

# Performance Task

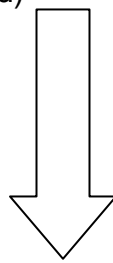
## Genetic Engineering: Bioethics of the Hunger Games



Male Jabberjay (Genetically Engineered)



Female Mockingbird (Wild Type)



Mockingjay (Hybrid)

Modeled after Smarter Balanced ELA Performance Tasks



## Genetic Engineering: Bioethics of the Hunger Games

### Introductory Classroom Activity (25 minutes)

- Present on a projector (or distribute a handout) of images of organisms that have been genetically engineered (see attached). After giving students a moment to look at the images, ask, “Have you heard in the news about specific examples of bioengineered organisms (plants, animals and bacteria)?” “What are some examples of genetically engineered organisms that you are aware of?”
- Let students know that they are going to watch two short video clips that address the issues of genetic engineering. The first video gives an overall explanation of how genetic engineering allows us to isolate and copy genes via the use of plasmids and bacteria. The second video discusses genetic engineering for both animal and human cloning, and then turns to the question of possible future human enhancement via genetic engineering.
- Present on a projector the two video clips:

<http://www.youtube.com/watch?v=nfC689EIUVk>

<http://www.youtube.com/watch?v=mXfYshYnblA>

- Following the two videos, engage students in a brief classroom discussion using some of the following as discussion questions:
  - What information was provided about what genetic engineering consists of?
  - How can bacteria such as E. coli be used in order replicate a particular gene or DNA sequence?
  - How can genetically engineered organisms benefit society?
  - How can genetically engineered organisms harm society?
  - Do you feel that regulation should be required in order to allow or prevent human cloning from occurring in the United States?
- Say to the students, “In the performance task that you are going to participate in this week, you will learn more genetically engineered organisms. You will also learn more about the debate over the pros and cons of genetically engineered organisms. Eventually, you will need to take a position on whether we should encourage or discourage the use of genetically engineered organisms here in the United States. It is important to know that, as some of the resources you will be using point out, that some people support genetic engineering while others are adamantly opposed to it.”

## Student Directions

### Genetic Engineering: Bioethics of the Hunger Games

#### Task:

In your science class, you have been learning about biotechnology and the potential risks and benefits of allowing genetic engineering of organisms (including humans). You have learned about the overall process of how a gene or part of a DNA sequence can be replicated via the use of bioengineering. Bioengineering is a very controversial topic in which there has been some resistance to its use with plants, animals and even humans. As part of your research on this issue, you have found four sources giving additional information about genetic engineering and its role in medicine, scientific research and even in the popular book, *The Hunger Games*.

After you have reviewed these sources, you will answer some questions about them. Briefly review these resources and the three questions that follow. Then, go back and read the sources carefully so you will have the information you need to answer the questions and complete your research. You may take notes in the margin as you find information in the sources to capture your thoughts, reactions and any questions you might have, as you read.

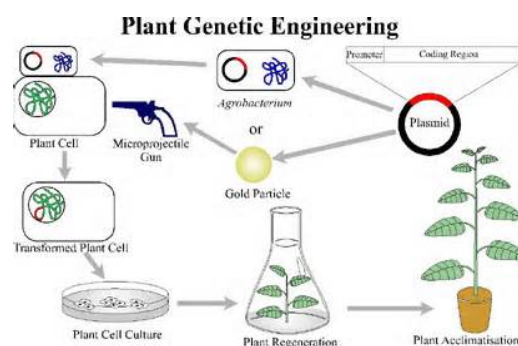
In Part 2, you will write an argumentative essay on a topic related to the sources.

#### Directions for Beginning:

You will now examine several sources. You can re-examine the sources as often as you like.

#### Initial Questions:

After examining the research sources, use the rest of the time in Part 1 to answer the three questions about them. Your answers to these questions will be part of your score for the reading portion of the assessment. Also, your answers will help you think about the information you have read and viewed, which should help you write your argumentative essay. Both your margin notes and your answers to the questions will be available to you as you work on your essay.



### **Source #1: D.I.Y Biology, on the Wings of the Mockingjay**

*This article, from the May 14, 2012 issue of the **The New York Times**, gives a synopsis of the use of genetic engineering in the popular science fiction novel, *The Hunger Games*. This article also discusses the newly developed concept of Do-It-Yourself Biology and how accessible it is to the general public.*

Genetically modified organisms are not wildly popular these days, except one: a fictional bird that is central to the hugely popular movie and book trilogy “The Hunger Games.” That’s the mockingjay, a cross between a mockingbird and a genetically engineered spy bird called a jabberjay.

The action in “The Hunger Games” takes place in a fictional future in which teenagers are forced to hunt and kill one another in annual competitions designed to entertain and suppress a highly controlled population. The mockingjay first appears as a symbol, when Katniss Everdeen, the heroine, is given a pin that depicts the bird. Mockingjay pins, although not the birds, have spread to the real world.

“They’re funny birds and something of a slap in the face to the Capitol,” Katniss explains in the first book. And the nature of that slap in face is a new twist on the great fear about genetic engineering, that modified organisms or their genes will escape into the wild and wreak havoc. The mockingjay is just such an unintended consequence, resulting from a failed creation of the government, what Katniss means when she refers to “the Capitol.” But rather than being a disaster, the bird is a much-loved reminder of the limits of totalitarian control.

The origin of the bird, Katniss explains, is that the rulers modified an unspecified species of jay to make a new creature, an animal of the state called a jabberjay. Jabberjays were intended to function as biological recording machines that no one would suspect. They would listen to conversations and then return to their masters to replay them.

The jabberjays, all male, were left to die out when the public realized what they were doing. Like genetically modified organisms today, the jabberjays were not expected to survive in the wild, but they bred with mockingbirds and produced a thriving hybrid that could mimic human sounds and songs, and lived on, to the irritation of the government and the delight of the people.

Setting aside whether jays could actually breed with mockingbirds — this is a kind of fairy tale, after all — the choice of species rings true. Jays, along with crows and

ravens, belong to a highly intelligent group of birds called the corvids. And jays are naturally thieves and spies, keeping track of where other jays hide food, for example, to raid it later. Mockingbirds, of course, have a fantastic ability to mimic other birds' songs. Coincidentally, or perhaps not, Thomas Jefferson, a lover of both birds and liberty, kept a pet mockingbird in the White House.

I asked Joan Slonczewski, a microbiologist and science fiction writer at Kenyon College in Ohio, about her take on the mockingjay. Dr. Slonczewski, whose recent books include a text and a novel, "The Highest Frontier," teaches a course called "Biology in Science Fiction." The tools needed to modify organisms are already widely dispersed in industry and beyond. "Now anybody can do a start-up," she said.

That's no exaggeration. Do-it-yourself biology is growing. The technology to copy pieces of DNA can be bought on eBay for a few hundred dollars, as Carl Zimmer reported in The New York Times in March. As to where D.I.Y. biology may lead, Freeman Dyson, a thinker at the Institute for Advanced Study known for his provocative ideas, presented one view in 2007 in The New York Review of Books. He envisioned the tools of biotechnology spreading to everyone, including pet breeders and children, and leading to "an explosion of diversity of new living creatures."

Eventually, he wrote, the mixing of genes by humans will initiate a new stage in evolution. Along the way, if he is right, the world may have more than its share of do-it-yourself mockingjays.



## Source #2: Controversial Deadly Bird Flu Research Finally Published

*This article from the May 2012 edition of **Nature** discusses about how easy the avian flu (H5N1) spread from birds to humans, based on the fact that only four mutations occurred in one single gene.*

A controversial report regarding avian flu research was finally published on May 3 in the journal *Nature*.

The research, which studies how the avian H5N1 influenza spreads among mammals, had been contested by government review panels who wanted to stop the report from being published.

According to *Med Page Today*, the study finds four key mutations in a gene of the H5N1 avian flu that helps it adjust to mammals. The debate about the publication of the paper was based on fears that terrorist groups or criminals could use the findings to harm others.

“This information could be used by an aggressor and shows one of the building blocks for the development of a potential BW (biowarfare) weapon,” highlighted the AFP on the report’s response to the danger of publicizing the information.

Flu and public health researchers argued that the study was important in informing the public to be prepared and aware of the virus.

“Our study shows that relatively few amino acid mutations are sufficient for a virus with an avian H5 hemagglutinin to acquire the ability to transmit in mammals,” remarked Yoshihiro Kawaoka, a University of Wisconsin-Madison flu researcher, in a prepared statement. “This study has significant public health benefits and contributes to our understanding of this important pathogen. By identifying mutations that facilitate transmission among mammals, those whose job it is to monitor viruses circulating in nature can look for these mutations so measures can be taken to effectively protect human health.”

The group of researchers had already identified a subset of viruses in some poultry in Egypt and parts of Southeast Asia. Kawaoka’s study on the H5N1 virus transmissibility found that there were unknown mutations that could pass. With these unknown mutations, he believes that it is important to continue the research to find out how mutations function. The findings also show that the viruses that currently circulate in nature only need four mutations to the hemagglutinin protein to become a bigger risk to human health. The team looked at a laboratory-modified bird flu/human flue hybrid virus that could affect humans with a few mutations. They learned that the virus could be controlled by medical countermeasures like an H15N vaccine or oseltamivir, an antiviral drug.

“H5N1 viruses remain a significant threat for humans as potential pandemic flu strain. We have found that relatively few mutations enable this virus to transmit in mammals. These same mutations have the potential to occur in nature,” commented Kawaoka in the statement.

The H5N1 virus, since 2003, has affected at least 600 humans and killed half of the people it's infected. The virus, found mostly in Asia, can be transmitted in close proximity of fowl but it doesn't easily transmit among humans. The flu depends on its ability to take control of host cells, make new virus particles that can then infect other cells, and transmit to other hosts. However, the flu virus must change its topography to adjust to new host species. As such, the protein hemagglutinin allows viruses to enter host cells and uses a “globular head” to bind to the host cell. The amino acids in the hemagglutinin can then unlock the host cell, allowing the virus to enter and spread the infection.

“The first clues about what properties of the HA protein, other than receptor specificity, might be important for mammalian airborne transmission,” described Vincent Racaniello, a virologist at Columbia University, in a Nature article. “It would have been a huge loss not to publish this.”

Overall, flu viruses are powerful in their ability to adapt to new animal hosts, exchange genetic information, and then mutate.

“It is hard to predict. The additional mutations may emerge as the virus continues to circulate.”

As such, the study identifies the tool that allows H5N1 to transmit and helps them better understand the basis of the how the influenza virus transmits.

“Should surveillance activities identify flu strains accumulating additional key mutations, these emerging viruses should then be priority candidates for vaccine development and antiviral evaluation,” mentioned Kawaoka in the statement.

Furthermore, it will help governments better develop their public health policies.

“That is an important public health message, we have to take H5N1 seriously. It doesn't mean it will become a pandemic, but it can,” noted Malik Peiris, a virology professor at the University of Hong Kong who wrote an accompanying commentary, in an interview with Reuters.





### **Source #3: Amateurs Are New Fear in Creating Mutant Virus**

*This article, from the March 5, 2012 issue of **The New York Times**, discusses how easy it might be to create deadly viruses using bioengineering. The article also discusses more about “Do-It-Yourself” movement and how terrorists could do genetic experiments of their own that could potentially harm society.*

Just how easy is it to make a deadly virus?

This disturbing question has been on the minds of many scientists recently, thanks to a pair of controversial experiments in which the H5N1 bird flu virus was transformed into mutant forms that spread among mammals.

After months of intense worldwide debate, a panel of scientists brought together by the World Health Organization recommended last week in favor of publishing the results. There is no word on exactly when those papers — withheld since last fall by the journals *Nature* and *Science* — will appear. But when they do, will it be possible for others to recreate the mutant virus? And if so, who might they be and how would they do it?

Scientists are sharply divided on those questions, as they are on the whole complex of issues surrounding the mutated virus known as muth5N1.

On the question of who, while terrorists and cults have long been a concern in biosecurity circles, some scientists also fear that publication may allow curious amateurs to recreate the mutated virus — raising the risk of an accidental release.

Over the past decade, more amateur biologists have started to do genetic experiments of their own. One hub of this so-called D.I.Y. biology movement, the Web site [DIYbio.org](http://DIYbio.org), now has more than 2,000 members.

“I worry about the garage scientist, about the do-your-own scientist, about the person who just wants to try and see if they can do it,” Michael T. Osterholm of the University of Minnesota said last week at a meeting of biosecurity experts in Washington.

Dr. Arturo Casadevall of the Albert Einstein College of Medicine in New York City, who along with Dr. Osterholm is a member of the scientific advisory board that initially recommended against publishing the papers, agreed. “Mike is right,” he said in a telephone interview. “Humans are very inventive.”

Advocates of D.I.Y. biology say such fears not only are wildly exaggerated, but could interfere with their efforts to educate the public.

“I am really sick and tired of folks waving this particular red flag,” said Ellen D. Jorgensen, a molecular biologist who is president of Genspace, a “community biotechnology lab” in Brooklyn.

There are many ways to make a virus. The simplest and oldest way is to get the viruses do all the work. In the 19th century, doctors produced smallpox vaccines by inoculating cows with cowpox viruses. The viruses replicated in the cows and produced scabs, which were then applied to patients, protecting them from the closely related smallpox virus.

By the turn of the century, scientists had discovered how to isolate a number of other viruses from animals and transfer them to new hosts. And by midcentury scientists were rearing viruses in colonies of cells, which made their study far easier. (Viruses have to infect host cells to reproduce; they cannot replicate on their own.)

More recently, scientists discovered how to make new viruses — or at least new variations on old ones. The biotechnology revolution of the 1970s enabled them to move genes from one virus to another.

Flu vaccines can be made this way. Scientists can move some genes from a dangerous flu strain to a harmless virus that grows quickly in chicken eggs. They inject the engineered viruses into the eggs to let them multiply, then kill the viruses to prepare injectable vaccines.

Scientists have also learned how to tweak individual virus genes. They remove a portion of the gene and then use enzymes to mutate specific sites. Using other enzymes, they paste the altered portion back into the virus's genes.

Another way to make altered viruses is to harness evolution. In a method called serial passage, scientists infect an animal with viruses. The descendants of those viruses mutate inside the animal, and some mutations allow certain viruses to multiply faster than others. The scientists then take a sample of the viruses and infect another animal.

Viruses can change in important ways during this process. If it is done in the presence of antiviral drugs, scientists can observe how viruses evolve resistance. And viruses can become weak, making them useful as vaccines.

At the biosecurity meeting in Washington last week, Ron Fouchier, who led the Dutch team that created one of the mutant H5N1 viruses, described part of the experiment.

The scientists used well-established methods: First they introduced a few mutations into the H5N1 flu genes that they thought might help the bird flu infect mammals. They administered the viruses to the throats of ferrets, waited for the animals to get sick and then transferred viruses to other ferrets. After several rounds, they ended up with a strain that could spread on its own from one ferret to another in the air.

If trained virologists could see the full details of the paper, there would be several ways they could make mutH5N1 for themselves. The most sophisticated way would be to make the viruses from scratch. They could take the publicly available genome sequence

of H5N1 and rewrite it to include the new mutations, then simply copy the new sequence into an e-mail.

“It’s outsourced to companies that do this for a living,” said Steffen Mueller, a virologist at Stony Brook University on Long Island, who regularly synthesizes flu viruses to design new vaccines.

A DNA-synthesis company would then send back harmless segments of the flu’s genes, pasted into the DNA of bacteria. The scientists could cut out the viral segments from the bacteria, paste them together and inject the reconstructed virus genes into cells. If everything went right, the cells would start making muth5N1 viruses.

The synthesis companies are on the lookout for matches between requested DNA and the genomes of dangerous pathogens. But some experts say such safeguards are hardly airtight. “You could imagine a determined actor could cleverly disguise orders,” Dr. Casadevall said. “I have a lot of respect for human ingenuity.”

Synthesizing viruses has a high-tech glamour about it, but trained virologists could use a simpler method. Knowing the mutations acquired by muth5N1, they could simply alter ordinary H5N1 viruses at the same sites in its genes to match it.

Virologists might even be able to figure out how to make muth5N1 from the few details that have already emerged. According to reports, there were only five mutations in the Dutch viruses, and these were most likely at key sites involved in getting viruses into host cells.

Matthew B. Frieman, a virologist at the University of Maryland School of Medicine, said that a review of the scientific literature could point to where the mutations were inserted. “It’s not like nuclear fission,” he said.

Some of the equipment that scientists use to work on viruses has grown so inexpensive that it is no longer limited to university labs. Devices for duplicating pieces of DNA sell for a few hundred dollars on eBay, for example.

Those falling costs have spurred the rise of the D.I.Y. biology movement; they have also generated concerns about what a do-it-yourselfer might be able to accomplish.

D.I.Y. biologists sometimes laugh at the sinister powers people think they have. “People overestimate our technological abilities and underestimate our ethics,” said Jason Bobe, a founder of DIYbio.org.

Todd Kuiken, a senior research associate at the Woodrow Wilson Center in Washington who specializes in the movement, points out that typical D.I.Y. projects are relatively simple, like inserting a gene into bacteria to make them glow. Producing viruses involves much more expensive equipment to do things like rearing host cells. “It’s not going to happen in someone’s basement,” he said.

Nor do these amateurs have the years of training it takes to grow viruses successfully. “It’s like I say, ‘I want to be a four-star chef,’ ” said Dr. Jorgensen, the president of Genspace, who worked with viruses for her Ph.D. “You can read about it, but unless someone teaches you side by side, I don’t think you’re going to get far.”

It is hard to predict how the future evolution of biotechnology will affect the risk of homegrown pathogens.

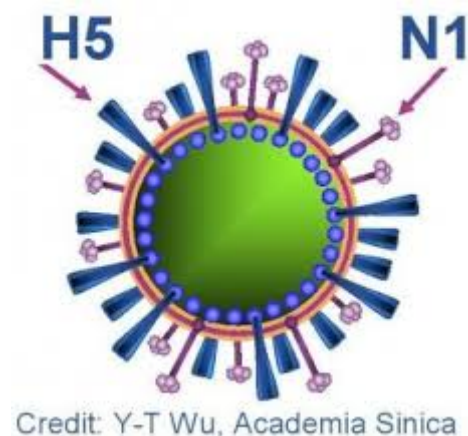
“There ought to be oversight down the road,” Mr. Bobe said. But he and others question whether holding back scientific information can reduce the risk. While it might be challenging to make one particular flu virus, like mutH5N1, it is not hard to try to breed new flu viruses.

“If you are a farmer somewhere in China, you could do it,” said Dr. Mueller, the virologist at Stony Brook. All that would be necessary is to bring some sick chickens in contact with ferrets or other mammals. “Without knowing what you’re doing, you could do it anyway.”

Of course, someone trying to make a new flu this way might well end up its first victim.

And some experts say that regardless of how a lethal virus might arise, the important thing is to be able to defeat it when it appears, so that we can avoid a global catastrophe like the 1918 flu pandemic, which killed 50 million people.

“The only thing that can be done, and to my mind should be done,” said Ron Atlas, a University of Louisville microbiologist and expert on bioterrorism, “is to have a vaccine that protect against this. We need an urgent program for a generalized influenza vaccine. We would take off the table another 1918-type event.”



#### **Source #4: Genetic Engineering Today: The Promise and the Ethics**

*This article was published in **Positive Health Online** (Integrated Medicine for the 21<sup>st</sup> Century) web site on July 2011. The article discusses the future of genetic engineering and the benefits that the use of genetic engineering could have in improving human life now and in the future.*

Genetic engineering holds the promise of eradicating gruesome genetic disorders that terrorize their victims and plague the families emotionally and financially. Genetic engineering changes a person's genome by introducing new DNA or changing the underlying DNA of the host, providing normal functioning and eradicating disease. Gene therapy is often used to treat genetic disorders that occur when genes are expressed improperly or have a nucleotide insertion or deletion, causing genetic abnormalities. The idea of gene therapy is that a benign virus is used to insert a good copy of the gene into an individual. The newly altered cells are expected to divide as normal. Theoretically, genetic engineering could be used to drastically change individuals' genomes, which could enable people to re-grow limbs and other organs, perhaps even extremely complex ones such as the spine. The promise is that genetic therapy could be used to treat diabetes, cystic fibrosis, or other genetic diseases with replacing the targeted gene. Carriers may make informed choices about their options of having a baby or caring for the baby with a disease. If genetic engineering could be used to replace mutated genes with the healthy ones, then that too is beneficial and can help millions of patients.

Today, human cloning is a common theme in science fiction. It refers to deliberate and creation of a genetically identical copy of a person. There are two types of human cloning: therapeutic and reproductive. Therapeutic cloning involves cloning cells from an adult for use in medicine and medical research. It is critical to note that therapeutic cloning refers to cloning specific cells for specific organs and NOT an entire human being. Therapeutic cloning could have incredible benefits in treatment of diseases: it can deliver genetically identical cells for regenerative medicine and tissues and organs for transplantation. Reproductive cloning is a highly controversial topic and a different matter altogether. It refers to creating an identical copy of a human being. Reproductive cloning could produce benefits for infertile couples so that their baby would have at least some of their genetic characteristics. However, such cloning has not been performed on humans and is illegal in many countries.

Genetic selection procedures can be applied after a fetus or an embryo is tested for a genetic abnormality through prenatal screening or through Pre-implantation Genetic Diagnosis (PGD). PGD tests embryos for genetic sequences associated with specific conditions. A cell is extracted from an embryo at its eight-cell stage and analyzed. Embryos with the selected characteristics can be implanted in a woman's uterus to develop into a child. It is believed that the procedure does not affect further development and viability of the fetus, although more testing is required to be certain. This process of implanting the embryos with the specific characteristics is in fact genetic selection because it allows parents who have a known risk to pass a genetic disease to

their child to select those embryos unaffected by the mutated gene. It was introduced in 1990 and is used to prevent Down's syndrome, Tay-Sachs disease, cystic fibrosis, sickle cell, Huntington's chorea, and Cooley's anemia. However, PGD has become controversial because some parents want to use it to select the baby's gender or to ensure that siblings of their sick children can provide bone marrow or tissues for transplantation. This technique can even be used to select cosmetic traits, such as eye colour, i.e., design a child. A newer variation of PGD, called Pre-implantation Genetic Haplotyping, allows for many more genes to be tested, and for greater accuracy.

One of the biggest considerations surrounding genetic therapy is safety. Although the safety of genetic therapy is of utmost importance to doctors and scientists, risks still exist. Genes are delivered to cells using a delivery vector which are benign viruses. To make the virus usable to deliver gene therapy, disease causing genes of the virus are removed and are replaced with the genes needed by the patient to treat the disease. Then the new virus, carrying the needed genes, is inserted in the patient's cells where they can deliver the needed genetic material. The risks of this procedure include an immune response, where the body rejects and attacks these viruses which in severe cases can cause organ failure. The inserted viruses can attack cells other than the mutated ones for which they were intended. If this happens, the healthy cells can be damaged and cancerous changes can occur. The virus carrying the necessary genes can reverse to its original form and cause disease. The new DNA may affect the reproductive cells, resulting in genetic changes that could be passed to future children. The gene therapy clinical trials under way in the US are closely monitored by the Food and Drug Administration and the National Institutes of Health to ensure the safety of those who participate in the studies.

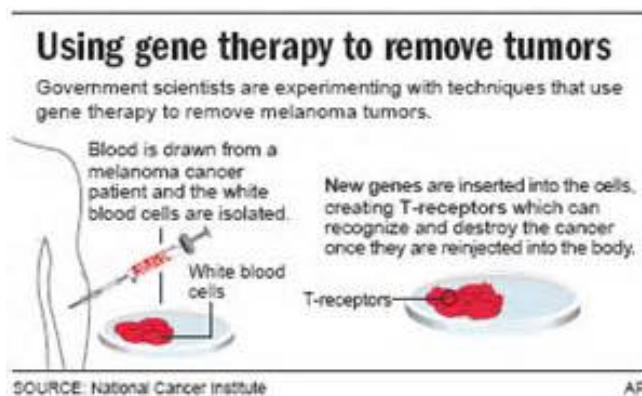
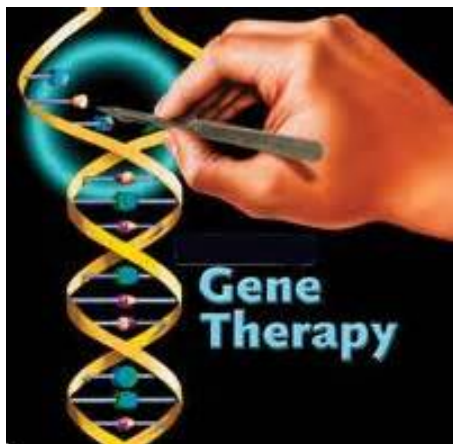
In recent years, *in-vitro* fertilization has become possible and has created another series of questions. For example, since embryos are harvested for fertilization, there may be more viable embryos than are fertilized at any given time. Those embryos are frozen and the question arises as to what to do with them in the future. The woman who owns these embryos has a difficult decision to make: she could have them fertilized and have those babies, or she could give them up for adoption, or she could donate them to science ensuring that they will never become a human life.

In a recent survey of over 2,000 people on their opinions of whether genetic testing is morally justified most people thought that testing for debilitating and terminal diseases including mental retardation was justified, while testing to select certain attributes was not. Some of the concerns with selecting attributes are that parents would select stature and eye and hair color. This would make our society lose its heterogeneity, changing the make-up of social dynamics. Current reproductive techniques involving *in-vitro* fertilization allow doctors and parents to do screening and selection to reduce the chance of a child born with a genetic disorder. Currently two types of testing are available. The first allows selection of sperm used to determine the gender of the baby and the genes it will carry. The second, Pre-implantation Genetic Diagnosis (PGD), selects the embryos screened to be free of genetic disease. Another technique, not yet used on humans, has to do with replacing faulty DNA with healthy DNA. Although the

PGD procedure is legally allowed, there is little oversight over its safety, especially long-term, since the technology is so new. The new procedure of preconception testing allows the parents to be aware that they are carriers of mutated genes and the likelihood of passing the mutation to their babies. This approach has already helped thousands of families to have healthy babies and to prevent debilitating diseases. The controversies abound with these procedures, despite these benefits. Some people are concerned that carrier and fetus testing will lead to more abortions. Others are concerned that these procedures are used for selection purposes instead of treatment and prevention of serious diseases.

Most of the concerns surrounding genetic engineering are a result of extremes in genetic engineering, the most common one being 'designer babies'. The term 'designer babies' refers to the parents' ability to select genetic traits for their baby by using genetic testing and genetic selection as part of the IVF process. Although current technology already offers a promise of enabling us to select specific genes to determine specific traits, such technology is in its infancy and risks are high. Today, if we select the 'blue eyes' gene, for example, we do not know what genetic disturbances we introduce in the process and what disorders and deformities this baby might have. Having acknowledged the current limitations, however, in the future we will most likely enhance the selection technology to control that no mutations are introduced when certain genes are selected. Once that happens, medical ethics will determine how widespread this practice will be. Today, we know that genetic testing and therapy to eradicate genetic diseases is widely supported; however, selecting the traits of the unborn child for non-health reasons is not supported by the broader community.

The promise of genetic engineering is that it offers technology and knowledge to eradicate life-threatening genetic and acquired devastating diseases, such as cancer; the majority of people endorse such progress. The ethical and safety concerns surrounding genetic testing are valid, but these should not prevent our study and progress in this promising field of science. Our capabilities for genetic selection are powerful today and will become even more powerful in the future.



**Question #1s** As noted in these four articles, bioengineering introduces a variety of moral and ethical issues. In the boxes below, list at least five major moral/ethical issues that are discussed in the articles and include which article(s) # that the issue was discussed.

Moral/Ethical Issue	Discussed in which article(s) (#)?
1.	
2.	
3.	
4.	
5.	

**Question #2:** As described in the four short introductions, each of these articles was taken from websites that are designed to appeal to a very specific audience. Choose **one** of the articles and analyze how the author's purpose is reflected in the article's tone and content. Be sure to include specific quotations from the text.



**Question #3:** None of the four articles directly states a position on whether genetic engineering should be banned in the United States. Complete the chart below to reflect the stance you think each of the authors would take if asked if genetic engineering should be banned in the United States. Cite specific wording from each article that supports your conclusion.

Article	Should it be banned? (Yes/No)	Specific wording from the text that supports your conclusion:
Article #1		
Article #2		
Article #3		
Article #4		

## Part 2

You will now have the opportunity to review your notes and sources, plan, draft, and revise your essay. You may use your notes and refer to the sources. You may also refer to the answers you wrote to the questions in Part 1. Now read your assignment and begin your work.

### Your Assignment

Based on the articles that you have researched and read, determine whether or not the United States should ban the future use of genetic engineering. Students at your school have been asked to write an argumentative essay either supporting the use of genetic engineering or arguing against it. Write your own argumentative essay that takes a clear position, using material from the articles you have read as support. Be sure that your recommendation acknowledges both sides of the issue so that people know that you have considered this recommendation carefully. You do not need to use all the sources, only the ones that most effectively and credibly support your position and your consideration of the opposing view.

