Understanding: The Power of Genes: Teacher’s Guide

Grade Level: 9-12  Curriculum Focus: Human Body  Lesson Duration: One or two class periods

Program Description
To what degree are we genetically programmed with certain traits and abilities? In segments that cover identical twins, the promising science of biotechnology, and the genetic inheritance of working dogs, students consider the classic nature-versus-nurture discussion in light of recent technologies and discoveries. This program includes two feature segments and two short segments.

Onscreen Questions
• Why are scientists interested in twins who were separated at birth?
• How does cloning differ from natural reproduction?
• How do genes influence people’s personalities?
• How does positive reinforcement help dogs learn?

Lesson Plan

Student Objectives
• Discuss new scientific information about genes.
• Consider how that information is changing thoughts about human behavior and scientific research.
• Write essays on how information about genetics affects private homes, the research laboratory, and hospitals and clinics.

Materials
• Paper and pencils
• Newsprint and markers
• Computer with Internet access
**Procedures**

1. Begin the lesson by asking students what they know about new genetics research. Write their ideas on a large sheet of newsprint. Students may discuss cloning animals, using DNA in criminal investigations, or gene therapy for some types of cancer.

2. Divide the class into groups of three or four students. Give the groups the option of focusing on one of the following environments:
   - Private homes
   - The research laboratory
   - Hospitals or clinics

3. After students select an environment, allow enough time for them to consider how new genetics research has affected it. Students should be able to answer the following questions:
   - What is the focus of the new research?
   - Does the new research challenge earlier ideas? If so, how?
   - How can the new research be applied to the selected environment? For example, could the new research about human behavior affect how children are raised? Could it affect scientific research or future medical treatments?

4. Give students time to conduct research during class. You may have them visit the following Web sites:

   **Pure Research and Medical Research**
   - [http://www.cancer.mgh.harvard.edu/cancer_ccr_index.htm](http://www.cancer.mgh.harvard.edu/cancer_ccr_index.htm)
   - [http://www.dnafiles.org/about/pgm14/index.html](http://www.dnafiles.org/about/pgm14/index.html)
   - [http://www.globalchange.com/clone_index.htm](http://www.globalchange.com/clone_index.htm)

   **Genes and Behavior**
   - [http://www.peele.net/lib/genes.html](http://www.peele.net/lib/genes.html)

5. During the next class, have the groups work together to create a report summarizing their findings. Students should include research to document their ideas and conclusions. If time permits, have each group present its findings.

6. Conclude the lesson by referring to students’ ideas at the beginning of the lesson. Have their ideas changed after working on this project? If so, how? What new insights do students have about genes and how they affect different aspects of human life?
Assessment

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

- **3 points:** Students participated actively in class discussions; worked closely within their group to conduct research; prepared a thorough, well-written, and well-documented report.
- **2 points:** Students participated in class discussions; worked somewhat closely within their group to conduct research; prepared a competent report.
- **1 point:** Students participated minimally in class discussions; did not work well within their group to conduct research; prepared an incomplete, poorly researched report.

Vocabulary

**behavior**

*Definition:* The actions an animal performs, from finding food to protecting itself to mating to taking care of its offspring

*Context:* Most animal behaviors help them survive in their environment.

**chromosome**

*Definition:* Material in the cell nucleus that contains genetic information

*Context:* Each chromosome contains two rods of chromatids, which contain key genetic information for cells.

**clone**

*Definition:* Two organisms that have the same genetic material so that they are exactly the same, or an organism that is genetically the same as the one from which it was made

*Context:* Identical twins are clones that occur in nature; Dolly the Sheep is an example of a scientifically produced clone.

**DNA**

*Definition:* A nucleic acid that carries the information passed from parents to their offspring; acronym for deoxyribonucleic acid

*Context:* When the structure of DNA was determined in 1953 by two scientists, it was considered a major scientific breakthrough.

**gene**

*Definition:* A specific strand of DNA that is responsible for a particular trait or characteristic

*Context:* A major scientific endeavor known as the Human Genome Project has mapped each gene in all the cells in the human body.
**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](http://books.nap.edu).

This lesson plan addresses the following science standards:

- Life Science: Molecular basis of heredity; Interdependence of organisms; Behavior of organisms
- Science as Inquiry: Understandings about 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/](http://www.mcrel.org/).

This lesson plan addresses the following national standards:

- Science — Life Sciences: Understands the principles of heredity and related concepts; Nature of Science: Understands the scientific enterprise
- Language Arts — Reading: Uses reading skills and strategies to understand and interpret a variety of informational texts

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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](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. Twin Traits (4 min.)
Identical twins share more than their physical appearance. Explore fascinating new twins studies to understand the differences between fraternal and identical twins.

II. Manipulating Nature (18 min.)
Breakthroughs in genetics research have created new ways to solve crimes, breed animals, and extend human life. They’ve also changed our understanding of DNA.

III. It’s In the Genes (19 min.)
Some scientists believe that advanced genetic technology will lead to even greater scientific achievements than the Industrial Revolution.

IV. Training Dogs for Duty (6 min.)
When properly trained, assistance and search-and-rescue dogs can be taught to overcome their inborn instincts and fears.

Curriculum Units

1. More Than Meets the Eye

Pre-viewing question
Q: Is your personality the result of your genes or your environment?
A: Answers will vary.

Post-viewing question
Q: How do identical twins differ from fraternal twins?
A: Identical twins, which occur when a single egg is fertilized and then divides into two embryos, have identical DNA. Fraternal twins develop when two eggs are fertilized and develop in the womb at the same time; they do not have the same DNA and may not even be the same gender.
2. An Understanding of Genetics

Pre-viewing question
Q: Which scientific breakthroughs have been the most important?
A: Answers will vary.

Post-viewing question
Q: Why is there infinite variety in the living world?
A: Because every time a strand of DNA replicates itself, it changes slightly.

3. DNA: A Silent Witness

Pre-viewing question
Q: How can DNA analysis help solve crimes?
A: Answers will vary.

Post-viewing question
Q: What are the chemical pairs found in DNA?
A: In a DNA molecule, adenine pairs with thymine and guanine pairs with cytosine. This chemical pairing dictates the creation of different proteins, which influence everything from eye color to IQ.

4. A Cold Hit

Pre-viewing question
Q: Is matching DNA sufficient evidence to convict someone of a crime?
A: Answers will vary.

Post-viewing question
Q: Why is a DNA database such a useful crime-solving tool?
A: Within a matter of minutes, a database like the one used by the FBI can cross-reference DNA found at a crime scene with DNA samples from hundreds of known criminals, identifying possible matches.

5. Giving Life

Pre-viewing question
Q: What potential dangers are involved with cloning?
A: Answers will vary.

Post-viewing question
Q: What did Dolly teach scientists?
A: Before Dolly, geneticists believed that once a cell becomes specialized—for example, becomes a skin or brain cell—its genetic instructions for creating another life were permanently switched off. Dolly’s creators forced cells into hibernation by starving them of some nutrients. This starvation essentially took the cell’s genetic material backwards to a state where its genetic instructions could create life.
6. Designer Cows

*Pre-viewing question*
Q: How far should we take genetic manipulation and cloning?
A: Answers will vary.

*Post-viewing question*
Q: What are transgenics?
A: These genetically altered animals have DNA from one species that’s been spliced into DNA from another.

7. Cross-Species Cloning

*Pre-viewing question*
Q: Can cloning and genetic manipulation save animals from extinction?
A: Answers will vary.

*Post-viewing question*
Q: What is cross-species cloning?
A: It’s the process by which scientists use the eggs of one animal as a universal recipient for the DNA of another species. The animal that is born will be entirely one species—for example, if a cow egg is reprogrammed with the DNA from a primate, the cow will give birth to a primate, not an animal that is half-primate, half-cow.

8. Inherited Genes

*Pre-viewing question*
Q: What traits do you share with your siblings or parents?
A: Answers will vary.

*Post-viewing question*
Q: Do you have the novelty-seeking or anxiety gene?
A: Answers will vary.

9. Gene Hunting

*Pre-viewing question*
Q: Is it important that we know about all human genes?
A: Answers will vary.

*Post-viewing question*
Q: Should we use genetic therapies to cure cosmetic problems?
A: Answers will vary.

10. Gene Therapy

*Pre-viewing question*
Q: What possibilities does advanced genetic technology hold?
A: Answers will vary.
Post-viewing question
Q: How has the concept behind gene therapy changed?
A: Just a few years ago, the concept was that we would use genes to replace those broken at birth. Now scientists have seen that gene therapy can be used to help the body repair itself and restore normal function.

11. Instincts and Conditioning

Pre-viewing question
Q: What instincts are dogs born with?
A: Answers will vary.

Post-viewing question
Q: What is positive reinforcement?
A: A system of rewards in which an animal receives praise and positive feedback for completing a job correctly.

12. Repetition and Confidence

Pre-viewing question
Q: How do you force yourself to overcome fears?
A: Answers will vary.

Post-viewing question
Q: Do you think rescue animals enjoy their work?
A: Answers will vary.