

HR 2 BREAKDOWN

TEAM: Team 5 Laboratory Fume Hood

Due Date:

Friday, July 10, 2020 at 11:59pm

Current State of Project:

The team has made final decisions regarding the final design of the structure of the fume hood. The material has been chosen to be polyethylene and similar materials which are resistant to carbon fiber particles. The top of the fume hood will be a pyramidal shape to reduce stagnation points of the airflow through the system. The filter will be a HEPA filter inserted into the attachment of the exhaust hose to the fume hood.

Feedback from the client indicated positive reactions to design decisions. Proceeding with the manufacturing and assembly stage, the client suggested we look into different options to build the final design. The team created three separate preliminary manufacturing processes that will be presented to the client in order to choose a final direction. Cost analysis was performed for each manufacturing option as well. A final direction will give the team a more unified plan to research into final implementation and testing procedures. The three manufacturing options are outlined below.

Manufacturing Option 1 : Modified Polyethylene Bin

Poly Box Truck - 20 Bushel, Gray



[More Images & Video](#)

Transport wet laundry, bulk materials and trash in these sturdy, high-capacity trucks.

- Tough, seamless polyethylene is easy to clean.
- 4" polyurethane swivel casters offer easy mobility.
- Galvanized steel base.
- [Hinged Polyethylene Lid](#) and [Spring Lift](#) available.

SPECIFY COLOR:

MODEL NO.	OVERALL DIM. L x W x H	INSIDE DIM. L x W x H	CU. FT. CAP.	BUSHEL CAP.	CAP. (LBS.)	WT. (LBS.)	PRICE EACH		COLOR	IN STOCK SHIPS TODAY
							1	3+		
H-1956GR	52 x 37 x 36"	42 x 26 x 30"	25	20	800	72	\$360	\$350	Gray	<input type="text" value="1"/> ADD

SHIPS ASSEMBLED VIA MOTOR FREIGHT

Figure 1. Main Component

Client feedback was taken into consideration in the manufacturing and assembly process, the team began to look for a large bin that could be modified as the main fume hood structure. The main box would be used as the fume hood structure and the 18-inch opening would be cut out to provide access to the workspace. The lid would be purchased and glued to the box as the bottom of the

structure to prevent pressure drops. Polycarbonate sheeting can additionally be purchased and mounted to the inside of the structure to create the pyramidal shape inside the fume hood. A hole can be cut on the top of the fume hood to provide the attachment of the filter hose which will also contain the filter. The pressure differential device will be permanently mounted on the fume hood to display the filter capacity.

Lid for Poly Box Truck - 20 Bushel, Gray

Hinged polyethylene lid opens easily at both ends.

- Fits 20 bushel [Poly Box Trucks](#).



[Enlarge & Video](#)

SPECIFY COLOR:

MODEL NO.	DESCRIPTION	WT. (LBS.)	PRICE EACH		COLOR	IN STOCK SHIPS TODAY
			1	3+		
H-3529GR	20 Bushel Lid	26	\$165	\$160	<input checked="" type="checkbox"/> Gray	1 <input type="button" value="ADD"/>

SHIPS ASSEMBLED VIA UPS

Figure 2. Main Component Lid

Suntuf

26 in. x 8 ft. Polycarbonate Roofing Panel in Clear



Figure 3. Polycarbonate Sheeting

Component	Pricing
Polyethylene Bin	\$360
Polyethylene Lid	\$165
Polycarbonate Sheeting	\$19.98

Total Manufacturing Cost = \$549.98

Manufacturing option 2:

The second potential option for our fume hood consists of manufacturing the fume hood using NAU resources and then assembling it. This option eliminates the majority of the cost of the device, however it requires that the fume hood will be assembled after its been made.

Pros for this particular option include: the cost of manufacturing only needing to cover material costs which is estimated to be \$86.54 which is significantly cheaper than the other options. The material used in the fume hood production would be polyethylene which the team has researched and found to be the best material for this application. The design will maintain all of Dr. Lerner’s requirements for the project. Cons for this option include the fume hood needing to be assembled after manufacturing which would increase the time before the device is functional. In addition to this the manufacturing may need to be outsourced depending on the resources available through NAU which would increase the cost.

Manufacturing option 3:

The third potential option for our fume hood consists of purchasing a pre-manufactured fume hood from belart. This third option eliminates the need for manufacturing and assembly as the unit comes as one molded fume hood shell. Figure 7 below shows this third option.

Pros for this particular option include: the removal of all manufacturing and assembly processes since the fume hood shell is one large molded unibody, This option includes the rounded pyramidal ceiling that matches the team’s designs, and it is made from a durable polyethylene plastic that reduces the risk of corrosion from the harmful effects of carbon fiber. Cons for this option include a price point that is over three times the team's budget. without shipping and tax, this option runs for \$1289.55. While

this large molded hood matches our required dimensions and weights it does not however meet the requirements for Cfms within the system. This pre-purchased model allows for cfms of up to 350 cfms, recommended. Our exhauster fan runs at 395 cfms and therefore we would be forced to lose 45 cfms to meet compatibility with this option. One additional con of this option is the diameter of the hood stack, our exhauster hose is 4 inches in diameter while the stack is 6 inches, which would then require a reducer to be 3-printed to connect the hose to the stack.



Figure 4: Pre-manufactured fume hood from Belart

The following are the Action Items each person completed between Hardware Review 1 and Hardware Review 2:

Team Member: Talal Alshammari

Action Item	Date Completed	Result/Proof of Completion
Gantt Chart	07/05/2020	<p>The Gantt Chart presented in Appendix A was created to manage the team tasks and assign them to the team members accordingly.</p> <p>However, some specific tasks regarding the manufacturing and design process were not included yet. The team will wait for the client decision on which manufacturing option he will approve.</p> <p>For the remaining weeks, there will be 7 tasks that should be delivered, which are the second website check, final presentation, final report, Optional Poster, Client Handout, Final CAD package, and the third website check.</p>
Implementation plan for Manufacturing option 1	07/10/2020	<p>If Dr. lerner, who is our client, approved the modified polyethylene bin option which was presented by shriley, the team will provide a design manual which includes:</p> <ul style="list-style-type: none"> - The poly box truck dimensions and specifications - The lid dimensions - The polycarbonate sheets dimensions - Modification manual that contains all the changes need to be done on the polyethylene bin - Assembly manual - Differential pressure system codes and manual of installation - Filter specification - Cost analysis.
Implementation plan for Manufacturing option 2	07/09/2020	<p>If Dr. Lerner approved the option of manufacturing the fume hood according to the team's design, the team will provide a design manual that includes:</p> <ul style="list-style-type: none"> - Fume hood dimensions. - Materials specifications - Differential pressure system codes and manual. - Assembly Plans - Filter specifications - Cost Analysis
Implementation plan for Manufacturing option 3	07/09/2020	<p>If Dr. Lerner approved the option of Pre-Purchasing the fume hood, the team will provide a design manual that includes:</p> <ul style="list-style-type: none"> - Fume Hood cost analysis - Fume hood purchasing sources - Fume hood assembly manual - Filter specification

		<ul style="list-style-type: none"> - Differential pressure system codes and manual - Cost Analysis
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Team Member: Zachary Bell

Action Item	Date Completed	Result/Proof of Completion
CAD model for arduino housing	07/10/2020	Completed CAD model to be used for housing an arduino uno rev 3. Model is pictured below.
Manufacturing option 2	07/06/2020	Found cost of materials when manufacturing fume hood design using NAU resources.
Manufacturing Process Research	07/03/2020	Researched manufacturing process methods that are best to use with polyethylene and found a manufacturing method that would be the best to use for fabricating a fume hood.

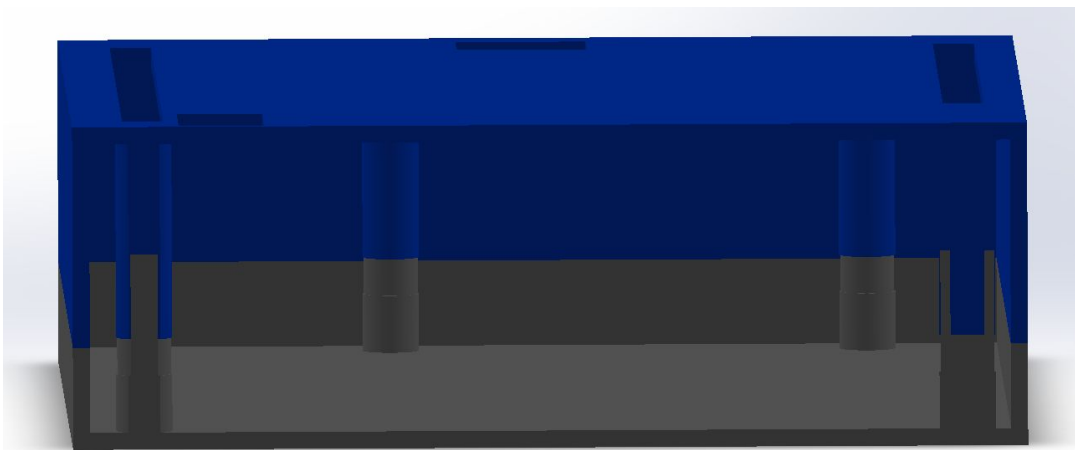


Figure 5: Cross sectional view of arduino housing

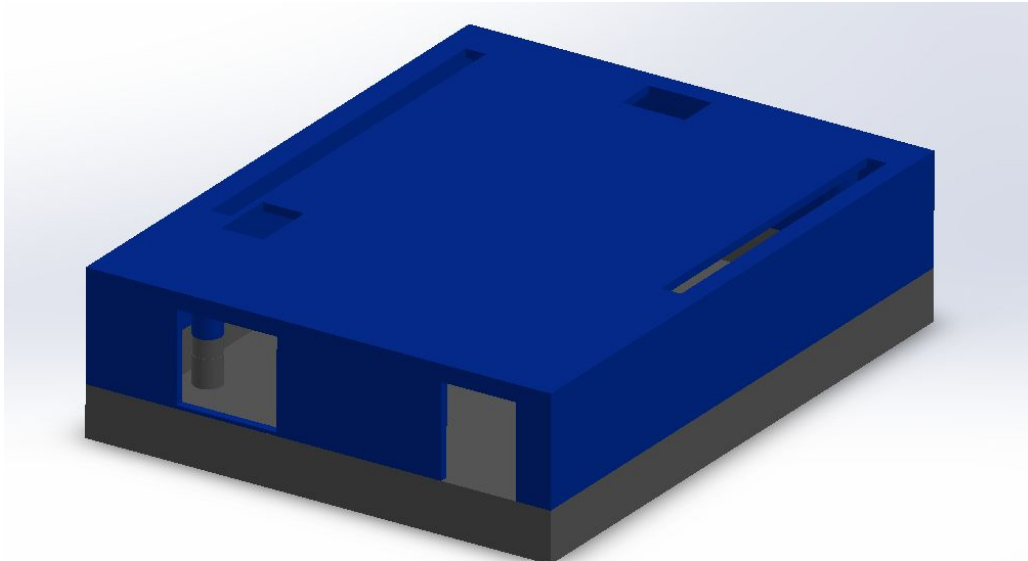


Figure 6: Housing for Arduino

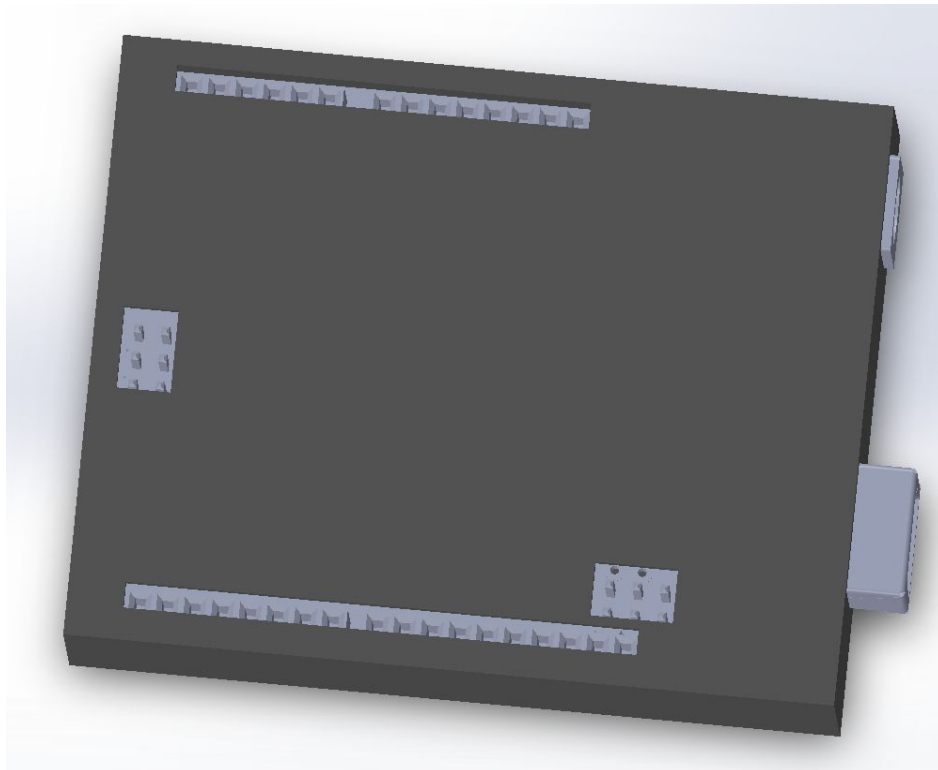
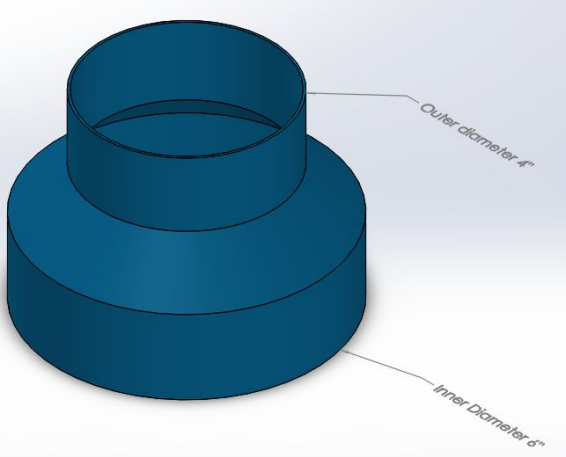


Figure 7: Housing for Arduino board demonstrating use.

Team Member: Bryce Davis

Action Item	Date Completed	Result/Proof of Completion
Manufacturing option 3	6/30/2020	Researched pre-manufactured fume hoods and discovered the large molded fume hood from belart.com
CAD model for 6" to 4" reducer for pre-purchased fume hood model	7/9/2020	<p>This reducer displayed is a 6" to 4" inch reducer for use in connecting the 4" hose to the 6" stack on the fume hood.</p> 
Filter Assessment	7/2/2020	Filter assessment including the determination of optimal location, optimal cleaning parameters and times; details concerning "caking", airflow penetration, air permeability, filter efficiency, and pressure drops across clean and clogged filters.

Team Member: Shirley Hatcher

Action Item	Date Completed	Result/Proof of Completion
Pressure Differential System	7/3/2020	Different Arduino Board suggested, permanent display design
Manufacturing Option 1	7/7/2020	Polyethylene Bin modified to be Fume Hood Structure with attached filter and pressure differential device to monitor filter capacity, displayed above
Testing Plan	7/5/20	Correlating numeric values to the allowable pressure drop across the filter and minimum volumetric flow rate through the system to ensure a safe working environment

The following are the Action Items for each team member between HR 2 and the Final Product presentation:

Team Member	Action Items	Date Due
Talal Alshammari	<ol style="list-style-type: none"> 1. Outlining the future work of the manufacturing option that Dr. Lerner will approve. 2. Edit the Gantt Chart accordingly. 3. Work on manufacturing manual. 	<ol style="list-style-type: none"> 1. 07/17/20 2. 07/17/20 3. 07/21/20
Zachary Bell	<ol style="list-style-type: none"> 1. Finishing CAD models for fume hood to be manufactured 2. Complete additional electronic housing CAD models for LCD screen, bread board and wiring 	<ol style="list-style-type: none"> 1. 07/21/20 2. 07/21/20
Bryce Davis	<ol style="list-style-type: none"> 1. Find filter that meets filter assessment demands 2. Risk analysis and mitigation factors 3. Website maintenance checks II and III 	<ol style="list-style-type: none"> 1. 7/21/2020 2. 7/21/2020 3. 8/4/2020
Shirley Hatcher	<ol style="list-style-type: none"> 1. Complete all work with Arduino for Pressure Differential 2. Complete Testing Plan with Calculations 3. Draft Client Product Presentation Memo 	<ol style="list-style-type: none"> 1. 7/21/20 2. 7/21/20 3. 7/11/20

References

[1] "Arduino Uno Rev-3 CAD Model" Andrew Witham,[Online].

Available:<https://grabcad.com/library/arduino-uno-r3-1> [Accessed 7 July 2020]

[2] "Poly Box Truck – 20 Bushel," U-Line, [Online]. Available:

https://www.uline.com/Product/Detail/H-1956BLU/Bulk-Trucks/Poly-Box-Truck-20-Bushel-Blue?pricode=WA9310&gadtype=pla&id=H-1956BLU&gclid=EAIaIQobChMI38Gox-7B6gIVA77ACh3onwfqEAQYASABEgLEffD_BwE&gclsrc=aw.ds

[3] "26 in. x 8 ft. Polycarbonate Roofing Panel in Clear" The Home Depot, [Online]. Available:

<https://www.homedepot.com/p/Suntuf-26-in-x-8-ft-Polycarbonate-Roofing-Panel-in-Clear-101697/100021329>

[4] "Bel-Art Large Molded Fume Hood," Bel-Art, [Online]. Available:

<https://www.belart.com/large-molded-fume-hood.html>. [Accessed 30 June 2020].

Appendix A : Gantt Chart

Activities	Party Responsible	Week 7				Week 8				Week 9				Week 10										
		W	Th	F	Sat	Sun	M	T	W	Th	F	Sat	Sun	M	T	W	Th							
		7/15	7/16	7/17	7/18	7/19	7/20	7/21	7/22	7/23	7/24	7/25	7/26	7/27	7/28	7/29	7/30	7/31	8/1	8/2	8/3	8/4	8/5	8/6
Wbsite Check II	Bryce																							
Final Presentation	Team																							
1. Introduction and project	Shirley																							
2. Understanding of the req	Shirley																							
3. Design solution to the pro	Bryce																							
4. Design Making	Zachary																							
5. Manufacturing and testin	Zachary																							
6. Budget	Talal																							
7. Future Work	Talal																							
Final Report	Team																							
1. Background	Shirley																							
2. Requirements	Bryce																							
3. Design Space Research	Zachary																							
4. Concept Generation	Talal																							
5. Design Selected	Team																							
6. Implementation 6.1 Desig	Talal																							
6. Implementation 6.2 Manu	Shirley																							
7. Risk Analysis and Mitiga	Zachary																							
8. ER Proofs	Bryce																							
9. Looking Forward 9.1 Fut	Talal																							
9. Looking Forward 9.2 Fut	Zackary																							
10. Conclusions	Shirley																							
Optional Poster	Team																							
Client Handout	Team																							
Final CAD Package	Talal & Zachary																							
Website Check III	Bryce																							