What's in Your Genes?

Unit Summary

Students use their knowledge of biotechnology applications to influence legislation for or against its usage. They study the general concepts of molecular genetics and the technique of developing and analyzing deoxyribonucleic acid (DNA) fingerprints through the use of gel electrophoresis. Next, students view the motion picture *Gattaca*, to see the effects of biotechnology on society. They then conduct more research into possible biotechnology applications. The culminating activities include using the *Showing Evidence Tool* to develop an argument supporting the use, use with limitations, or disuse of various biotechnology applications within the United States. Finally, in the simulation, students work in groups to develop several "bills" and attempt to persuade a panel of legislators to approve their recommendations.

At a Glance

Grade Level: 9–12
Subject: Biology
Topics: Biotechnology
Higher-Order Thinking Skills: Argumentation, Evaluation, Experimental Inquiry
Key Learnings: DNA, Fertilization, DNA Fingerprints, Molecular Genetics, Genetic Engineering, Gel Electrophoresis, Scientific Research
Time Needed: 5 weeks, 4 periods per week (three 50-minute periods and a 90-minute period)**Background:** Arizona, United States

Things You Need

Assessment
Standards
Resources

Curriculum-Framing Questions

- **Essential Question**
  Just because we can, should we?
- **Unit Questions**
  What is the social responsibility of acquiring scientific knowledge?
  What is the impact of biological discoveries and technological advances on society and on other living organisms?
- **Content Questions**
  In what ways is biotechnology being used today?
  How do you produce and analyze a DNA fingerprint using gel electrophoresis?
  How can the components and structure of a DNA molecule be identified?

Assessment Processes

View how a variety of student-centered assessments are used in the What's in Your Genes? Unit Plan. These assessments help students and teachers set goals; monitor student progress; provide feedback; assess thinking, processes, performances, and products; and reflect on learning throughout the learning cycle.

Instructional Procedures

Introduce the Unit

Begin the unit by writing the Essential Question, *Just because we can, should we?* on the board for the entire class to read. Present the idea that for every medical science breakthrough, ethical questions are raised. Inform students that they will use a science journal to write notes, make observations, and respond to questions throughout the unit. Have students list their ideas about the Essential Question in their science journals. Next, pose the Unit Questions, *What is the social responsibility of acquiring scientific knowledge?* and *What is the impact of biological discoveries and technological advances on society and on other living things?* Have students record their initial thoughts in their journals. Next, pair up students and have them share their ideas with their partners. Follow up with a class discussion and record students' thoughts on chart paper.

Learning Key Concepts: Lab Investigations

Review the structure of DNA and how DNA replication occurs. Have students conduct investigations of DNA and gel electrophoresis in a lab setting.

Investigate DNA

Tell students they will investigate deoxyribonucleic acid (DNA) extraction using kiwi fruit. Guide students through the

Kiwi Lab*. This activity allows students to visually spool the DNA from thousands of cells. Discuss what is happening to the kiwi throughout each step of the lab. Link students' prior knowledge of cells to this unit.

Review the structure of ribonucleic acid (RNA) and how protein synthesis occurs within cells. Demonstrate protein synthesis using models or show a video illustrating this to your students. Guide students as they decode a strand of DNA to a protein.

Ask students to decode at least five phrases in the decoding activity. Provide an example that reminds students of the process of creating an mRNA (messenger RNA) strand from the DNA strand, then creating tRNA (transfer RNA) anticodons from the mRNA codons. Print the two decoding activity handouts on different colored paper so that students sitting next to each other will have different phrases to decode. Then have the students solve the codes on a separate piece of paper showing the DNA strand, mRNA strand, tRNAs, and the decoded phrase.

Examine Gel Electrophoresis
Guide the students through the Dye Gel Electrophoresis Lab* during an extended lab period. Discuss proper protocol involved in the use of gel electrophoresis. Ask students to write their thoughts in their science journals about the following questions:

- *How can the components and structure of a DNA molecule be identified?*
- *How do you produce and analyze a DNA fingerprint using gel electrophoresis?*

While the gels are running, review the students' responses to the questions and the main concepts of the lab.

View the Human Genome video called *The Secrets of Our Lives* as well as the Milestones in Genetics: Timeline, available from The Human Genome Project Kit*. Summarize all of the important events. Next, guide students through the Who's the Daddy? (Whale Pod) Lab* during an extended lab period. While the gels are running, ask students to answer the questions in the student guide and provide an example of how to analyze the gels to determine the father. Assess the students' understanding of the main concepts of the unit through a written quiz.

After completing the lab activities, lead a discussion about applications of gel electrophoresis and other forms of biotechnology used today. Investigate real world applications of biotechnology further by viewing the movie Gattaca. Review the requirements of the *Gattaca* essay with students before viewing the movie. Discuss the essay rubric and answer any questions from the class. Hold a discussion after the movie about the possible effects of biotechnology on society.

Research and Determine a Position on the Use of Biotechnology
Let students know they will be researching and building an argument about uses of biotechnology. Cut the issue cards in fourths to create eight cards—one card for each of the following topics:

- Reproductive technology
- Cloning
- Privacy and confidentiality
- Patenting genes
- Genetically Engineered (Transgenic) Plants & Animals
- Gene Therapy
- DNA Forensics
- Genetic Testing for Inherited Diseases (Gene Testing)

Divide the class into eight groups and give each group a card. Instruct them to find resources that will provide pros and cons on the use of that form of biotechnology. Discuss what makes a resource valid and reliable. Ask students to collect and record information (minimum of 10 per student) about their issue, using the following format:

- Bibliographic information
- One-sentence summary of information
- Quote of factual information that would help form a claim on the issue

Next, have groups evaluate their researched information and draw some conclusions. Direct students to construct a claim as to whether the biotechnology application they are studying should be freely used, used with limitations, or banned from use. Have students discuss the research they found and pick the 10 best pieces of evidence to support their claim.

While students work in groups and discuss their research, observe conversations and use the evaluative thinking checklist to assess their evaluative thinking skills. Use the checklist throughout the learning cycle whenever students are evaluating information and engaging in group discussions and activities.

Use the Tool
Give students the tool guidelines. Introduce students to the *Showing Evidence Tool* by exploring the Try the Tool demonstration space together. Discuss the sample case together or create a sample project and show students how to add, describe, and rate evidence and claims.

Hold a discussion around the idea of reliable evidence. Have students ask themselves the following questions when

rating the reliability of an evidence source:

- *Is the source biased?*
- *Is the information current?*
- *Is the author an authority on the subject?*
- *Is the author expressing fact or opinion?*

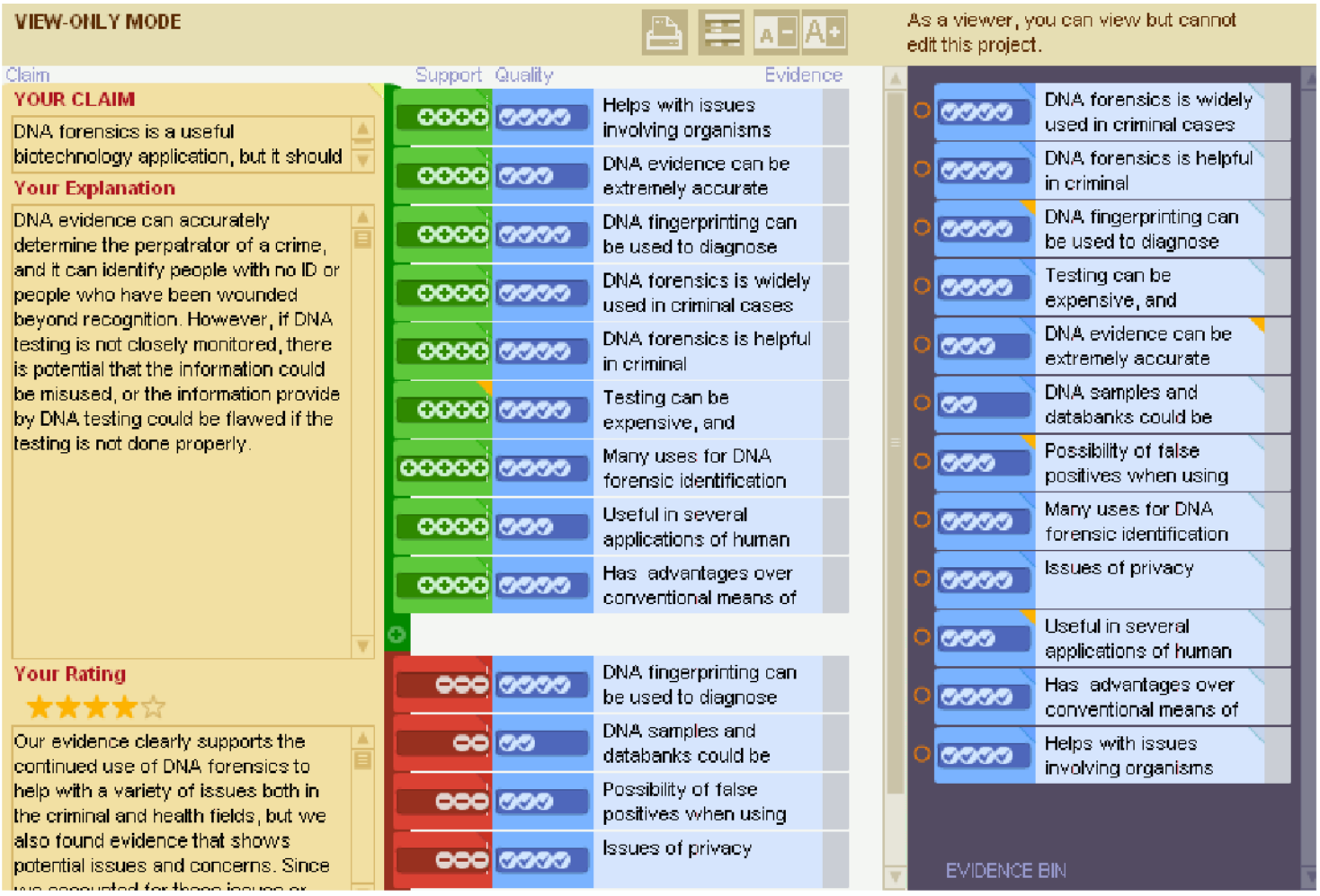
Distribute the argumentation rubric and explain to students that they should use the rubric as a guide as they work with *Showing Evidence*.

Before proceeding with the next activity, click here to set up the What's in Your Genes? project in your workspace. Organize students into teams and have them log into their team space. Ask students to create a claim in the workspace and add at least 10 pieces of evidence from their research. Use the Comments feature to give feedback, redirect effort, suggest new avenues of study, or ask for clarification about a team's thinking.

After the students finish putting their information into *Showing Evidence*, have them review the case of another group that researched the same issue. Direct the peer review groups to read and evaluate the claims of the group assigned to them. Instruct the students to make constructive comments and corrections where needed to the claims and evidence, using the argumentation rubric as a guide.

Examine the Showing Evidence Activity
The *Showing Evidence* space below represents one team's investigation in this project. The case you see is functional. You can double-click the evidence and comments to read the team's descriptions.

Project Name: What's in your genes? (Click here to set up this project in your workspace)
Prompt: Should we put limitations on the usages of biotechnology?



Lobby Your Position
Set up the following scenario:

> Step into the future, the year 2010…The entire Human Genome Project was completed in 2003, and biotechnology is advancing faster than ever before. Legislation is going before Congress and the House of Representatives to determine to what extent various forms of biotechnology will be used within the United States. You have been selected to make recommendations about these biotechnology applications. You will submit a bill to try persuade "legislators" to freely use, disuse, or limit the use of biotechnology on our lives. Your classmates will act as the legislators in this simulation and vote to either approve or reject your recommendations.

Have teams who peer reviewed each other work together to draft a bill by filling in the bill template. The contents of the bill should include:

- Position your bill supports
- Why the bill is needed
- Actions to be taken
- Key definitions
- Funding source (if applicable)

Distribute the bill rubric and review it with students before they begin drafting their bill. Have students use the evidence they collected while using *Showing Evidence* to back up their bill's recommendations during the presentation.

Allow each group 10 minutes to present their bill to the class. Have the group read the bill aloud and then field questions. Conclude the presentations by having the class vote on whether to approve each team's bill. See an example of one team's bill.

After each presentation, have students write a short summary in their science journals explaining the following:

- Key points of the bill
- Suggested changes (if applicable)
- Rationale for recommending to approve or reject the bill

Conduct a class discussion on the Essential Question again. Students should have more insight into what causes scientists to explore new solutions to problems and the ethical questions that sometimes arise from the new solutions.

Prerequisite Skills

- A unit on cells should be studied prior to beginning this unitDifferentiated Instruction

Differentiated Instruction

Resource Student

- Afford the student extra time for study
- Reduce the amount of evidence required
- Preselect research materials for the student
- Provide support from a resource specialists

Gifted Student

- Allow the student to explore multiple controversial biotechnological applications

English Language Learner

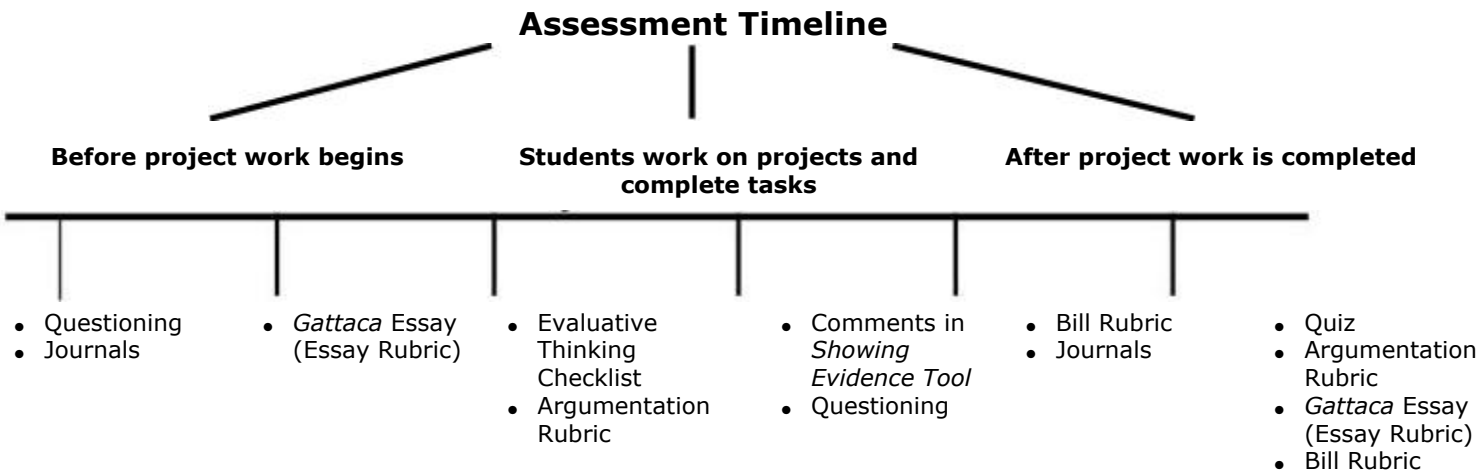
- Arrange for additional support from common language speakers with greater English proficiency
- Allow the student to present the bill in dual languages
- Use Biology Tutorials* offered in students' first languages

Credits

Lynne Coté is a high school biology teacher in Tucson, Arizona. She participated in the Intel® Teach Program, which resulted in this idea for a classroom project. A team of teachers expanded the plan into the example you see here.

Assessment Plan

Assessment Plan



Questioning is used throughout the unit to promote higher-order thinking and assess student understanding. A quiz is used to assess general knowledge of molecular genetics and students' understanding of the lab investigations. Other artifacts of student learning include the *Gattaca* essay, the use of the *Showing Evidence Tool* to support a claim, and the presentation of a bill. The essay rubric is used within the *Gattaca* essay document to assess essays. The argumentation rubric and bill rubric provide a framework for assessing student learning and guide students throughout completion of the projects. Also, periodically reviewing students' science journals is a way to keep informed about the progress of students and any difficulties they may be having. The evaluative thinking checklist is used throughout the learning process to observe and assess students' higher-order thinking.

Showing Evidence Tool: What's in Your Genes?

Content Standards and Objectives

Targeted Content Standards and Benchmarks

Arizona Content Standards/Benchmarks

High School Science Standards

Strands 1:

- Evaluate scientific information for relevance to a given problem.
- Evaluate whether investigational data support or do not support the proposed hypothesis.
- Critique reports of scientific studies (e.g., published papers, student reports).
- Support conclusions with logical scientific arguments.

Strand 2:

- Describe how human curiosity and needs have influenced science, impacting the quality of life worldwide.
- Analyze how specific changes in science have affected society.

Strand 3:

- Recognize the importance of basing arguments on a thorough understanding of the core concepts and principles of science and technology.
- Support a position on a science or technology issue.

Strand 4:

- Analyze the relationships among nucleic acids (DNA, RNA), genes, and chromosomes.
- Explain how genotypic variation occurs and results in phenotypic diversity.
- Describe how meiosis and fertilization maintain genetic variation.

Student Objectives

Students will be able to:

- Analyze information and determine the validity/reliability of the research and source
- Weigh evidence to determine the situation that will be best for the entire population
- Understand the value of being informed on issues
- Use prior knowledge of molecular genetics to interpret research on biotechnology issues

Resources

Materials and Resources

Printed Materials

Magazine Articles

- Multiple authors. (2003, April 11). Building on the DNA revolution. *Science*, several articles discussing the completion of the Human Genome Project.
- Multiple authors. (2003, April 24). DNA 50th anniversary: Double helix at 50. *Nature*, several articles discussing the completion of the Human Genome Project.

Supplies

Kiwi DNA Lab:

- Ziplock bags (1 per student pair)
- Strainer or funnel (1 per 10 students)
- Jar or beaker that fits strainer or funnel (1 per 10 students)
- Cheese cloth (cut to cover the funnel)
- Ice water bath (a large mixing bowl works well) (1 per 4–6 students)
- Extraction solution (1 tube of 20 ml. per student pair)
- Kiwifruit (cut into 12 pieces, each student pair needs 6 pieces)
- Cold 95% ethanol or isopropanol (3–4 ml. per student)
- Small test tubes (1 per student)

Dye Gel Electrophoresis Lab:

- 1 x TBE
- Agarose
- Various dye mixtures: Methyl Orange, Bromophenol Blue, Xylene Cyanol, Pyronin Y, Safranin O, Unknown (1 each per group)
- Practice loading dye (above)
- Micropipets and tips to load dye samples (6 per group)
- Small microcentrifuge tubes (0.5 ml. or 0.65 ml. size) (6 per group)
- Electrophoresis units and power supplies (1 per group)
- 1 x TBE for electrophoresis units
- Microwave oven
- Hot water bath for keeping agarose liquified

Who's Your Daddy? Lab:

- DNA from Mother (#1), Luna (#2), male whale A (#3), male whale B (#4) (1 per group)
- Agarose
- Tris-acetate/EDTA solution (TAE)
- Micropipette/tips (4 per group)
- Electrophoresis apparatus (1 per group)
- Methyl blue stain
- Light box (1 per group) Internet

Resources

- The Human Genome Project Kit
  www.nhgri.nih.gov/educationkit*
  Includes a video, multimedia CD-ROM, and tips for using the kit in your classroom
- DNA: Heredity & Beyond
  http://library.thinkquest.org/20830/main.htm*
  A 1998 ThinkQuest that gives background information regarding DNA, scientists, and related scientific discoveries as well as discusses ethical issues surrounding the manipulation of DNA
- Genetic Disorder Information on the Web
  www.ornl.gov/TechResources/Human_Genome/posters/chromosome/diseaseindex.html*
  Database linking to genetic disorders found on each individual chromosome
- Chromosome Viewer
  www.ornl.gov/TechResources/Human_Genome/posters/chromosome/chooser.html*
  Visual chromosome map of all 23 chromosome types with links to genetic diseases/disorders found on each individual chromosome
- Gene Testing

www.ornl.gov/TechResources/Human_Genome/medicine/genetest.html*
Includes a description of gene testing along with pros and cons

- Genetics in the Courtroom
  www.ornl.gov/TechResources/Human_Genome/courts/courts.html*
  Background and implications of using genetics in the courtroom
- Ethical, Legal, Social, Implications of Human Genome Project
  www.kumc.edu/gec/prof/geneelsi.html*
  Links to several sites that involve controversial biotechnology issues and usages
- Biotech Program (University of Arizona)
  http://biotech.biology.arizona.edu/labs/labs.html*
  Labs used in unit: Kiwi DNA Extraction, Agarose Gel Electrophoresis with Biological Dyes, DNA Fingerprinting: Whale Pod DNA
- Biology Project (University of Arizona)
  www.biology.arizona.edu*
  Tutorials in both English and Spanish

Other Resources

- Niccol, A. (Director). (1997). *Gattaca*. [VHS/DVD]. Los Angeles, CA: Columbia Pictures/Jersey Films.

Technology—Hardware

- Computer with Internet to access the *Showing Evidence Tool*
- Projection system to show students how to use the *Showing Evidence Tool*
- VCR or DVD player to play *Gattaca* and Humane Genome video

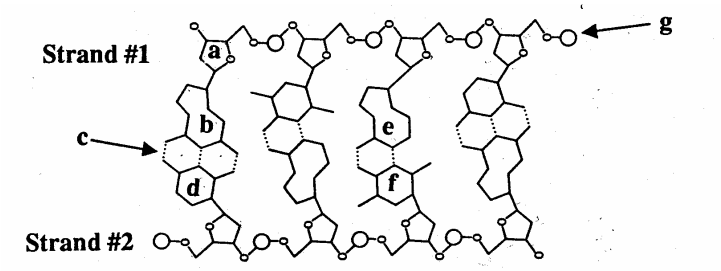
Technology—Software

- Word processing software to create biotechnology bills

Molecular Genetics Quiz

PLEASE DO NOT WRITE ON THIS COPY OF THE QUIZ. WRITE ALL ANSWERS ON THE ANSWER SHEET!

1. DNA stands for __(a)__ nucleic acid and RNA stands for _(b)_ nucleic acid.
2. The sugar of RNA is __(a)__ and the sugar of DNA is _(b)_ .
3. DNA is __(a)__ stranded and RNA is _(b)_ stranded,
4. RNA has __(a)__ as a nitrogen base instead of _(b)_ which is found in DNA.
5. DNA replication is considered to be a process _____.
6. Purines are ____ ringed nitrogen bases.
7. Pyrimidines are ____ ringed nitrogen bases.
8. Guanine and adenine are examples of _____.
9. Uracil, cytosine, and thymine are examples of _____.
10. Label the various parts of the DNA molecule below.



11. Strand #2 runs in what direction (3' → 5', 3' ← 5', 5' → 3', or 5' ← 3')?
11. Strand #1 runs in what direction (3' → 5', 3' ← 5', 5' → 3', or 5' ← 3')?
12. Strand #2 runs in what direction (3' → 5', 3' ← 5', 5' → 3', or 5' ← 3')?
13. The two strands of DNA are said to be _____ to each other.
14. List the full names of the three types of RNA (don't use abbreviations like rRNA).
15. What is the relationship between DNA and chromosomes?
16. Complete the mRNA strand, tRNA strand, and the code.
17. Which type of RNA copies DNA?
18. Which type of RNA has an amino acid attached to it?
19. Which type of RNA assembles ribosomes?
20. The first amino acid of every protein is _____.
21. The first major step of protein synthesis is __(a)__ and the second step is called _(b)_ .
22. The steps to translation in order are __(a)__ , _(b)_ , and _(c)_ .
23. The first codon of every protein is __(a)__ and it found on a _(b)_ RNA.
24. The first anti-codon of every protein is __(a)__ and it found on a _(b)_ RNA.
25. The structure of a DNA molecule can be described as a _____ _____.

Name:

Grade: ____/80

Period:

Review: Yes / No (20 pts)

Date:

Molecular Genetics Quiz

Answer Sheet

1.(a) _____

(b) _____

2.(a) _____

(b) _____

3.(a) _____

(b) _____

4.(a) _____

(b) _____

5. _____

6. _____

7. _____

8. _____

9. _____

10.(a) _____

(b) _____

(c) _____

(d) _____

(e) _____

(f) _____

(g) _____

11. _____

12. _____

13. _____

14.(a) _____

(b) _____

(c) _____

15. _____

16. **DNA: TAC/TGG/AAC/GTT/CAG/ACT**

mRNA: / / / / /

tRNA: / / / / /

a.a. seq: / / / / /

17. _____

18. _____

19. _____

20. _____

21.(a) _____

(b) _____

22.(a) _____

(b) _____

(c) _____

23.(a) _____

(b) _____

24.(a) _____

(b) _____

25. _____

2nd base in codon

1st base in codon	U	C	A	G	3rd base in codon
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	STOP	STOP	A
	Leu	Ser	STOP	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

Gattaca Essay Instructions

Take notes on symbolism (For example, the letters of the title are the nitrogen bases) and ways biotechnology (For example, pricking of the finger for a drop of blood to identify you) is being used within the movie.

Essay:

- Paragraph #1: Introduction
- Paragraph #2: Description of symbolism
- Paragraph #3: Biotechnology applications
- Paragraph #4: Could the biotechnology used in the movie be used today? If so, should it? Why or Why not?
- Paragraph #5: Conclusion

Your essay needs to be typed or in black or navy blue ink. No essays in pencil will be accepted.

Essay Rubric

CATEGORY	4	3	2	1
Introduction	Introduction has an inviting hook, clearly states the thesis and provides important background or setup for the essay.	Introduction clearly states the main topic and provides some good background, but is not particularly inviting to the reader.	Introduction states the thesis, but may be somewhat disorganized, unclear, or not fully developed.	There is no clear introduction of the main topic and/or the structure is very disorganized or lacking.
Content	There is a clear, well-focused topic. Main ideas stand out and are supported by strong, detailed information.	Main ideas are clear, but supporting information at times is too general or lacking additional development.	Main ideas are somewhat clear, and there is a need for more detailed supporting information.	The main ideas are not clear. There is unorganized or under-developed content and information.
Conclusion	Conclusion is strong and leaves readers with a feeling that they understand what the writer means.	Conclusion is recognizable and ties up almost all the loose ends.	Conclusion is recognizable, but does not fully tie up all the loose ends.	There is no clear conclusion; the paper just ends.
Grammar & Spelling	Writer makes almost no errors in grammar, punctuation, or spelling that would distract the reader from the content.	Writer makes a couple errors in grammar, punctuation, or spelling that distracts the reader from the content.	Writer makes several serious errors in grammar, punctuation, or spelling that distract the reader from the content.	Writer makes so many errors in grammar, punctuation, or spelling that it seriously distracts the reader from the content.

Argumentation Rubric

	4	3	2	1
Evidence	Presents a clear and accurate handling of all available evidence that addresses the central point of the claim. All evidence is properly documented and evaluated.	Presents all relevant evidence needed to support the claim with no major errors. Most evidence is properly documented and all is properly evaluated.	Provides evidence for the claim, but may not address all necessary aspects. Most evidence is properly documented and evaluated.	Fails to provide convincing evidence for the claim. Student shows lack of understanding of proper documentation and evaluation.
Claim	Claim is clearly stated, focused on topic, and explained. Rating of claim reflects realistic understanding of process.	Claim is clearly stated, focused on topic, and explained. Rating of claim may not reflect realistic understanding of process.	Claim is stated, focused on topic, and explained. Explanation might not show full understanding of topic/claim complexity, and claim rating might not indicate realistic understanding of process.	Claim is not clearly stated or is unfocused on topic. Explanation might be missing or lacking understanding of topic. Claim rating may be incomplete or unrealistic.
Relational Evidence	Student shows a clear and deep understanding of evidence in relation to the claim.	Student shows a clear understanding of evidence in relation to the claim. Rationale of support (non-support) may not reflect depth of understanding.	Student shows a basic understanding of evidence in relation to the claim. Rationale of support (non-support) may not reflect depth of understanding.	Student's understanding of evidence/claim relationship is weak or inconsistent. Rationale does not support rating.
Conclusion	Conclusion reflects understanding of depth and/or complexity of topic based upon evidence gathered. Includes concise explanation and refutation of alternative perspectives. Conclusion is clearly related to claim.	Conclusion reflects understanding of topic based upon evidence gathered. Includes good explanation and response to key alternative arguments. Conclusion is clearly related to claim.	Conclusion reflects understanding of topic based upon evidence gathered. Little attention is paid to alternative perspectives. Conclusion is not clearly related to claim.	Conclusion is not related to claim and/or does not show relationship between claim, evidence, and conclusion. Alternative perspectives are not addressed.

Bill Rubric

	4	3	2	1
Purpose	The purpose of our bill is clear and comprehensive and we demonstrate extensive background knowledge of the issue.	The purpose of our bill is clear and we demonstrate background knowledge of the issue.	The purpose of our bill is fairly clear and we demonstrate basic background knowledge of the issue.	The purpose of our bill is unclear and we demonstrate minimal background knowledge of the issue.
Format	Our bill contains all required elements, including position, purpose, actions, definitions, and funding. All elements are in order.	Our bill contains most elements, although some may be missing, incomplete, or incorrectly ordered.	Our bill contains only a few of the required elements, or elements are largely incomplete.	Our bill contains none of the required elements and is incomplete.
Recommendations	Our bill demonstrates thoughtful analysis of the issue and recommends effective and affordable solutions based upon the evidence gathered.	Our bill demonstrates an analysis of the issue and recommends solutions that may be cost-prohibitive. Uses the evidence gathered adequately.	Our bill demonstrates a moderate level of analysis of the issue. It recommends solutions that may be ineffective and/or cost-prohibitive. or are not based on the evidence gathered.	Our bill demonstrates a superficial analysis of the issue. It recommends solutions that are ineffective, unrealistic or are not based on the evidence gathered.
Presentation	We respond thoughtfully to all questions and cite research from a variety of reliable sources.	We respond to nearly all questions in a thorough manner and cite research sources that are reliable.	We are not able to respond to many questions, and our research sources are limited and not identified.	We are unable to answer questions and have no research sources identified.

High School Evaluation Checklist

Use this checklist to observe and assess the evaluative thinking of students.

Determining the Credibility of Sources

- ☐ Infers assumptions supporting information when determining the credibility of a source
- ☐ Detects bias
- ☐ Determines expertise of author
- ☐ Determines credibility of qualitative and quantitative evidence

Responding to Persuasive Arguments

- ☐ Looks for sound reasoning in persuasive arguments
- ☐ Detects false dilemmas in arguments-- reducing complex issues with multiple options to either-or issues
- ☐ Detects begging the question in arguments—using a claim itself as evidence for the validity of the claim
- ☐ Detects poisoning the well in arguments—discounting any evidence that conflicts with their views
- ☐ Detects evading the issue in arguments—changing the subject to one that is less difficult to deal with
- ☐ Detects appeals to authority in arguments—claiming validity by referring to an authority's position
- ☐ Detects arguing from ignorance in arguments—arguing that since a claim cannot be proven to be false, it must be true
- ☐ Detects straw man in arguments—portraying an opposing point of view inaccurately

Forming Opinions

- ☐ Uses thorough and sophisticated analysis of different kinds of information from wide variety of sources to form opinions

Communicating Opinions

- ☐ Explains opinion with sincere belief and commitment
- ☐ Presents various conflicting viewpoints explaining their benefits and drawbacks
- ☐ Conveys the complexity of issue by describing interaction of variety of factors

Protein-Phrase Synthesis

2nd Anticodon

1st Anticodon	A	G	U	C	3rd Anticodon
A	I	L	I	M	**A**
	N	O	M	O	**G**
	I	J	I	K	**U**
	N	O	M	O	**C**
G	S	T	P	T	**A**
	S	S	P	T	**G**
	R	R	P	R	**U**
	S	U	Q	U	**C**
U	E	E	A	E	**A**
	F	F	A	G	**G**
	B	B	A	D	**U**
	START	G	A	H	**C**
C	Q	Z	W	I	**A**
	C	A	X	T	**G**
	STOP	Y	V	T	**U**
	STOP	E	Y	U	**C**

Instructions: **On a separate piece of paper aligned lengthwise, label and copy a DNA code. Create a complementary mRNA strand below the DNA strand (Transcription). Create a complementarty tRNA strand below the mRNA strand. Use the chart to the left to to decode the message. Using the tRNA anticodons, determine the corresponsing letters of the phrase and write the decoded phrase below the tRNA strand (Translation).**

How to use the Decoding Chart: Find the first base of the anticodon on the far left-hand column of the chart. This will determine the rows that the letter will lie within. Then locate the second base on the top. This determines the column that the letter will lie within. Finally, find the third base on the far right-hand column. Follow the row left from that base and it will narrow your selection to the cell that the letter (analygous to an amino acid) is in. Now you should have the decoded phrase.

DNA STRAND # 1

TAC	AGT	GCC	GAG	GGA	TCT	AGG	ATT	GGA	CAT

DNA STRAND # 2

TAC	TCG	ACG	CTA	AAA	AGA	TCT	CAG	TTG	GGA	GAC	CAT

DNA STRAND # 3

TAC	CTA	TCC	TTT	CCG	GAC	CCC	GTA	TCT	AGG	CAG	CAC

DNA STRAND # 4

TAC	ATA	AGA	AGG	CTT	TGA	TAT	AAA	ACG	AGA	ACC	TCG	CGT	CAT

DNA STRAND # 5

TAC	CTC	AGG	TAT	TTT	TAT	CTC	CGT	AGG	TAT	TTG	TAT	CTC	CGT	ACG	CAT

DNA STRAND # 6

TAC	TAT	TAA	TTT	ATG	ATG	TAA	GGC	GTT	GAA	CAG	AGG	GGA	GGA	CTC	CAC

DNA STRAND # 7

TAC	CCG	TCC	ATA	GGG	AAA	GAA	AAG	GCA	GAG	ACG	TCC	CGG	GGT	TCT	CAC

DNA STRAND # 8

TAC	CGT	ACG	GCC	GGT	TAA	GCC	AAG	TAT	TGA	AGA	AAA	TAA	CTT	CGG	TAT	AGA	TAA	CAT

Protein-Phrase Synthesis

2nd Anticodon

1st Anticodon	A	G	U	C	3rd Anticodon
A	I	L	I	M	**A**
	N	O	M	O	**G**
	I	J	I	K	**U**
	N	O	M	O	**C**
G	S	T	P	T	**A**
	S	S	P	T	**G**
	R	R	P	R	**U**
	S	U	Q	U	**C**
U	E	E	A	E	**A**
	F	F	A	G	**G**
	B	B	A	D	**U**
	START	G	A	H	**C**
C	Q	Z	W	I	**A**
	C	A	X	T	**G**
	STOP	Y	V	T	**U**
	STOP	E	Y	U	**C**

<u>Instructions:</u> **On a separate piece of paper aligned lengthwise, label and copy a DNA code. Create a complementary mRNA strand below the DNA strand (Transcription). Create a complementarty tRNA strand below the mRNA strand. Use the chart to the left to to decode the message. Using the tRNA anticodons, determine the corresponsing letters of the phrase and write the decoded phrase below the tRNA strand (Translation).**

<u>How to use the Decoding Chart</u>: Find the first base of the anticodon on the far left-hand column of the chart. This will determine the rows that the letter will lie within. Then locate the second base on the top. This determines the column that the letter will lie within. Finally, find the third base on the far right-hand column. Follow the row left from that base and it will narrow your selection to the cell that the letter (analygous to an amino acid) is in. Now you should have the decoded phrase.

DNA STRAND # 9

TAC	ACA	ACG	CCC	AAG	CCG	TTG	AAT	AAC	CTT	AAA	TCA	CTA	GAT	CCC	AGA	TAA	GAG	CAC

DNA STRAND # 10

TAC	GAT	TTT	AAG	TCT	AGG	ACA	TTA	CAG	GGA	GAA	AGC	TAG	ACT	ATT	AAG	TCT	AAG	TGA	GAA	GAA	CAC

Protein-Phrase Synthesis

2nd Anticodon

1st Anticodon	A	G	U	C	3rd Anticodon
A	I	L	I	M	**A**
	N	O	M	O	**G**
	I	J	I	K	**U**
	N	O	M	O	**C**
G	S	T	P	T	**A**
	S	S	P	T	**G**
	R	R	P	R	**U**
	S	U	Q	U	**C**
U	E	E	A	E	**A**
	F	F	A	G	**G**
	B	B	A	D	**U**
	START	G	A	H	**C**
C	Q	Z	W	I	**A**
	C	A	X	T	**G**
	STOP	Y	V	T	**U**
	STOP	E	Y	U	**C**

<u>Instructions:</u> **On a separate piece of paper aligned lengthwise, label and copy a DNA code. Create a complementary mRNA strand below the DNA strand (Transcription). Create a complementarty tRNA strand below the mRNA strand. Use the chart to the left to to decode the message. Using the tRNA anticodons, determine the corresponsing letters of the phrase and write the decoded phrase below the tRNA strand (Translation).**

<u>How to use the Decoding Chart</u>: Find the first base of the anticodon on the far left-hand column of the chart. This will determine the rows that the letter will lie within. Then locate the second base on the top. This determines the column that the letter will lie within. Finally, find the third base on the far right-hand column. Follow the row left from that base and it will narrow your selection to the cell that the letter (analygous to an amino acid) is in. Now you should have the decoded phrase.

DNA STRAND # 11

TAC	TCC	TGA	CTC	TCT	CCC	TCT	CGC	CAT

DNA STRAND # 12

TAC	AAT	GGG	AAC	CCG	GCA	TCC	AAT	GAA	TGG	CCC	AAG	CAC

DNA STRAND # 13

TAC	TCG	AGG	AGG	TCT	AGT	AGC	TAT	ACT	AAT	TCT	TCT	ACG	CAT

DNA STRAND # 14

TAC	GGA	TCC	TTA	GGA	GAA	TTT	AGA	AGA	TAG	AGG	AGA	ACT	GAA	CAT

DNA STRAND # 15

TAC	TCC	TTG	CTT	TCA	TTA	TCG	GAT	TAA	TTG	GCA	TCT	TTT	CTC	CAC

DNA STRAND # 16

TAC	CGT	CGC	TTC	TCC	ATG	GAA	CAG	AGG	GCA	TGA	CAC

DNA STRAND # 17

TAC	CTA	TCC	TAA	GAT	TAA	GGG	GGA	TCC	TAA	TAT	TAA	TCA	TAG	CAC

DNA STRAND # 18

Protein-Phrase Synthesis

2nd Anticodon

1st Anticodon	A	G	U	C	3rd Anticodon
A	I	L	I	M	**A**
	N	O	M	O	**G**
	I	J	I	K	**U**
	N	O	M	O	**C**
G	S	T	P	T	**A**
	S	S	P	T	**G**
	R	R	P	R	**U**
	S	U	Q	U	**C**
U	E	E	A	E	**A**
	F	F	A	G	**G**
	B	B	A	D	**U**
	START	G	A	H	**C**
C	Q	Z	W	I	**A**
	C	A	X	T	**G**
	STOP	Y	V	T	**U**
	STOP	E	Y	U	**C**

Instructions: **On a separate piece of paper aligned lengthwise, label and copy a DNA code. Create a complementary mRNA strand below the DNA strand (Transcription). Create a complementarty tRNA strand below the mRNA strand. Use the chart to the left to to decode the message. Using the tRNA anticodons, determine the corresponsing letters of the phrase and write the decoded phrase below the tRNA strand (Translation).**

How to use the Decoding Chart: Find the first base of the anticodon on the far left-hand column of the chart. This will determine the rows that the letter will lie within. Then locate the second base on the top. This determines the column that the letter will lie within. Finally, find the third base on the far right-hand column. Follow the row left from that base and it will narrow your selection to the cell that the letter (analygous to an amino acid) is in. Now you should have the decoded phrase.

TAC	CTA	ACG	GAT	TCT	GGA	AGC	CTC	AGG	CCC	GAT	ACA	AGG	GGA	TCC	TAA	GGT	CAT

DNA STRAND # 19

TAC	GAC	GGC	CAG	CAG	TAA	GGG	GAC	AAT	GAG	TTT	AGT	AGC	GGC	GGT	AAC	TCA	CTC	CAT

DNA STRAND # 20

TAC	TTT	GGA	GGA	AAA	CCG	CCC	TCT	TAA	AAA	GAC	TAA	CTT	CGC	GAT	CTC	CCG	TCC	AAT	AAC	TGC	CAT

Protein-Phrase Synthesis

2nd Anticodon

1st Anticodon	A	G	U	C	3rd Anticodon
A	I	L	I	M	**A**
	N	O	M	O	**G**
	I	J	I	K	**U**
	N	O	M	O	**C**
G	S	T	P	T	**A**
	S	S	P	T	**G**
	R	R	P	R	**U**
	S	U	Q	U	**C**
U	E	E	A	E	**A**
	F	F	A	G	**G**
	B	B	A	D	**U**
	START	G	A	H	**C**
C	Q	Z	W	I	**A**
	C	A	X	T	**G**
	STOP	Y	V	T	**U**
	STOP	E	Y	U	**C**

Instructions: **On a separate piece of paper aligned lengthwise, label and copy a DNA code. Create a complementary mRNA strand below the DNA strand (Transcription). Create a complementarty tRNA strand below the mRNA strand. Use the chart to the left to decode the message. Using the tRNA anticodons, determine the corresponsing letters of the phrase and write the decoded phrase below the tRNA strand (Translation).**

How to use the Decoding Chart: Find the first base of the anticodon on the far left-hand column of the chart. This will determine the rows that the letter will lie within. Then locate the second base on the top; this determines the column that the letter will lie within. Finally, find the third base on the far right-hand column. Follow the row left from that base and it will narrow your selection to the cell that the letter (analygous to an amino acid) is in. Now you should have the decoded phrase.

DNA STRAND # 1

TAC	AGT	GCC	GAG	GGA	TCT	AGG	ATT	GGA	CAT
start	j	u	s	t	d	o	i	t	stop

DNA STRAND # 2

TAC	TCG	ACG	CTA	AAA	AGA	TCT	CAG	TTG	GGA	GAC	CAT
start	g	o	w	i	l	d	c	a	t	s	stop

DNA STRAND # 3

TAC	CTA	TCC	TTT	CCG	GAC	CCC	GTA	TCT	AGG	CAG	CAC

start w h a t s u p d o c stop

DNA STRAND # 4

TAC	ATA	AGA	AGG	CTT	TGA	TAT	AAA	ACG	AGA	ACC	TCG	CGT	CAT
start	i	l	o	v	e	b	i	o	l	o	g	y	stop

DNA STRAND # 5

TAC	CTC	AGG	TAT	TTT	TAT	CTC	CGT	AGG	TAT	TTG	TAT	CTC	CGT	ACG	CAT
start	y	o	b	a	b	y	y	o	b	a	b	y	y	o	stop

DNA STRAND # 6

TAC	TAT	TAA	TTT	ATG	ATG	TAA	GGC	GTT	GAA	CAG	AGG	GGA	GGA	CTC	CAC
start	b	e	a	m	m	e	u	p	s	c	o	t	t	y	stop

DNA STRAND # 7

TAC	CCG	TCC	ATA	GGG	AAA	GAA	AAG	GCA	GAG	ACG	TCC	CGG	GGT	TCT	CAC
start	t	h	i	s	i	s	n	t	s	o	h	a	r	d	stop

DNA STRAND # 8

TAC	CGT	ACG	GCC	GGT	TAA	GCC	AAG	TAT	TGA	AGA	AAA	TAA	CTT	CGG	TAT	AGA	TAA	CAT
start	y	o	u	r	e	u	n	b	e	l	i	e	v	a	b	l	e	stop

DNA STRAND # 9

TAC	ACA	ACG	CCC	AAG	CCG	TTG	AAT	AAC	CTT	AAA	TCA	CTA	GAT	CCC	AGA	TAA	GAG	CAC
start	m	o	u	n	t	a	i	n	v	i	e	w	r	u	l	e	s	stop

DNA STRAND # 10

TAC	GAT	TTT	AAG	TCT	AGG	ACA	TTA	CAG	GGA	GAA	AGC	TAG	ACT	ATT	AAG	TCT	AAG	TGA	GAA	GAA	CAC
start	r	a	n	d	o	m	a	c	t	s	o	f	k	i	n	d	n	e	s	s	stop

DNA STRAND # 11

TAC	TCC	TGA	CTC	TCT	CCC	TCT	CGC	CAT
start	h	e	y	d	u	d	e	stop

DNA STRAND # 12

TAC	AAT	GGG	AAC	CCG	GCA	TCC	AAT	GAA	TGG	CCC	AAG	CAC
start	i	s	n	t	t	h	i	s	f	u	n	stop

DNA STRAND # 13

TAC	TCG	AGG	AGG	TCT	AGT	AGC	TAT	ACT	AAT	TCT	TCT	ACG	CAT
start	g	o	o	d	j	o	b	k	i	d	d	o	stop

DNA STRAND # 14

TAC	GGA	TCC	TTA	GGA	GAA	TTT	AGA	AGA	TAG	AGG	AGA	ACT	GAA	CAT
start	t	h	a	t	s	a	l	l	f	o	l	k	s	stop

DNA STRAND # 15

TAC	TCC	TTG	CTT	TCA	TTA	TCG	GAT	TAA	TTG	GCA	TCT	TTT	CTC	CAC
start	h	a	v	e	a	g	r	e	a	t	d	a	y	stop

DNA STRAND # 16

TAC	CGT	CGC	TTC	TCC	ATG	GAA	CAG	AGG	GCA	TGA	CAC
start	y	e	a	h	m	s	c	o	t	e	stop

DNA STRAND # 17

TAC	CTA	TCC	TAA	GAT	TAA	GGG	GGA	TCC	TAA	TAT	TAA	TCA	TAG	CAC
start	w	h	e	r	e	s	t	h	e	b	e	e	f	stop

DNA STRAND # 18

TAC	CTA	ACG	GAT	TCT	GGA	AGC	CTC	AGG	CCC	GAT	ACA	AGG	GGA	TCC	TAA	GGT	CAT
start	w	o	r	d	t	o	y	o	u	r	m	o	t	h	e	r	stop

DNA STRAND # 19

TAC	GAC	GGC	CAG	CAG	TAA	GGG	GAC	AAT	GAG	TTT	AGT	AGC	GGC	GGT	AAC	TCA	CTC	CAT
start	s	u	c	c	e	s	s	i	s	a	j	o	u	r	n	e	y	stop

DNA STRAND # 20

TAC	TTT	GGA	GGA	AAA	CCG	CCC	TCT	TAA	AAA	GAC	TAA	CTT	CGC	GAT	CTC	CCG	TCC	AAT	AAC	TGC	CAT
start	a	t	t	i	t	u	d	e	i	s	e	v	e	r	y	t	h	i	n	g	stop

Reproductive Technology

Cloning

Privacy and confidentiality

Patenting Genes

Genetically Engineered (Transgenic) Plants & Animals

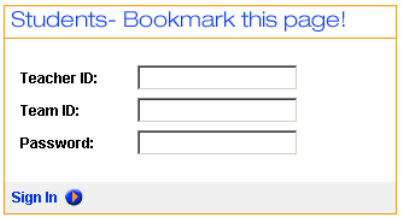
DNA Forensics

Gene Therapy

Genetic Testing for Inherited Diseases (Gene Testing)

Tool Guidelines

1. **Log in to project.**



Teacher ID:

Team ID:

Password:

2. **Click the project name to enter the case.**

3. **Working with your partner, determine which of your team's pieces of evidence are the most credible.**

4. **Input your team's 10 most credible pieces of evidence.**

   Complete the following for each of the chosen pieces of evidence:
   a. **Input the summarizing sentence in the Summary section.**
   b. **Input the quote in the Explanation section.**
   c. **Input the URL address in the Source section.**
   d. **Rate it.**

Rating	✓	✓✓	✓✓✓	✓✓✓✓	✓✓✓✓✓
Author	Individual	Individual or Expert	Creditable Author	Expert in the field	Expert in the field
Sponsoring Organization	None	Biased Organization	Unbiased Organization	Credible Organization	Credible Organization
How strong is the quote?	Based on opinion	Opinion based slant	Gives both pros and cons of the usage	Factually based	Facts that are statistically supported

5. **Discuss with your partner and create a claim that is supported by your evidence not your opinion.**

   Choose one of the following statements for your claim and insert your issue in the blank:
   _____ ***should be freely used without limitations.***
   _____ ***should be used with the following limitations …***
   _____ ***should be banned from use.***

6. **Drag each piece of evidence one at a time over to the area supporting (green) or not supporting (red) the claim.**
   a. **Discuss with your partner how well the piece of evidence supports or doesn't support the claim.**
   b. **Rate it.**

Rating					
What was	1-2	1-2	3	4	5

the evidence rated					
How does it support or not support the claim?	**Weakly**	**Fairly**	**Strongly**	**Strongly**	**Strongly**

c. **Write a through explanation based on your discussion.**

7. **Continue inputting the remaining nine pieces of evidence as you did in Step 6.**

8. **Write a through explanation for why you chose your claim.**

9. **Finish by ranking how strongly your claim is supported.**

Ranking					
Number of pieces supporting evidence	**0-1**	**2-3**	**4-5**	**6-7**	**8-10**
Number of pieces not supporting evidence	**8-10**	**6-7**	**4-5**	**2-3**	**0-1**
How strong is the quality of supporting evidence	**The supporting evidence has a quality rating of 3 or less.**	**The supporting evidences have a quality rating of 3 or less.**	**Three or more pieces of supporting evidences have a quality rating of 4 or higher.**	**Four or more pieces of supporting evidences have a quality rating of 4 or higher.**	**Six or more pieces of supporting evidences have a quality rating of 4 or higher.**

IN THE HOUSE OF REPRESENTATIVES

REPRESENTATIVE(S)

INTRODUCED THE FOLLOWING BILL:

A BILL

TO ESTABLISH:

1. BE IT ENACTED BY THE HOUSE OF REPRESENTATIVES AND THE UNITED STATES SENATE
2. IN CONGRESS ASSEMBLED, THAT
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
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14.
15.
16.
17.
18.
19.
20.

PRESIDENTIAL ACTION OF LEGISLATION

SIGN _____

PASS WITHOUT SIGNATURE _____

VETO _____

IN THE HOUSE OF REPRESENTATIVES

REPRESENTATIVE(S) ALI, CHENTEL, AMBER, HEATHER

INTRODUCED THE FOLLOWING BILL:

A BILL

TO ESTABLISH THE MOVEMENT FOR ANTI-GENE PATENTING

1. BE IT ENACTED BY THE HOUSE OF REPRESENTATIVES AND THE UNITED STATES SENATE
2. IN CONGRESS ASSEMBLED, THAT
3. PATENTING PIECES OF DNA IS UNLAWFUL AND INFRINGES ON THE RIGHTS OF FREE USE
4. OF KNOWLEDGE. DNA IS NOT A MAN-MADE ITEM AND PATENTING SOMETHING MADE
5. BY NATURE IS IN VIOLATION OF THE U.S. TERMS OF ISSUING A PATENT. THE MEANS BY
6. WHICH AN INVENTOR FINDS AND CREATES THE PRODUCT WITH THE USE OF DNA IS BY
7. ALL MEANS PATENTABLE. THE FREE USE OF DNA DOES NOT INFRINGE UPON THE RIGHTS
8. OF SCIENTISTS WHO DISCOVER PERVIOUSLY UNKNOWN PIECES OF DNA AND/OR
9. ENZYMES. ALL BUT THE NATURALLY OCCURING SUBSTANCES ARE PATENTABLE, THUS
10. THE INDIVIDUAL'S DISCOVERIES ARE STILL FOUND NOVEL AND PROTECT BY USE OF A
11. U.S. PATENT. THE OPEN USE OF DNA IS OVER ALL MORE PRODUCTIVE FOR THE BENEFIT
12. OF RESEARCH AND FINDING CURES/MEDICINES TO BE PUT IN TO USE IN HUMANS. OVER
13. ALL THIS BILL WILL PROTECT THE FREE EXCHANGE OF KNOWLEDGE WHILE
14. PROTECTING THE DISCOVERIES OF INDEPENDENT RESEARCH GROUPS AND SCIENTISTS.
15. THE U.S. DEFINITION OF "NOVEL" WILL BE PROTECTED BY THE INSTATMENT OF THIS
16. BILL. THE INFORMATION HERE INSTATED CAN BE USED AS A PRECURSER TO PROMPT
17. THE INTERNATIONAL BAN OF PATENTING GENES AND OTHER GENETIC INFORMATION
18. CREATED BY NATURE, NOT HUMAN BEINGS. OVER ALL THE ENTIRE POPULATION WILL
19. BENEFIT FROM THE OPEN EXCHANGE OF INFORMATION. CURES TO DISEASES WILL
20. MORE EASILY BE DISCOVERED AND THE HUMAN GENOME WILL BE WORKED ON AND
21. DECODED MORE QUICKLY. THIS BILL WILL OVER ALL ENHANCE THE QUALITY OF LIFE
22. FOR MILLIONS, WHILE STILL PROTECTING THE CREATIVE RIGHTS OF SCIENTISTS.

PRESIDENTIAL ACTION OF LEGISLATION

SIGN _____

PASS WITHOUT SIGNATURE _____

VETO _____