1. Do you feel like this troubleshooting experience was worthwhile?

* Yes, it allowed us to take a step back from the experiment and conceptualize what was going on.
* Yes because I was able to see what most likely caused my errors
* Absolutely, it helps to understand the material when you can say what should have happened but didn’t because of a specific reason
* Yes without a doubt since it helped us understand how to fix errors and better understand what our results meant by taking a lab period to analyze the results
* Yes, it allowed me to assess my mistakes and try to fix the problem to get a better outcome
* Yes. I think it was helpful to go through how things could be improved or changed
* Yes, helped me understand the process and possible flaws. PCR troubleshooting helped me understand and correct error
* Yes the troubleshooting exercise was helpful. It was good to understand why things don’t work and it gave us an opportunity to correct our mistakes
* I think it was a good idea although my reactions did not work in the next week
* Yes because it helped to redo and see if our mistakes could be fixed
* Yes because it was an opportunity to fix or get the correct results
* Yes, it was nice to understand why an experiment didn’t work and what could be improved
* Yes-it was helpful to discuss the reasoning behind each procedure
* Not really, because I didn’t have to troubleshoot the second time and when I did troubleshoot the first time it still didn’t work
* Yes, I think it’s important to reflect on the process if we didn’t get the results we expected for the future. It’s also good practice because things don’t always end up like you expect in research and it’s important to figure out why
* Yes-I realized that my BB minichunks were not digesting properly and troubleshooting showed me how this issue could be resolved
* Yes, I do. It allowed us to revisit what may and may not have been successful and learn from the experience. It also reinforced certain techniques.
* Helpful because allowed another chance to do experiment. Difficult/confusing because every individual did something different at the same time
* Yes, because I had made several errors in procedure and felt a bit more comfortable going through it a second time.
* Yes, I thin after labs where much of the class could not get results from our gels it was a little discouraging, so the troubleshooting week allowed some of us the chance to alter technique and get results
* Definitely. The troubleshooting really helped me understand the lab techniques better, as well as what exactly we wanted to accomplish. The repetition of the PCR, finish and templateless, and the running of gels was an immense help, allowing me to be very comfortable performing them on my own.

2. Do you think we should have had more troubleshooting labs?

* Yes. They helped me understand everything, and made the labs much more clear.
* Possibly. I believe a couple more could have slowed down the process for more conceptualization. Lie a discussion midweek or something.
* Yes, I found them very helpful and it was one of the labs I learned the most from
* I think the 1 troubleshooting lab was enough.
* Yes because again it helps bring everything together and shows how research is actually done.
* No, because they can be time consuming
* It would have been helpful to have another troubleshooting lab for the second half of the semester
* No because one or two is enough to further understand the lab without taking up too much time
* No because it was time consuming and boring
* Yes, for practice
* No, there wouldn’t be enough time
* No, tedious work
* No. While I think it is important to troubleshoot, having too many could waste valuable lab time
* Yes-I felt like a lot of the time we moved on to the next step without discussing the results of the previous step, especially if the previous step failed
* No, because the overwhelming majority of students did not yield different or improved results after
* I think we could have a troubleshooting for the last E. coli transformation because some people didn’t get any white colonies
* No, but I think that troubleshooting should be explained earlier in the semester (as in how/what types of troubleshooting may need to be completed)
* No, I believe the ratio of new material to troubleshooting was balanced well
* No. Different individuals troubleshoot differently. Should have opportunity to troubleshoot but is not as helpful when many different students must do different experiments at the same time
* Given the available time, no, it would not make sense. If we could afford the time, yes.
* I think more troubleshooting labs would be helpful because in real life I feel like most lab work involves constant troubleshooting

3. Do you feel that previous labs accurately reflected what it means to do research?

Option 1:Yes, I believe previous labs reflect real research because:

* Yes and no because we are developing skills that are necessary for completing real research but generally the end product was known
* It provokes self-exploration and understanding by questioning and analyzing results
* Some experiments work and some do not, which is what it means to do research
* I have completed actual chemistry research under a professor here at Loyola

Option 2: There are aspects of different labs that portray real research including:

* Completing more complex lab procedure in organic chemistry and physical chemistry. However, these labs did not have meaningful results like this lab. If I messed up something in a previous lab, it really did not have a great effect. In this lab, everything had a purpose for moving forward to the next technique.
* The processes that we included with the techniques applied during the lab with streaking and just proper lab protocol
* Only my Eco-Evo lab gave me a research opportunity, the rest were mostly exercises from a book
* Following lab procedure and conducting an experiment/following directions
* Identifying an unknown in microbiology, independent protein purification project in biochemistry II
* Because I took cancer bio and we did research projects and designed our own experiment
* Developmental Bio 410
* Troubleshooting, But after the experiment was over, the data didn’t go anywhere like with syn lab
* A lot of the labs give you a basic understanding but do not allow you to retry and troubleshoot particular parts of the project
* Developing/performing your own research project
* Cancer bio made me feel like it was real research because there were real life applications of what we were doing and we “didn’t know” what to expect. Most other labs have an end product already known and you either get that result or not, which I don’t think research is.
* They are good for techniques. But in terms of experimental design, critical thinking, analyzing results, and troubleshooting, not helpful

Option 3: They have not accurately reflected real research because:

* They are all pre-canned. We knew what the outcomes should be and there is not as much creativity/options to troubleshoot lab design as you go through the course
* They tend to focus more on technique, which is essential
* Various techniques that are used in research labs
* We knew the mechanism and what we were to achieve. The rests of the lab work did not matter.
* They were all very structured and new results weren’t expected. We were told what our end product should be or what is happening, but here we learned processes and then saw how it works when doing real experiments with unexpected results.

4. Do you feel that the work you did this semester accurately reflected what it is like for researchers in a lab?

Option 1: Yes, the work this semester is reminiscent of what scientists do because:

* We experienced failed labs where there was a need for adaptation. In past labs, the finished product was essentially always known.
* Involves learning from mistakes and understanding that results will never be promising or what you would like to expect
* Gels, transformation, etc. All of the weekly routine
* It is a lot of trial and error, and also a lot of down time
* It really felt like I was performing new work. Watching videos of synthetic biologists wok on genome sequencing showed that they are doing exactly what we are performing. Having successful techniques performed made it much more satisfying, especially after repeated failure. Also, this was the most fun lab I’ve ever taken
* We tackled the problems one day at a time and had to think very hard every step of the way, constantly problem solving
* Because it wasn’t just an assignment that we knew would work. We tested different genes and changed reaction conditions to achieve our desired product. Mistakes were made, some of that can be fixed and some that cannot be fixed, as well as not necessarily knowing the outcome.
* We didn’t know what to expect or if what we were doing would work. We used basic techniques to find something new.
* They base results on whether they can continue to the next step. Errors can occur.
* We all had setbacks with results and every day in the lab was linked form one day to the next.
* We were uncertain of whether or not out experiment would be successful
* It required extensive processes, but used molecules and DNA where results were unknown thus requiring troubleshooting and fine tuning

Option 2: There are aspects that reflect what scientists do every day, including:

* Using the same techniques and tools that scientists do; but only met once a week rather than more frequently
* Troubleshooting, frequent check points to test prior steps, collaboration
* Using a catalogue of techniques in different contexts and making adjustments when results are unexpected
* Not knowing what the results of the experiments are. But we know which direction we were taking the whole time and were given protocols
* Working on something that has never been done before but not enough troubleshooting
* Understanding why a certain portion of the research did not work
* The lab was some sort unorganized and our materials were sometimes the reason experiments didn’t work. This reflects all the experiments that don’t work for scientist on a day to day basis I guess.
* Doing things multiple times and having things not work

5. What was the most challenging aspect of Synthetic Biology Lab?

* The level of precision needed to handle such delicate subject matter. Also, the week between labs ruined any sense of continuity
* Frustrating to see that I had no colony growth at the end of my yeast transformation
* The length
* Running the PCR
* Understanding each individual part of the lab. Everything was a little overwhelming, and it became difficult to distinguish what each lab was, and why we performed each step
* Being aware of the next steps to take in the lab
* Understanding what was happening
* Trying to visually picture the different transformations
* Not knowing if I was doing technique correctly or if steps did not work because of the things we were working with
* The lab reports
* Being able to put in words what was happening in the lab. I get it in the pictures, but sometimes I find it hard to explain in my own words what is going on
* Troubleshooting was the most challenging aspect
* Probably understanding what was happening on a molecular level and remembering how it worked
* Using technology and applying the information on the internet with lab
* Obtaining successful results
* Doing a lot of techniques before learning about them in class
* The exams
* Not having the correct/not enough reagents or reagents that were defunct; Not knowing why my experiment didn’t work
* Understanding the overall big picture of the concepts and how they fit together
* Nothing really worked. So it was frustrating spending all this time in lab with no results
* Nothing worked and lab reports had nothing to do with what we were learning in lab or lecture

6. What did you enjoy most about Synthetic Biology Lab?

* I honestly enjoyed all of it. Every day we were able to engage in hands-on biological procedures
* I enjoyed seeing results after gel electrophoresis and loading gels
* There wasn’t any pressure
* Transformation
* Performing the different labs, especially running the different gels. Also, having eventual success at the gel electrophoresis was fun
* Really the scientific articles and performing multiple gels and PCR
* Gel electrophoresis
* Running the gels
* Really interesting project and good exposure to techniques
* Seeing if steps worked or not
* I enjoyed the idea of being part of a larger research project and hopefully contribute to something in the future because of this research
* Actually contributing to research
* The fact that it was actual research
* Real world research experience
* The thrill of something working the way it was supposed. The research aspect of this course kept it interesting.
* Coming to lab every Monday and doing things I’ve never done before and feeling like my research was as important as the learning process
* The labs were fun, so was the paper project
* Being a part of a project that people all over the world are working on; Doing something that has not been successful before
* Gel electrophoresis and participating in a world-wide study
* Electrophoresis
* When things actually worked

7. Has your experience changed the way you think about research?

* I actually enjoyed the troubleshooting part so it further increased my interest in conducting research
* No I still like research
* I knew I wouldn’t like research and doing this lab supported this
* I was unaware of the amount of free time/downtime. For some reason, I thought lab time would be super busy
* This lab has shown me that a lot of research can be unsuccessful, and multiple trials are necessary. It’s about what I expected, although the disappointment of failure affected me more, but it made the success that much better. I’d say I feel the same about research, I just hope I can do some research opportunities in the future
* This semester reaffirmed my hopes to do research in the future because I liked the process of it as much as I thought I would
* It did change it because I did not know about troubleshooting and how frequently it is done
* I did not know that there was a way to troubleshoot the experiments, where you wouldn’t have to start from the beginning
* Pretty consistent with my other research experiences. I felt like I had less ability to figure things out (solve the problems) because we had to work as a class and because our meetings were only once a week
* I did not realize how common it is for researchers to not get the results they want
* I was not a huge fan of doing research before this lab but I think I would be more open to it now after seeing the impact I can have by doing research
* I was unaware of how much troubleshooting goes into planning experiments and for that reason I think I would dislike future research but I wouldn’t be deterred from using it
* Yes, I really wasn’t sure how I would feel about research, but after this lab I found I liked it
* Previously unaware of all the steps required to check that is the correct sequence; previously unknown how research is a large collaborative effort
* It’s made me appreciate research a lot more and the patience and precision that go along with it
* No, but my boyfriend does research and his experiences have solidified my desire to avoid research as much as possible
* No, I knew research involves a ton of troubleshooting and repetition
* Yes-it did not go as smoothly/quickly as I thought research was
* This solidified my expectation of how real research works. I knew experiments don’t always work and there is both great planning and troubleshooting
* No it’s made me realize that I don’t want to enter into research
* Yes it reminded me how much I hate doing research

8. Has your experience made you consider pursuing/not pursuing a career in research?

* Coming into this course, I wanted to enter the field of biotechnology, so I knew this course would run parallel. I was fortunately right and was able to gain lab experience with certain lab techniques.
* Possibly
* Yes, I do not want to pursue research, but as I said above I knew before this lab
* It has, I enjoy problem solving
* After this class, I’m still interested in research, perhaps more so than before. It hasn’t really made me consider not pursuing a career in research, but it does make me want to look at other options, just to gauge everything I can go towards.
* Yes, I still would like to earn a PhD in Epidemiology focusing on infectious diseases
* Not really, I enjoy it but I don’t think I’d want to pursue a career in it because it frustrates me when I get no results
* It makes me a little more interested in doing research, but not enough to want to pursue it as a career
* It didn’t turn me off from research, but I’m not really planning to go in that direction. It’s still a possibility at some point in the future
* I would not consider pursuing a career in research
* Research is not my first choice of a career but after this semester I have definitely considered it more as a career choice than ever before
* The only reason I would not pursue a career in research is because of the possible frustration from troubleshooting
* It has made me want to find a research program to do over the summer to see if I like it more
* Experience helped consider research as a career; Interesting application of what we learn in class; However, it is frustrating when obtain deviant results
* It has made me more interested in research, but I think I’d be more comfortable as a technician or technologist
* No, it has not impacted my opinions at all
* Yes, I’ve realized I do not wish to pursue a career in research
* Somewhat-I want to be part of some research, but cannot see myself working on it for a very long time because I like to be able to see the direct applications of how this is helping others first hand
* I have learned that a career in research is not for me
* No, it’s made me less interested
* No! It made me realize I do not belong in research