GENETIC MODIFICATION OF ORGANISMS Name_____
Summer Packet for 8th grade science
Mrs. McDonald-Kojes & Ms. Reyes Due Date September 19, 2018

This packet is designed to expose students to the various issues surrounding GMO foods and to help them understand the complexity of the issues surrounding the biotechnology movement. Students will read several articles regarding "Genetically Modified Organisms" and perform structured text comprehension activities. The articles will bring a more global understanding to the issue of GMOs and will trigger students to think about biotechnology, globalization and ethics.

Begin by reading the instructions followed by taking the pre-assessment pg 3&4

Task #1 Genetic Modification – The Basics!

1. Read the section titled "Background Information," fill in the DNA on the activity sheets.
2. Read the section titled "Gene Expression," complete the sentence and label the diagram.
3. Read the section titled "Genetically Modified Organisms," fill in the most important information in your own words on the activity sheets.

Task # 2: "FROM THE LAB TO THE DINNER TABLE" –
"Genetically Modified Food" by Keith R. Schneider & Renee G. Schneider.
1. Read the article then complete the worksheet.

Task # 3: Reaching Out For The Core on "The Impact of Genetically Modified Organisms on Human Health". This task has been developed to guide students in a close reading of the article mentioned above. It follows a progressive set of text-‐dependent questions and interconnected journal entries to further students' familiarity and comprehension of GMOs and their impact on society. This task was designed to increase students' attainment and text comprehension.
1. Read the article then complete the worksheet.

Task #4 Ethics of Genetic Engineering

Students will read the article "Designer babies." and identify the various reasons why parents and/or doctors may choose to use genetic engineering. Students will then judge how ethical these reasons are by placing them on a continuum and explaining their choice. This activity will prepare them to make their final claim about whether or not genetic engineering should be allowed. It also asks them to consider and address the counterargument.

************Final Performance Task************* Electronic submission only***********

Review the information and evidence gathered from all the texts on the topic of Genetic Modification. **Then write a five-‑paragraph argumentative essay analyzing the significance, ethics, and impact of GMO on society, arguing whether it should be continued and/or regulated.**

• First, review and evaluate the collected data from all texts studied to make inferences, distinguish relevant facts from speculation, and delineate arguments.
• In your analysis, make sure to state a claim that addresses the essay prompt. Acknowledge and refute counterclaims with logical reasoning to elaborate and strengthen expository paragraphs.
• Cite the most relevant textual evidence that supports your arguments from at least three of the texts discussed in class; select three other texts not included but found through your own research to distinguish relevant facts and cite research that would support your claim.
• Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence, while establishing and maintaining a formal style.

Provide a concluding statement or section that follows from and supports the argument presented.
Check the rubric and grade yourself by circling the box you think you earned for each section.
• Avoid plagiarism and follow standard (MLA) citation format. Most citations require one to answer four basic questions:

- Who wrote it/created it? (Author)
- What is the title? (name of webpage, name of website, name of online database)?
- Where was it published/where can it be found again (online address or city of publication)?
- When was it published (copyright year/ date last revised online, date viewed online) ?

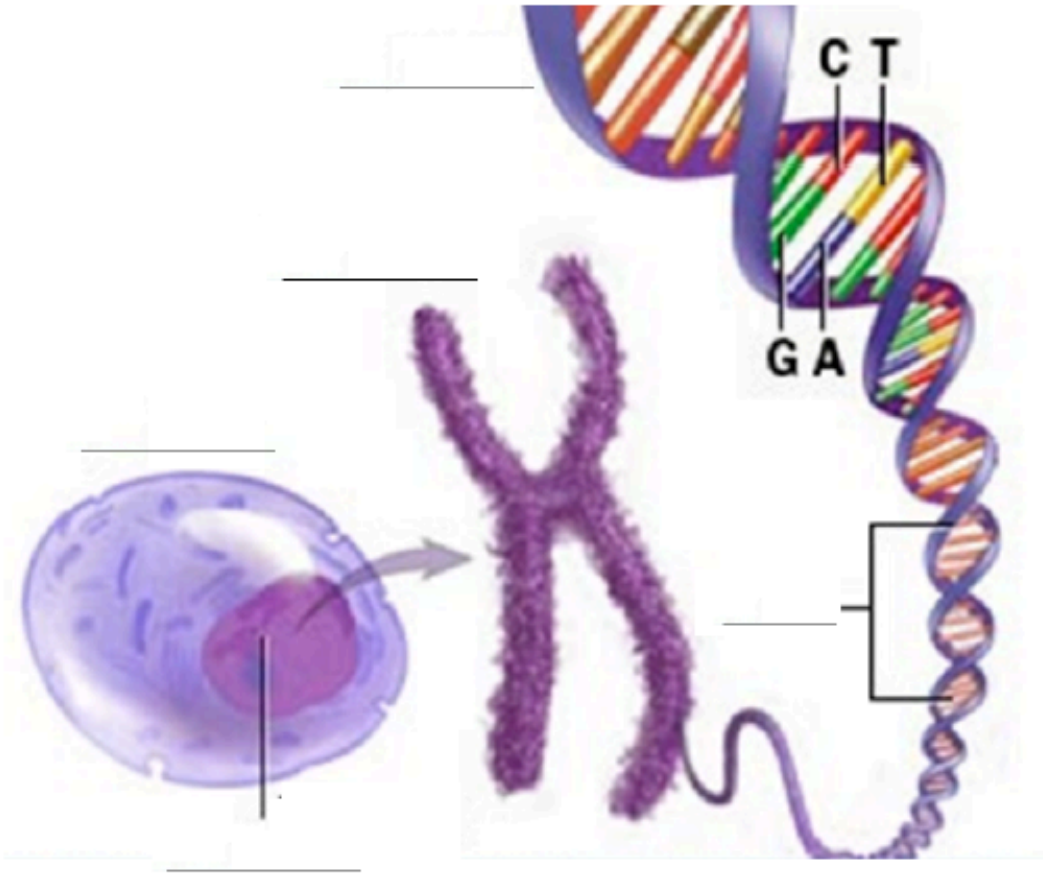
Some of your research will be done on these worksheets. I will require two things of all students this year. First,you will need to use your MS390 email account. All questions and submissions must be made via your MS390 account. Second you will need to learn how to write a document in google drive and share it with me. If you need a tutorial, this one will do http://www.wikihow.com/Use-Google-Drive there are many others. It is user friendly and makes the need for a flash drive obsolete. The final five paragraph essay must be turned in electronically via google drive. No other method will be accepted. If you do not have a computer at home with internet access there are libraries that do. Get a library card and get started. Do not wait until the end of the summer to begin working on this project. You only get one chance to make a first impression. Wow me. Remember "You are somebody! You have places to go and people to impress!" Impress me!
Questions? I am happy to help. Reach me at EKojes@ms390.com

Name: _____ Date: _____ Class: _____

GMO Pre-Assessment

Label the following vocabulary words on the diagram below **and** put a * next to the words that refer to genetic material.

- cell
- nucleus
- chromosome
- gene
- DNA



Describe the relationship between **genes** and **traits**.

_____

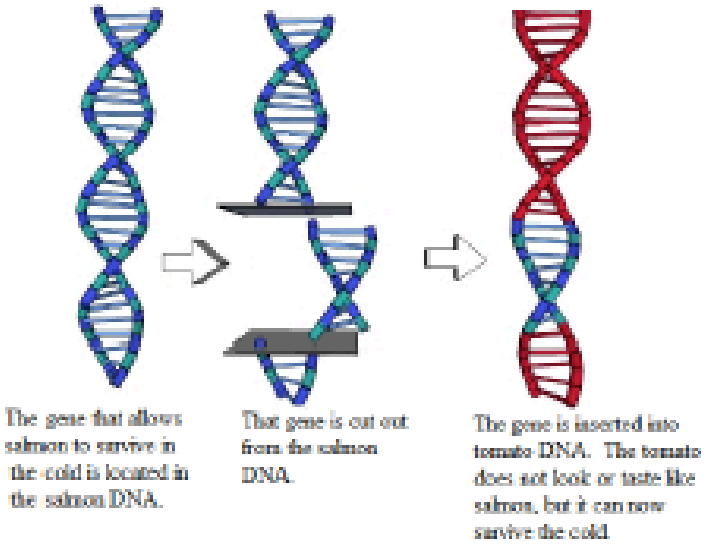
_____

_____

_____

_____

A genetically modified organism (GMO) is a living thing that has a gene from a different species inserted into its DNA. This causes the GMO to make or do things that it normally would not be able to. An example is illustrated in the diagram below.



In the US, GMOs are sold in supermarkets and by law do not need to be labeled. In a well-written paragraph, answer the following question: *Should GMOs continue to be sold without being labeled?*

In your response, be sure to:

- State a claim.
- Support claims with clear reasons and relevant evidence.
- Use a counterclaim to support your claim.
- <u>Include what you already know about GMOs.</u>

BACKGROUND INFORMATION

DNA: THE BASICS

In 1944, Oswald Avery, with colleagues Colin MacLeod, and Maclyn McCarty, shocked many scientists when they demonstrated, in a rather elegant experiment, that **DNA** (**D**eoxyribo**N**ucleic **A**cid) was in fact the material of heredity. Amazingly, a molecule consisting of only four basic components was responsible for carrying all the genetic information necessary for life.

DNA, a molecule found in the nucleus of cells, is composed of chains of subunits called **nucleotides**. Each nucleotide is composed of 3 parts; a deoxyribose sugar, a phosphate group, and one of four nitrogenous **bases**. It is these four bases; adenine, thymine, guanine, and cytosine (A, T, G, and C for short) that compose our genetic code. These nucleotides are linked together by phosphodiester bonds to create the sugar/phosphate backbone of DNA. Complementary base pairing of the four nucleotides, A with T and G with C, comprise the inside of the molecule, joining the two strands together to form the characteristic **double helix**.

Within this double helix, it is the particular sequence of the four bases that provide all of the information necessary for the form and function of life. Some stretches of DNA are organized into **genes**, each of which contains the information or "recipe" for making one or more **proteins**. Humans utilize hundreds of thousands of proteins to carry out nearly endless numbers of functions in the body.

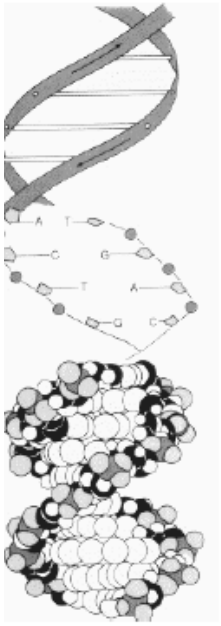
Fact Files

The Discovery of DNA

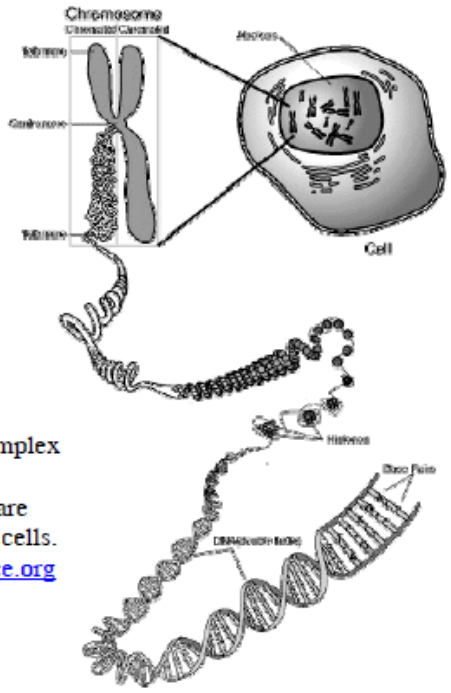
DNA was first discovered in 1869 by Friedrich Miescher. However, its role in the transmission of genetic material was not confirmed until a series of experiments by Alfred Hershey and Martha Chase in 1952. Finally, in 1953, the 3-D structure of DNA was solved by Rosalind Franklin, James Watson and Francis Crick.

Go Online!

For: Transcription/Translation Game
Visit:
http://gslc.genetics.utah.edu/units/basics/transcribe/



The structure of DNA.
DNA is composed of a series of nucleotides which bind to each other through hydrogen bonding. In DNA, adenine always pairs with thymine and cytosine always pairs with guanine. The joining of the two DNA strands by hydrogen bonding forms the characteristic double helix structure of DNA. Photo source: http://academy.d20.co.edu/kadets/lundberg/images/biology/dna71.gif



The organization of DNA.
DNA is tightly woven through a complex of proteins called histones into **chromosomes**. The chromosomes are housed in the nucleus of eukaryotic cells. Photo source: www.accessexcellence.org

GENETICALLY MODIFIED ORGANISMS

Genetically modified organisms, or **GMOs**, are organisms whose DNA has been altered to include an additional gene, or genes, from another organism to give that altered organism a desired characteristic. The first GMO was created in 1973 by Stanley Cohen and Herbert Boyer. Since then, numerous GMOs have been created including genetically altered corn, soybeans, tomatoes, rice, potatoes, and wheat to name a few. Not surprisingly, GMOs are present in many products available on the supermarket shelves and produce bins today. However, many people do not realize they are eating GMOs everyday. This is partially because in the US, products which contain GMOs do not need to be labeled and those which are made from less than five percent GMOs can be labeled "GMO-free."

Food/Crop	Number of GMO varieties	Source of new genes
Canola	4	California bay, turnip rape, bacteria, virus
Corn (not blue corn)	13	bacteria, corn, virus
Cotton	5	bacteria, tobacco, virus
Dairy products from cows injected with genetically altered rBGH	1	cattle
Papaya	1	bacteria, virus
Potatoes (Russett, Burbank)	1	bacteria
Radicchio (red-hearted chicory)	1	bacteria
Squash (yellow crook-neck)	2	viruses
Soybeans	3	petunia, soybean, bacteria, virus
Tomatoes	5	bacteria, tomato, virus

Source: (http://www.purfood.org/ge/usc98gefood.cfm) and (http://www.safe-food.org).

So, how are GMOs created? GMOs are usually generated by recombinant DNA technology. **Recombinant DNA technology** is a process which allows scientists to artificially combine genetic material from one or more organisms. In the laboratory, scientists create a plasmid, or circular piece of DNA, which contains their gene(s) of interest. This plasmid also contains a **promoter** to drive gene expression and a **terminator** that stops gene transcription. The most common promoter used in GMOs is the 35S promoter because it is constitutive (i.e. it is always turned on). The most common termination sequence is the NOS terminator. Once this plasmid is created, it is ready to be inserted into the plant. A common way to genetically engineer a plant is to use *Agrobacterium tumefaciens*, a bacterium which causes crown gall disease in plants and subsequently inserts some of its DNA into the plant genome, including engineered DNA if desired. Other mechanisms of inserting the desired DNA into an organism include using a gene gun (literally shooting the DNA into the plant cells) and electroporation (using electricity to force DNA into the plant cells). The individual plants will then be screened to determine which have been genetically modified. Scientists will then selectively breed the modified

Fact Files

First County to Ban GMO Production

In 2004, Mendocino County, California became the first county in the United States to ban the production of genetically modified organisms.

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For: Recombinant DNA Animation
Visit:
http://www.learner.org/channel/courses/biology/units/gmo/images.html

Genetically Modified Organism

(j-ne-tik-lE mă-d-fI-D or-g-ni-zm) – A living thing whose DNA has been altered to include an additional gene, or genes, from another living thing, in order to alter or add a desired characteristic.

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Visit:
www.biology.arizona.edu/immunology/activities/elisa/main.html

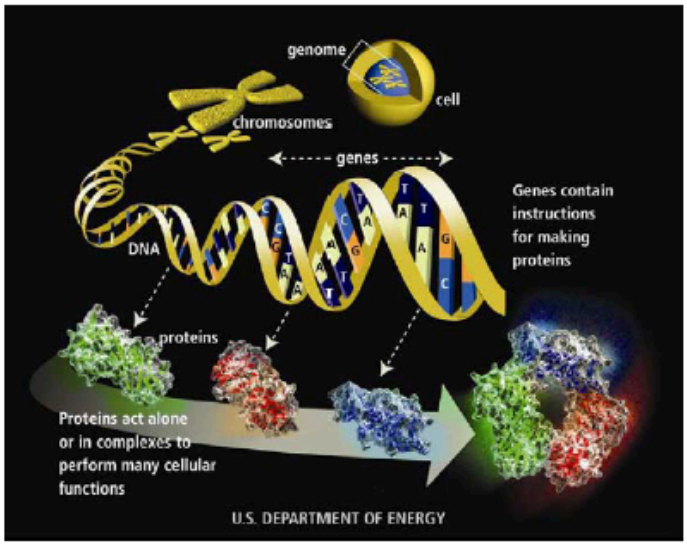
GENE EXPRESSION

Almost every cell in the human body contains identical DNA; however, each cell expresses a different set of genes depending on its function. For example, some genes may be activated in heart cells but not in liver cells. Each gene is regulated by other molecules in the cell that can bind to the DNA and control gene expression.

Once a gene is "turned on", a process known as **transcription** begins, where the DNA is chemically rewritten as an RNA molecule. In mammalian cells, once the DNA has been transcribed to RNA, the molecule undergoes a series of modifications in a process known as RNA processing. After processing, the RNA molecule, known as messenger RNA (mRNA), is transported out of the nucleus. Once out of the nucleus, ribosomes bind to the mRNA to begin **translation**. In translation, every three letters of the mRNA sequence code for an amino acid. Once the mRNA is translated, the polypeptide chain, or protein, is then released from the ribosome.

Go Online!

For: Transcription/Translation Game
Visit:
http://gslc.genetics.utah.edu/units/basics/transcribe/



DNA structure and organization
DNA is composed of a series of nucleotides which bind to each other through hydrogen bonding. DNA is tightly woven into chromosomes with the help of a complex of proteins called histones. The chromosomes are housed in the nucleus of eukaryotic cells. DNA contains the instructions or "recipes" for making all of the proteins in our body.

GENETICALLY MODIFIED ORGANISMS

Genetically modified organisms, or **GMOs**, are organisms whose DNA has been altered to include an additional gene, or genes, from another organism to give that altered organism a desired characteristic. Many different genetically modified plants have been created including: genetically altered corn, soybeans, tomatoes, rice, potatoes, and wheat, to name a few. Not surprisingly, GMOs are present in many products available on supermarket shelves and produce bins today. Many people do not realize they are eating GMOs everyday.

So, how are GMOs created? GMOs are usually generated using recombinant DNA technology. **Recombinant DNA technology** is a process which allows scientists to artificially combine genetic material from one or more organisms. Scientists must first isolate the gene(s)

Fact Files

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they would like to add to a plant. Then, they need to build a piece of DNA with this gene(s) in it, along with other things necessary to express the gene. Once this DNA, or plasmid, is created, it is ready to be inserted into the plant. The most common way to genetically engineer a plant is to use the bacterium *Agrobacterium tumefaciens*, a bacterium which causes crown gall disease in plants and inserts some of its DNA into the plant genome, including the engineered DNA. The individual plants will then be screened to determine which have been genetically modified. Scientists will then selectively breed the modified plants. While the process may not sound too difficult, it often takes seven to fifteen years to create a new market-ready GMO.

GMOs are fairly easy to detect given recent advances in science. The most common technique for detection is **polymerase chain reaction** (**PCR**). PCR is sensitive, efficient and can detect the presence of foreign DNA segments. In this experiment, you will isolate DNA from soy flour, perform PCR, and carry out agarose **gel electrophoresis** to determine which samples of soy flour contain genetically modified soybeans.

THE PROS AND CONS OF GMOs

Genetically modified organisms are highly controversial in today's society. In Europe, many GMO containing foods are banned, or at least required to be labeled as containing GMO products if more than one percent of the product is from a GMO. Why are people so concerned about GMOs? Let's investigate the pros and cons.

GMOs have been created for many reasons including: improved nutrition, drought resistance, pest resistance, improved flavor, and increased shelf-life. Supporters even argue GMOs can help fight world hunger and nutrition deficiencies, prevent erosion, and protect the environment from the use of harmful chemicals.

However, those opposed to GMOs are concerned about the adverse health effects these products may have on the consumers who eat them. They question whether these plants are producing allergens and transferring **antibiotic resistance genes** across species. They are also concerned about "genetic pollution" of the environment, as some of these GM plants can **cross pollinate** with others. In fact, pollen from genetically modified (GM) plants has been found many miles away from GM fields. They are concerned about the effects of genetic pollution on natural plant species and biodiversity. They are also concerned that these plants might speed up the naturally occurring evolutionary process, creating super weeds and super bugs that may have negative impacts on both the GMOs and naturally occurring plants.

Go Online!

For: Recombinant DNA Animation
Visit:
http://www.learner.org/channel/courses/biology/units/gmo/images.html

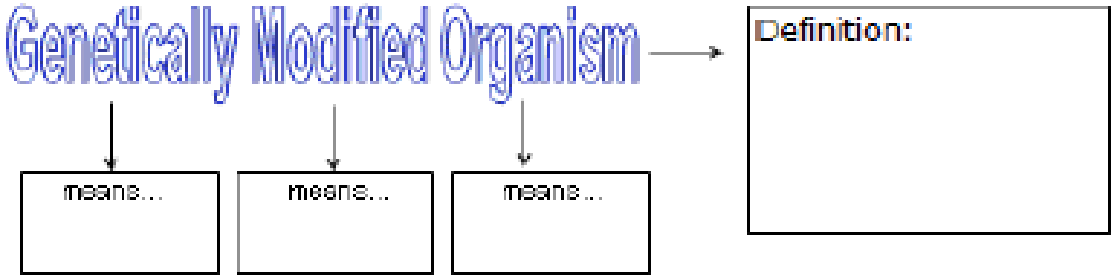
▲ **Bt hybrid corn versus non-Bt hybrid corn.** Bt hybrid corn (above) is protected from a common pest, the European corn borer. Bt hybrid corn contains Bt toxin from the bacterium *Bacillus thuringiensis*. The toxin crystallizes inside an insect, ultimately leading to the starvation and death of the insect. Thus, the presence of Bt toxin in the modified corn kills insects that would otherwise eat and destroy corn crops.

Name:_____Date:_____Class:_____

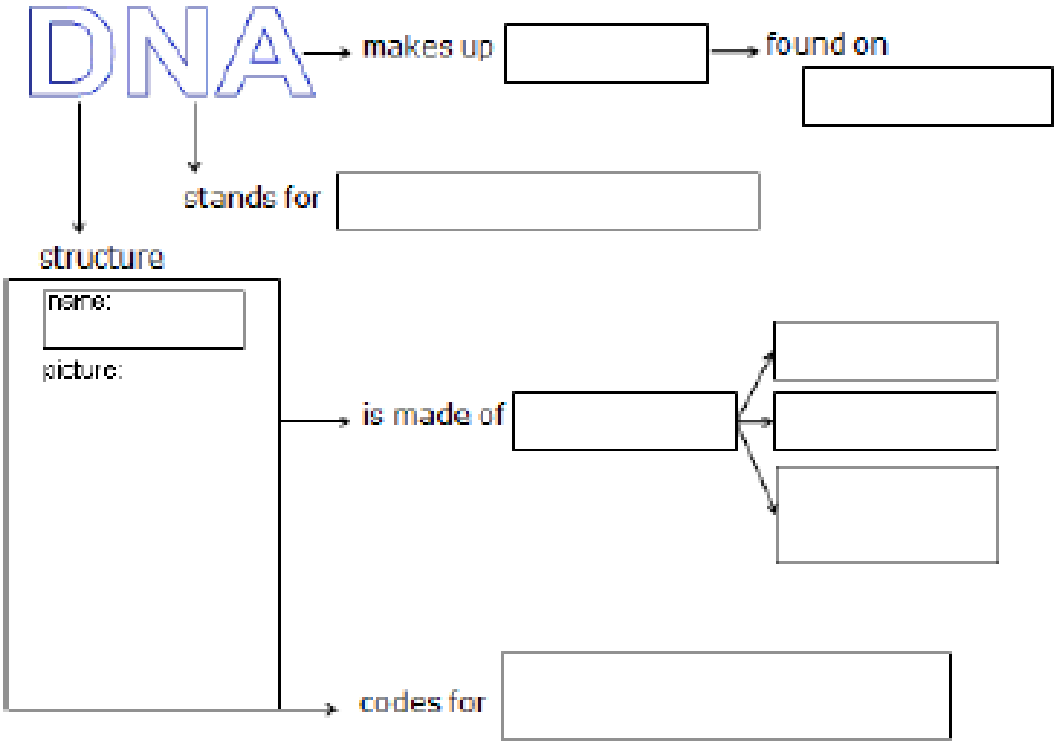
Genetic Modification – the Basics!

Activity Sheet

Directions: Complete each graphic organizer using the given prompts and information from the reading.



Background Information:



Gene Expression:

Directions: Complete each the sentence using the information from the reading.

Almost every cell has ([circle one] different/similar/identical) DNA that functions differently because_____

Directions: Label the processes involved in gene expression in the white boxes and label the structures involved in gene expression on the black lines.

Directions: Complete the graphic organizer using the given prompts and information from the reading.

Directions: List and describe Recombinant DNA Techniques using information from the reading.

Recombinant DNA Techniques:

1. _____ -_____
2. _____ -_____
3. _____ -_____

Directions: List important facts about Genetically Modified Organisms using information from the reading.

Important Facts about Genetically Modified Organisms:

- _____
- _____
- _____
- _____
- _____
- _____

FSHN02-2

UF UNIVERSITY of FLORIDA
IFAS Extension

Genetically Modified Food[1]

Keith R. Schneider, Renee Goodrich Schneider[2]

What are GM Foods?

A genetically modified (GM) food is a result of recombinant DNA biotechnological procedures that allow the genetic makeup of an organism to be modified. This can be accomplished by incorporating genes from other organisms or by rearranging genes already present. These changes can result in the expression of attributes not found in the original organism. Examples of products that have been engineered include delayed-ripening tomatoes; pest-resistant crops, such as virus-resistant squash and Colorado potato beetle-resistant potato; herbicide-tolerant crops, such asbromoxynil-tolerant cotton and lyphosate-tolerant soybean; and many others. In fact, since 1987, seed producers have submitted nearly 11,600 applications to USDA APHIS (United States Department of Agriculture Animal and Plant Health Inspection Service) for field testing.

Genetic modification can be used to assist food manufacturers and to improve on the storage capacity or nutritional value of foods. The first commercial food product developed from gene splicing (a term for a type of genetic modification) was the Flavr Savr™ Tomato. The Flavr Savr™ Tomato had a gene added to prevent the breakdown of cell walls as the fruit ripened. The genetic modifications allow these tomatoes to remain firm even after extended shipping and storage times.

Hard cheeses provide another example of the use of genetically modified organisms in food production. Chymosin, the primary component of rennet, is the milk-clotting enzyme used to make cheese and other dairy products. Traditionally, this substance was derived from the stomachs of calves. It is now commercially produced by genetically modified microorganisms (most commonly, fungi). The FDA gave chymosin (from both traditional and GM sources) "generally recognized as safe" (GRAS) status, which makes it exempt from the usual premarket approval requirements. Approximately 90% of hard cheeses are now made using this enzyme, which is obtained from a genetically modified source.

Types of GM Foods

A **genetically modified** (GM) organism is one that has had its genetic material altered through any method. (Although traditional breeding and

1. This document is FSHN02-2, one of a series of the Food Science and Human Nutrition Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Publication: January 2002. Revised: November 2006. Reviewed November 2009. Please visit the EDIS Web Site at http://edis.ifas.ufl.edu.

2. Keith R. Schneider, associate professor, and Renee Goodrich Schneider, associate professor, Food Science and Human Nutrition Department, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville FL 32611

hybridization are technically genetic modifications, these techniques pre-date recombinant techniques and will therefore not be considered GM in this discussion.) A **genetically engineered** (GE) organism is one that is modified using techniques that permit the direct transfer or removal of genes in that organism. Such techniques are also called recombinant DNA or rDNA techniques. Lastly, **transgenic** organisms have a gene from another organism moved into them.

For example, the plant product known as "Bt corn" is a transgenic plant, because it contains a gene from the bacterium *Bacillus thuringiensis*. Initially, the term "transgenic" was used when DNA had been transferred from an organism of one genus to an organism of another genus. More recently, the term has been used to describe the practice of taking DNA from an animal or bacterial source and cloning it into plants. For instance, genes from an animal, such as a fish, may be inserted into the genomes of foods such as strawberries or tomatoes.

This practice has raised ethical issues as well as concerns about possible health implications. Groups opposed to the genetic manipulation of food have termed this practice and its subsequent products "Frankenfood." Though more research is needed, the FDA feels that there are no serious food safety issues associated with these products, although they are always alert for possible food allergens.

GM foods are classified into one of three generations. First-generation crops have enhanced input traits, such as herbicide tolerance, better insect resistance, and better tolerance to environmental stress. Second-generation crops include those with added-value output traits, such as nutrient enhancement for animal feed. Third-generation crops include those that produce pharmaceuticals, improve the processing of bio-based fuels, or produce products beyond food and fiber.

As previously mentioned, since 1987, seed producers have submitted nearly 11,600 applications for field testing. More than 92% of these have been approved. Applications peaked in 2002, with 1,190 approvals. Most involve major crops, with more than 5,000 approvals for corn, the most commonly improved crop (followed by soybeans, potatoes, and cotton). More than 6,600 of the approved applications include GE varieties with herbicide tolerance or insect resistance.

How Could GM Foods Help Consumers?

Industry has argued that we need GM foods because they will reduce production costs by reducing the need for additional chemicals (pesticides and fertilizers) and mechanical inputs. Theoretically, the savings could, in turn, be passed on to the consumer. The nutrition implications are also often cited as an obvious benefit for consumers, since the bioengineering could create plants that could produce more nutritious food. An example of one such product is "Golden Rice." This strain of rice contains beta-carotene, a source of vitamin A and iron. Developing countries that rely on rice as their major food source are often are the same countries to suffer from high rates of childhood blindness and maternal anemia. Iron and vitamin A have been shown to aid in the prevention and treatment of maternal anemia and blindness, so "Golden Rice" might help to reduce the rates of these problems.

Are There Health Concerns About GM Foods?

The potential for GM foods to cause allergic reactions is the most obvious health concern associated with these products. Specific proteins in milk, eggs, wheat, fish, tree nuts, peanuts, soybeans, and shellfish cause over 90% of food allergies. If a protein from one of these food types were to be incorporated into a food that normally would not have this protein, people who are allergic to these proteins could unknowingly consume such a food and suffer allergic reactions. The FDA has put measures into place to prevent such a scenario by requiring that each producer of a GM food product present scientific evidence that they have not incorporated any allergenic substance into their product. If this evidence cannot be produced, the FDA requires a label to be put on the product to alert consumers.

What Kinds of GM Foods Are Sold in the U.S.?

It has been estimated that 60 to 70% of food products in retail stores already contain genetically modified ingredients. In 1998, U.S. farms cultivated over 45 million acres of GM commodities. This is a 250% increase from 1997 plantings. Commonly planted GM Foods include many major agricultural commodities, with genetically modified plants accounting for 25% of the corn acreage, 38% of the soybean acreage, and 45% of the cotton acreage grown today. Worldwide, over 69 million acres of GM crops were cultivated in 1998, with 15% of the acreage in developing countries.

In 2000, the media carried many stories about GM salmon. These fish are twice the size of normal salmon and can grow up to ten times faster, while being fed 10 to 25% less food. The company that engineered the GM fish claims the salmon are sterile and would therefore be unable to breed if they were to escape into the environment.

The Flavr Savr™ Tomato

The first genetically modified crop approved for commercial sale was the Flavr-Savr tomato. The product, developed by a company called Calgene, was approved by the FDA in 1993. It went on sale one year later, but in 1997, due to increasing public concerns and the need for specialized transportation equipment, production ceased. Calgene (which was subsequently bought by Monsanto) wanted to create a tomato with a vine-ripened taste that could withstand the rigors of shipping. What they created was a controversy that is still being debated a decade later.

Bt *(Bacillus thuringiensis)* Corn

Bt corn is a hybrid plant bioengineered to produce an insecticide. This induced insecticide provides effective, consistent control of pests such as the European corn borer and offers some protection against the fall armyworm and corn earworm. It does so at a lower cost than insecticides, and with better results. In August of 1995, both the EPA and the USDA approved Bt corn for commercial use as a human food product. The use of Bt corn has increased dramatically, from 1.4% in 1996 to about 30% of total corn acreage (26 million acres) in 1999.

The StarLink Corn Incident

StarLink (Aventis Crop Science) is the trademark for a variety of corn that was genetically modified to produce its own pesticidal protein, Cry9C. This protein, like other GM insecticides, was effective in controlling certain insects and thus could substitute for chemical insecticidal sprays. When questions about the potential human allergenicity of the Cry9C protein arose, investigations showed the EPA had approved StarLink in 1998 for use only in animal feed and other industrial, nonfood uses.

In September 2000, StarLink corn was found in the human food supply--first in corn tortillas, but later in other processed foods. This event triggered extensive publicity and increased public awareness of the presence of GM-derived foods in the American food supply. The U.S. registration for StarLink corn was voluntarily withdrawn by Aventis Crop Science. This means that StarLink corn is no longer available for sale and should not be planted. Seed companies have destroyed their stocks of StarLink corn seed. The use of previously stockpiled StarLink corn in livestock feed and for industrial, non-food uses remains fully approved by the Environmental Protection Agency (EPA).

L-Tryptophan

Concerns have also been raised about contaminated L-Tryptophan, a food supplement that was implicated in cases of Eosinophilia Myalgia Syndrome (EMS). L-Tryptophan was linked to 37 deaths in the late 1980s in the U.S. The supplement was produced by fermentation using a GM bacterium, but the FDA believes this problem was almost certainly due to the omission of an important purification stage from the process, not to the use of GM organisms in production. Although the product involved GM-produced ingredients, the adverse effects were not attributable to the GM character of the product or process. This tragic case illustrates the importance of strict quality control monitoring for all food products, regardless of their source.

How the FDA and the EPA Ensure Food Safety

There is no one statute or federal agency devoted to the regulation of GM foods. The public relies on the FDA for assurance that the foods we buy are safe and wholesome. Under the Food, Drug, and Cosmetics Act, the FDA has the authority to ensure the safety of most domestic and imported foods in the U.S. market (except meat and poultry, which are regulated by the USDA).

The pesticides used in or on foods are regulated primarily by the Environmental Protection Agency (EPA), which reviews safety and sets tolerances (or establishes exemptions from tolerance) for pesticides. The FDA monitors foods to enforce the tolerances for pesticides set by EPA. Finally, it is USDA-APHIS that controls the field trials of any GM crop that falls under permitting requirements.

The Future

With all the controversy surrounding GM foods, especially in Europe, researchers have been searching for new methods to enhance crop production. The newest technique is called marker-assisted selection (MAS). This product combines traditional genetics and molecular biology. MAS allows for the selection of genes that control traits of interest, such as color, meat quality, or disease resistance. It has the promise of becoming a valuable tool in selecting organisms for these traits of interest. Because this process uses existing DNA, not transgenic DNA, to choose desired traits, MAS stands to be less controversial then other GM techniques.

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Maryanski, James. 1996. FDA/CFSAN safety assurance of foods derived by modern biotechnology in the United States. U.S. Food and Drug Administration presentation. http://www.cfsan.fda.gov/~lrd/biojap96.html.

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b. State three essentials everyone should know about GMO according to Schneider and Schneider…

HEADER	ARTICLE SCRAP
1.	
2.	
3.	

2. Identify in the article three examples of organisms that have been genetically modified, why and how they were modified.

ORGANISM MODIFICATION	WHY	HOW
1.		
2.		
3.		

3. Unpacking Information:
   a. Study and Discussion: Ask students to answer questions, and then share their findings about the potential risks and rewards of genetically modified organisms as presented in the article.

Suggested guiding questions

1. How do Schneider and Schneider define genetically modified foods?

2. List some of the potential benefits of GM foods to humans and the environment as stated in the article.

3. List some of the potential risks of GM foods to humans and the environment presented in the article.

4. Explain, using at least one example from the article, how GM foods could be used to decrease some health problems around the world.

5. Explain, using evidence from the article, how GM foods could be used to solve problems of starvation around the world.

6. Explain why the authors think some people might be opposed to GM foods and why the public in general relies on the FDA for assurance.

Answer in Google drive document and "share" with EKojes@ms390.com

T · H · E OHIO STATE UNIVERSITY EXTENSION

Extension FactSheet

HYG-5058-0

Family and Consumer Sciences, 1787 Neil Avenue, Columbus, OH 43210

The Impact of Genetically Modified Organisms on Human Health

Sereana Howard Dresbach, Ph.D.
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Amanda Sokolowski, M.S.
John Allred, Ph.D.

What are genetically modified organisms?

A genetically modified organism (GMO) is an organism whose genetic structure has been altered by incorporating a gene that will express a desirable trait, often termed gene splicing. Most often the transferred gene allows the organism to express a trait that will add to its desirability to producers or consumers of the end product. For example, the first food produced from gene splicing and evaluated by the FDA was the *Flavr Savr Tomato*. Tomatoes generally get softer as they ripen because of a protein in the tomato that breaks down the cell walls of the tomato, which makes it difficult to transport a quality ripe tomato across the country. The *Flavr Savr Tomato* had a gene spliced into its DNA to prevent the breakdown of the tomatoes' cell walls. The result of the incorporation of the new gene is a firm ripe tomato for consumers on store shelves (1).

What are the impacts of genetically modified organisms?

While not all impacts have been fully researched, specific aspects have been documented. Genetically modified organisms are theorized to reduce production costs due to reduced chemical and mechanical needs in planting, maintenance, and harvest. Conceivably, this savings could in turn be passed on to the consumer. The most obvious benefits to consumers are the nutrition implications. The biotechnology of gene splicing allows for the opportunity of creating plants that will produce food that is more nutrient dense. This is the case with a product termed "Golden Rice," which contains beta carotene, a source of vitamin A and iron. Rice is a dietary staple in most developing countries. These are the same countries that suffer from high rates of childhood blindness and maternal anemia. Iron and vitamin A have been identified to prevent or treat maternal anemia and blindness, respectively. Research efforts are underway to identify other ways to increase efficiency and productivity of our food sources, thus allowing us to prevent diseases and feed the growing population as well (2).

What are the nutritional concerns of consuming genetically modified organisms?

The most obvious nutrition concern with genetically modified organisms is the risk of allergic reactions. More than 90% of food allergies occur in response to specific proteins in milk, eggs, wheat, fish, tree nuts, peanuts, soybeans, and shellfish (3). The risk for allergic reaction stems from a protein from one of these foods incorporated into a food that does not cause a known allergic reaction. For example, if an individual who has a known allergy to peanuts unsuspectingly consumed a genetically modified organism that contained the allergenic protein from the peanut, conceivably the individual would experience an allergic reaction. This concern has been addressed with FDA measures put into place to prevent such a scenario. The FDA requires that each presenter of a genetically modified organism show scientific evidence that they have not incorporated an allergenic substance into their product. If the presenter cannot produce this evidence, the FDA requires a label on the product to alert the consumer of its possible allergic reaction (4).

Why would the FDA approve genetically modified organisms without clinical trials?

Genes code for the production of specific proteins. All proteins consist of amino acids. Proteins differ from one another based on the sequence of the amino acids. When

humans consume a GMO that has had a gene spliced into its genetic structure, we are then consuming that protein. Once we have ingested the protein, the genetically modified organism digests in the same way every other protein we consume. When it reaches the stomach, the stomach acid straightens and unwinds the protein. Concurrently, the stomach acid activates pepsin, which is an enzyme that breaks the protein apart into smaller amino acid sequences. The partially broken down protein then enters the small intestines where it is broken down to smaller peptides by the enzymes, trypsin, chymotrypsin, and carboxypeptidases A & B. Finally, the peptides are cleaved into individual amino acids by aminopeptidases when they come in contact with the cells that line the intestines. The body then takes up the amino acids. The body, in effect, breaks down all bonds and subsequently uses the amino acids. The human body cells cannot discern what is a gene from a "natural" or genetically modified organism because they are completely unbound from the original plant.

At this point, traditional clinical trials to investigate impact would be difficult. Clinical trials would be difficult to perform because 60-70% of food products in groceries are already genetically modified. It would be extremely difficult to get a large enough control group (people who consume no GMOs) to conduct a valid study (3). Therefore, the FDA has taken precautions to make sure that GMOs do not affect human health. When a new product is introduced, the presenter must provide information as to what gene was incorporated and where the gene was incorporated in order to receive approval. The FDA must determine if the newly incorporated protein is similar to that of other proteins found in our foods. If it is not, then the newly incorporated protein must be treated as a food additive and will require pre-market approval by the FDA (1).

Investigation questions to be addressed concerning GMOs

There are many questions to be answered before genetically modified organisms can be labeled "a good idea" or "a bad idea." At this time, some questions are being investigated from multiple discipline perspectives. Some general investigation areas include:

- Genetically modified organisms have potential to help prevent diseases.

  Can these food items be used effectively to prevent disease in at-risk populations?

- GMOs have potential to create less expensive foods that contain the appropriate amount of nutrients.

  Can this translate into appropriate food supplies for people with limited economic resources?

- GMOs could produce more food from the same amount or less cropland.

  What is the economic impact to U.S. and world agricultural economies?

- GMOs could be developed that can survive droughts or floods on lands that are currently unable to sustain crops.

  What are the environmental impacts of bringing this land into production?

- GMOs augment certain properties of foods through genetic manipulation.

  Can we understand interactions with other systems of the body, other foods, pharmaceuticals, or allergic reactions?

Before any hard and fast conclusions can be made about positive or negative impacts on human health, multidisciplinary research efforts must address a multitude of questions that probably don't have an answer. Before any policy decisions are made, more conclusive research must be completed.

References

1. FDA's Policy for Foods Developed by Biotechnology http://vm.cfsan.fda.gov/~lrd/biopolcy.html
2. Smith, Nick. April 13, 2000. "Seeds of Opportunity: An Assessment of the Benefits, Safety, and Oversight of Plant Genomics and Agriculture Biotechnology." For the One Hundred and Sixth Congress Second Session.
3. The Ohio State University's College of Food, Agricultural, and Environmental Sciences: John B. Allred http://ohioline.ag.ohio-state.edu/gmo.html
4. FDA/CFSAN Safety Assurance of Foods Derived by Modern Biotechnology in the United States http://cfsan.fda.gov/~lrd/biojap96.html

8/01-klw

Formative Assessment #3 – Reaching Out For The Core on "The Impact of Genetically Modified Organisms on Human Health" by Sereana Howard Dresbach

	GUIDING QUESTIONS	EVIDENCE FROM THE ARTICLE
DISCUSSION OF PARAGRAPHS 1-2	1. What is the concept behind the verb "splice" in paragraph one?	
	2. According to the author, what is the relationship between desirability and gene splicing?	
	3. What are the implications made by the author when she stated that "nutrition is the most obvious benefits of GMO to consumers" in paragraph two? Exemplify.	

	GUIDING QUESTIONS	EVIDENCE FROM THE ARTICLE
DISCUSSION OF PARAGRAPHS 3-6	4. What does the author mention as an FDA requirement before allowing GMO from presenters? What follows if the requirement is not produced?	
	5. According to the article, what features make proteins differ from one another?	
	6. Draw a chain of events delineating the process that takes place after the ingestion of GMO into a human body as described in paragraph four.	

Day Three Assessment

- Writing response: Students review information previously gathered from journal entries and answer questions to addres following prompt:
  - *State and explain the point that the author is making by using the word impact in the title of this article.*

This analysis should be written for an audience that is interested in learning about the relationship between GMOs and human health and has never read this article before.

Name:_____ Date: _____ Class#_____

Argumentative Essay Organizer

Article: _____

Text-based arguments supporting GMO:	Text-based counterarguments against GMO:

Argumentative Essay Checklist

Introduction

- ☐ My argumentative essay has a creative, thoughtful, and interesting title.
- ☐ My "lead-in sentence" is well designed to grab the reader's attention.
- ☐ There is a transition from the lead-in sentence to the overview of the issue.
- ☐ My overview of the issue is well articulated and gives the reader a clear picture of the situation by acknowledging all the view points on the issue.
- ☐ There is a strong claim in my introduction which clearly and directly responds to the writing prompt or essay question (the words in the prompt may be used to formulate the thesis statement).
- ☐ The introduction has at least 6–8 sentences.

Body Paragraphs

- ☐ The topic sentence is the first sentence of each body paragraph.
- ☐ The topic sentences introduce logical and text-based arguments that support the claim and respond to the essay question.
- ☐ Body paragraphs are developed with at least two supporting citations from the articles used in class.
- ☐ Provide reader with the context for each supporting quote: setup – quote – analysis.
- ☐ Follow each quote with at least two sentences of analysis that explain how the quote supports and proves the topic sentence and therefore the claim.
- ☐ One of the body parts acknowledges the counterclaim and counterarguments.
- ☐ The counterclaim and counterarguments are destroyed by a strong refutation.
- ☐ The last sentence of each body paragraph is a concluding sentence that summarizes the paragraph and/or transitions to the next paragraph.
- ☐ Each body part has at least 8–10 sentences.

Conclusion

- ☐ Restates the claim.
- ☐ Summarizes the main arguments without being repetitive.
- ☐ May possibly revisit the hook or provide an appropriate quotation.
- ☐ Expands on the ideas in the essay, leaving the reader thinking and pondering.
- ☐ The conclusion has at least 6–8 sentences.

Other Important Aspects

- ☐ Use formal writing style, tone, and language.
- ☐ Avoid slang, non-specific language, and contractions.
- ☐ Use a great variety of transitional words.
- ☐ Pay attention to spelling, punctuation, and grammar.
- ☐ Always proofread and self-edit your work.

Pros and Cons of Designer Babies

Designer babies are babies, whose genetic makeup has been artificially screened and chosen by scientists, via genetic engineering. This concept has raised numerous ethical issues. Let's have a look at the pros and cons of designer babies.

Did You Know?

The term 'designer baby' was actually coined by journalists and not scientists.

The term 'designer baby' made its entry into the Oxford English Dictionary in 2004, where it is defined as "a baby whose genetic makeup has been artificially selected by genetic engineering, combined with in vitro fertilization to ensure the presence or absence of particular genes or characteristics."

What is a Designer Baby?

Advances in genetics have given birth to this concept of 'designer baby', wherein, parents and doctors are able to genetically screen embryos for any genetic disorders. In vitro fertilization (IVF) technique involves the fertilization of the egg by the sperm in test tubes, outside the mother's body. This allows doctors to screen the embryos. Genetic screening has made it possible to eliminate genes associated with several genetic defects and terminal illnesses.

A revolutionary technique called 'preimplantation process', when used in conjunction with tissue typing, is used to screen embryos for any genetic disease and only the disease-free embryos are implanted into the mother's womb. However, the technique is not limited to screening for genetic and hereditary disorders, but is also used for cosmetic reasons.

Dr. Jeff Steinberg, Director of the Los Angeles Fertility Institute, who played a major role in the world's first test tube baby in 1978, states that by using preimplantation genetic diagnosis (PGD), parents can choose the gender, eye, skin, and hair color of the baby. Various other physical traits such as intelligence, beauty, height, stopping a propensity towards obesity, freedom from mental illnesses, athletic ability, etc. can be also determined. He went on to say that this service is available solely to couples seeking IVF.

Designer babies have been debated for over a decade. While some people believe designer babies can revolutionize life beyond our imagination, others believe such a revolutionizing technique can cause harm to mankind in the future. Let's have a look at the pros and cons of designer babies.

Pros of Designer Babies

Savior Child

Adam Nash was the world's first known designer baby, born by the revolutionary 'preimplantation process' in the year 2000. Scientists genetically selected his embryo, so that he would possess the right cells to save his dying sister's life. His sister suffered from Fanconi's anemia (blood disorder), and mostly the chances of Adam getting that disorder was also very high. Out of a total of 30 embryos, an embryo free from Fanconi's anemia was chosen. When Adam was born, the blood cells from his umbilical cord, were transplanted into his sister's body, which saved her life. In no way was Adam subjected to any kind of medical procedures to save his sister's life, thus, Adam was in no way affected.

Same was the case with Charlie Whitaker, who suffered from Diamond-Blackfan Anemia. His parents wanted to have a designer baby to save Charlie's life. Since they were denied the right in UK, they went to US, to have their baby. In 2003, Charlie's baby brother was born and the stem cells from his umbilical cord would be used to treat Charlie.

However, many pro-life groups are against the concept of savior children. Let's have a look at what the parents of savior children have to say in their defense.

Pro-life Group's Argument

The savior child is wanted to save the other sibling, and may feel unloved for being exploited.

Parents' Defense

Jason and Lesley Gregory decide to have a designer baby, to save the life of their daughter Harriet, who is born with a rare brain condition. However, the birth of baby Michael to save Harriet, was criticized by may pro-life groups that said children need to be born for their own worth, not to save siblings. To this Lesley Gregory, mother of Harriet and Michael says, "We love Michael as much as we do our other children. When he's older we'll tell him what his purpose was, that he's extra-special for the gift he gave. If something happened to Harriet, hopefully Michael's arrival would cushion the blow. Until then we'll do everything in our power to save her. Wouldn't any parent do the same?"

On the other hand, a not so fortunate Shahana Hashmi, was denied the right to have a designer baby in the UK (on ethical grounds), to save her four-year old son who was suffering from a rare and terminal blood disorder. Later, when the right was restored, her body has passed the viable reproductive stage, and she was unable to bring a savior child for her ailing son. To this she says, "Our intention was never to create a designer child. It was to create a much loved child who could help his brother."

Prevent Genetic Disorders

Genetic screening can reduce the baby's chances of being born with several serious diseases like Down syndrome, spinal muscular atrophy, cystic fibrosis, familial hypercholesterolemia, rare blood disorders such as Diamond-Blackfan anemia, etc. Families with inherited medical conditions like diabetes, obesity, hypertension, etc. or diseases like parkinson's disease, thalassemia, cancer, arthritis, hypothyroidism, Alzheimer's disease, etc. may want to go in for designer babies to prevent the next generation from inheriting genes with these diseases.

Disease-bearing genes can be screened for and only those without the disease can be implanted into the uterus. Thus, ensuring a healthy next generation. With the help of this new technology, parents can be assured their children won't have to struggle with the same illness they or their family members are going through.

Cons of a Designer Baby

Abandoning or Aborting the designer baby, after retrieval of stem cells

Pro-life groups fear designer babies will spearhead inhuman actions. According to their fears, couples may go in for designer babies just for the stem cells, and then give up the baby for adoption. Couples may even go in for surrogacy and then even decide to abort the fetus at 7 months, after obtaining the necessary stem cells. There are scores of reports of cases in Ukraine, wherein, surrogate mothers were paid to abort the child at 7 months, and stem cells were used in beauty treatments. This is nothing but brutal murder for something as ridiculous as physical beauty.

Stem cell research has given birth to some beasts, who will go to any extent to make money. Some doctors in Ukraine tell pregnant women to abort their babies, saying the fetus has some birth defects, even when the fetus is perfectly healthy. They lie, just to get hold of the stem cells. Aborted babies are the best source of organs and stem cells. Abortion clinics in Ukraine ship bodies of aborted babies to cities like Moscow, where the stem cells are used for cosmetic treatments. Thus, while on one hand, stem cell research is being used to create life that can save another life, it is also taking life away from millions. The demand for stem cells and fetal organs is leading to several atrocities, too painful to even think about.

Destruction of Unwanted Embryos

As in the case of Molly Nash, 12 embryos were created in the lab, and only after a lot of screening was Adam born. This means, 11 other embryos were destroyed and only one was chosen to be born. This seems unethical because, the others were not chosen because of their genetic buildup. The very fact that all embryos have one thing in common: life, it is unethical to destroy them or in other words 'murder' them. Are embryos considered disposable?

Savior Child Undergoes Medical Procedures

Savior children are selected base on their genetic makeup. Their tissues are a match to those of their siblings. If only the tissues from the cord blood is required to save the sibling, it is fine, however, sometimes savior children are also conceived for organ donation. When bone transplants are the only way to save the sibling, the savior child has to undergo invasive treatment, which is not fair.

Baby Max Mathew was born as a savior child (2010), to save his sister Megan, who was suffering from a rare inherited blood disorder, Fanconi anemia. However, because the tissues obtained from Max's cord blood wasn't sufficient, an invasive procedure was carried out to recover some bone marrow stem cells. Again the question arises, can the child give his/her consent for this medical procedure? Is it not unfair to the child? .

Designer Babies with Enhanced Looks and Abilities

The adoption of genetic engineering for genetic enhancements has spearheaded a lot of controversies. People have begun asking the question, "Is it ethical to create designer babies with enhanced physical ability and appearance?" The National Director of Christian Voice, Stephen Green said, "The objection to the idea of designer babies is that it divorces procreation from the act of sexual congress, and there's a real sense in which it is playing God." Critics point out that the level of biodiversity in the human race will plummet, which can result in long-term disaster.

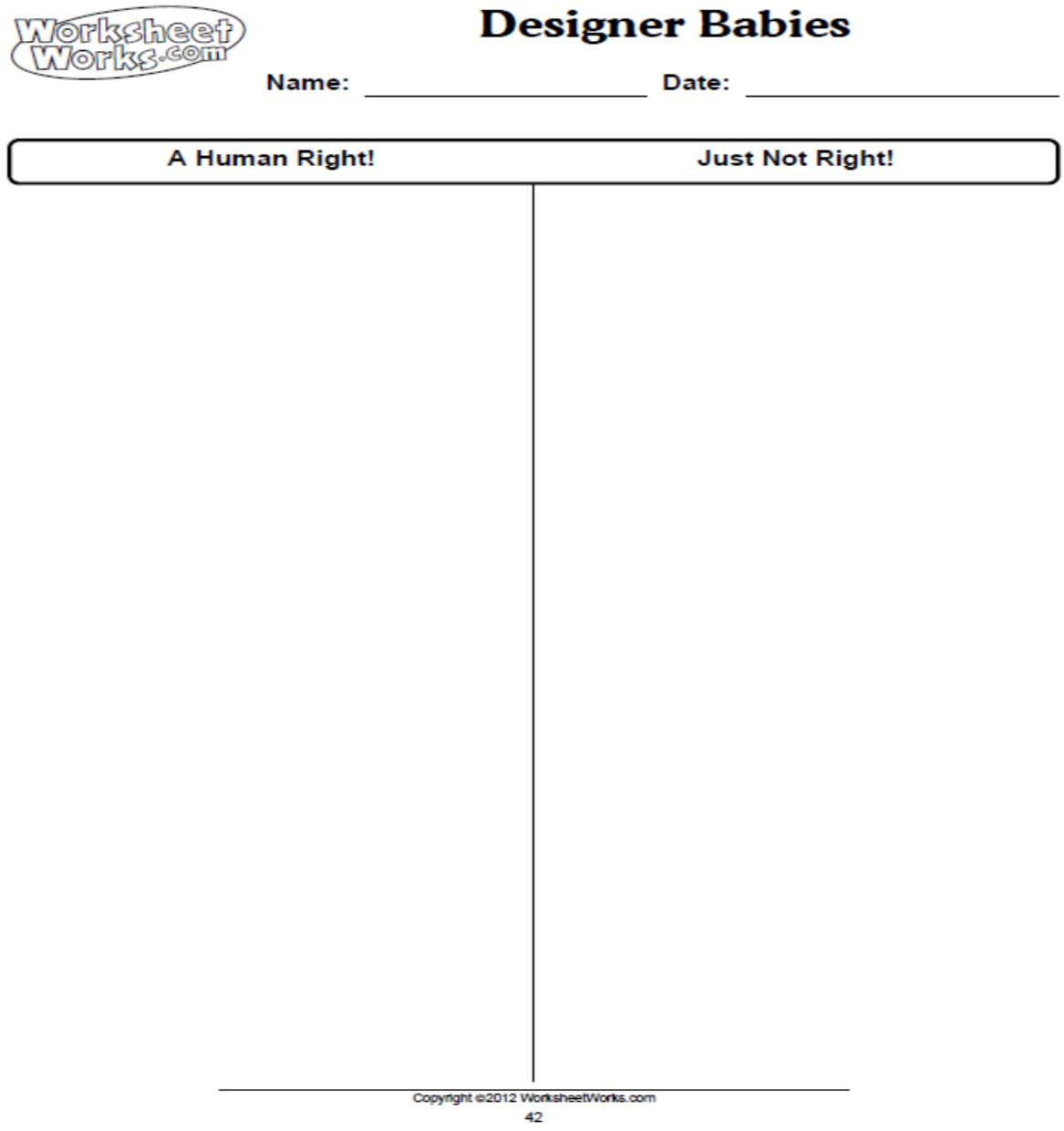
Eugenics is defined as "the study of or belief in the possibility of improving the qualities of the human species or a human population, by such means as discouraging reproduction by persons having genetic defects or presumed to have inheritable undesirable traits." Adolf Hitler was on a quest to create a race of Aryan Blond, blue-eyed and tall people. Creating designer babies is believed to be on the same lines. The question arises, which skin color and physical features are to be chosen? The advent of designer babies will affect biodiversity. Moreover, traits decided by parents, eliminates the say of the child in his or her life. Parents passionate about sports, would have the athletic ability engineered into the child, however, the child may not want the same. This reduces the child's freedom to choose.

Genetic engineering, if accepted, will have a negative impact on the society. It will result in increase of unreasonable fear or hatred towards foreigners or anyone who appears different. People with genetic defects will be socially rejected. They will be called 'gene poor' and will be separated from the society as well. Today, people who have genetic defects are already treated differently and cast out from society in several parts across the world. Designer babies concept, will lead to discrimination on the basis of certain qualities or traits. Kids of rich families will receive genetic enhancement, leading to genetic aristocracy. This gives them an unfair advantage over the other children. People unable to afford genetic engineering will be looked down upon, thereby, creating a

greater rift in society. Moreover, most parts of the world are still male dominated, and sex or gender determination of the baby, can lead to gender discrimination across the globe.

Genetic engineering can be likened to a knife, it can be used to destroy or bring life. What you use it for makes all the difference! While on one end, it is nothing but brutally wrong to use designer baby stem cells for cosmetic purposes, while on the other end using this technology to save life cannot be ignored. Stepping into the shoes of a sick child's parent, wouldn't you jump into having a savior child, without even the bat of the eye? Or would you find it too unethical to save your sick child, by the means of a designer baby?

By Priya Johnson Last Updated: March 20, 2013



Name: _____ Date: _____ Class# _____

Claim and a Counterclaim Organizer

Question: _____

_____

CLAIM	Argument #1(reason for claim)	Text-Based Evidence (Citation: Setup – Quote – Analysis)
	Argument #2(reason for claim)	Text-Based Evidence (Citation: Setup – Quote – Analysis)
	Argument # 3(reason for claim)	Text-Based Evidence (Citation: Setup – Quote – Analysis)

COUNTERCLAIM	Refutation (reason why counterclaim is wrong)	Text-Based Evidence (Citation: Setup – Quote – Analysis)

Name: Class: Date: **GMO Argumentative Rubric**

Component	4 (Exemplary)	3 (Proficient)	2 (Developing)	1 (Needs Support)
Introduces Claim about GMO CCLS-WHST.6-8.1a	The student introduces claim(s) about GMO use in society, acknowledges and distinguishes the claim(s) from alternate or opposing claim(s) during the introduction.	The claim demonstrates the student's position on GMO use in society, but the student may not fully make clear, the alternate claim(s) during the introduction.	The claim is somewhat unclear and the reader is unsure of the position the writer is taking on the significance, ethics, and impact of GMO use in society. The counterclaim(s) is unclear.	The claim is very unclear and phrased in a confusing way. The reader is left confused as to the position the writer is taking on the significance, ethics, and impact of GMO use in society. The counterclaim is not mentioned in the introduction.
Reasoning/ Citing Evidence CCLS-WHST.6-8.1b CCLS- RST.6-8.1	The student supports the claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic, using credible sources. The student can cite specific textual evidence from at least 6 credible sources to support the analysis of science and technical texts about GMO use in society.	The student supports the claim(s) with logical reasoning and relevant, accurate data and evidence, but struggles to demonstrate a comprehensive understanding of the topic, using credible sources. The student can cite specific textual evidence from at least 5 credible sources to support the analysis of science and technical texts about GMO use in society.	The student attempts to support the claim(s), but demonstrates some gaps in reasoning and logic. Data and evidence choices may not be the most relevant, although the sources are credible. The student can cite specific textual evidence from at least 4 credible sources to support the analysis of science and technical texts about GMO use in society.	The student cannot support the claim(s), logically, or the claim is not clear. Data and evidence do not relate to the claim or are missing; the sources are not credible or are missing. The student cites from 3 or fewer credible sources and/or does not cite specific textual evidence from at least one credible source.
Facts/Reasoned Judgment/Speculation CCLS- RST.6-8.8	The student can distinguish among facts, reasoned judgment based on research findings, and speculation in a text, and this is evident in the written work.	The student can distinguish facts, but may struggle to explain the nuances reasoned judgment based on research findings may have in the written work. The student is capable of distinguishing speculation from reasoned judgment and facts, and this is evident in the written work.	The student does not clearly distinguish between facts and reasoned judgment based on research findings in the written work. The student may struggle to distinguish speculation from reasoned judgment and facts, and this is evident in the written work.	The student does not distinguish between facts and reasoned judgment based on research findings in the written work. The student cannot distinguish speculation from reasoned judgment and facts, and this is evident in the written work.
Counterclaim/ Refutation CCLS- WHST.6-8.1b	The writer clearly expresses counterclaim(s) to the claim and organizes the reasons and evidence logically.	The writer expresses counterclaim(s) to the claim, but may need help organizing the reasons and evidence logically.	The writer's counterclaim(s) may be unclear; the writer may need help organizing the reasons and evidence logically.	The counterclaim is missing; little/no logical organization of reasons and evidence.
Conclusion CCLS-WHST.6-8.1e	Student provides a concluding statement or section that follows from and supports the argument presented.	Student provides a concluding statement or section that mostly follows from and supports the argument presented.	Student provides a concluding statement or section that vaguely follows from and supports the argument presented.	Student's written work ends abruptly or does not contain a concluding statement or section that follows from and supports the argument presented.
Transitions CCLS- WHST.6-8.1c	The student uses words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.	The student could use support in using words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.	The student struggles to use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence, resulting in a confusing organizational structure.	The student does not use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence, resulting in a fragmented and confusing organizational structure.
Formal Style CCLS- WHST.6-8.1d	Student establishes and maintains a formal style.	Student mostly establishes and maintains a formal style.	Student may establish a formal style, but the student fails to maintain it throughout the paper.	Student fails to establish and maintain a formal style.
Conventions (Spelling, Grammar, Punctuation and Capitalization) CCLS- L.8.2	There are no mistakes in conventions. The writer uses comma, ellipsis, and dash to indicate pause, break, or omission.	There are 1-2 mistakes in conventions using comma, ellipsis, and dash to indicate pause, break, or omission.	There are 3-4 mistakes in conventions using comma, ellipsis, and dash to indicate pause, break, or omission.	There are more than 4 mistakes in conventions using comma, ellipsis, and dash to indicate pause, break, or omission and/or student does not attempt to incorporate all of these grammar techniques

6

Accuracy of Scientific Background NYS Intermediate Level Science Core Curriculum Standard 4 Major Understandings 2.1a-2.1c, 3.1a	The definition of a GMO and the process used to create a GMO are correctly stated and elaborated upon to show complete understanding of the concept.	The definition of a GMO and the process used to create a GMO are correctly stated.	The definition of a GMO and the process used to create a GMO are somewhat vague and/or contain an error.	The definition of a GMO and the process used to create a GMO are missing or incorrect.
Accuracy of Scientific Support NYS Intermediate Level Science Core Curriculum Standard 4 Major Understandings 2.1a-2.1c, 3.1a	The supporting reasons and evidence contain a detailed explanation and show a clear understanding of related scientific concepts such as genetics, human health, etc.	The supporting reasons and evidence show a clear understanding of related scientific concepts such as genetics, human health, etc.	The supporting reasons and evidence show a vague understanding of related scientific concepts of genetics, human health, etc.	The supporting reasons and evidence contain errors in related scientific concepts such as genetics, human health, etc.

Grade: **Teacher Comments:**

GMO's	pts	pts	comment
pre assessment pg 3 & 4	10		
task 1 pg 9,10	20		
task 2 pg 15 & 16	20		Schneider Questions
task 3 pg 19,20, 21	30		
task 4 pg 27 & 28	20		