SOCIETY OF PHYSICS STUDENTS
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Marsh White Award Report

Project Proposal Title	The Edible Laser
Name of School	Appalachian State University
SPS Chapter Number	Z5-0216
Project Lead (name then email address)	Dr. Brooke Hester hesterbc@appstate.edu
Additional Project Leads (two lists: names then emails)	Dr. Lauren Woods graywoodsbl@appstate.edu Jose Salazar salazarj@appstate.edu Jack Griffin griffinjh1@appstate.edu
SPS Chapter Advisor	Brooke Hester
Total Amount Received from SPS	$250
Total Amount Expended from SPS	$250

Summary of Award Activities

The edible laser has been designed and built by students at Appalachian State University. The edible laser will be an educational tool that students, faculty, and the general public can utilize to explore the science of lasers. The inside of the laser is visible so that students may learn about each of the components and how they form a functional design. The overall goal of this project is to test edible materials as our gain medium. The project is still in progress and is expected to be completed by end of 2017.

Statement of Activity

Overview of Award Activity

- Brief description – The edible laser sits upon a small breadboard with a 2 W pump at one end. There is a single flat mirror, two curved mirrors, and one dichroic mirror. The two curved mirrors and the dichroic mirror form our laser cavity for the edible material. Several optical components are mounted on rotating or translating stages for high-precision positioning. Within the cavity, the gain medium is enclosed in a flow cell for liquid media and is placed on an adjustable mount with clamps for solids.
- Outcomes – The project is still developing, but the laser assembly is completed. The next step in our process is to research lasing materials and put them to the test to understand their lasing efficiencies. Finally, we intend to make this project a demonstration for students and the public to teach the science of lasers.
- Audience – The edible laser project was intended to reach Appalachian State students in the classroom as well as the public during outreach events and demo shows.
- Context of the Project – The Appalachian State SPS chapter has a strong emphasis on outreach. This project allows us to implement a new and exciting demo into our regular events and stir up enthusiasm in younger populations to pursue an education in the sciences.

Impact Assement: How the Project/Activity/Event Promoted Interest in Physics

Goals:

1.	Create a design for the edible laser build	Complete
2.	Buy parts and build the design	Complete
3.	Align the pump laser through the cavity	In Progress
4.	Use a known material to get fluorescence and lasing	In Progress
5.	Test edible materials	Future work
6.	Develop a demonstration to use in outreach and teaching exercises	Future work

The edible laser is not complete, and therefore has not yet been used in outreach or teaching exercises. This is the ultimate goal of our project and will hopefully be accomplished by the end of the year. The SPS chapter hosted a meeting where both Jose and Jack gave a presentation of our project to other students. This was the first introduction of our work to the public and it allowed us to gage the level of interest people would have with an edible laser demo. Lasers are exciting and people seemed enthusiastic about learning how they work.

When the edible laser is complete we will take it to the surrounding schools in our area and teach students about lasers. We will create a demonstration that shows the inner components of a laser and how they work together. This also allows us to explain laser safety and how to recognize the risks associated with them. We will be able to assess our impact of this project by surveying the SPS club members first to determine the interests and learning outcomes. At outreach events we will gauge impact via verbal excitement and how the audience interacted with the experience.

Key Metrics and Reflection

Please answer the questions below. Please indicate if a question is not applicable to your project.

Who was the target audience of your project?	Students and the general public
How many attendees/participants were directly impacted by your project?	The project is not completed and has not reached the public yet.
How many students from your SPS chapter were involved in the activity, and in what capacity?	Two students actively worked on the design, construction, and testing of the project.
Was the amount of money you received from SPS sufficient to carry out the activities outlined in your proposal? Could you have used additional funding? If yes, how much would you have liked and how would the additional funding have augmented your activity?	The $250 gave our project a good initial start and we have made a lot of progress. The second half of the funding will allow us to finish buying supplies and begin testing materials.
Do you anticipate repeating this project/activity/event in the future, or having a follow-up project/activity/event? If yes, please describe.	Once this project is completed it will be available to the faculty and the SPS student chapter to use in teaching demonstrations and lab and outreach activities. A follow up project could be to update the parts to allow simpler use.
What new relationships did you build through this project?	Throughout this project the two students used teamwork to design and build the edible laser. They worked closely with Dr. Hester and Dr. Woods, an instructor in the department of chemistry, who were able to share their knowledge and skillsets on the science of lasers as well as professionalism. The project also formed a relationship with Dr. Andreas Velten at University of Wisconson-Madison. He has been able to advise our team with the laser design and even visited our campus where students were able to talk with him one one one and form professional connections.
If you were to do your project again, what would you do differently?	If the project were to be done again, our team would like to have had all the parts we would need from the start. Progress is slow when new parts are in the mail.

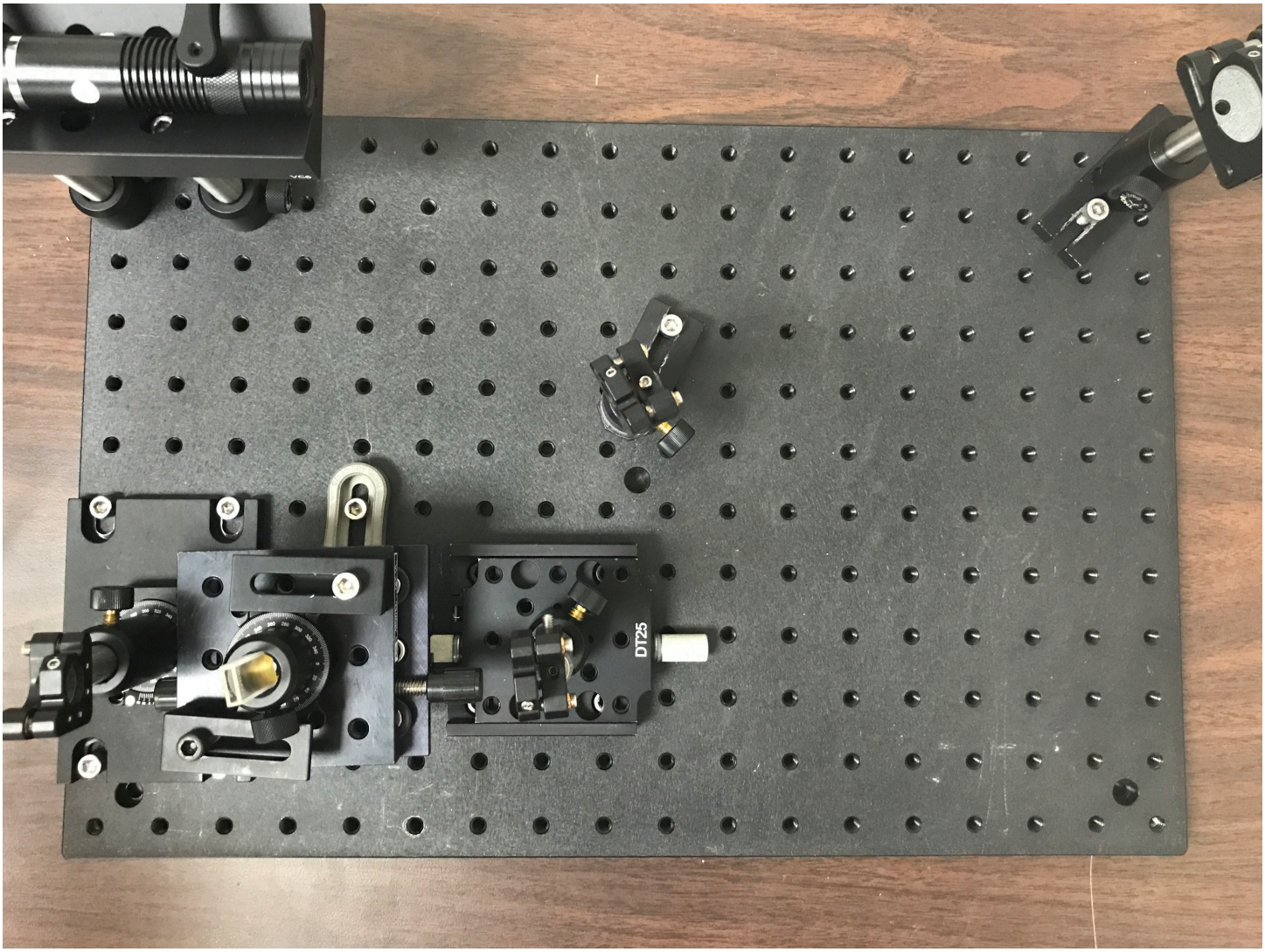
Expenditures

Expenditure Table

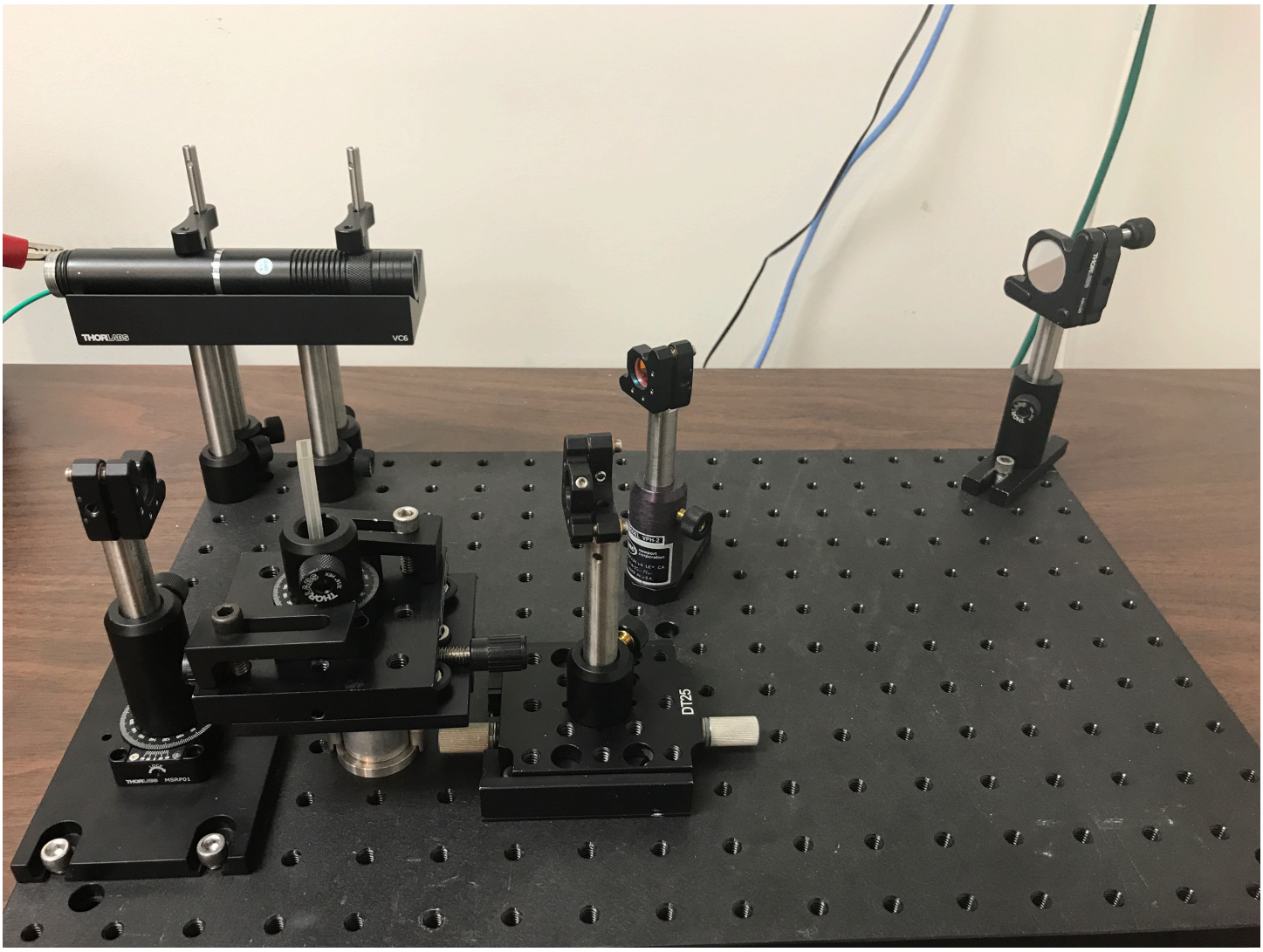
Qty	Item	Cost
10	8-32 to ¼-20 Thread Adapter	$19.40
1	Clamp 'L' shape 0.68" high 0.75" wide 2 long slot	$4.21
1	½" Dia. x 3" Length: Pack of 5 Posts	$24.39
1	Ø ½" x 3" Stainless Steel Optical Post, 8-32 Stud, ¼"-20	$5.42
1	1" Post Holder with Spring-loaded Thumbscrews Pack of 5	$35.15
1	1" Post Holder with Spring-loaded Thumbscrews	$7.03
1	Clamp 'L' shape 0.68" x 0.75", 5 Pack	$21.05
1	Translation Base Mount	$23.20
1	Long Hex Driver kit	$39.99
1	Zip Ties	$4.99
1	Nitrile Gloves	$4.98
3	Compressed Air Canisters	$34.23
1	Folding Hex Key Tool	$7.98
5	¼" Nylon Washers, 4 Pack	$2.90
10	¼" Hex Nuts	$1.40
1	Shipping and Handling and Tax	$15.65
	Total of Expenses	251.97

At the start of this project there were a lot of borrowed equipent from other labs in the department. In order begin construction we needed to buy a few parts and screws. This allowed us to assemble the edible laser and begin to start allignment. Along the way, many small items needed to be purchased to assist our development. Hex keys were needed because we did not have all the correct sizes to fit our screws and washers and nuts were needed in the design as well. We expended the initail $250 and will use the second round of funding to buy dyes and household and edible materials for testing the laser. We intend to purchace an additional laser to expand our wavelenght range and will use it to quantify gain efficiencies of uncharacterized media.

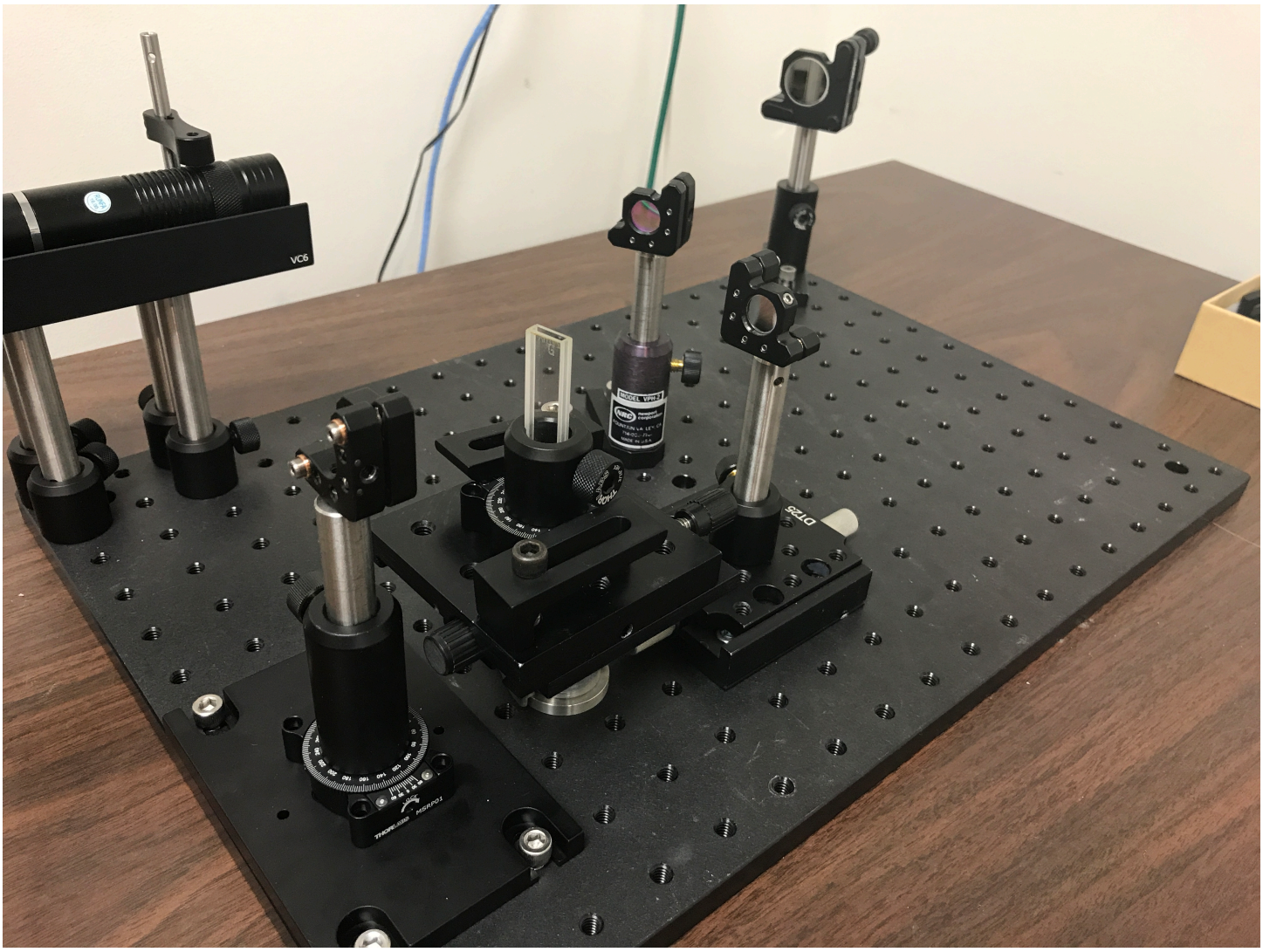
Activity Photos



An overhead view of the breadboard with the laser pumo in the top left corner.
Taken by Jack Griffin.

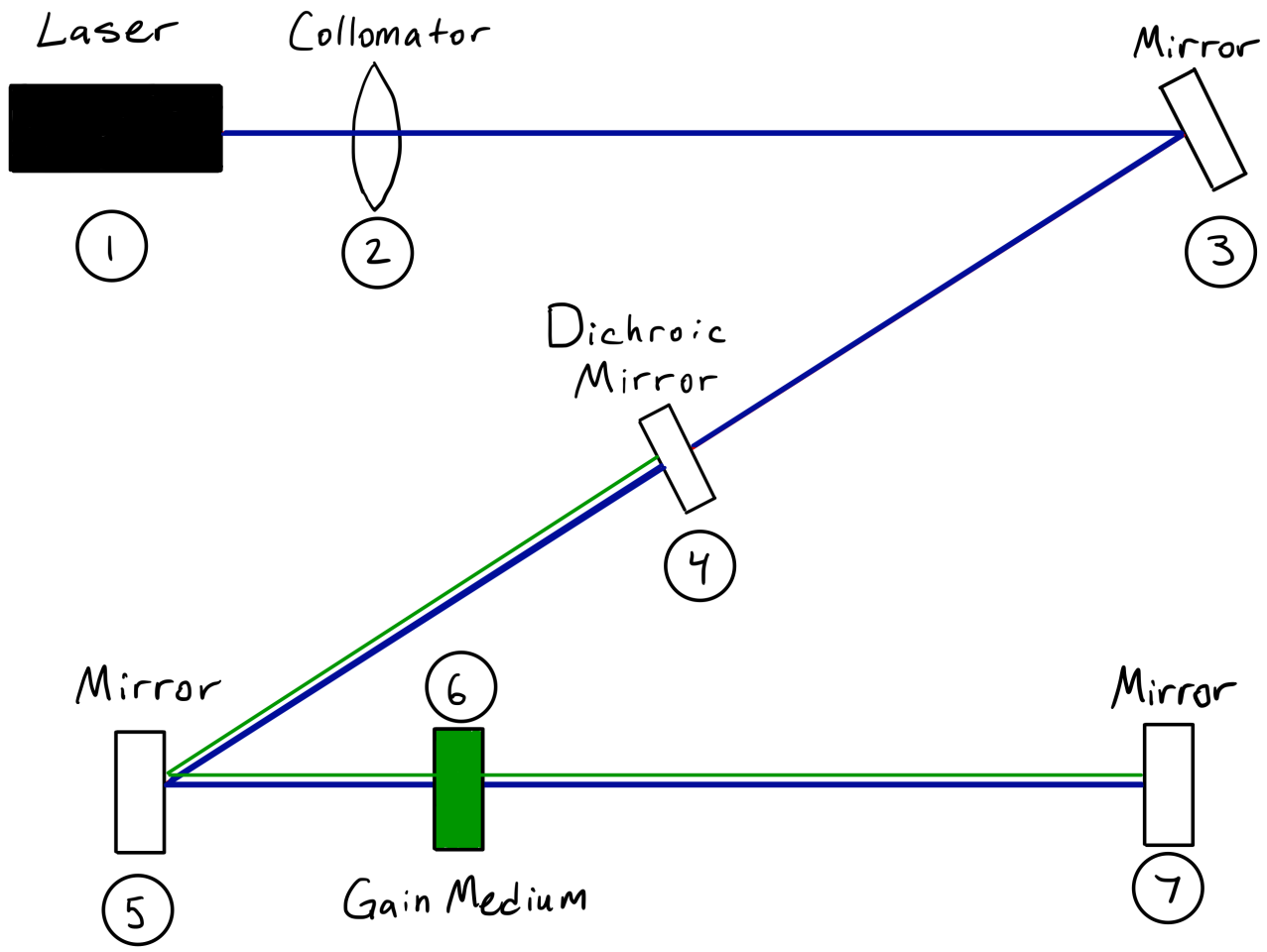


A front view of the breadboard.
Taken by Jack Griffin.



A front-left (corner) view of the breadboard.
Taken by Jack Griffin.

The laser being positioned by Jack.
Taken by Dr. Lauren Woods



An early design of our breadboard layout used to place our components. The laser pump we used has a collomator inside its casing. The drawing does not use the actual size and spacing as our project, but the geometry is correct.
Drawn by Jack Griffin.