HS Lesson 5: Disproving the Proof

(Pre or Post-Exhibit Visit)

Objectives:

1. Students will realize that a progression of discoveries have led to the genetics knowledge that scientists currently have.
2. Students will understand how genetic experiments disproved previous theories on inheritance.

Curriculum Connection:

This lesson is best taught at the end of a unit on genetics. Students should have prior knowledge of Mendel's experiments and basic principles on the structure of DNA and how it controls the synthesis of proteins.

Exhibit Link:

This activity connects with *Discovery* and helps students better understand the purpose and sequence of discoveries made. It also connects with the stages of discovery as set forth in the exhibit: Discovering the Secret, Cracking the Code, Cut and Paste, and Racing to the Frontier.

Class Time Required:

One hour

Materials Needed:

- Paper & Pencil
- Biology Textbook

Focus Activity:

Review with students the current understanding of how genes are passed from parents to offspring. Each parent donates half of the chromosomes. The traits are passed as discreet units, etc. Remind them that we have not always believed or understood this to be the case. Have the students work in groups of two and come up with some alternative ideas that people might have once believed about how people got their characteristics.

Lesson Steps:

1. Discuss the students' answers. Then, write on the board the following ideas that people used to believe about heredity:
   A. (384 BC – 1800s) – Aristotle – Eggs and sperm formed from particles in the body called pangenes, which come together from all parts of the body, mainly the blood.
   B. (1600s) - Leeuewenhoek – All inherited traits come from the father; the mother is only the incubator of the offspring.
   C. (1600s) – Regnier de Graaf – All inherited traits come from the mother; the sperm is only the catalyst which stimulates the growth of the egg.
   D. (early 1800s) – Blending Theory – Traits of the parents are blended irreversibly, much as paints do, to form the traits of the offspring.
   E. (mid 1800s) – Darwin & Lamarck – Changes that occur in various parts of the body during a person's life could be passed on to the next generation.
2. Have students use their textbooks and/or other resources you select to find statements that show these ideas to be incorrect. Also have students find specific aspects of Mendel's experiment that showed these theories to be incorrect.
3. After discussing some of the students' answers, have them take on the roles of some of these scientists. (Assign each pair of students a scientist, or allow them to choose.) When Mendel's evidence was published, what kind of response might he have had? Have the students list questions that they would have asked Mendel. This can lead to a good discussion of how Mendel's work was received in real life.

Extensions & Modifications:

- As an extension to Step 3, you could become Mendel, and each student could come up with questions they would ask Mendel when he is presenting his findings.
- For lower level students, you could list some of the major principles from Mendel's experiment and allow them to match up these ideas with the theories that they disproved.
- More advanced students could come up with an experiment that might disprove our current understanding of inheritance.
- Discuss how science is built on experimental evidence and how all theories are both testable and falsifiable

Important terms: Gregor Mendel, heredity

Writing Prompts/Potential Discussion Questions:

1. One of the challenges of being a good scientist is to ensure that one's experiments answer a specific question and can be repeated with the same results. Every scientist studied in this activity is still revered because the evidence in their experiments was considered credible. With this in mind, what would you consider credible evidence in science?
2. It has taken over two thousand years to come to our current thinking about inheritance. Discuss the possibility that in two thousand years we could have a very different understanding of inheritance. Use the scientific method in your discussion.
3. Discuss how misperceptions of genetic traits might have affected people's attitudes and behaviors. For example, if 200 years ago people believed that all traits came from women, would that have raised women's perceived standing in society?
4. By the early 1900s, it was firmly established that both parents contribute equally to the child's traits and that acquired traits such as loss of a leg are not passed down to the children. Discuss ways that such discoveries might have changed decisions that parents might have made about having kids.

Additional Resources:

Taking a Chance on Heredity: How Gregor Mendel Solved a Basic Mystery of Heredity
By Stan Dick
http://classweb.gmu.edu/mgabel/unit2-math-web/mendel.pdf
This PDF available online provides information about various theories of heredity, focusing on Mendel.

National Standards Addressed:

Standard G – Nature of Scientific Knowledge

Because all scientific ideas depend on experimental and observational confirmation, all scientific knowledge is, in principle, subject to change as new evidence becomes available. The core ideas of science such as the conservation of energy or the laws of motion have been subjected to a wide variety of confirmations and are therefore unlikely to change in the areas in which they have been tested. In areas where data or understanding are incomplete, such as the details of human evolution or questions surrounding global warming, new data may well lead to changes in current ideas or resolve current conflicts. In situations where information is still fragmentary, it is normal for scientific ideas to be incomplete, but this is also where the opportunity for making advances may be greatest.