**Title:** Human Genome Project: Science and Ethics

**Grade Level(s):** 9-12

**Subject/Content:** Science/Biology

**Summary of Lesson:** This lesson will allow the students to understand what the human genome project is, its origins, and ethical questions that have arisen since the project’s inception.

**Focus Question:** What makes up a human genome, and who, if anyone, ‘owns’ the human genome sequence?

**Resources:** *Science in Context*

**Procedures:**

**Steps/Activities by the teacher:**

- Lead the class in a discussion of DNA and genetics. Introduce the Human Genome as a concept, and define it for the students. Ask them how long they believe it would take to sequence a human genome. Record their answers.
- Ask students to consider who ‘owns’ the human genome, once it has been sequenced? How should the human genome be used? Record their answers.
- Direct students to work in a small group.
- Direct students to research the Human Genome Project, using *Science in Context* or another online source, and to choose articles from their results. As a group, they should complete the reading assignment, discuss some of the ethical issues on the subject and collaboratively come to a consensus on one of the issues.
- Using their notes from their research, they should create a short classroom presentation (using Web 2.0 tools such as Prezi or Glogster, or PowerPoint if the instructor prefers) representing the group’s point of view on one of the ethical issues raised by the Human Genome Project. The presentation should include appropriate resources and raise questions for classroom discussion.
- Allow each group to input their questions into an interactive survey tool, such as SurveyMonkey, Google Forms, or another tool suggested by the instructor. Those with access to Smartboards and Smart Responders may use that tool instead.
- When the presentations and surveys are complete, ask the students to take the surveys.
- When all students are finished, groups should look at their survey results and discuss what they learned about the Human Genome Project.

**Steps/Activities by Student(s):**

- Follow the instructor’s directions, and work individually or in a small group.
- Access *Science in Context* or another online source and search for information on the Human Genome Project.
- From the results, as a group or with your partner, choose one or more of the articles and read it thoroughly, taking notes.
As a small group, discuss some of the ethical issues on the subject and collaboratively come to a consensus on one of the issues.

Using your notes from your research, create a short classroom presentation (using Web 2.0 tools such as Prezi or Glogster, or PowerPoint if the instructor prefers) representing the group’s point of view on one of the ethical issues raised by the Human Genome Project.

As a group, input your questions into an interactive survey tool, such as SurveyMonkey, Google Forms, or another tool suggested by the instructor.

When the class presentations and survey creation is complete, the class will complete the surveys.

When all students are finished, the class will look at the survey results and discuss what you have learned about the Human Genome Project.

Learning Outcome: Students will gain an understanding of not only the science behind the Human Genome Project, but also the ethical issues that the project presents.

Related Activities:

English/Language Arts

• Emphasize note taking and summarization skills.
• Ability to pull relevant information out of an article and to synthesize information.
• Use technology to present information and to interact as a class.

Learning Expectation: Students will use their research skills to locate articles about the Human Genome Project and extract relevant information. Students will be able to synthesize the information in one of the articles they find, and develop discussion questions based on the article. Students will create a survey using the information they find, and form opinions about the ethical questions presented by the Human Genome Project.

Standards Alignment

Next Generation Science Standards

HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

LS1.A. All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins.

LS3.A. Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species’ characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.

HS-ESS3-2. Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions.
HS-ESS3-2. Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.

HS-ESS3-2. Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues.

HS-ESS3-3. Science is a result of human endeavors, imagination, and creativity.

HS-ESS3-3. New technologies can have deep impacts on society and the environment, including some that were not anticipated.

**Standard Source:** Next Generation Science Standards (2013)

**Common Core State Standards:**

**Grade 9-10**

CCSS.ELA-LITERACY.W.9-10.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

CCSS.ELA-LITERACY.W.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

CCSS.ELA-LITERACY.RST.9-10. Determine the central ideas or conclusions of a text; trace the text’s explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

CCSS.ELA-LITERACY.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.

**Grade 11-12**

CCSS.ELA-LITERACY.CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.

CCSS.ELA-LITERACY.RI.11-12.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

CCSS.ELA-LITERACY.RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

CCSS.ELA-LITERACY.W.11-12.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

**Standard Source:** Common Core State Standards (2010)