<table>
<thead>
<tr>
<th><strong>Objectives</strong></th>
<th>Given a computer with internet access, a student will be able to research information about The Human Genome Project and discuss their findings on Yammer and achieve two points on the three point grading scale.</th>
</tr>
</thead>
</table>
| **Standards**  | This project meets the following Indiana Academic Standards for Science  
- Standard 1: Nature of Science and Thinking  
- Standard 2: Scientific Thinking  
- Standard 3: The Physical Setting  
- Standard 4: The Living Environment  
- Standard 6: Common Themes |
| **Materials**   | - Newspaper and magazine articles and other current resources about the Human Genome Project  
- Internet access  
- Poster board |
| **Procedure**   | 1. Begin the lesson by asking students what they know about genes. Explain to students that genes are made up of double strands of deoxyribonucleic acid, or DNA. The DNA provides the genetic instructions for everything a cell does. In particular, the sequence of the subunits of DNA, called bases, plays a part in determining whether a person will get sick and how well that person will respond to medication. To understand how the body works as well as diseases and treatments, scientists must understand the human genome, or the complete set of genetic instructions. To do so, they are mapping these instructions in the Human Genome Project, or HGP.  

2. Share the following information about the HGP with the students:  
-The long-term goal of the project is to locate the estimated 30,000 or more human genes on all the chromosomes and determine their sequence along each strand of DNA.  
-In June 2000, scientists were able to complete a rough draft of the human genome a year ahead of schedule. Scientists use this information to understand how genes function, how genetic material varies among people, and how some genetic variations predispose people to disease.  
-The HGP also invests in studying the ethical, legal, and social implications of these findings. For additional information about genes, students may want to consult the following Web site before proceeding with the activity: The Science Behind the Human Genome Project. (Classroom sources on the subject may also be very useful.)  

3. Tell students that the HGP is a complex project and has scientific, ethical, and medical ramifications. During this lesson, students will work in small groups to research the project. Before students divide into groups, provide them with an overview of the HGP. |
4. Divide the class into three groups to research different facets of the HGP. Have them use the Web sites listed below to research the following areas:

Group 1: Scientific findings. The number of genes discovered and their sequence, as well as definitions of key scientific terms such as chromosome, DNA, gene, and protein.

Group 2: Potential applications. The tools used to detect genes carrying disease and how this information can be applied to individual treatment plans.

Group 3: Ethical implications. The ethical issues involved with screening adults and fetuses for genetic diseases, using new technology to treat diseases, and other issues associated with mapping the human genome.

5. Tell students that the Web sites below have information relevant to their research:

Group 1: Scientific findings
- Human Genome Project 5-Year Plan
- Twenty Questions About DNA Sequencing
- Human Genome Project Science

Group 2: Potential applications
- The Human Genome Project: From Maps to Medicine
- From the Genome to the Proteome

Group 3: Ethical implications
- National Center for Biotechnology Information
- Issues and Bioethics
- Center for the Study of Bioethics
- The American Journal of Bioethics

6. Give students time in class to work on their research. Have the students create a Yammer account. Have each of the groups create a corresponding group on Yammer. Group 1 can use Yammer to post their research so that each of the group members is on the same page. Group 2 and Group 3 can use Yammer in the same way. There should also be a general forum where all of the students as a class can discuss their research together. This is a good way for them to brainstorm their final presentations as well. Students can record their findings on the computer or in notebooks. Tell students that they can use illustrations to depict some of their findings, such as the structure of DNA or the shape of a chromosome.

7. Give each group an opportunity to present its findings. Then create a display of each group's presentation. The scientific findings display could include a labeled diagram showing the relationships among DNA, genes, chromosomes, and proteins. The potential applications display could present a case study showing how the genes responsible for an illness were identified and how that information was used to develop treatment. The ethical implications display could present a list of issues that have emerged from this new knowledge.
8. Place the displays on a several large pieces of poster board. Use the displays to discuss the complexity of the project.

9. Conclude the lesson by discussing students' overall reaction to the Human Genome Project. Do students think that the advantages of the project outweigh the challenges? Do they think this information has the potential to save lives?

<table>
<thead>
<tr>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use the following three-point rubric to evaluate how well students conduct their research, compile their findings, present them to the class, and participate in class discussions on complex issues:</td>
</tr>
<tr>
<td>• <strong>Three points:</strong> exhibited strong research skills; showed above-average ability to compile findings and present them to the class; demonstrated the ability to share keen insights and ideas during class discussions and post them on Yammer.</td>
</tr>
<tr>
<td>• <strong>Two points:</strong> exhibited on-grade research skills; showed average ability to compile findings and present them to the class; demonstrated on-grade ability to share insights and ideas during class discussions and on Yammer.</td>
</tr>
<tr>
<td>• <strong>One point:</strong> exhibited slightly below-average research skills; had some problems in compiling findings and presenting them to the class; demonstrated difficulty sharing insights and ideas during class discussions and on Yammer.</td>
</tr>
</tbody>
</table>