Discovering DNA

Pre-viewing question

Q: What is DNA?

A: Short for deoxyribonucleic acid, it's the genetic code found in all living things.

Post-viewing question

Q: What is the structure and makeup of DNA?

A: DNA is found in a ladder-like structure that is twisted into a double helix. Four chemical bases—cytosine, adenine, thymine and guanine—form pairs to create the “rungs” of the ladder. Except for identical twins, no two people have the same sequence of pairs.

4. DNA Molecule

Pre-viewing question

Q: Why are models useful in science?

A: Answers will vary.

Post-viewing question

Q: What does the polymerized chain reaction do?

A: A PCR is like a high-tech copy machine. It can make millions of copies of a section of DNA code, making scientific study easier.

5. Mutant Genes

Pre-viewing question

Q: Do humans and flies share any similar characteristics?

A: Answers will vary.

Post-viewing question

Q: What are homeotic genes?

A: These genes control the development of body parts. They work like switches, turning other genes on and off.

6. Memory Games

Pre-viewing question

Q: Does memory play an important role in your daily life?

A: Answers will vary.

Post-viewing question

Q: What are some pros and cons of experimenting with human memory?

A: Answers will vary.



7. Reading the Genetic Code

Pre-viewing question

Q: What human characteristics are created through DNA?

A: Answers will vary.

Post-viewing question

Q: What is messenger RNA, and what does it do?

A: Messenger RNA copies part of the DNA code in a cell's nucleus and carries that code into the cell's cytoplasm, where it is used to create proteins.

8. Tracking Human Traits

Pre-viewing question

Q: If you could change one aspect of your genetic makeup, what would it be?

A: Answers will vary.

Post-viewing question

Q: What does the completion of the Human Genome Project mean for science and society?

A: Answers will vary.

