

MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY

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# The Effect of Education on the Public Opinion of Synthetic Biology

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OURE Fellows Project

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## **Abstract**

The field of synthetic biology is rapidly growing. The applications have great potential, but they also present new risks and dangers. Future progress in this field substantially depends on public support; therefore, it is important to have quantitative measures of the public opinion of synthetic biology. Using statistical sampling in the form of surveys, we have collected data from an unprecedented religious standpoint. Qualitative data collected from group discussions was used to design the surveys. Findings show that subjects with a religious affiliation were more likely to disapprove of synthetic biology. Findings also reveal a significant difference between educational treatments. A “hands on” approach designed to simultaneously entertain and educate subjects was more effective at increasing positive perceptions of synthetic biology than a formal presentation. The data collected from this research provides significant insights into public opinion and the design of educational tools.

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## **Introduction**

Synthetic biology is an emerging field stemmed from molecular genetics that applies engineering approaches to biological systems. Synthetic biology is the engineering of biological components and systems that do not exist in nature and the re-engineering of existing biological elements; it is determined on the intentional design of artificial biological systems, rather than on the understanding of natural biology. Research in this field has almost limitless applications, including medicine, food and agriculture, industry, the environment, and alternative energy. A major proponent of synthetic biology is iGEM - the International Genetically Engineered Machines Competition - which is an international collaboration to advance synthetic biology.

Synthetic Biology has the potential to completely change the face of this world for the better. Technology in this field is already advancing at a rapid rate, and soon the research and application opportunities could be endless. However, there are some important concerns with public perception of this new field that have not yet been examined in full. The future of this discipline could depend on a favorable public opinion of this research. Future progress depends on institutional and governmental support of the field. Public opinion in society directly influences this progress via governmental regulations and the decisions made in industry. A favorable public opinion and understanding of synthetic biology will allow the field to flourish, while an unfavorable public opinion could cause the research to be stunted.

The need for public support in this new field has led to an inundation of educational programs geared towards educating the public in the advantages and consequences of synthetic biology. However, not all educational programs effectively educate the public about synthetic biology or rally public support. In fact, a surprising number of educational programs report that participants were less likely to support the research after attending the program. These research programs also bypass religious groups as target audiences, presumably to avoid conflict. For this reason previous programs have gathered little to no insight from the perspective of religious communities.

Our basic hypothesis is that empirical analysis of educational programs will lead to more effective education techniques and ultimately, a more positive perception of synthetic biology. The first goal of this study is to determine which educational treatments are most effective at 1) educating the public and 2) increasing positive public perceptions of the field. The second goal of this study is to determine how the perceptions of religious groups differ from non-religious groups after exposed to educational treatments.

The study compares two basic types of commonly used educational programs. The first type of program is a formal presentation followed by group discussions. The second type of program uses a more “hands on” approach and presents information in the form of short presentations and activities. Qualitative analysis of facilitated group discussions and statistical sampling in the form of surveys was used to analyze data. Preliminary surveys were administered to all participants before the educational treatment began and post surveys were administered after the program.

While our ultimate intentions are to increase public support of synthetic biology, we took great strides to ensure our presentations presented both the benefits and risks of synthetic biology. It is extremely important in this type of research to educate people objectively and avoid any kind of biased influence.

Data and trends apparent from this research can be used in the future to develop effective educational programs that increase positive perceptions of synthetic biology.

## **Methods**

The primary methods of research employed were facilitated group discussions and educational treatments preceded and followed by statistical sampling in the form of surveys. Facilitated group discussions were used to collect qualitative data that, in turn, was used to design surveys and educational treatments. Before beginning our research, we obtained Institutional Review Board (IRB) approval to ensure the legitimacy of our research and methods.

### *Facilitated Group Discussions*

Preliminary data was collected in order to determine what information was needed in the educational treatments and surveys. Qualitative analysis of facilitated group discussions was used for this purpose. We hosted a Synthetic Biology Speak UP Speak OUT in collaboration with Miner Mentors a peer education program organized through Leadership and Cultural Programs. The goal of Speak UP Speak OUT is to facilitate open discussions among students about current and sometimes controversial issues that are relevant to our lives. Students from different backgrounds on the S&T campus were invited to come discuss synthetic biology. The discussion moved from dangers and benefits of synthetic biology to public perception of synthetic biology, especially in media and worst-case scenario movies. Many of the students were not familiar with synthetic biology, so the discussion was representative of uninformed perceptions. This was helpful in determining an education level for the presentations and common misconceptions and confusion on which we could focus on clarifying.

## *Target Audience*

Synthetic biology educational programs rarely target religious groups because of the potential for controversy. Originally, our project was intended to target religious groups of different denominations to collect novel viewpoints of synthetic biology.

Our plan was to ask the churches if we could host an educational program in their facility and if they would be interested in participating in a survey. This plan would ensure a large sample size but it would be difficult to execute and possibly precarious for the presenters. In a rural, conservative community it was a real possibility that our presentation could upset church members and threaten the success of the research.

Instead of visiting every church we planned educational events on campus and invited members of religious groups to our events. We contacted all churches by phone within the city of Rolla and inquired if they would like more information about participating in our program. Fliers were sent to the churches who wanted more information as advertisement for the event. Campus church groups were also invited to the event through multiple email advertisements.

Due to unforeseen circumstances, the target audience was changed from solely religious groups to all members of the population in order to increase sample size.

## *Advertising and Incentives*

Many types of advertisements were used to increase participation in the educational events. Approximately three weeks before the events information was sent out during the Town and Campus News radio announcements and a large (3'x4') banner was hung in the Havener Center. At that time announcements were also sent out to the press through the S&T Communications Department. Fliers were hung across campus and in the residence halls two weeks before the events. Email advertisements were sent out across campus listservs and announcements were posted in the campus eConnection one week before the event. A few days before the event small fliers were handed out on campus to students passing by.

Incentives were provided to encourage participation in the educational programs. Food was provided at each event in the form of homemade baked goods, catering from Jimmy Johns, and catering from Chartwells. Door prizes were also advertised and given out at the events. Door prizes consisted of gift cards, items from the S&T bookstore, color changing cups, and promotional pens.

## *Educational Treatment 1 Design*

Educational treatment 1 was a formal powerpoint presentation followed by a facilitated discussion. This educational treatment was designed to mimic the educational programs currently used by synthetic biology researchers to reach out to the public.

We presented the information on the powerpoint in this order: the basic definition of synthetic biology, the basic explanation of designing DNA, the history of synthetic biology, examples of synthetic biology applications, safety concerns, and a brief discussion about ethics. After the

presentation a professor facilitated discussion and questions. Great care was taken to ensure the discussion remained respectful and open.

### *Educational Treatment 2 Design*

Educational treatment 2 was the more hands on educational approach. It included a few short presentations, a short educational activity, and an in-depth educational activity. The entire event lasted almost three hours. We collaborated with the Missouri S&T iGEM Team to host this event.

The first presentation was an overview of synthetic biology and some potential applications. It included all the information from the formal presentation, including a basic definition of synthetic biology, a basic explanation of designing DNA, and the history of synthetic biology and iGEM. It included some of the same applications discussed in the formal presentation, as well as a few more. It also included some information about the Missouri S&T iGEM Team.

A presentation about the safety and ethics of synthetic biology immediately followed the general overview of synthetic biology. The ethics and safety discussion was slightly more detailed than the ethics and safety information presented in educational treatment 1. It presented many broad ethical questions for the audience to consider, as well as some more specific information about the types of risks involved with synthetic biology research and current safety measures being taken in synthetic biology.

After these two short presentations, the volunteers participated in a DNA extraction activity, in which they extracted DNA from wheat germ. The activity was fun and simple, but it gave participants an idea of the techniques involved in manipulating DNA. This hands on introduction into the techniques involved in synthetic biology led into a short presentation on the “synthetic biology process.” This presentation was an overview of how synthetic biologists go from observing a gene in nature to isolating the gene and turning it into a “biobrick” that can be inserted other organisms. Through this presentation, the participants gained further insight into the science behind the applications of synthetic biology.

With this background information, we moved forward to the main part of the educational event: a Plasmid Design Activity. We adopted this activity from the British Columbia iGEM team, which shared the activity on an open wetware site called “Community Bricks,” where iGEM teams share their educational and outreach activities. The plasmid activity gave participants a choice of three real-world scenarios which could be solved using synthetic biology. Participants were also given a “library” and “kit” of biobricks (standardized DNA parts) to choose from and work with. The library contained descriptions of all the available biobricks, their size, and their function. The kit included the physical biobricks (pipe cleaners of various sizes and colors) described in the library. Biobricks included genes for basic survival, genes for solving specific problems presented in the scenarios, and genes to be used as safety devices.

Each group chose a scenario and designed a small, circular piece of DNA called a plasmid. At first, the groups were allowed to include as many biobricks as they wanted. This allowed them to have a system that fulfilled all the objectives of the scenario with the best growth and reproduction and the highest safety measures. Once participants understood the concepts behind the activity, they had no problem designing this biological system.

However, once the first part of the activity was complete, facilitators imposed a size restriction on the plasmid. Large plasmids are unstable in nature, so a plasmid must be under a certain size to maintain stability and function of the biological system. This forced participants to critically evaluate which genes were most necessary; they had to think about designing their system from more of an engineering perspective for limiting the size of their plasmid while still designing a practical system. They had to choose between functionality, growth and reproduction, and safety, in most cases reducing all three.

Although this activity was definitely simplified from actual science, it was quite in-depth for participants unfamiliar with synthetic biology. It required critical thinking, and allowed people to see synthetic biology from an engineering, design, and safety perspective. It also caused participants to focus on a particular practical application and how synthetic biologists might go about solving such a problem.

To finish educational treatment 2, we gave a short presentation on a current real-world example of DNA manipulation, ethics, safety, and regulation. This presentation was about GMOs (genetically modified organisms), current practices, and current regulations. It allowed audience members to realize that there are many genetically modified organisms that we buy and consume every day without knowing it. It emphasized the importance of keeping the public informed about synthetic biology and creating and enforcing ethical practices and regulations in this developing field.

Between presentations and activities, and after the final presentation, there were several discussions about the material presented and synthetic biology as a whole. As in educational treatment 1, great care was taken to ensure an open and respectful discussion.

### *Survey Design*

Surveys were designed with the help of fellow S&T student, Razmus Kerwin, who majors in Technical Communications. Razmus provided us with advice and expertise in the survey development process. Survey questions were created using background information gathered from the Speak UP Speak OUT.

At each event playing cards were passed out to all participants and were used as personal identification codes. Each participant was instructed to record their card suit and number on their surveys. This ensured no identifying information was attached to their survey responses.

Before participants began the educational programs they were informed that the events were completely voluntary and confidential. We also informed participants that this data would be used for an OURE project and future iGEM presentations. Participants were required to fill out and sign an informed consent form before beginning the surveys.

Preliminary surveys and post surveys were developed to assess a change in opinion. The independent variable in our research was either educational treatment or religious affiliation. The dependent variable was response to the survey questions. A likert scale was used to assess opinions on the surveys. Likert scales are less complicated to analyze than other survey methods and they are easy for the respondent to use. Demographic data was also collected. See the attached surveys for the survey design and questions.

Surveys were administered before the educational programs began and after they ended. A participant's pre-survey and post-survey was connected with the playing card number they recorded on their survey. This way data could be paired and analyzed.

## Results

### *Educational Treatment 1*

Educational treatment 1 was a formal presentation coupled with a facilitated discussion. Twenty people participated in this study, 10 with a religious affiliation and 10 with no religious affiliation. Participants with a religious affiliation rated their overall approval of sciences lower in pre- and post-surveys than participants with no religious affiliations (figure 1). Additionally, participants with a religious affiliation tended to rate synthetic biology with less approval and trust after the educational treatment than participants with no religious affiliation (figure 2). Note that, overall, participants indicated that they were more familiar with synthetic biology after the educational treatment.

Overall, participants thought their community would have a lower approval of synthetic biology than they themselves did (figure 3).

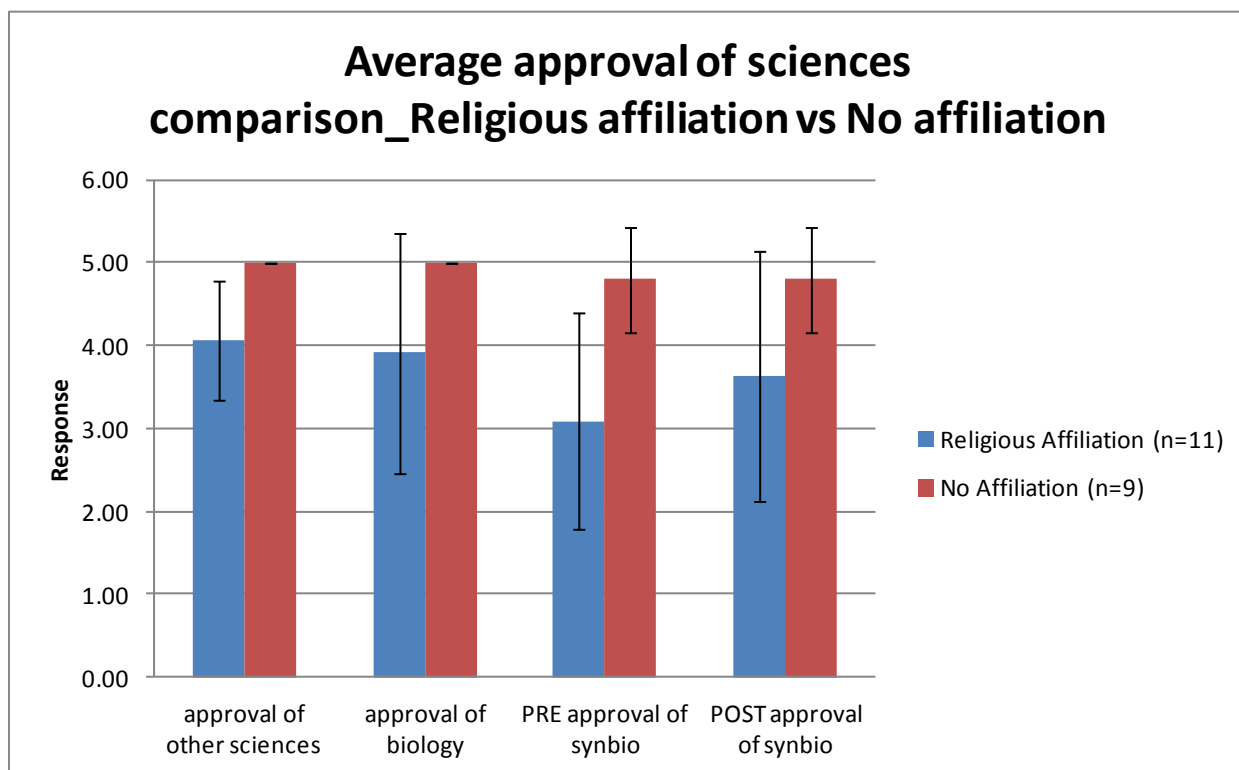


Figure 1: Average approval of sciences comparison for educational treatment 1

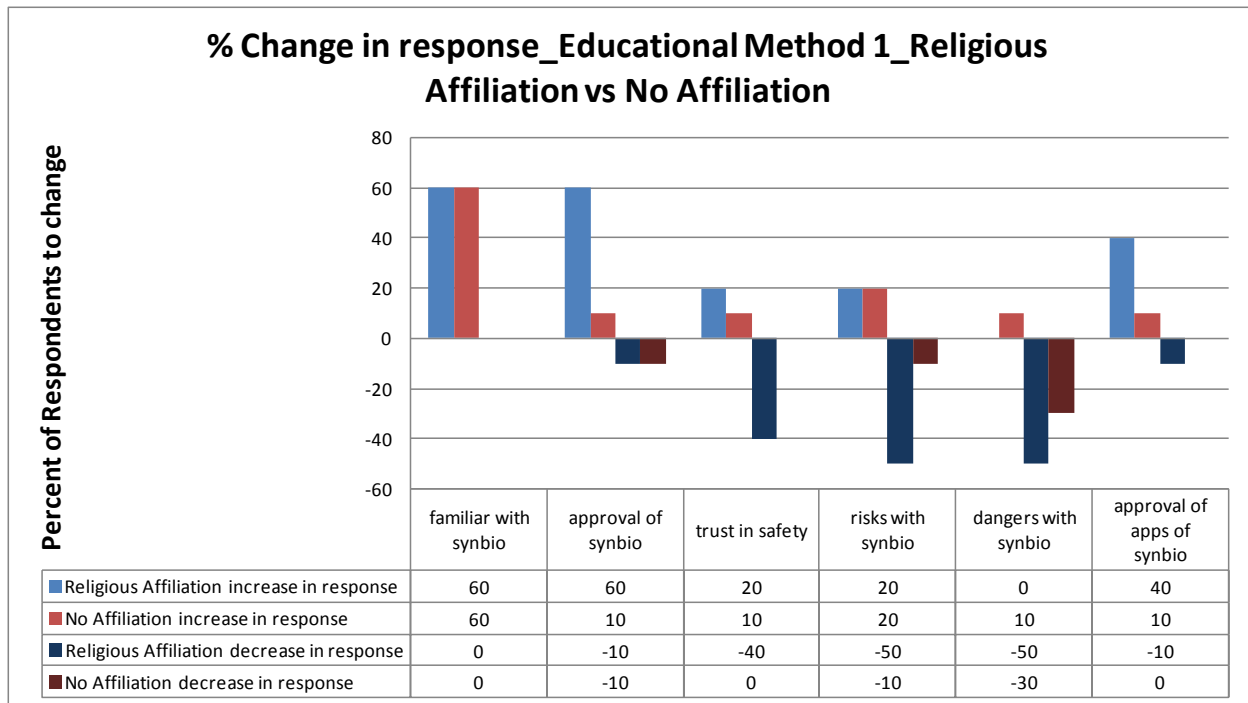


Figure 2: Percent of participants with change in response for educational treatment 1

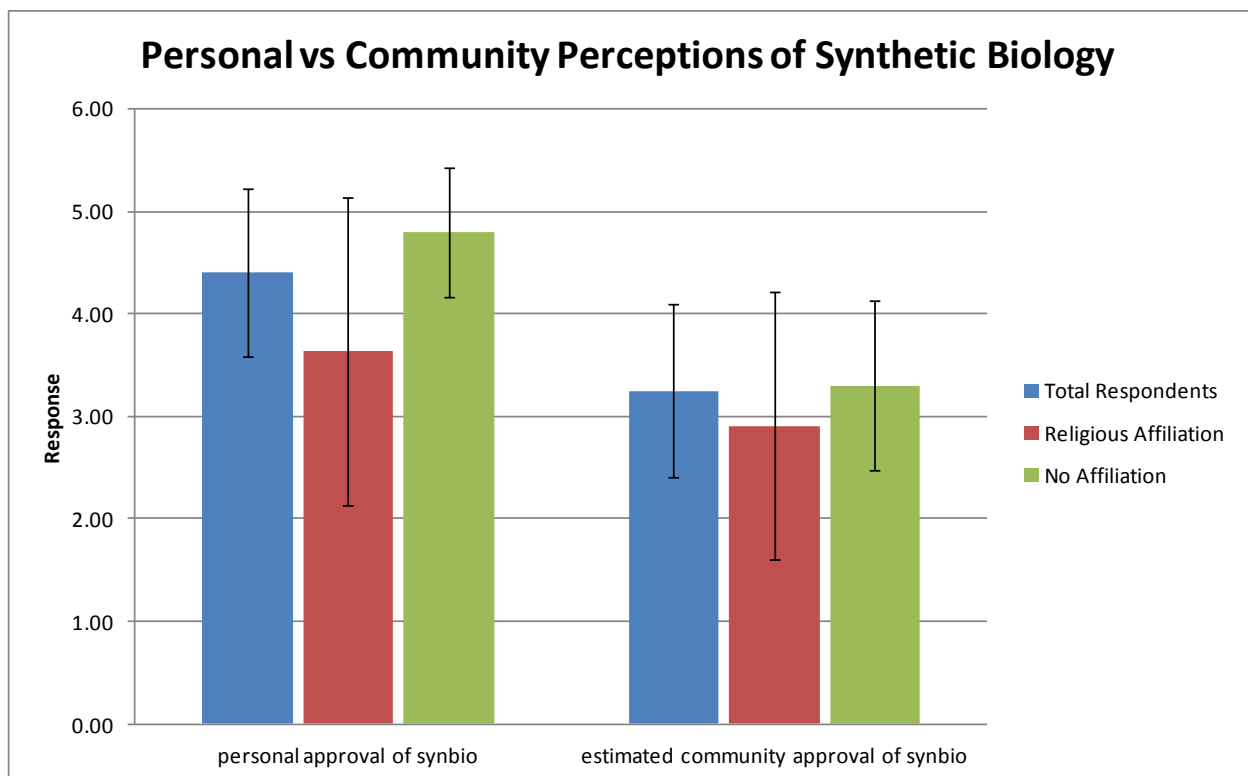


Figure 3: Personal versus community perceptions for educational treatment 1



## Educational Treatment 2

Educational treatment 2 was a hands on, educational activity. Eleven people participated in this study, 5 with a religious affiliation and 6 with no religious affiliation. As seen in figure 4, participants with a religious affiliation rated their overall approval of sciences only slightly lower than participants without a religious affiliation. There was no significant difference in the change in opinion regarding approval and trust of synthetic biology between the two participant groups (figure 5).

More participants (73% in educational treatment 2 vs 60% in educational treatment 1) indicated that they were more familiar with synthetic biology after the educational treatment. Interestingly, twice as many participants with a religious affiliation indicated they were more familiar with the subject after education than participants with no religious affiliation. Also of interest, is that more participants in educational treatment 2 had an increased approval of synthetic biology than those in educational treatment 1.

As with educational treatment 1, participants in educational treatment 2 estimated that their community would have a lower approval of synthetic biology (figure 6).

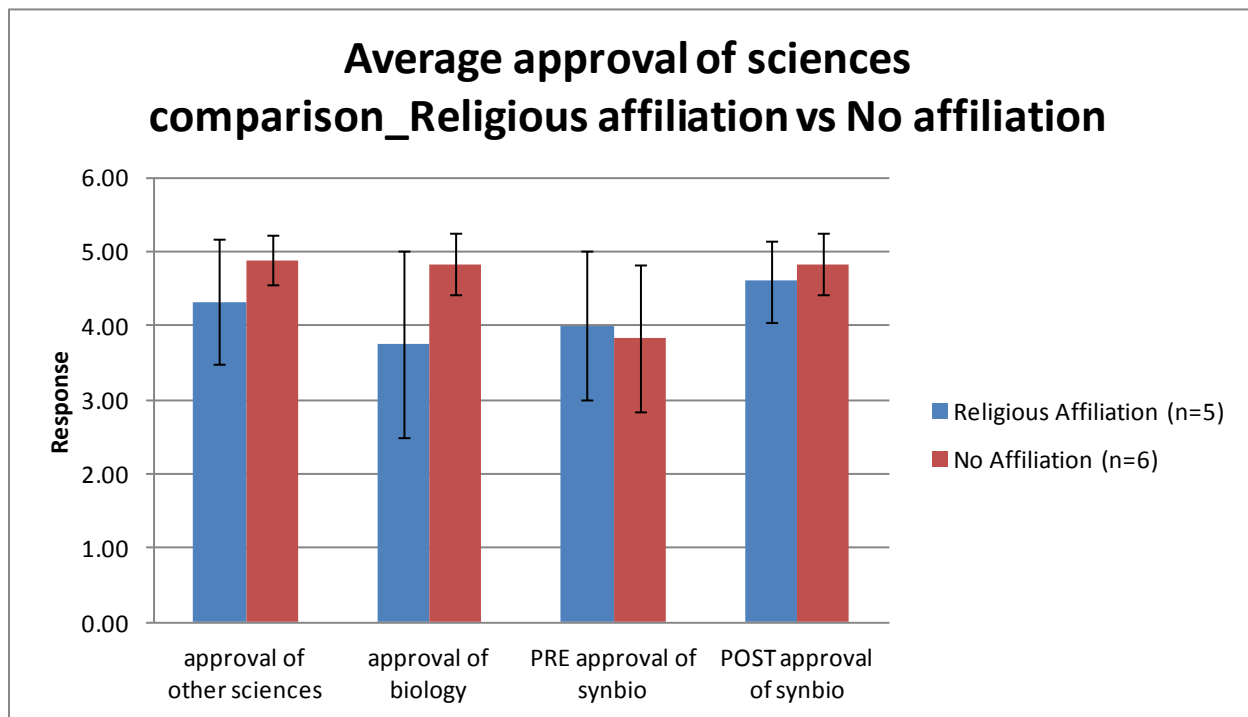


Figure 4: Average approval of sciences comparison for educational treatment 2

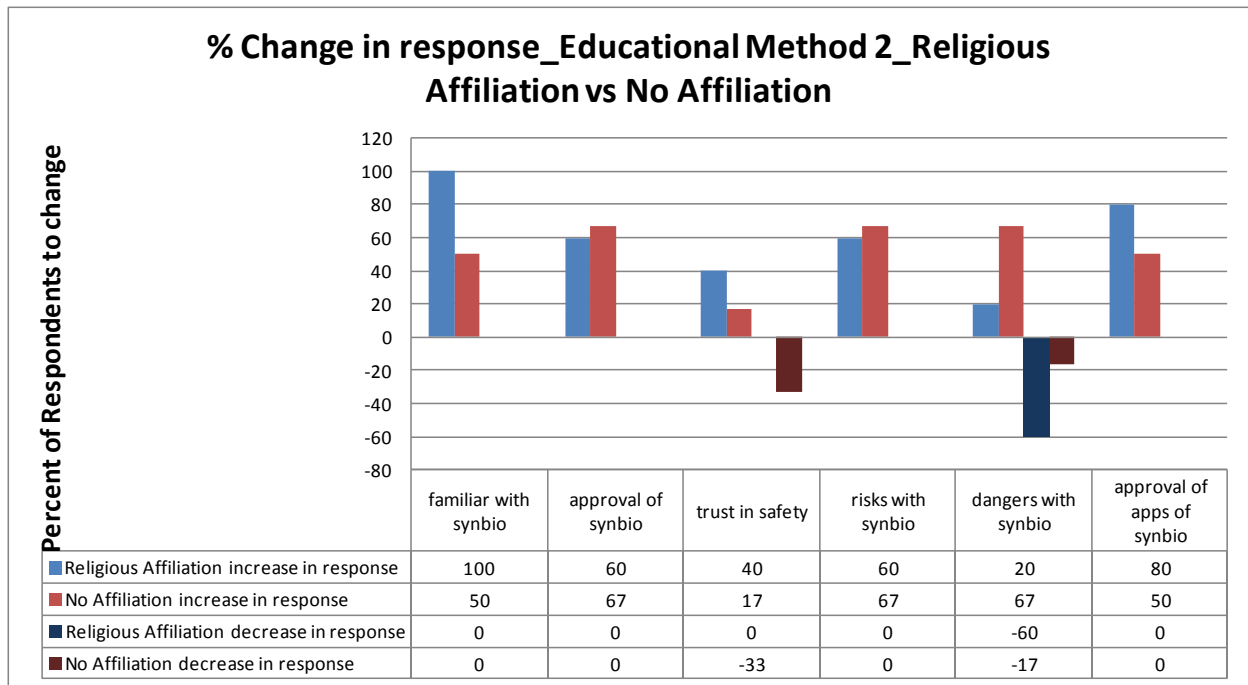


Figure 5: Percent of participants with change in response for educational treatment 2

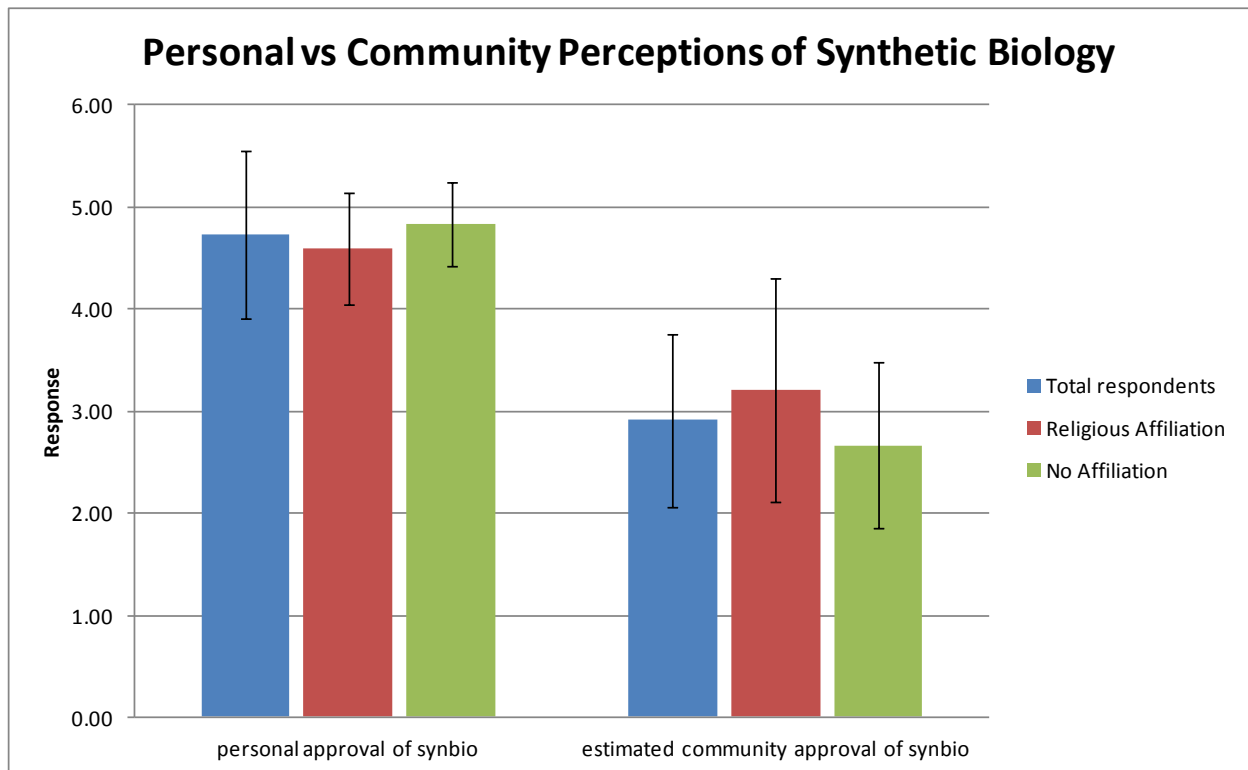


Figure 6: Personal versus community perceptions for educational treatment 2

## Comparison of Treatments

The table below shows the averages of responses for respondents with a religious affiliation and without a religious affiliation. The data is not paired as it is in figures 2 and 5. Changes between educational treatments do not reflect each participants change in response but the change in response for the group as a whole. Percent change was calculated by dividing the difference in post- and pre-survey responses by 5 (the total value of the scale).

The data from educational treatment 1 also indicates significant differences between participants with a religious affiliation and participants without a religious affiliation, as evidenced in table 1. Participants with a religious affiliation had a slight increase in their approval of synthetic biology, while participants with no religious affiliation had no change in their approval of synthetic biology. However, it is notable that the participants with no religious affiliation had a very high average rating of synthetic biology approval (4.8), which was 1.71 points higher than the initial rating by the religious affiliation group.

A difference is also observed in the percent change in trust in safety and risk rating between the two groups in educational treatment 1. The religious affiliation group decreased their ratings of trust and risk, while the nonreligious affiliation group slightly increased their ratings in these areas. Both groups decreased their dangers ratings, however, the religious affiliation group decreased their rating by approximately twice as much as the nonreligious affiliation group. Both groups increased their application approval ratings.

Trends for educational treatment 2 were more random (table 2), which is probably due to the small sample size.

Educational Treatment 1						
	Familiarity	Overall Approval	Trust in Safety	Risk Rating	Dangers Rating	Application Approval
<b>Religious presurvey</b>	1.50	3.09	3.45	2.64	2.64	3.18
<b>Religious postsurvey</b>	2.18	3.64	3.18	2.18	2.00	3.45
<i>Percent Change</i>	13.6%	11.0%	-5.4%	-9.2%	-12.8%	5.4%
<b>Nonreligious presurvey</b>	2.10	4.80	4.60	3.70	3.90	4.80
<b>Nonreligious postsurvey</b>	2.90	4.80	4.70	3.80	3.60	5.00
<i>Percent Change</i>	16.0%	0.0%	2.0%	2.0%	-6.0%	4.0%

Table 1: Average ratings of religious and nonreligious groups for educational treatment 1

Educational Treatment 2						
	Familiarity	Overall Approval	Trust in Safety	Risk Rating	Dangers Rating	Application Approval
<b>Religious presurvey</b>	1.40	4.00	3.60	3.40	3.20	3.40
<b>Religious postsurvey</b>	2.60	4.60	4.20	4.00	2.80	4.60
<i>Percent Change</i>	24.0%	12.0%	12.0%	12.0%	-8.0%	24.0%
<b>Nonreligious presurvey</b>	1.67	3.83	4.67	3.33	3.33	3.38
<b>Nonreligious postsurvey</b>	2.33	4.83	4.50	4.17	3.67	4.50
<i>Percent Change</i>	13.2%	20.0%	-3.4%	16.8%	6.8%	22.4%

Table 2: Average ratings of religious and nonreligious groups for educational treatment 2

## Discussion

### *Sample size*

Originally, the target population for this study was different religious groups. The project goal was to compare differences in opinion between religious denominations. However, after months of preparation, weeks of advertising, and hundreds of dollars in giveaways, not a single person from a religious group volunteered to participate in our study.

We concluded that, likely due to the controversy between some science and religions, people from religious backgrounds were uncomfortable participating in a synthetic biology educational program and therefore did not volunteer. Another possible explanation for the lack of participation is that the social norm in an area such as rural Missouri predisposes community members not to participate. It was necessary to open up our study to all demographics, not just religious groups, in order to continue with the research. This setback resulted in a less than preferable sample size.

Due to a small sample size it was necessary to lump all participants into a “religious affiliation” category and a “no religious affiliation” category instead of comparing multiple demographics. The data in this study is not statistically significant or accurately represents the entire population because of the small sample size. However, it does show trends that warrant further investigation.

### *Approval of Sciences*

In the pre-survey for both educational treatments participants were asked if they were familiar with and approved of biology, chemistry, physics, and synthetic biology. In figure 1 and figure 4 subjects with a religious affiliation rated their approval of all sciences less than subjects with no religious affiliation. While the data is not significant due to the sample size, the trend suggests that members of religious groups have less approval for scientific research than people who do not identify with religious groups. This correlation also supports our previous assumption that a lack of participation could be due to this trend.

Notice that the responses between subjects with a religious affiliation and without a religious affiliation differ more in the first treatment than in the second treatment. We speculate that this is because a formal presentation would attract a more conservative audience than a hands on activity. The difference in response between the two treatments could be attributed to personalities.

### *Familiarity with and Approval of Synthetic Biology*

Both educational treatments led to an overall increase in familiarity with the concepts of synthetic biology. This indicates that both educational treatments are meeting their primary goal of educating the public. However, treatment 2 (73% indicate they were more familiar) is more effective at educating the public than treatment 1 (60% indicate they were more familiar). This is not surprising as many people learn better with interactive activities than by simply listening.

Of course, educating the public is only the first goal of educational programs. Synthetic biology educational programs also strive to win over public support so the field can flourish under governmental and institutional oversight. We found that familiarity with synthetic biology does not predict approval of synthetic biology. In the formal presentation, 60% of participants increased their familiarity ratings but only 35% increased approval ratings, and 10% even decreased their approval ratings. In the hands on activity, 73% of participants increased their familiarity ratings and 64% of respondents increased and none decreased their approval ratings. This finding shows that approval of synthetic biology does not depend on familiarity with synthetic biology. Therefore, treatment 2 was more effective at educating the public and better executed the goals of an educational program since approval was also high.

An interesting note is the difference between religious affiliation and no religious affiliation in familiarity with synthetic biology (figure 5). All of the participants with a religious affiliation indicated they were more familiar with the research after the education compared to only half of the no affiliation respondents. The cause of this correlation could be an interesting topic to research in the future.

### *Community Approval of Synthetic Biology*

We asked participants to estimate their community's approval of synthetic biology. In both educational treatments the overall response was the same (figure 3, figure 6). On average, participants rated their community's approval of synthetic biology lower than their own approval. In fact, only one participant rated their community's approval higher than their own. The responses were the same for both religious affiliation and no religious affiliation groups.

These results display a false uniqueness effect. That is, the results indicate that people tend to believe that they are unique - that they are an outlier in their community. A larger sample size with the same results would strongly indicate that people have false perceptions about their community's opinions of synthetic biology. This data could be used to show people that their community does indeed have the same level of support for synthetic biology, thus enabling people to more freely support synthetic biology. This could be a huge step in gaining public approval of synthetic biology.

### *Trust, Risks, Dangers, and Approval of Synthetic Biology*

As researchers, we strive to present information about the risks and dangers of synthetic biology with an unbiased influence. However, the purpose of an effective educational presentation is to rally support for the research. If an educational program leaves the audience worried about their safety, they are less likely to support the field. A formal presentation gives more of an overview that leaves the audience to imagine the possibilities - good or bad, real or imagined.

However, a hands on activity is fundamentally different. It focuses on teaching the audience about the how and why of the science and safety. A hands on activity allows subjects to critically think about a specific practical application of synthetic biology and how DNA parts are designed to include built-in safety devices. This gives them a concrete idea of how synthetic biology and safety actually work without leaving much to the imagination.

The hands on activity was significantly more effective at generating approval of synthetic biology than the formal presentation. People who participated in the hands on activity rated synthetic biology more positively after the treatment with a few exceptions (figure 5). We believe this is due to the fact that participants were able to integrate unbiased information regarding safety into practical applications.

As seen in figure 2, many participants negatively changed their opinion of synthetic biology after the educational treatment 1 in the areas of trust, risks, and dangers. This data reflects prior reports that educational programs can decrease public support of synthetic biology.

Significant differences were observed in religious versus nonreligious affiliation groups in educational treatment 1. Extreme changes are noticed with the religious affiliation group, as shown in figure 2. The religious affiliation group initially had lower ratings of synthetic biology, and changed their ratings after the educational treatment (table 1). Very little changes are seen in the no affiliation group (figure 2). The lack of change can be accounted for because the no affiliation group had very high initial ratings, which remained high in the post-survey (table 1).

The observed differences in the religious affiliation and nonreligious affiliation groups is an interesting finding. This could be due to a number of factors, and further research could provide great insights into the differences in these groups.

No significant trends were observed between religious affiliation and nonreligious affiliation groups for educational treatment 2 (table 2).

## **Conclusion**

The field of synthetic biology is growing rapidly, even today it has the potential to impact our world. However, the future of this emerging field depends on institutional and governmental support. The level of support this research will receive depends on public opinion. Government regulations and public policy is driven by the beliefs and viewpoints of the public. If the public are not educated on the benefits and risks of synthetic biology they cannot make informed decisions regarding its support.

Previously, researchers who work in the field of synthetic biology have taken it into their own hands to educate the public. However, some educational programs fall short of expectations and leave audiences in fear. A goal of this study is to determine which type of main educational program, a formal presentation or a hands on activity, is most effective at educating the public and rallying support for the field. A second goal of this study was to learn how members of religious groups would respond to synthetic biology. Previous educational programs avoid religious groups as target audiences because of the potential controversy.

The data presented in this research gives insight into the differences between educational programs and tendencies of people with religious affiliations. This study has supports the notion that a hands on educational approach better educated the public and builds their approval of synthetic biology. Data also indicates that almost all participants experience a false uniqueness effect, where they believe their community does not have as high of an approval as themselves. Finally, this study highlighted a trend that people with religious affiliations tend to rate synthetic biology with less approval than people with no religious affiliation.

The results obtained have many implications for further educational programs about synthetic biology. Based on our findings educational programs should incorporate in-depth, hands on activities. They should also include statistics about the public opinion of synthetic biology so the audience members can see they are not alone in their attitudes about the subject.

While the findings of this study are inconclusive due to an unrepresentative sample, it does open the door for further research. This study offers intriguing data regarding the opinions of people with religious affiliations. Some correlations appear strong but the sample is not large enough to even draw tentative conclusions. Further research could have the potential to draw strong correlations between religious beliefs and public opinion.

Overall this study is important to the field of synthetic biology. It explores novel issues and has the potential to greatly impact current educational programs.

## **Acknowledgements**

There are several people and organizations that we would like to thank for assisting us with this research. First, we would like to thank our collaborator from the Technical Communications Department, Razmus Kerwin, who designed and helped distribute the surveys, as well as helped with advertising. We would also like to thank Whitney Osmonson, who attended many of our meetings, gave us valuable feedback, and helped with advertising. We are extremely grateful to the Missouri S&T iGEM Team, which was fundamental in organizing and hosting educational treatment 2. We also credit the British Columbia iGEM Team for developing and sharing the plasmid activity used in educational treatment 2. We would also like to recognize the Miner Alumni Association for partially sponsoring the Missouri S&T iGEM Team for educational treatment 2.

We would also like to thank the Office of Undergraduate Studies for funding this research project, as well as the Departments of Biological Sciences and Technical Communication for supporting us in our research efforts. Last - but certainly not least - our advisor, Dr. Westenberg, was a huge help, as always.

Thanks again to everyone who supported us and participated in our research!

# Appendix

## Public Opinion of Synthetic Biology – Survey #1

*Thank you for your participation in this research survey.*

Participation in this survey is voluntary. No personally identifying information will be collected or retained. You are free to withdraw your participation in this survey at any time.

Please indicate your age, gender, and religious affiliation.

Age: \_\_\_\_\_ Gender : M F Religious affiliation: (if any) \_\_\_\_\_

**What is the highest level of education that you have completed?**

High school   Some College   Associate's degree   Bachelor's degree   Master's degree   Doctorate

Please read the following questions carefully and indicate your response.

**How familiar are you with the science of biology?**

1 (Not at all)   2 (A little bit)   3 (Have a good working knowledge)   4 (Very familiar)   5 (I am an expert)

**Indicate your approval of biology research.**

1 (strong disapproval)   2 (mild disapproval)   3 (no opinion)   4 (mild approval)   5 (strong approval)

**How familiar are you with the science of chemistry?**

1 (Not at all)   2 (A little bit)   3 (Have a good working knowledge)   4 (Very familiar)   5 (I am an expert)

**Indicate your approval of chemistry research.**

1 (strong disapproval)   2 (mild disapproval)   3 (no opinion)   4 (mild approval)   5 (strong approval)



**How familiar are you with the science of physics?**

1 (Not at all) 2 (A little bit) 3 (Have a good working knowledge) 4 (Very familiar) 5 (I am an expert)

**Indicate your approval of physics research.**

1 (strong disapproval) 2 (mild disapproval) 3 (no opinion) 4 (mild approval) 5 (strong approval)

**How familiar are you with the science of synthetic biology?**

1 (Not at all) 2 (A little bit) 3 (Have a good working knowledge) 4 (Very familiar) 5 (I am an expert)

**Indicate your approval of synthetic biology research.**

1 (strong disapproval) 2 (mild disapproval) 3 (no opinion) 4 (mild approval) 5 (strong approval)

**Indicate your level of trust in the scientific oversight and safety process**

1 (no trust at all) 2 (very little trust) 3 (no opinion) 4 (some confidence) 5 (full confidence)

**Do you feel that there may be risks associated with synthetic biology research?**

1 (severe risk) 2 (significant risk) 3 (no opinion) 4 (little risk) 5 (no risk at all)

**How dangerous do you think are the risks associated with synthetic biology research?**

1 (extremely dangerous) 2 (somewhat dangerous) 3 (no opinion) 4 (presents little danger) 5 (presents no danger at all)

**Indicate your approval of the applications of synthetic biology research.**

1 (strong disapproval) 2 (mild disapproval) 3 (no opinion) 4 (mild approval) 5 (strong approval)

## Public Opinion of Synthetic Biology – Survey #2

*Thank you for your participation in this research survey.*

Participation in this survey is voluntary. No personally identifying information will be collected or retained. You are free to withdraw your participation in this survey at any time.

Please indicate your age, gender, and religious affiliation.

Age: \_\_\_\_\_ Gender : M F Religious affiliation: (if any) \_\_\_\_\_

**What is the highest level of education that you have completed?**

High school   Some College   Associate's degree   Bachelor's degree   Master's degree   Doctorate

Please read the following questions carefully and indicate your response.

**How familiar are you with the science of synthetic biology?**

1 (Not at all)   2 (A little bit)   3 (Have a good working knowledge)   4 (Very familiar)   5 (I am an expert)

**Indicate your approval of synthetic biology research.**

1 (strong disapproval)   2 (mild disapproval)   3 (no opinion)   4 (mild approval)   5 (strong approval)

**Indicate your level of trust in the scientific oversight and safety process**

1 (no trust at all)   2 (very little trust)   3 (no opinion)   4 (some confidence)   5 (full confidence)

**Do you feel that there may be risks associated with synthetic biology research?**

1 (severe risk)   2 (significant risk)   3 (no opinion)   4 (little risk)   5 (no risk at all)

**How dangerous do you think are the risks associated with synthetic biology research?**

1 (extremely dangerous) 2 (somewhat dangerous) 3 (no opinion) 4 (presents little danger) 5 (presents no danger at all)

**Indicate your approval of the applications of synthetic biology research.**

1 (strong disapproval) 2 (mild disapproval) 3 (no opinion) 4 (mild approval) 5 (strong approval)

**In your opinion, what are your community's thoughts on synthetic biology?**

1 (strong disapproval) 2 (mild disapproval) 3 (no opinion) 4 (mild approval) 5 (strong approval)

**Has attending this presentation changed or affected your thoughts on synthetic biology?**

Yes                      No

**How has this presentation changed or affected your thoughts on synthetic biology?**

1 (feel much more negative) 2 (feel a little more negative) 3 (no change) 4 (feel a little more positive) 5 (feel much more positive)

**In your own words, please share your opinion on synthetic biology research:**