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Students' Knowledge and Opinions Concerning Genetically Modified Organisms: A Survey at University of Colorado Boulder

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ABSTRACT

This paper discusses the controversial topic of Genetically Modified Organisms, their relationship with food crops, and how opinions on their use are formed. University students are taught to think critically about each subject presented to them and view multiple aspects of the issue. It could be assumed that students studying in an environmental field, such as Environmental Studies, may have more knowledge and stronger opinions about the topic. A survey was sent to roughly 10,000 CU-Boulder students in order to figure out where they get their information on GMOs, what risks and benefits they know about GMOs, and what their overall opinion is about them. The results showed a much more neutral response to how GMOs are being used and revealed that students are using more objective and scientific sources for their information gathering. The respondents also recognized both the concerns and benefits that result from GMOs for food crops. Having more information about the topic did not necessarily show a stronger opinion regarding the topic. One recommendation for future studies would be to survey public opinions on GMOs, then provide them with information they do not already know about GMOs, and see if it changes their opinion.

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INTRODUCTION

Food is important. That is not a difficult statement to argue or debate; all humans need food to survive. Yet the production of food and food itself is changing; whether the changes are beneficial or not hinges upon public perception. Genetically modified (GM) organisms (GMOs) have been getting a lot of attention recently. Some scientists state that GMOs offer benefits regarding worldwide food availability, while others state that GMOs cause negative health effects and are harmful to the environment. Because there are many contrasting reports, obtaining honest, valid information regarding the effects of GMOs is difficult. The public's perception on the use of GMOs can be skewed and mislead by campaigning from biased markets attempting to gain support. However, institutions throughout the nation, and even around the globe, attempt to teach students to identify credible sources. Since students are taught to notice these sources that have been peer-reviewed, and to utilize critical thinking when provided a problematic situation, they may have a better understanding surrounding the GMO debate.

This report tests and discusses the influences of institutional learning on student perceptions concerning a controversial topic. The purpose is to find out if the area of study students immerse themselves in affects their opinion or perceptions around a widely debated topic, specifically GMOs. Students of Environmental Studies (ENVS) at the University of Colorado at Boulder (UCB) are presented with information about issues regarding our environment, such as: deforestation, global warming, hydraulic fracturing, sustainable energy, and ecological conservation. Furthermore, they are taught ways to think of approaches to help fix the current environmental problems. Therefore, it would not be surprising if ENVS students have heard of GMOs before most other students have and have created an opinion about them. An individual is affected not only by the individuals with whom he interacts but also the institutions

he lives and works in (Barton, 1968). The hypothesis of this report is: Assuming ENVS majors are more informed on environmental issues and topics, ENVS students will have stronger opinions (leaning more to one side than the other) toward the public debate of GMOs than students in other fields of study at UCB. This research tests that hypothesis with an anonymous survey that was sent out to as many students at UCB with questions about GMOs. How much understanding of GMOs they have, where they got their information, and where they stand on using GMOs. Hopefully this experiment will be able to provide some insight on understanding student's knowledge toward GMOs and how their area of study may affect their decision making.

BACKGROUND and LITERATURE REVIEW: THE PUBLIC DEBATE OF GENETICALLY MODIFIED ORGANISMS

As the world population continues to increase at an alarming rate, there are serious concerns about the ability that is needed to sustain the large influx of people. With improved understanding of biological processes, a new technology was developed in 1973 in order to grow food to be resistant to pests, weeds, and the elements: genetic engineering. Genetic engineering is the technological process that deals with the manipulation and modification of an organism's genetic material. All GMOs and GM foods are products of and have undergone genetic engineering. However, with this new technology comes much concern. Some concerns people have with GM crops are: health risks, environmental risks, and monopoly of agribusiness. In this section several different topics will be discussed, such as background information and description of GMOs, the concerns that surround them, the benefits that they can bring, and the perceptions that public around the world have of them.

WHAT IS A GMO?

To begin, let us discuss a bit about what genetic modification is and where it began. Genetic modification (GM) is the biotechnological process of manipulation of the genes of an organism either through amplification or suppression of a gene already in the organism, or through an addition of a new gene from another organism. The new gene must be introduced into the organism's cells for the gene to take effect. A protoplast (a cell with its cell wall removed) stage is required to allow full transplantation of the new gene into the organism. With the cell wall removed, it is much easier to access the nucleus of the cell where all the genetic information is stored. Three different classes have been used to classify plants that are GM: *i*) wide transfer - gene movement from organisms of other kingdoms into plants; *ii*) close transfer - movement between species of plants; and *iii*) tweaking - manipulation of levels or patterns of expression of genes already present in the plant (Lemaux, 2008). A GMO may also be referred to as transgenic, which is an organism that has had a gene transferred to its genome from another organism.

The first GMO was created back in 1974 with bacteria. Utilizing the technique of DNA cloning they created, Stanley Cohen and Herbert Boyer created the first GM DNA organism using the bacteria *Agrobacterium tumefaciens* as a vector (Woodward & Noble, 2010). The very first GM crop that was commercialized and approved by the Food and Drug Administration was the 'Flavr Savr tomato' in 1994. The Flavr Savr tomato was modified to suppress its production of polygalacturonase (PG) enzyme, which causes fruit to soften (Bruening & Lyons, 2000). Without the PG enzyme to breakdown the cell-wall pectin, the tomato was able to remain firm longer, giving it a desirable longer shelf life. Although the Flavr Savr tomato was the first GM crop to be sold in grocery stores, and the first created GMO was made in 1974, the process of

modifying organisms' genes to yield a more desirable trait has been around for thousands of years.

What most people may not know is we have been genetically modifying our food ever since we began cultivating crops. Neil DeGrasse Tyson has made a recent viral video stating this point saying, "we have systemically genetically modified all the foods, the vegetables and animals, that we have eaten ever since we cultivated them; it's called 'artificial selection', that's how we genetically modified them" (Mooney, 2014). Artificial selection (aka selective breeding) is a biological process humans use to isolate a desirable trait from another organism and intentionally breed that organism to exploit that trait. Tyson goes on to mention that since we are able to now use artificial selection in a lab, people are starting to "complain". Since we have been using artificial selection on crops ever since we have been cultivating them, means there is nothing wrong with creating transgenic crops in a lab, right?

Whether or not there are complaints about GMOs does not help to explain the possible consequences that could arise from biotechnology such as GE. The full extent of how transgenic foods impact human health and the environment is not known. There is an abundant amount of contradicting studies explaining the uses and effects of genetically modified organisms (GMOs) that will be discussed throughout this paper. One example is the addition of a gene from the bacteria Bacillus thuringiensis (Bt), that produces an insect repelling trait, into corn seed. The insect toxicity of Bt resides in crystal proteins called δ-endotoxins, which are broken down in the stomach; it has been believed that this protein has no toxicity to beneficial insects, other animals, or humans (Gasser, 1989). A study from the Center of Disease Control and Prevention (CDC), which will be discussed later, argues otherwise. Although crops that have been GM sound like a panacea for food availability around the world, the full effect of these crops is not well known.

Genes from the DNA of an organism can be extracted and imbedded into the DNA of a desired crop to produce certain desired results. For example, the Bt bacteria can produce a protein that naturally fights off other insects through the use of pheromones. The gene that produces this protein is isolated, copied, and inserted into corn seed so it may express the same protein. Scientists implant the gene into the corn through the use of a Particle Gun. The particle gun method has the potential to allow direct transformation of commercial genotypes by eliminating the need for passage through a protoplast stage (Gasser, 1989). Scientists open up a passage through the cell of the corn to directly implant the new gene into the nucleus of the cell using the Particle Gun. They then use recombinant DNA to attach the new gene onto the DNA of the target organism. Many crops and plants have been grown through the use of this biotechnology. The U.S. continued to lead the world in the adoption of biotechnology-derived crops in 2005 with about 123 million acres or 55% of the total global planted area (Sankula, 2006). In 2010, that number increased to 165 million acres in the U.S. with global crops totaling 366 million acres of biotechnology-derived crops (BIO site, 2011). Information from the study of transgenic plants is serving as an important focus for unifying basic plant science research in plant breeding, pathology, biochemistry, and physiology with molecular biology (Gasser, 1989).

RISKS OF USING GMOs

It has been said by environmental organizations and some scientists that GM foods have harmful and negative impacts on the environment and human health. Some of the negative impacts that have been stated include: wildlife damage, unsuspecting allergic reactions, and other possible unknown health effects. Potential adverse effects can arise from intended modifications (e.g. from the pesticidal substance) or from unintended effects resulting from the production of

an unexpected metabolite (EPA Research Program, 2005). While there may be claims that there are health effects caused by GM foods, there is no definitive data in support of such claims. Yet, the act of spraying pesticide chemicals on the crops does raise the probability of adverse effects occurring.

The Center for Disease Control and Prevention (CDC) conducted an epidemiological investigation to observe the effects on health of human test subjects after consumption of genetically modified corn products. They reported that "for 10 of 24 case subjects, symptom onset was rapid (within 1 hour)… reported loss of consciousness… weakness or dizziness. Nineteen individuals sought medical care… for allergic reaction. Two people were hospitalized" (CDC, 2001). The GM corn products that the participants ate contained the protein Cry9c from the Bt bacterium. Even though the CDC concluded that there was no clear evidence that the allergic reactions observed were associated with the Cry9c protein, they did not rule out the possibility of the protein having an effect (CDC, 2001). In 2009, Seralini et al also tested the chronic effects caused by the consumption of GM corn on the health of rats. The conclusion they found was that their observations did not allow a clear statement of toxicity, but possible signs of toxicity found in the rats liver (Seralini et al, 2009). Physiological reactions to chemicals and proteins produced by other organisms can be complex and difficult to understand because reactions for each individual can vary.

Effects on wildlife are another concern that has been brought up from skeptics of GM foods. English Nature launched a media campaign saying that the commercialization of herbicide-tolerant GM crops could lead to wildlife being damaged (Carter et al, 2010). Because some GM crops are herbicide-tolerant, farmers are then able to spray their crops with herbicides, killing weeds and any other plants in order to keep them from competing with the growing crops.

However, killing these undesirable plants can harm animals that use them for shelter or food, particularly birds. Ecological relationships include many cascading and higher order interactions that are intrinsically difficult to test and evaluate for significance at limited temporal and spatial scales (Wolfenbarger & Phifer, 2000). Pollen transfer causes neighboring non-GM crop fields to become infected from invading GM crops, causing unwanted ecological impacts to farmers. "Pollen from transgenic crops may cross with related crops or weeds, potentially transferring the engineered genes" (EPA Study, 2005).

This has powerful consequences on farmers who try to grow organic crops and are toppled by large GM companies (e.g. Monsanto) who infect their organic crops. Organic, by the USDA definition, prohibits the use of genetic engineering, or genetically modified organisms (GMOs) (McEvoy, 2013). GM companies file lawsuits against these organic farmers regarding rights to the GM seeds the now-non-organic crops are producing, due to seed patents. While pollen transfer of GM crops to non-GM crops is a real struggle that is being fought, other environmental and ecological impacts are imprecise due to limited research and short timeframes. Longer more extensive research on environmental impacts need to be conducted to fully grasp the effects GM crops may express.

Because of the possibility of human health effects caused by GM foods, and the possible harm they cause to wildlife, ethical concerns about the use of GM foods have been risen. These concerns include the ethical use of biotechnology; that is, how we look at and treat food safety and the environment. Should we be allowed to manipulate the genetic makeup of plants to benefit ourselves, even if we do not know the consequences? Some may if we have the intelligence and ability to improve our crops to benefit the human race, we should manipulate the crops. Others might argue we should not create anything that would not occur naturally and this

manipulation gives us to have too much control of the natural world. “Tied in with these ethical concerns is the argument by consumer advocates and NGOs that consumers have a ‘right to know’ whether the foods they are purchasing and consuming are either genetically modified or contain genetically modified ingredients” (Sheldon, 2007). The fight against labelling GM foods is another large and arduous battle between the ethical use of biotechnology and food marketing. Food companies in the United States are not required to give out information on how they produce their food, yet people believe that have the right to know what they are putting into their bodies. This is another topic for further research: the transparency of food corporations and the labels on the food they produce exercising people’s rights to know.

BENEFITS OF USING GMOs

In spite of the negative impacts that are believed to surround GM foods, there are many beneficial aspects that come from using GM foods and crops. It is able to increase food production worldwide by improving yield through increasing crops pest resistance and abiotic stress tolerance. The ability to make crops insect repellent is a huge advantage when attempting to produce a large quantity of food. Insects have large negative affects toward crops. They eat away at the stalks and nest inside of the crops. Constant expression of the same insecticidal protein in transgenic crops could lead to increase of resistance of the toxin in insects (Wolfenbarger & Phifer, 2000). Switching which protein the crops express could help fight against the evolutionary arms race between insects and the crops.

Ever since the implementation of GM foods in modern agriculture the production of food has increased at an appreciable rate. As the production increases, the ability to reduce world hunger and food availability increases. Many farmers choose to look at the use of GM foods in

this light (to increase overall crop production and thus provide improved short term food availability) instead of thinking of the possible health risks to themselves or the ecosystem (Lewis, 2010). "Overall growth of GM crop hectares in 2006 was 13%, or 12 million ha, and [glyphosate-resistant] technology was the dominant [herbicide resistant] technology planted" (Dill, 2008). Glyphosate is an herbicide resistant gene used on crops to ensure that they do not die when sprayed with herbicide to kill unwanted competing plants (i.e. weeds). Many benefits to farmers and food companies have come about from using GM techniques in their crops. During the last ten years, this technology has made important positive socio-economic and environmental contributions including a $5 billion direct income benefit to farmers in 2005 (Brookes & Barfoot, 2006). Some contributions that Brookes and Barfoot are referring to are reduced CO_2 emissions by performing fewer spray runs over the crops, which will reduce the amount of fuel used, while also reducing the amount of chemicals used.

Nutritional value is another potential benefit from using GM foods because it is possible to add genes expressing a trait of nutritional value. Most crops though are not grown to provide added nutritional value. On the basis of a systematic review of studies of satisfactory quality, there is no evidence of a difference in nutrient quality between organically and conventionally produced food stuffs (Dangour, 2009). GM crops main priority is to resist the negative effects of outside factors (e.g. insects, weeds, and weather tolerance) from reducing its productive yield. However, some crops are engineered to provide extra nutrients in parts of the world where they are lacking. Reliance on rice as a primary food staple contributes to vitamin A deficiency, a serious public health problem in at least 26 countries, including highly populated areas of Asia, Africa, and Latin America (Beyer er al, 2002). Vitamin A deficiency has become a global issue, causing blindness and maternal mortality. This vitamin is able to be genetically engineered into

rice. This results in the rice turning gold in color, which led to its name 'Golden Rice'. This can only be achieved by recombinant technologies rather than by conventional breeding to contribute to the alleviation of Vitamin A deficiency (Beyer et al, 2002). Conventional breeding is producing hybrid crops by hand pollinating one crop with another to produce a combination of both. It is impossible to cross-breed some crops with another due to physiological difference in the plants, so no hybrid can be produced. Also, isolating one particular gene to be expressed is nearly impossible through conventional breeding. The only way to develop a crop with the desired characteristics would be to modify its DNA with the desired gene. The media has dubbed the limited production of pro-vitamin A in Golden Rice a major hurdle to the success of the solving the Vitamin A deficiency problem (Paine, 2005). However, definitive statements on the benefits of Golden Rice for the alleviation of Vitamin A deficiency cannot be made (Paine, 2005). There has been a delay of the production of Golden Rice for the past 10 years and the cause for the delay is due to GE-regulation (Potrykus, 2012).

The thought of adding vitamins and nutrients into crops has not been around for a long time, so there has not been many experiments testing its feasibility. There is immense power in this new technology to improve nutritional quality of crops to help feed this ever-growing population (Jauhar, 2003). While it is always a good thing to be optimistic and think of all of the good that can come from a given product, it is always wise to consider every possible impact as well.

PUBLIC PERCEPTIONS ABOUT GMOs

There seems to be a split in public opinion about whether the uses of GM foods are beneficial or detrimental to human evolution. Many who believe they are beneficial believe so

based on increased production yield and nutritional value; while those who believe they are detrimental is because of unknown environmental impacts and health concerns. The skepticism that public consumers have for GM foods seems to mainly stem from them not fully understanding what GMOs are or the benefits that GM foods can have. "The acceptability of specific products is contingent on whether specific benefits are actually desired by consumers and who is perceived to be the recipient of such benefits" (Miles, 2005). Consumers may believe that the only benefits that come from using GM foods are those that benefit the farmers and food companies who produce the food and sell it to consumers. Then again, some consumers still may not accept GM products even if the benefits were directed at them.

A study in 2004 tested whether consumer's acceptance of GM foods would change if beneficial information about the food was provided. The study held an auction in three U.S. and two European locations, in a setting using real food and real money so people were held accountable for their decisions. Information on environmental, health, and world benefits significantly decreased the amount of money consumers demanded to consume a GM cookie versus a cookie with no GM ingredients in all locations except France (Lusk et al, 2004). These results suggest that the value consumers place on GM foods can be changed through added information (Lusk et al, 2004). The perceptions people place on the food they consume (or any decision really) are incredibly influential to their morals and beliefs. Other studies have found results that conflict with this study's results. In Europe, very few GM products have been approved for marketing as foods, and there is widespread public concern about their safety and environmental impacts (Rowland, 2002). Some people are worried about how the GM food they ingest could cause negative reactions in their bodies. However, other studies have shown that although consumers are concerned about health, safety and the environmental implications of

GM food, they are optimistic about their potential benefits (Rodríguez-Entrena & Sayadi, 2013). It seems as if the general opinion one particular study group has regarding GM foods depends on who is in that study group.

In another study, most of the respondents had a negative outlook toward GM foods, but not all of them. A questionnaire was sent to 2,000 addresses, the addressees' ages were 18 to 65, in Sweden and most subjects had rather negative opinions towards the use of GE in food production (Magnusson & Hursti, 2002). A majority of people declared that it would be against their principles and that it would be morally wrong for them to eat GM foods (Magnusson & Hursti, 2002). This study also found males, younger subjects, and those with three years of upper secondary school education were significantly more positive towards the food applications than women, older subjects, and other educational groups (Magnusson & Hursti, 2002). In result, a majority of the respondents from the Swedish survey had negative opinions toward GM production. The respondents that were younger and more educated, however, had a more positive attitude to GM food. It appears, with previous studies, as if more knowledge and communication surrounding the debate of production of GM crops could result in more positive outlooks on the topic.

The issue is that the majority of what is being discussed about GM products is speculation and rumors instead of facts. The benefits that were discussed earlier in the paper are not well advertised or well-known to the public, and because of this skepticism about GM products is high. This has the effect of instilling fear and unease within the consumers who hear about this information without checking its credibility. There is an obvious need for the second-generation GM foods to provide direct and clear advantages for the consumer, either in the developed, or in the developing world (Rowland, 2002). The second-generation GM foods

Rowland mentions are those that have gone through rigorous testing and strict regulations. The current generation of GM foods and products are in their adolescent stage, still figuring out what the possibilities can come from them and how to improve them. As the techniques and methods of producing GM foods becomes more well-known and understood, there will be more confidence in stating the advantages and disadvantages of the products.

Right now, the best way for controversies about GM foods and crops to subside would be for companies utilizing GM technology and their scientists to have better communication and transparency with the public consumers. To resolve all of the conflicting issues about GM products and to make its technology more beneficial, interested parties in GM products, such as non-governmental organizations (NGOs), government bodies (such as: EPA, USDA, FDA, etc.), biotech companies, and scientists need to work proactively (Chetty, 2007). This way, the information gathered by the scientists and biotech companies through research experiments can present the data to NGOs and government bodies so they can properly report it to the public. Having more communication and more knowledge about a process that is not commonly well-known is key for such a process to become more accepted. However, we must be cautious in concluding that increases in education and knowledge can increase the acceptance of GM food (Rodríguez-Entrena & Sayadi, 2013). There is not a simple solution to such a controversial topic.

There is currently a strong dichotomy between accepting and disregarding the use of GM foods. The pro-GMO camp charges its opponents with blowing potential risks out of proportion in order to manipulate public opinion against this new technology (Marris, 2001). Anti-GMO groups tend to lobby undecided public consumers by making erroneous claims about GM products, overstating the harms that come from them. Pro-GMO groups also tend to sway the undecided public by understating the harms and over exaggerating the benefits. Claire Marris

conducted an interview experiment to get public views on GMOs and she concluded "participants knew and accepted that it was necessary to counter-balance risks with benefits, but felt that they were not told how this judgment had been made." (2001). Deciding which has a larger influence, the risks or the benefits, all boils down to personal preferences: do you believe the benefits outweigh the risks, or are the risks too high?

A majority of the consumers appear to believe that risks outweigh benefits and still have uncertainties about GM foods. In response to these concerns, some regulatory adjustments have been proposed, reflecting increasing opposition to GM foods and consistently strong public opinion in favor of labeling (Wohlers, 2013). People feel that they should be allowed to choose whether or not they consume GM foods. GM foods are becoming more ubiquitous and the complete knowledge of their benefits and complications is not fully known. Estimates suggest that as much as 80% of U.S. processed food may contain an ingredient from a GE group (Lemaux, 2008). Labeling GM food products may not stop the production of GM foods and crops from being grown, but allow people a choice between GM and non-GM foods. Currently more than 15 states in the United States, concentrated in the West, Midwest, and Northeast, are considering such legislation of food labeling (Wohlers, 2013). Sooner or later, as GM foods become larger and more dominant, people will demand labeling on GM foods and all of the United States will have labels delineating GM and non-GM foods.

The debate about the increased utilization of GM foods into common food sources has become a sensitive topic among people of all walks of life: naturalists, capitalists, and even scientists. Naturalists believes that genetically engineered manipulation of food is unnatural and provides negative effects, while capitalists believes there is opportunity and world improvement through the genetically engineered manipulation of food. Many scientists are split with the

decision as well, debating whether the benefit of the advancement of this new technology is worth ignoring the ethical issues that are involved. Some scientists wonder why the debate over agricultural biotechnology and its applications continue to transpire while there are proven facts that biotechnology-derived crops are economically viable, environmentally sustainable, and are as safe as, if not safer, than their conventional counterparts (Sankula, 2006). Advantages and disadvantages are prevalent with GM food production, just like with any large scale decision. Disadvantages of GM foods are that there is a potential of adverse health effects, damages to ecosystems and wildlife, and ethical concerns. Advantages of GM foods are increasing food production and crop yield, reducing food availability and world hunger, and the possibility of adding nutrients to crops. While there are many opposing sides to this issue, there is no consensus. The more we experiment, test, and understand the effects of GMOs, there will be more information to be able to decide if GMOs are more advantageous or detrimental. Until that day though, all we can do is continue to gather more information and increase our communication about it to better understand this topic.

METHODS

Students studying at an academic institution are taught to question and critically assess all situations and inform themselves of issues they do not fully comprehend. In order to test my hypothesis that states ENVS students will have a stronger opinion on the production of GMOs, an online survey was used to ask questions about their knowledge and opinion on GMOs. The survey was created using the online software Qualtrics, and was then distributed to 40% of enrolled students attending CU-Boulder. No control group was used in this experiment (i.e. no public participants took the survey). The survey consisted of 20 questions and was anonymous.

There were six questions from the survey that asked basic information about the students, which were: gender, race, age, class year at UCB, the school they are enrolled in, and their major.

Knowing the major of each student is a vital component to this research in order to analyze their responses with their field of study. Many students may have different responses or opinions toward GMOs and the decision made about them. Yet the decisions of what students in one particular major believe could vary significantly to another due to the teaching protocols students are subjected to in their major. Professors and teachers convey subject matter to their students in different ways; depending on the field of study the teacher may ask the students to think about a topic in separate ways from other fields of study. The strength of their beliefs, alongside with the knowledge of the issue, is the most important result. The other 14 questions referred to the topic of GMOs.

To collect these results, questions about the processes of GMOs and their affects were asked. Several other aspects about students relationships and knowledge about GMOs were asked, such as: where each subject obtains his or her information about GMOs, ranking them on how often they use each source, their opinions about labeling foods that have GM ingredients in them, and as well as how often they eat organic foods. These types of questions are created to form an understanding about the student's lifestyle and how that could affect their responses. To rate their overall opinion of the way GMOs are produced and sold in stores, each subject may choose between the options of: Strongly Disagree, Disagree, Neither Agree nor Disagree, Agree, or Strongly Agree. A full copy of the survey, each question, and the answer choices may be seen in Appendix A.

Attempting to disseminate an online survey to a campus of roughly 30,000 students, undergraduate and graduate, is not an impossible task, but it is definitely not a simple task. There

are no public records or lists of each student's emails in any school or department at UCB, so contact with the Registrar's office was needed. After contact with the Registrar's office was established, they informed me that I must get in contact with the Campus Communications and Engagement (CCE). They are the department from which all surveys, newsletters, and information about all UCB events and news is distributed to each student. I learned that CCE has never been approached by a student who wanted to send out a survey for a project to the rest of the student body. This information brought the progression of my experiment to a halt. In an attempt to continue the experiment, which meant getting assistance from CCE to send out the survey, CCE had policy meetings to create a new policy for students desiring to send out survey's to fellow students. The process for adding a policy took several weeks and the conclusion that the CCE came to was that they were unable to send direct survey's from one student to all students. The Assistant Director made a comment saying, "as we do not release campus email addresses to independent parties or for non-university business, we have determined we cannot support a direct one-to-one email." They were, however, able to develop "a promotion protocol to get your survey in front of as many of our campus audience members as possible". This protocol consisted of promoting the survey on a special student research survey webpage, through a special tag in the campus Buff Bulletin Board, as well as through Community Notes in *CU-Boulder Today.* Although the survey was not directly sent to and received by all students at UCB, the survey was accessible to anyone that witnessed any of those promotions.

With the survey not directly delivered to each student, the expected response rate for the survey of 10% was not achieved so other options of distributing the survey out to as many students had to be taken. Instead of attempting to go through the Registrar's office at UCB, I

decided to get in contact with each individual school at UCB myself and speak directly to the dean. Emailing each individual dean, or advisors to the deans, I asked for approval and assistance in sending out the survey. Each school was contacted: Arts & Science, Business, Education, Engineering, Music, Environmental design, Journalism, and the Graduate school. I asked if they would allow me to email them the link to the survey, as well as a short paragraph describing the contents and subject of the survey, and have them forward the survey on to the students enrolled in their school. Some agreed and were willing to distribute the survey among their enrolled students, while other schools either did not have access to a list of their students' emails or would not approve.

The School of Arts & Sciences has 39 major departments included within their school so the dean did not have a list of all the students in each department. It was suggested to contact each department individually and ask for their permission, which is what I did. Each major departments was contacted and informed about the ongoing project and survey and all were asked if they would be willing to assist in sending out my survey. Several responded stating they would help, some replied saying they would not help, and the rest never responded. In the end, about 19 departments under Arts & Science helped distribute the survey to their students. Approximately 10,000 surveys were sent out to the students and more than 300 students responded.

Responses to the survey questions that were received were then processed and analyzed through the Qualtrics Survey Software. Answers to the same questions from multiple respondents were grouped together and the mean, variance, and standard deviation of each question were recorded. Once the goal (10% of the # of students the survey was sent to) was

reached, then comparative analysis between the responses was conducted and discussion of the results is expressed below.

RESULTS

After attempting to distribute the survey to the entire student population at UCB, which is roughly 30,000 students, the survey was only directly sent to just over 10,000 students. The survey was sent to all the students in the Education school, the Journalism school, the Music school, the Graduate school, and in 19 departments within the Arts & Science School. The departments in the Arts & Science school that were willing to forward the survey on to their students are as followed: Asian Languages and Civilizations, Asian Studies, Chemistry and Biochemistry, Classics, Ecology and Evolutionary Biology, Economics, Environmental Studies, Geological Sciences, Germanic and Slavic Languages and Literatures, Integrative Physiology, International Affairs, Linguistics, Molecular, Cellular, and Developmental Biology, Philosophy, Religious Studies, Spanish and Portuguese, Speech, Language and Hearing Services, Theatre and Dance, and Women and Gender Studies.

STUDENT DEMOGRAPHIC QUESTIONS

Although the survey was sent to over 10,000 students, and was expected to get a roughly 10% of that amount of students to respond to the survey, a total of 347 students responded to the survey. Additionally, not all of the 347 respondents completed the survey. Only 306 fully completed the survey where the other 41 stopped at indiscriminate places. This means that all of the questions will not have an equal amount of responses to them. Out of all of the students that received the survey, 347 took the survey, giving a total response rate percentage of

approximately 3.5%. Even though that is less than half of the expected response rate for the survey, there is still data to evaluate and analyze. All tables, graphs, and figures from the survey results can be found in Appendix B.

Females responded the most to the survey with 65% of the total, whereas 32% were males, with the other 3% not disclosing their gender. The race that responded to the survey the most was White/Caucasian at 83% with Asians next at 5%. Another 5% did not specify their race. Many of the respondents are older students, mainly seniors or Graduates, whereas most of the respondents saying they have not heard of GMOs are freshman (Appendix C). The age of most of the respondents, at 37%, is 23 or older with 21-22 year olds coming in second with 32%. A majority of the respondents were older students, either seniors or Graduates, as they make up 55% of the respondent's class year, with Graduates at the highest with 29%. Having mostly CU Graduate students answering and responding had an effect on the answers to the rest of the survey. Most of the responses came from the School of Arts & Sciences (60%). This is mainly because most majors taught at UCB go through Arts & Sciences unless they are more specialized.

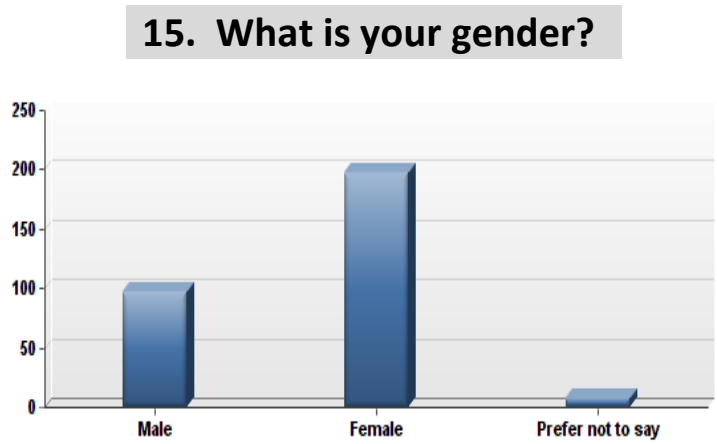

Figure 1: Graph showing the number of males and females who participated in the survey.

		Have you heard of Genetically Modified/Engineered Organisms (GMOs) before this survey? (If yes, p...		
		Yes	No	Total
How old are you?	17-18	17	2	19
	19-20	68	4	72
	21-22	92	4	96
	23 or older	110	0	110
	Prefer not to say	4	0	4
	Total	291	10	301
Class Year	Freshman	27	4	31
	Sophomore	38	2	40
	Junior	38	1	39
	Senior	75	2	77
	5th Year	14	0	14
	Graduate	87	1	88
	Part-time matriculated	2	0	2
	Other	10	0	10
	Total	291	10	301

Table 1: Cross Tabulation of Age and Class Year of each participant and if they have heard of Genetically Modified Organisms before taking the survey.

16. How old are you?

#	Answer		Response	%
1	17-18		19	6%
2	19-20		72	24%
3	21-22		96	32%
4	23 or older		110	37%
5	Prefer not to say		4	1%
	Total		301	100%

Figure 2: Answers to question asking age of each respondent.

The major that was highest in responding were Music/Music Education Majors at 29 total respondents, with Anthropology majors at 28 total respondents. Chemistry and Environmental Studies majors were next at 20 respondents each and Journalism majors was the 5th highest at 17. The lowest majors to respond were Accounting, Art History, and Marketing majors with no students in the major responding to the survey. Astronomy, Business, Economics, and Sociology majors were the next lowest at only 2 respondents from each major.

GMO QUESTIONS

Out of 335 respondents, 97% said that they have heard of Genetically Modified Organisms. This is a remarkably high percentage that was not expected. The level of understanding that all of the respondents had on GMOs had an average score of 60, which a little bit more than a moderate understanding of GMOs. Measuring for this variable was done on a self-ranked scale from 0 to 100, where 0 was No Understanding, 50 was Moderate Understanding and 100 as Complete Understanding. The major that ranked itself with having the highest understanding of GMOs Political Science majors with an average of 83. Environmental Studies majors had an average understanding level of 74 after Political Science. The major with the lowest understanding level is Sociology with an average understanding level of 27. The majors that have averages of 0 did not have participants in the major take the survey. Almost four-fifths of the respondents knew that organic foods have not been genetically modified/engineered at 79%.

Each major was clumped into a group of similar area of study to acquire a different perspective of the data. A total of five groups were created which were: Business, Natural and

Physical Sciences, Social Sciences, Art, and Applied Sciences. Majors based on their study focus

were grouped into one of these groups and each of their responses were collected and totaled. A

list of which major was lumped in which group can be found in Appendix C. Looking at the

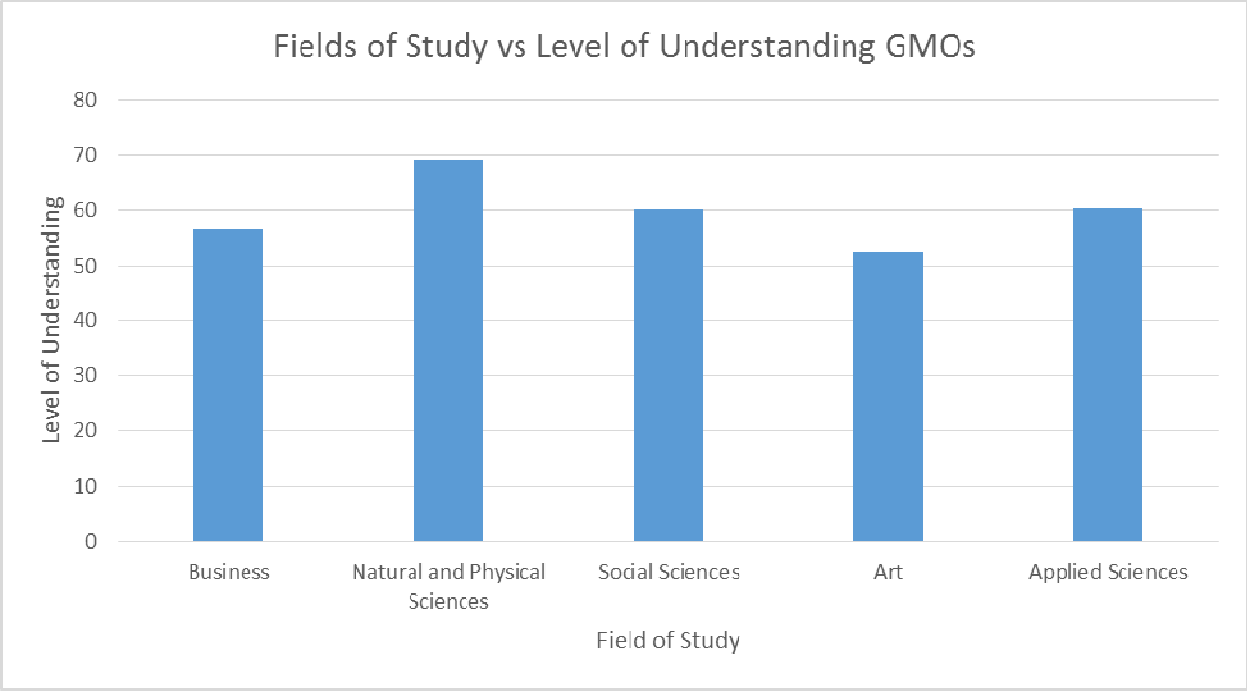

Figure 3: Level of understanding of GMOs between different fields of study.

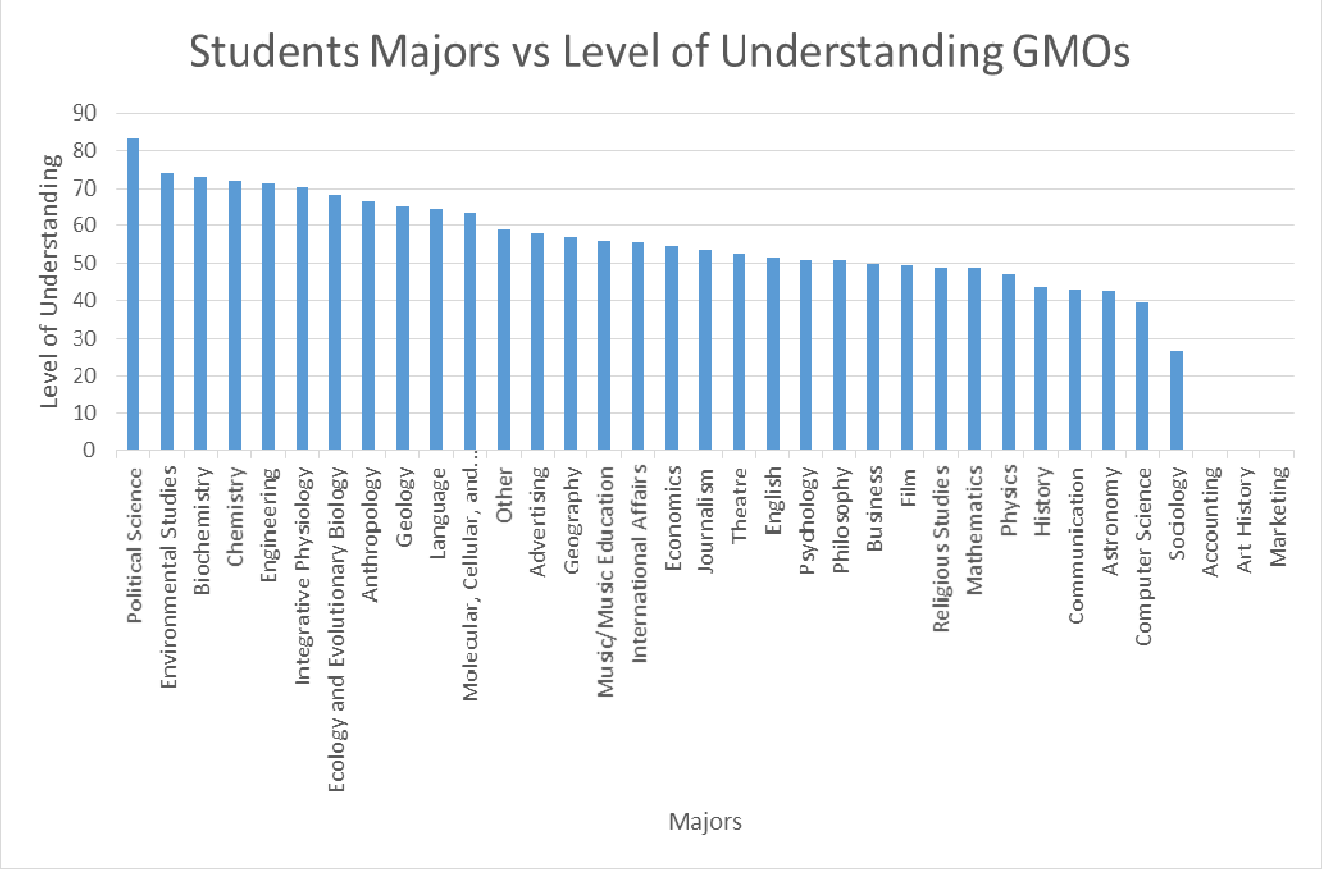

Figure 4: Graph comparing the level of understanding on GMOs with each participants major.

grouped majors and their level of understanding toward GMOs, the field of study that shows the

most knowledge about GMOs are those in Natural and Physical Sciences. The field of study that has the least amount of knowledge is the field of Art.

With these different levels of understanding, most of the respondents had concerns with GMOs, at 66% of 319 responses. A lot of their concerns revolve around health issues and wildlife impact, but mostly with agricultural company control at 82%. The area of least concern about GMOs is the contamination of non-GMO crops from near-by GMO crops at 61% of total responses. There are 21% of respondents that had other concerns regarding GMOs and their written answers can be found in Appendix B. A majority of the written response lean to the issue of long term affects that GMOs may have on the environment and human health. Other written concerns mention lack of information given, mutation resistance, mono-cropping and monocultures, and loss of biodiversity.

Despite the high amount of concern many of the respondents appeared to exhibit, the most selected attitude toward the production and selling of GMOs in stores was Neutral at 32%. There was then a close tie between respondents Agreeing and Disagreeing at 21% and 22% respectively. The major that had the strongest Disagreeing opinion were the Anthropology majors with half of the participants being against GMOs. The major that had the strongest Agreeing opinion toward GMOs was Biochemistry with 83% of the students agreeing, with Chemistry in second with 70% of their students agreeing. The respondents seem to agree that there are concerns regarding the use and consumption of GMOs, but they also believe there are benefits that can come from GMOs. There are 83% of students that believe GMOs can help produce higher crop yield, 70% that believe there are lower costs by using less pesticides and herbicides, and 59% believe GMOs will help with weather intolerance.

5. What is your opinion toward the producing and selling of Genetically Modified foods, or foods containing GMOs, in stores?

#	Answer		Response	%
1	Strongly Disagree		34	11%
2	Disagree		65	22%
3	Neither Agree nor Disagree		96	32%
4	Agree		62	21%
5	Strongly Agree		43	14%
	Total		300	100%

Figure 5: Percentages and numbers of answers for each participant's opinions on GMOs

		What is your opinion toward the producing and selling of Genetically Modified foods, or foods con...					
		Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Total
What is your current or intended major? If you have one, what is your current minor? - Major	Accounting	0	0	0	0	0	0
	Advertising	2	3	1	3	1	10
	Anthropology	7	6	8	3	2	26
	Art History	0	0	0	0	0	0
	Astronomy	0	0	0	2	0	2
	Biochemistry	0	0	2	5	5	12
	Business	0	1	0	0	0	1
	Chemistry	0	1	5	5	9	20
	Communication	0	5	3	0	1	9
	Computer Science	0	0	0	2	1	3
	Economics	0	1	1	0	0	2
	Ecology and Evolutionary Biology	0	1	2	1	2	6
	English	1	3	4	1	0	9
	Engineering	1	0	6	1	3	11
	Environmental Studies	1	7	6	6	0	20
	Film	0	2	2	1	1	6
	Geography	0	0	1	2	0	3
	Geology	0	0	5	1	2	8
	History	0	2	1	0	1	4
	Integrative Physiology	1	0	3	1	0	5
	International Affairs	4	2	0	0	0	6
	Journalism	1	6	6	3	1	17
	Language	4	1	2	0	2	9
	Marketing	0	0	0	0	0	0
	Mathematics	2	0	1	2	0	5
	Molecular, Cellular, and Developmental Biology	0	1	0	3	0	4
	Music/Music Education	2	6	11	5	2	26
	Philosophy	2	3	6	3	4	18
	Physics	0	0	2	1	0	3
	Political Science	1	0	1	1	0	3
	Psychology	1	5	4	0	0	10
	Religious Studies	1	1	1	2	1	6
	Sociology	0	0	1	1	0	2
	Theatre	0	1	1	2	0	4
	Other	3	6	2	1	3	15
	Total	34	64	88	58	41	285

Table 2: Cross tabulation of each major that participated in the survey and their opinions about using GMOs.

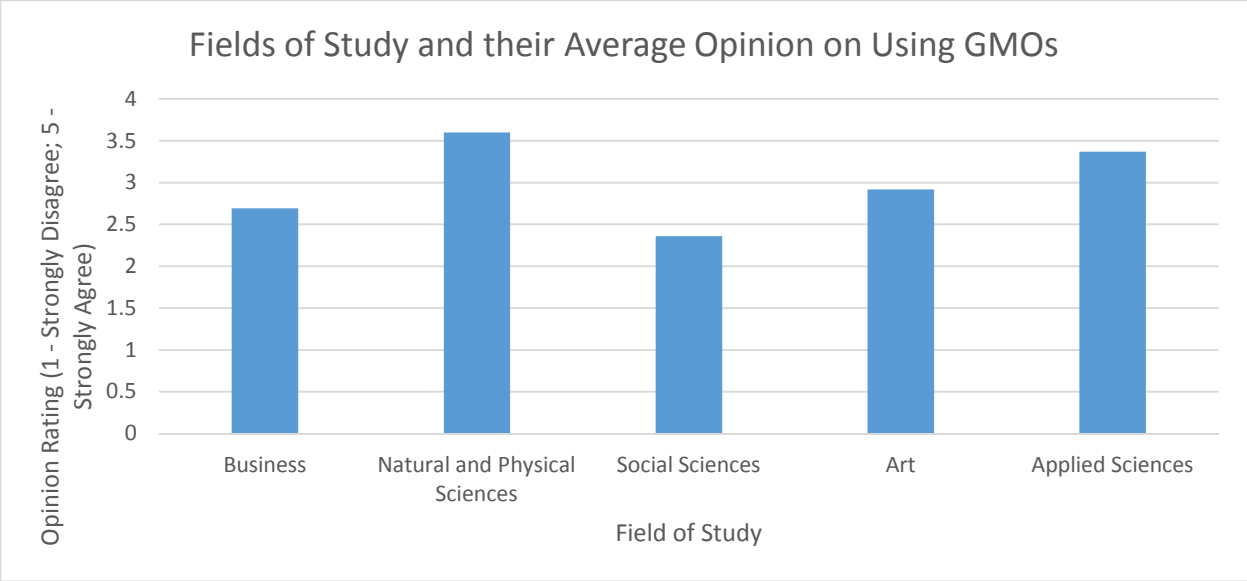

Figure 6: Graph comparing majors grouped into different fields of study and what their collective opinions are on using GMOs.

		As Genetically Engineered technology increases, do you believe it will cause more risks or more b...			
		Risks > Benefits	Benefits > Risks	No Opinion	Total
What is your current or intended major? If you have one, what is your current minor? - Major	Accounting	0	0	0	0
	Advertising	7	1	2	10
	Anthropology	15	7	4	26
	Art History	0	0	0	0
	Astronomy	0	2	0	2
	Biochemistry	0	10	2	12
	Business	1	0	0	1
	Chemistry	2	16	2	20
	Communication	7	2	0	9
	Computer Science	0	3	0	3
	Economics	1	0	1	2
	Ecology and Evolutionary Biology	1	4	1	6
	English	7	1	1	9
	Engineering	2	7	2	11
	Environmental Studies	8	7	5	20
	Film	3	1	2	6
	Geography	0	3	0	3
	Geology	1	6	1	8
	History	2	2	0	4
	Integrative Physiology	2	1	2	5
	International Affairs	4	2	0	6
	Journalism	8	4	5	17
	Language	5	3	1	9
	Marketing	0	0	0	0
	Mathematics	2	3	0	5
	Molecular, Cellular, and Developmental Biology	1	3	0	4
	Music/Music Education	11	9	6	26
	Philosophy	8	8	2	18
	Physics	0	2	1	3
	Political Science	2	1	0	3
	Psychology	8	2	0	10
	Religious Studies	3	3	0	6
	Sociology	1	1	0	2
	Theatre	1	2	1	4
	Other	9	4	2	15
	Total	122	120	43	285

Table 3: Cross tabulation of the survey participants major and their answers to the question asking if Genetic Engineering will cause more benefits or more risks in the future.

Figure 6 shows the result of the grouped responses of majors explained previously and what their opinions are on using GMOs. Natural and Physical Science majors have the highest level of opinion, which means they are more agreeable to GMOs. The Social Science majors have the lowest level of opinion meaning they are more against GMOs. The other three (Art, Business, and Applied Sciences) appear to have the most neutral stance, with Art majors being the most neutral.

The respondents believe there are both concerns and benefits surrounding GMOs, putting them at a draw at concluding whether GMOs are good or bad. More people are neutral to the opinion and there is even a tie between whether they believe Genetic Engineering will cause more risks or more benefits in the future at 42% on both sides. The other 16% do not have an opinion. This could be due to where each of the respondent gets their information about GMOs from. The top four sources that are used among the survey takers seem to be: Internet Sites, Scientific Articles/Literature Reviews, the News/Media and Documentaries/TV, in roughly that order. Internet Sites has the lowest mean and standard deviation, meaning that out of the rest of the options available, it was picked the most to be the primary source of information. The lowest four sources that seem to be used are: Work Associates, Organizations/Groups, Social Media, and Friends/Family, with Work Associates being the least common source of information.

STUDENT LIFESTYLE QUESTIONS

Other questions were asked about each respondent's lifestyle habits and eating, with questions such as: How often do you read food labels? When you read food labels, do you look for GMOs? Do you believe foods with GMOs should be labelled? How often do you eat organic foods? Around 62% believed that foods containing GMOs should be labeled, where 19% thought

they should not be labeled and the other 19% had no opinion. Food labeling seems to be an important factor in the GMO controversy as 37% of the respondents read food labels most of the time and 24% always read food labels. However, 66% of the respondents said that they do not look for GMOs when they read food labels. Most of the respondents also eat organic food during the week. Students eating organic foods 2-3 times a week are the highest with 30% of the total respondents where eating organic foods daily was second highest at 27%. In the end though, only a handful, 30%, stated that they would continue to seek information on GMOs after taking the survey where 35% said they would not seek more information and the other 35% did not know.

DISCUSSION

The conversation about GMOs has become a controversial debate that is thick with biased rhetoric, causing confusion within the public. People gather information from all different source platforms such as the TV, the internet, or from special interest organizations. Students attending a well-respected university may have differing first impressions of a controversial topic because they are taught to think critically about such topics. What students are taught and how they are shown to gather information can have an impact on their decision-making and opinion about a topic that is largely debated. A survey was made and used to record the student's views and opinion on the largely debated topic of GMOs and to see if ENVS students how much knowledge they have on GMOs and if it affects their ideals of them.

STUDENT DEMOGRAPHICS

The survey asked if the respondent had ever heard of Genetically Modified Organisms. Over 95% of the students who took the survey answered they have heard of GMOs. It seems

GMOs are not uncommon to students at UCB, which is probably due to the large environmentally-friendly community that resides in Boulder, and may also be well known amongst the locals. The age group for the responses was not as expected. More than half of the participants were either in their senior year or Graduate students. The age of respondents that participated the most were in the early 20's to older at 69% of the total respondents. Since the participants of the survey seem to be a bit older than the average stereotypical college student, it could be thought that they are also a bit more wise and knowledgeable than the younger students. This would make sense as younger students are starting their first year in college and are not familiar with some topics that are discussed. Older students may know more of the benefits and problems that come with GMOs, making the decision of whether they are good or bad more indecisive.

The number of female respondents compared to male respondents is much larger than expected. There was thought to be an even mix of gender test subjects with slight deviations for one compared to the other. Yet the number of female participants is more than double the number male participants. Females seem to have a larger concern for their health and what they put into their body than the concern males do. Most males do not worry extensively about possible health issues or outside impacts the choice of their food may have. Females also tend to prepare the food for their families and children, so they are more curious about what they will be serving to their loved ones. When seeing the promotion for the survey, many males would not have much of an interest taking a survey about GMOs, where females may take it much more seriously.

The total number of each major that responded was fairly surprising. The major with the largest number of students responding were Music/Music Education students with 26

respondents. This is definitely unexpected as Music majors are not thought to have much of an opinion toward the public debate of GMOs and their use, yet they had the highest response rate. The other highest majors who participated (Anthropology, Environmental Studies, and Chemistry respectively) make more sense in their participation. Anthropology majors study how humans interact with each other and with the environment around them, so they make connections on how humans treat the world and people around them. Environmental Studies have a similar studying field as Anthropology, but stick to more of the environmental and natural aspects of the world and how to conserve the resources we have. Chemistry majors focus on the molecular structures of living, and non-living, objects so they would know the scientific understanding of GMOs and their production.

The majors that were least involved with the survey were Accounting, Art History, and Marketing. Not one student from all three of these majors responded to the survey that was sent to them, which may stand to suggest that the survey was not sent to them as some department directors did not respond about sending the survey out. However, Astronomy, Business, Economics, and Sociology did have responses, but at the lowest rate of two respondents. This is not that surprising as these majors do not seem to have a large invested interest in GMOs and what how food crops are grown. Business and Economics majors, on the other hand, may have some interest as many GMO producing companies (e.g. Monsanto, Dupont, and DOW to name a few) have made a considerable profit off of them. Yet, on the scientific and health aspects of GMOs they may not have much of an opinion, and that does show in the results.

STUDENTS AND GMOs

The hypothesis for this paper was that Environmental Studies majors had more knowledge and information about the public debate surrounding GMOs, so they would have a stronger opinion to them. However, from the data gathered from ENVS students who responded, the hypothesis is not supported. There was a tie between each opinion toward GMOs. There were seven students that Agreed, six students that Disagreed, and six students that Neither Agreed or Disagreed. Although there were students supporting each side of controversy, there is no significant weight of students on either side to make a definitive decision. ENVS students ranked themselves as second to the rest of the majors for have the highest level of understanding about GMOs. If ENVS students do have a higher knowledge on GMOs than other major students, and they do not have a strong opinion on the use of GMOs, than it must mean having more knowledge on a debated topic does not make a person more bias, but more unbiased.

Students that show to have less of an understanding and knowledge about GMOs show to have more bias in the debate of using GMOs. Computer Science and Astronomy students ranked on the lower end of understanding. The students in those majors who responded were more biased to agree with using GMOs. However, this is not the case with all of the majors. Biochemistry and Chemistry students who responded to the survey ranked third and fourth behind ENVS majors in level of understanding. Although they were ranked high on knowledge of GMOs, they were the majors that had the strongest opinion toward using GMOs, which was for using them. They also believed that using GMOs in the future will create more benefits than risks, where ENVS students were unbiased on the point being evenly split.

Seeing this trend with the Biochemistry and Chemistry students compared with the results from the ENVS students makes me think that not just the amount of knowledge of GMOs

affects a student's opinion, but also what they study. Biochemistry and Chemistry students study chemical and molecular structures of organic and inorganic material. Students in those majors learn about how chemical reactions interact and produce different products. They also know the safety and/or dangers of those chemical products. GMOs are produced through the introduction of new genes and the proteins and chemicals they produce for desired outcomes, which Biochemistry and Chemistry students are familiar with. Many of the companies producing GMOs (e.g. Monsanto, DuPont, DOW, and others) employee biochemists to help create and test new GMOs. It should be no surprise then to see that students studying in Biochemistry or Chemistry would agree that GMOs are beneficial and should be produced.

On the other hand, there are some majors who also state they have a good understanding of GMOs, yet they believe GMOs should no longer be produced. Anthropology students had a large response rate of 26 students responding, and had a level of understanding around 66. Despite the more than moderate level of understanding, those students still believed that producing GMOs are bad and they disagree with using them. The Anthropology students also appear to believe that the risks of genetic engineering technology will outweigh the benefit effects in the future. Anthropology students study humans past interactions with the environment and other humans, so having this knowledge may have them believe that manipulating nature to this extent could be drastic.

Looking back at Figure 6, showing the groups of majors and their average opinions, it is clear to see that different broad fields of study have conflicting opinions when it comes to producing GMOs. Majors in the field of study of Natural and Physical Sciences seems to agree more with producing and using GMOs, while those in Social Sciences tend to disagree more with them. Majors in Natural and Physical Science contain Biochemistry, Chemistry, Ecology, ENVS,

and other natural studies that are comprehensive in the biological/chemical sciences of how GMOs work and are more likely to see benefits that come from them. While Social Science majors focus on how people see and interact with GMOs and focus more on the concerns people have about them. The other three groups (Business, Art and Applied Sciences) show to have a bit less understanding than the other two groups and more neutral on an opinion.

Where the students get their information about GMOs is an important part in whether they have a strong opinion. The number one source used for information on GMOs was Internet Sites, which could be any page they would find if they Googled "GMOs", with Scientific Articles right behind. This was not all too shocking, as most people now seem to get all their information off of online websites. It is also reassuring to see that students are still using scientific articles as a source of information regarding a fairly complicated and controversial topic. One interesting piece of data was too see information gathered from Organizations/Groups as second to last. I would think many anti-GMO organizations would be sending out pamphlets and newsletters about their opinion on how to use GMOs. Yet it seems the more scientific and objective areas of research are used more often instead of the subjective and biased ways.

A large majority of the respondents had concerns with the production of GMOs, yet at the same time many more responded with benefits that they can bring. The largest concern that respondents have is agricultural companies producing and selling the GM foods controlling most of the crops. The next highest concern is health issues that may come from consuming GM food products. Studies have been done on the types of health consequences GMOs cause, yet the validity of the reports are low and complete knowledge of the health risks are sparse. So having uncertainty on their affects adds a large fear factor to many people's opinions. Conversely, people still observed the benefits that GMOs have on crops. The benefit that people say the most

with GMOs was that they increase the crop yield and provide more food during harvest time. This is an important benefit that is one of the main reason food crops began to be GM. The other benefit that was viewed was having lower agricultural costs on the crops with less pesticides and herbicides being used. Having lower costs helps the farmers with less chemicals to buy, which is also beneficial to have less chemicals on the food. It is refreshing to see that although many people have concerns regarding GMOs, they are also able to see the benefits it brings. Having these double-sided views can present respondents with a neutral stance on producing and selling GMOs.

There were many limitations and complications that I ran into while conducting this experiment which could have affected the results. The first would be that the survey was not sent out to every student who is attending UCB. It was very difficult to distribute the survey when there was not a list of student's email addresses I could have forward the survey to. The number of responses that was received was below the common rate of 10% to feel as if it was a good representation of all students at UCB. Several majors only had a handful of respondents, where some had none, which did not allow a good representation of each of those majors and skewed the averages of the leveling of understanding, opinions, and other results. Around 40 of the surveys were half completed, which had to be discarded so to not further skew the results. Confusion with wording on some of the survey questions may have affected the answers of each respondent. Finally, creating survey questions to accurately measure students' level of understanding and opinions on GMOs. The survey had to be short and informative, but also not too overwhelming while still trying to acquire a good measurement.

CONCLUSION

There are many tough decisions being made throughout the world, and many are still being debated on their ethical consequences. There is a lot of good that can come from using genetic engineering. Crops can become more weather tolerant, require less chemical sprays to be put on them, and can help increase nutrients within the food. However there are also a lot of potential bad that can arise from using genetic engineering. There are unknown health consequences that can occur from ingestion foods that have been genetically modified. Plants that have genetically modified can also have negative effects on wildlife and the environment they are living in.

It was hypothesized that students studying Environmental Studies would have a stronger opinion about GMOs based on the premise that they have greater knowledge about environmental issues. The results show that Environmental Studies majors have a higher level of understanding when it comes to GMOs, yet they have less of a strong opinion when it comes to producing and selling them. ENVS students are taught to think critically and observe both sides of the argument with environmental issues. Having more knowledge about GMOs may lead to them not taking one side over another since they are able to see multiple perspectives of the argument.

There were other majors though that claimed to have a high level of understanding as well, but also had strong opinions toward producing GMOs. Biochemistry and Chemistry students showed to agree with the production of GMOs, while Anthropology students were against it. It appears that the field of study students associate themselves with has an effect on their opinion toward GMOs, despite their level of understanding. The overall results with all the

participants showed that college students are still indecisive about whether or not GMOs are good or bad.

RECOMMENDATIONS:

Some recommendations for future studies exploring Genetically Modified Organisms could be to perform the same type of study with a public population and compare the results with those from the students. Or to perform the same type of study with different interest groups and organizations, in order to get a sense on where they stand. There are also not many long term environmental impact studies conducted regarding Genetically Modified Organisms effects. The actually environmental impacts are uncertain and need further studying. One last suggestion would be to inform people of the benefits and risks about GMOs and get rid of some of the misinformation to see if people's opinions would change if they knew more.

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APPENDIX A – SURVEY QUESTIONS

1. Have you heard of Genetically Modified/Engineered Organisms (GMOs) before this survey? (If yes, please state when)
   a. ☐ Yes ____
   b. ☐ No

2. What is your level of understanding about GMOs?

0 - No understanding	25 - A little understanding	50 - Moderate understanding	75 - A lot of understanding	100 - Complete understanding

3. Do you have concerns about GMOs?
   a. ☐ Yes
   b. ☐ No
4. What are your concerns with GMOs?
   a. ☐ Health issues (e.g. cancer, allergies, etc.)
   b. ☐ Wildlife impact
   c. ☐ Contamination of non-GMO crops
   d. ☐ Agricultural company control over crops
   e. ☐ Other ____
   f. ☐ No concerns
5. What is your opinion toward the producing and selling of Genetically Modified foods, or foods containing GMOs, in stores?
   a. ☐ Strongly Disagree
   b. ☐ Disagree
   c. ☐ Neither Agree nor Disagree
   d. ☐ Agree
   e. ☐ Strongly Agree

6. In what ways has your information about GMOs been obtained? (Rank suggestions below by dragging)

   Documentaries/TV

   Internet Sites

Scientific Articles/Literature Reviews

News/Media

Social Media

Friends/Family

Organizations/Groups (e.g. flyers or meetings)

Work Associates

7. How often do you read food labels?
    a. ☐ Never
    b. ☐ Rarely
    c. ☐ Sometimes
    d. ☐ Most of the Time
    e. ☐ Always
8. When you read food labels, are GMOs something you look for?
    a. ☐ Yes
    b. ☐ No
9. Do you believe foods containing GMOs should be labeled?
    a. ☐ Yes
    b. ☐ No
    c. ☐ No Opinion
10. How often do you eat organic foods?
    a. ☐ Never
    b. ☐ Less than Once a Month
    c. ☐ Once a Month
    d. ☐ 2-3 Times a Month
    e. ☐ Once a Week
    f. ☐ 2-3 Times a Week
    g. ☐ Daily
11. Are you aware that organic foods have <u>not</u> been Genetically Modified/Engineered?
    a. ☐ Yes
    b. ☐ No
12. What do you think are the benefits of using GMOs? (Check all that apply)
    a. ☐ Increased nutrients

b. ☐ Weather intolerance
c. ☐ Higher crop yield
d. ☐ Lower costs (i.e. less pesticides & herbicides)
e. ☐ Improved tastes
f. ☐ No benefits

13. As Genetically Engineered technology increases, do you believe it will cause more risks or more benefits in the future?
    a. ☐ Risks > Benefits
    b. ☐ Benefits > Risks
    c. ☐ No Opinion
14. After taking this survey, will you seek out more information about Genetically Modified Organisms?
    a. ☐ Yes
    b. ☐ No
    c. ☐ Not sure
15. What is your gender?
    a. ☐ Male
    b. ☐ Female
    c. ☐ Prefer not to say
16. How old are you?
    a. ☐ 17-18
    b. ☐ 19-20
    c. ☐ 21-22
    d. ☐ 23 or older
    e. ☐ Prefer not to say
17. What is your race?
    a. ☐ White/Caucasian
    b. ☐ African American
    c. ☐ Hispanic
    d. ☐ Asian
    e. ☐ Native American
    f. ☐ Pacific Islander

g. ☐ Other
h. ☐ Race not specified

18. Class Year
    a. ☐ Freshman
    b. ☐ Sophomore
    c. ☐ Junior
    d. ☐ Senior
    e. ☐ 5th Year
    f. ☐ Graduate
    g. ☐ Part-time matriculated
    h. ☐ Other
19. School/College
    a. School of Arts and Sciences
    b. School of Business
    c. School of Engineering
    d. School of Education
    e. International College
    f. School of Law
    g. School of Music
    h. School of Media and Journalism
    i. Graduate School
    j. Other

20. What is your current or intended major? If you have one, what is your current minor?

Accounting

Advertising

Anthropology

Art History

Astronomy

Biochemistry

Business

Chemistry

Communication

Computer Science

Economics

Ecology and Evolutionary Biology

English

Engineering

Environmental Studies

Film

Geography

Geology

History

Integrative Physiology

International Affairs

Journalism

Language Marketing Mathematics

Molecular, Cellular, and Developmental Biology

Music/Music Education

Philosophy

Physics

Political Science

Psychology

Religious Studies

Sociology

Theatre

Other

APPENDIX B – SURVEY RESULTS

1. Have you heard of Genetically Modified/Engineered Organisms (GMOs) before this survey? (If yes, please state when)

#	Answer		Response	%
1	Yes		324	97%
2	No		11	3%
	Total		335	100%

Statistic	Value
Min Value	1
Max Value	2
Mean	1.03
Variance	0.03
Standard Deviation	0.18
Total Responses	335

2. What is your level of understanding about GMOs?

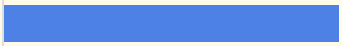
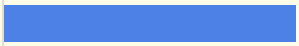
#	Answer	Min Value	Max Value	Average Value	Standard Deviation	Responses
1		0.00	100.00	59.84	22.53	318

Statistic	Value
Total Responses	318

3. Do you have concerns about GMOs?

#	Answer		Response	%
1	Yes		212	66%
2	No		107	34%
	Total		319	100%

Statistic	Value
Min Value	1
Max Value	2
Mean	1.34
Variance	0.22
Standard Deviation	0.47
Total Responses	319

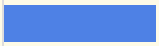
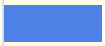
4. What are your concerns with GMOs?				
#	Answer		Response	%
1	Health issues (e.g. cancer, allergies, etc.)		140	70%
2	Wildlife impact		137	69%
3	Contamination of non-GMO crops		122	61%
4	Agricultural company control over crops		164	82%
5	Other		41	21%

Statistic	Value
Min Value	1
Max Value	5
Total Responses	199

Other
Concerned about people who are concerned about GMOs ...Good south park episode
Changing natures natural balance, not just wildlife
effect on human microbiome
mutations that could result in unknown genetic impacts
evolutionary effects
And how they will affect bacteria/microorganisms that evolve at much faster rates than larger organisms... similar to issues with pesticides
Suppression of smaller, more ethical, and more sustainable farmers; and movement away from permaculture and biomimicry practices in agriculture; I do not like the idea of monocropping on such a large scale
All of the above
Long term effects on the planet
Effects of monoculture
lack of information given
Long term unseen
resistance from GMO mutations
Resulting mutations in plants and animals
The reasons foods are genetically modified (e.g. increased pest resistence vs. resistence to a specific poison)
Atmospheric impact
Unregulated, untested, GRAS
Unknown ecosystem impacts
labeling will potentially hurt organic farmers
Soil health
losing the longterm ability to produce food
Loss of biodiversity
strongly associated with other bad agg. practices like lack of genetic diversity and pesticide use
Extensive use of pesticides on crops with resistance imparted via GM
Pesticide resistance/escalation, soil destruction
BUMBLE BEES!
All of this, a little.
Endocrine system disruption, large scale disease-induced crop failure, lack of testing or accountability
just generally heard that they are "bad"; worried about loss of diversity
Monsanto's affliation with the FDA.
long run impacts
Patenting mixed with company propaganda creates monopolies that impoverish farmers, eg, with rice monopolization in India, leading to many farmer suicides. This is abhorrent.
domesticated farm animal feed
how it will effect natural evolution for plants and creatures alike
MONSANTO
Impact on soils
reduced variety of crops
anyway i can potentially be harmed im concerned about
uncoreseen consequences

I don't know what impact GMOs have.

5. What is your opinion toward the producing and selling of Genetically Modified foods, or foods containing GMOs, in stores?

#	Answer		Response	%
1	Strongly Disagree		34	11%
2	Disagree		65	22%
3	Neither Agree nor Disagree		96	32%
4	Agree		62	21%
5	Strongly Agree		43	14%
	Total		300	100%

Statistic	Value
Min Value	1
Max Value	5
Mean	3.05
Variance	1.45
Standard Deviation	1.21
Total Responses	300

6. In what ways has your information about GMOs been obtained? (Rank suggestions below by dragging)

#	Answer	1	2	3	4	5	6	7	8	Total Responses
1	Documentaries/TV	68	62	48	42	13	26	25	16	300
2	Internet Sites	42	71	72	47	38	18	9	3	300
3	Scientific Articles/Literature Reviews	85	44	44	49	21	21	15	21	300
4	News/Media	42	43	58	62	46	30	12	7	300
5	Social Media	6	21	22	24	73	54	50	50	300
6	Friends/Family	41	30	21	43	47	61	40	17	300
7	Organizations/Groups (e.g. flyers or meetings)	9	14	17	19	42	70	97	32	300
8	Work Associates	7	15	18	14	20	20	52	154	300
	Total	300	300	300	300	300	300	300	300	-

Statistic	Documentaries/TV	Internet Sites	Scientific Articles/Literature Reviews	News/ Media	Social Media	Friends/Family	Organizations /Groups (e.g. flyers or meetings)	Work Associates
Min Value	1	1	1	1	1	1	1	1
Max Value	8	8	8	8	8	8	8	8
Mean	3.43	3.24	3.35	3.67	5.50	4.51	5.76	6.54
Variance	4.71	2.68	4.80	3.21	3.43	4.53	3.10	4.12
Standard Deviation	2.17	1.64	2.19	1.79	1.85	2.13	1.76	2.03
Total Responses	300	300	300	300	300	300	300	300

7. How often do you read food labels?

#	Answer		Response	%
1	Never		7	2%
2	Rarely		25	8%
3	Sometimes		85	28%
4	Most of the Time		110	37%
5	Always		73	24%
	Total		300	100%

Statistic	Value
Min Value	1
Max Value	5
Mean	3.72
Variance	1.00
Standard Deviation	1.00
Total Responses	300

8. When you read food labels, are GMOs something you look for?

#	Answer		Response	%
1	Yes		99	34%
2	No		189	66%
	Total		288	100%

Statistic	Value
Min Value	1
Max Value	2
Mean	1.66
Variance	0.23
Standard Deviation	0.48
Total Responses	288

9. Do you believe foods containing GMOs should be labeled?

#	Answer		Response	%
1	Yes		183	62%
2	No		55	19%
3	No Opinion		57	19%
	Total		295	100%

Statistic	Value
Min Value	1
Max Value	3
Mean	1.57
Variance	0.63
Standard Deviation	0.80
Total Responses	295

10. How often do you eat organic foods?

#	Answer		Response	%
1	Never		1	0%
2	Less than Once a Month		21	7%
3	Once a Month		21	7%
4	2-3 Times a Month		40	14%
5	Once a Week		44	15%
6	2-3 Times a Week		88	30%
7	Daily		80	27%
	Total		295	100%

Statistic	Value
Min Value	1
Max Value	7
Mean	5.34
Variance	2.39
Standard Deviation	1.55
Total Responses	295

11. Are you aware that organic foods have not been Genetically Modified/Engineered?

#	Answer		Response	%
1	Yes		234	79%
2	No		61	21%
	Total		295	100%

Statistic	Value
Min Value	1
Max Value	2
Mean	1.21
Variance	0.16
Standard Deviation	0.41
Total Responses	295

12. What do you think are the benefits of using GMOs? (Check all that apply)

#	Answer		Response	%
1	Increased nutrients		115	39%
2	Weather intolerance		175	59%
3	Higher crop yield		246	83%
4	Lower costs (i.e. less pesticides & herbicides)		207	70%
5	Improved tastes		53	18%
6	No benefits		33	11%

Statistic	Value
Min Value	1
Max Value	6
Total Responses	295

13. As Genetically Engineered technology increases, do you believe it will cause more risks or more benefits in the future?

#	Answer		Response	%
1	Risks > Benefits		125	42%
2	Benefits > Risks		123	42%
3	No Opinion		47	16%
	Total		295	100%

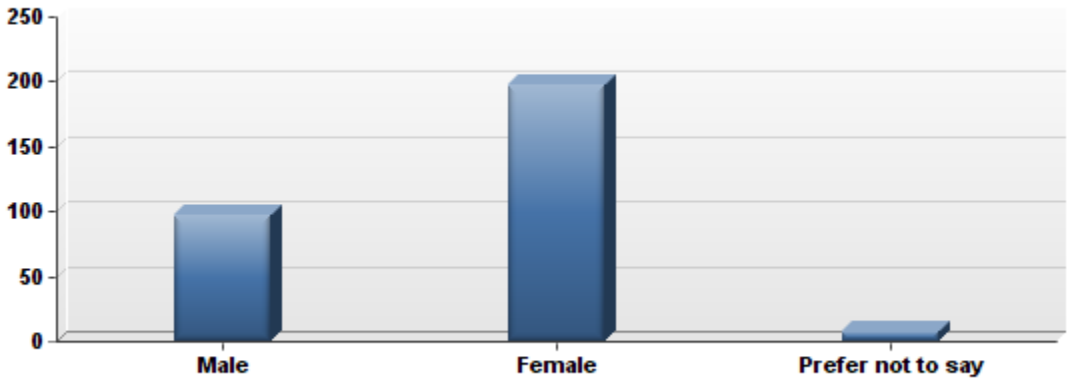
Statistic	Value
Min Value	1
Max Value	3
Mean	1.74
Variance	0.51
Standard Deviation	0.72
Total Responses	295

14. After taking this survey, will you seek out more information about Genetically Modified Organisms?

#	Answer		Response	%
1	Yes		88	30%
2	No		104	35%
3	Not sure		103	35%
	Total		295	100%

Statistic	Value
Min Value	1
Max Value	3
Mean	2.05
Variance	0.65
Standard Deviation	0.80
Total Responses	295

15. What is your gender?



#		Answer		Response	%
1		Male		97	32%
2		Female		197	65%
3		Prefer not to say		7	2%
		Total		301	100%

Statistic	Value
Min Value	1
Max Value	3
Mean	1.70
Variance	0.26
Standard Deviation	0.51
Total Responses	301

16. How old are you?

#	Answer		Response	%
1	17-18		19	6%
2	19-20		72	24%
3	21-22		96	32%
4	23 or older		110	37%
5	Prefer not to say		4	1%
	Total		301	100%

Statistic	Value
Min Value	1
Max Value	5
Mean	3.03
Variance	0.91
Standard Deviation	0.96
Total Responses	301

17. What is your race?

#	Answer		Response	%
1	White/Caucasian		250	83%
2	African American		2	1%
3	Hispanic		11	4%
4	Asian		14	5%
5	Native American		1	0%
6	Pacific Islander		2	1%
7	Other		7	2%
8	Race not specified		14	5%
	Total		301	100%

Other
Multiracial
black, white, native american
Nepaleses and White
Mixed
mixed, Hispanic and Caucasian
homo sapiens
White / Asian

Statistic	Value
Min Value	1
Max Value	8
Mean	1.73
Variance	3.38
Standard Deviation	1.84
Total Responses	301

18. Class Year				
#	Answer		Response	%
1	Freshman		31	10%
2	Sophomore		40	13%
3	Junior		39	13%
4	Senior		77	26%
5	5th Year		14	5%
6	Graduate		88	29%
7	Part-time matriculated		2	1%
8	Other		10	3%
	Total		301	100%

Statistic	Value
Min Value	1
Max Value	8
Mean	4.08
Variance	3.40
Standard Deviation	1.84
Total Responses	301

19. School/College				
#	Answer		Response	%
1	School of Arts and Sciences		180	60%
2	School of Business		2	1%
3	School of Engineering		16	5%
4	School of Education		22	7%
5	International College		0	0%
6	School of Law		1	0%
7	School of Music		28	9%
8	Other		7	2%
9	School of Media and Journalism		22	7%
10	Graduate School		23	8%
	Total		301	100%

Statistic	Value
Min Value	1
Max Value	10
Mean	3.34
Variance	10.87
Standard Deviation	3.30
Total Responses	301

#	Question	Accounting	Advertising	Anthropology	Art History	Astronomy	Biochemistry	Business	Chemistry	Communication	Computer Science	Economics	cology and Evolutionary Biology	English	Engineering	Environmental Studies	Film	Geography	Geology	History	Integrative Physiology	International Affairs	Journalism	Language	Marketing	Mathematics	Molecular, Cellular, and Developmental Biology	Music/Music Education	Philosophy	Physics	Political Science	Psychology	Religious Studies	Sociology	Theatre	Other	Total Responses	Mean
1	Major	0	11	28	0	2	12	2	20	9	4	2	6	9	13	20	6	3	8	4	5	6	17	9	0	5	4	29	18	3	3	10	6	2	4	15	295	17.87
2	Minor	0	0	2	3	3	3	4	3	3	2	3	12	3	4	4	3	0	5	5	0	0	3	12	1	5	2	6	7	4	5	6	3	4	2	39	161	23.16

Statistic	Major	Minor
Min Value	2	3
Max Value	35	35
Mean	17.87	23.16
Variance	102.22	106.54
Standard Deviation	10.11	10.32
Total Responses	295	161

APPENDIX C – CROSS TABULATIONS and OTHER GRAPHS

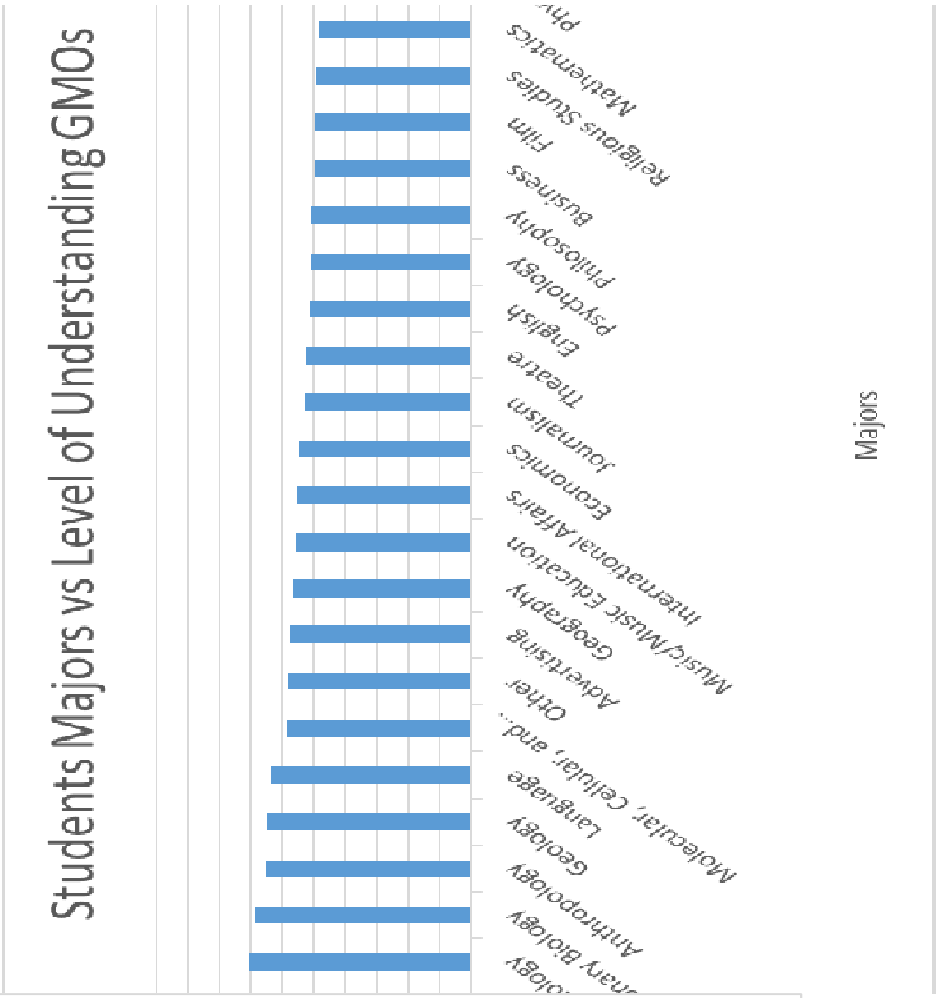
		Have you heard of Genetically Modified/Engineered Organisms (GMOs) before this survey? (If yes, p...		
		Yes	No	Total
How old are you?	17-18	17	2	19
	19-20	68	4	72
	21-22	92	4	96
	23 or older	110	0	110
	Prefer not to say	4	0	4
	Total	291	10	301
Class Year	Freshman	27	4	31
	Sophomore	38	2	40
	Junior	38	1	39
	Senior	75	2	77
	5th Year	14	0	14
	Graduate	87	1	88
	Part-time matriculated	2	0	2
	Other	10	0	10
	Total	291	10	301

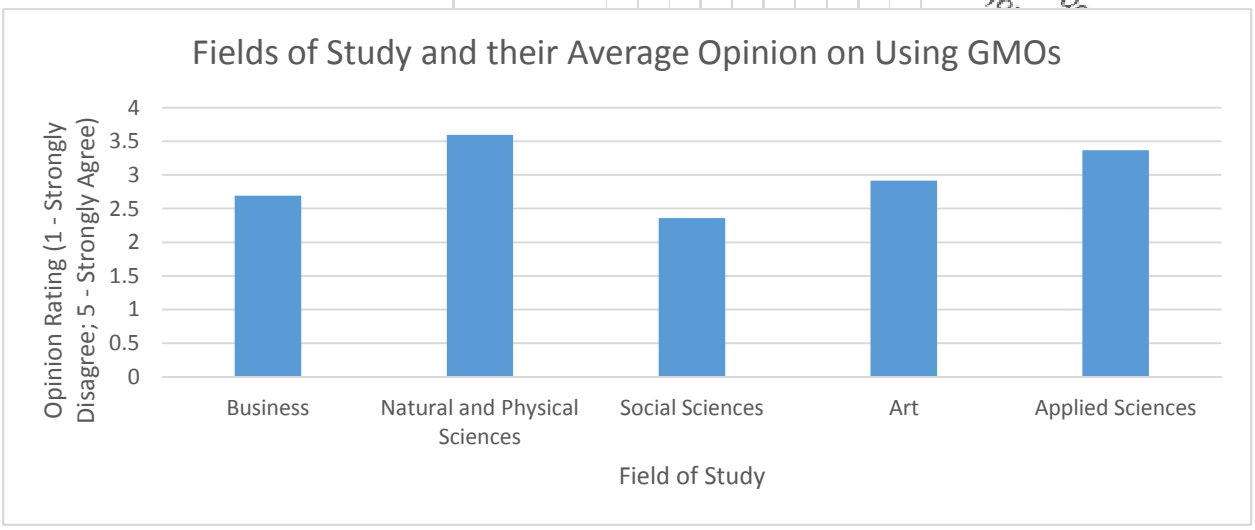
		What is your opinion toward the producing and selling of Genetically Modified foods, or foods con...					
		Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Total
What is your current or intended major? If you have one, what is your current minor? - Major	Accounting	0	0	0	0	0	0
	Advertising	2	3	1	3	1	10
	Anthropology	7	6	8	3	2	26
	Art History	0	0	0	0	0	0
	Astronomy	0	0	0	2	0	2
	Biochemistry	0	0	2	5	5	12
	Business	0	1	0	0	0	1
	Chemistry	0	1	5	5	9	20
	Communication	0	5	3	0	1	9
	Computer Science	0	0	0	2	1	3
	Economics	0	1	1	0	0	2
	Ecology and Evolutionary Biology	0	1	2	1	2	6
	English	1	3	4	1	0	9
	Engineering	1	0	6	1	3	11
	Environmental Studies	1	7	6	6	0	20
	Film	0	2	2	1	1	6
	Geography	0	0	1	2	0	3
	Geology	0	0	5	1	2	8
	History	0	2	1	0	1	4
	Integrative Physiology	1	0	3	1	0	5
	International Affairs	4	2	0	0	0	6
	Journalism	1	6	6	3	1	17
	Language	4	1	2	0	2	9
	Marketing	0	0	0	0	0	0
	Mathematics	2	0	1	2	0	5
	Molecular, Cellular, and Developmental Biology	0	1	0	3	0	4
	Music/Music Education	2	6	11	5	2	26
	Philosophy	2	3	6	3	4	18
	Physics	0	0	2	1	0	3
	Political Science	1	0	1	1	0	3
	Psychology	1	5	4	0	0	10
	Religious Studies	1	1	1	2	1	6
	Sociology	0	0	1	1	0	2
	Theatre	0	1	1	2	0	4
	Other	3	6	2	1	3	15
	Total	34	64	88	58	41	285
What is your current or intended major? If you have one, what is your current minor? - Minor	Accounting	0	0	0	0	0	0
	Advertising	0	0	0	0	0	0
	Anthropology	1	0	0	1	0	2
	Art History	2	0	0	0	0	2
	Astronomy	0	0	1	1	1	3
	Biochemistry	0	0	1	2	0	3
	Business	0	0	3	0	1	4
	Chemistry	1	0	0	1	1	3
	Communication	1	1	0	1	0	3
	Computer Science	0	0	1	0	0	1
	Economics	1	0	1	0	1	3
	Ecology and Evolutionary Biology	1	4	5	2	0	12
	English	0	1	2	0	0	3
	Engineering	0	0	3	0	0	3
	Environmental Studies	1	0	0	3	0	4
	Film	0	2	0	0	1	3
	Geography	0	0	0	0	0	0
	Geology	0	0	4	1	0	5
	History	1	0	2	1	1	5
	Integrative Physiology	0	0	0	0	0	0
	International Affairs	0	0	0	0	0	0
	Journalism	0	1	1	1	0	3
	Language	3	4	0	2	3	12
	Marketing	0	1	0	0	0	1
	Mathematics	0	0	2	2	1	5
	Molecular, Cellular, and Developmental Biology	0	0	1	0	1	2
	Music/Music Education	1	1	3	0	1	6
	Philosophy	3	2	1	1	0	7
	Physics	0	0	0	0	4	4
	Political Science	1	2	2	0	0	5
	Psychology	1	0	1	3	1	6
	Religious Studies	0	3	0	0	0	3
	Sociology	0	3	1	0	0	4
	Theatre	1	0	1	0	0	2
	Other	7	10	15	3	2	37
	Total	26	35	51	25	19	156
Class Year	Freshman	0	6	15	4	2	27
	Sophomore	8	7	16	5	2	38
	Junior	6	13	7	6	6	38
	Senior	6	17	30	14	8	75
	5th Year	1	4	4	3	2	14
	Graduate	10	15	18	24	20	87
	Part-time matriculated	0	1	0	1	0	2
	Other	3	2	2	1	2	10
	Total	34	65	92	58	42	291

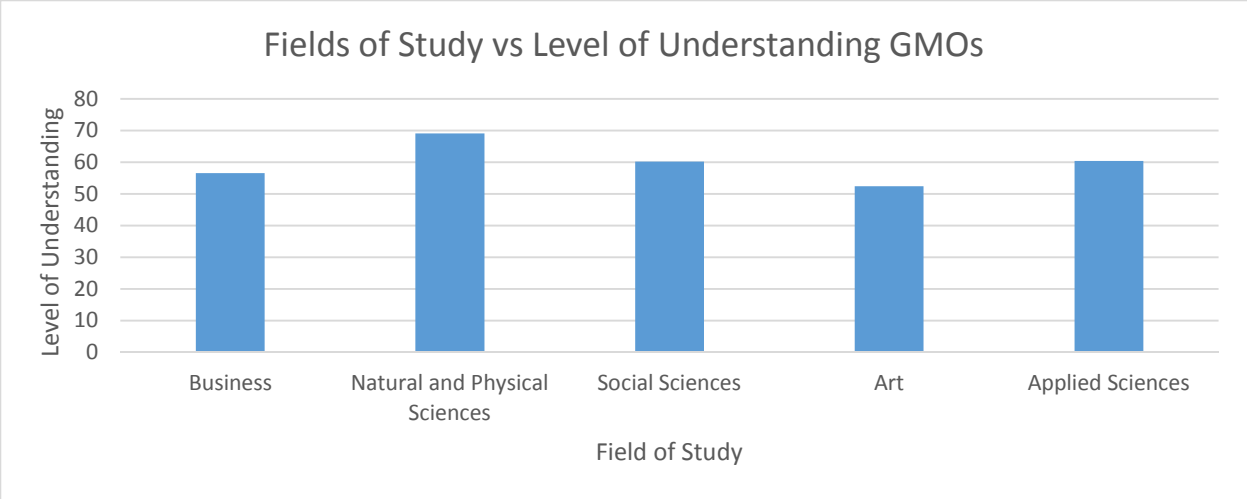
		As Genetically Engineered technology increases, do you believe it will cause more risks or more b...			
		Risks > Benefits	Benefits > Risks	No Opinion	Total
What is your current or intended major? If you have one, what is your current minor? - Major	Accounting	0	0	0	0
	Advertising	7	1	2	10
	Anthropology	15	7	4	26
	Art History	0	0	0	0
	Astronomy	0	2	0	2
	Biochemistry	0	10	2	12
	Business	1	0	0	1
	Chemistry	2	16	2	20
	Communication	7	2	0	9
	Computer Science	0	3	0	3
	Economics	1	0	1	2
	Ecology and Evolutionary Biology	1	4	1	6
	English	7	1	1	9
	Engineering	2	7	2	11
	Environmental Studies	8	7	5	20
	Film	3	1	2	6
	Geography	0	3	0	3
	Geology	1	6	1	8
	History	2	2	0	4
	Integrative Physiology	2	1	2	5
	International Affairs	4	2	0	6
	Journalism	8	4	5	17
	Language	5	3	1	9
	Marketing	0	0	0	0
	Mathematics	2	3	0	5
	Molecular, Cellular, and Developmental Biology	1	3	0	4
	Music/Music Education	11	9	6	26
	Philosophy	8	8	2	18
	Physics	0	2	1	3
	Political Science	2	1	0	3
	Psychology	8	2	0	10
	Religious Studies	3	3	0	6
	Sociology	1	1	0	2
	Theatre	1	2	1	4
	Other	9	4	2	15
	Total	122	120	43	285
What is your current or intended major? If you have one, what is your current minor? - Minor	Accounting	0	0	0	0
	Advertising	0	0	0	0
	Anthropology	0	2	0	2
	Art History	2	0	0	2
	Astronomy	0	2	1	3
	Biochemistry	0	3	0	3
	Business	1	2	1	4
	Chemistry	1	2	0	3
	Communication	3	0	0	3
	Computer Science	0	1	0	1
	Economics	1	2	0	3
	Ecology and Evolutionary Biology	6	4	2	12
	English	1	1	1	3
	Engineering	0	1	2	3
	Environmental Studies	2	0	2	4
	Film	2	1	0	3
	Geography	0	0	0	0
	Geology	2	2	1	5
	History	2	3	0	5
	Integrative Physiology	0	0	0	0
	International Affairs	0	0	0	0
	Journalism	1	2	0	3
	Language	6	6	0	12
	Marketing	0	0	1	1
	Mathematics	0	5	0	5
	Molecular, Cellular, and Developmental Biology	1	1	0	2
	Music/Music Education	3	2	1	6
	Philosophy	5	1	1	7
	Physics	0	4	0	4
	Political Science	3	0	2	5
	Psychology	5	1	0	6
	Religious Studies	3	0	0	3
	Sociology	3	1	0	4
	Theatre	1	0	1	2
	Other	23	6	8	37
	Total	77	55	24	156
Class Year	Freshman	12	10	5	27
	Sophomore	17	13	8	38
	Junior	18	16	4	38
	Senior	32	29	14	75
	5th Year	9	4	1	14
	Graduate	29	47	11	87
	Part-time matriculated	1	1	0	2
	Other	7	2	1	10
	Total	125	122	44	291

		Have you heard of Genetically Modified/Engineered Organisms (GMOs) before this survey? (If yes, p...		
		Yes	No	Total
Class Year	Freshman	27	4	31
	Sophomore	38	2	40
	Junior	38	1	39
	Senior	75	2	77
	5th Year	14	0	14
	Graduate	87	1	88
	Part-time matriculated	2	0	2
	Other	10	0	10
	Total	291	10	301
What is your current or intended major? If you have one, what is your current minor? - Major	Accounting	0	0	0
	Advertising	10	1	11
	Anthropology	26	2	28
	Art History	0	0	0
	Astronomy	2	0	2
	Biochemistry	12	0	12
	Business	1	1	2
	Chemistry	20	0	20
	Communication	9	0	9
	Computer Science	3	1	4
	Economics	2	0	2
	Ecology and Evolutionary Biology	6	0	6
	English	9	0	9
	Engineering	11	2	13
	Environmental Studies	20	0	20
	Film	6	0	6
	Geography	3	0	3
	Geology	8	0	8
	History	4	0	4
	Integrative Physiology	5	0	5
	International Affairs	6	0	6
	Journalism	17	0	17
	Language	9	0	9
	Marketing	0	0	0
	Mathematics	5	0	5
	Molecular, Cellular, and Developmental Biology	4	0	4
	Music/Music Education	26	3	29
	Philosophy	18	0	18
	Physics	3	0	3
	Political Science	3	0	3
	Psychology	10	0	10
	Religious Studies	6	0	6
	Sociology	2	0	2
	Theatre	4	0	4
	Other	15	0	15
	Total	285	10	295

		After taking this survey, will you seek out more information about Genetically Modified Organisms?			
		Yes	No	Not sure	Total
What is your current or intended major? If you have one, what is your current minor? - Major	Accounting	0	0	0	0
	Advertising	4	3	3	10
	Anthropology	7	6	13	26
	Art History	0	0	0	0
	Astronomy	0	0	2	2
	Biochemistry	2	6	4	12
	Business	0	0	1	1
	Chemistry	2	14	4	20
	Communication	6	0	3	9
	Computer Science	0	1	2	3
	Economics	2	0	0	2
	Ecology and Evolutionary Biology	1	4	1	6
	English	2	4	3	9
	Engineering	1	5	5	11
	Environmental Studies	4	13	3	20
	Film	2	2	2	6
	Geography	1	2	0	3
	Geology	3	2	3	8
	History	0	2	2	4
	Integrative Physiology	3	0	2	5
	International Affairs	1	2	3	6
	Journalism	10	3	4	17
	Language	5	2	2	9
	Marketing	0	0	0	0
	Mathematics	0	4	1	5
	Molecular, Cellular, and Developmental Biology	1	1	2	4
	Music/Music Education	9	6	11	26
	Philosophy	3	3	12	18
	Physics	2	0	1	3
	Political Science	2	0	1	3
	Psychology	5	1	4	10
	Religious Studies	1	4	1	6
	Sociology	1	1	0	2
	Theatre	1	1	2	4
	Other	4	7	4	15
	Total	85	99	101	285
Class Year	Freshman	11	6	10	27
	Sophomore	18	5	15	38
	Junior	12	13	13	38
	Senior	26	17	32	75
	5th Year	2	8	4	14
	Graduate	14	46	27	87
	Part-time matriculated	2	0	0	2
	Other	2	6	2	10
	Total	87	101	103	291


Students Majors vs Level of Understanding GMOs
Majors
Religious Studies
Mathematics
Film
Business
Philosophy
Psychology
English
Theatre
Journalism
Economics
International Affairs
Music Education
Geography
Advertising
Other
Molecular, Cellular, and...
Language
Geology
Anthropology
Primary Biology


Fields of Study and their Average Opinion on Using GMOs
Opinion Rating (1 - Strongly Disagree; 5 - Strongly Agree)
4
3.5
3
2.5
2
1.5
1
0.5
0
Business
Natural and Physical Sciences
Social Sciences
Art
Applied Sciences
Field of Study



Majors in each group:

Business – Accounting; Advertising; Business; Marketing; Economics

Natural and Physical Sciences – Astronomy; Biochemistry; Chemistry; Ecology and Evolutionary Biology; Environmental Studies; Geology; Integrative Physiology; Molecular, Cellular, and Developmental Biology; Physics

Social Sciences – Anthropology; Geography; International Affairs; Political Science; Psychology; Sociology

Art – Art History; English; Film; History; Journalism; Language; Music/Music Education; Philosophy; Theatre

Applied Sciences – Computer Science; Engineering; Mathematics