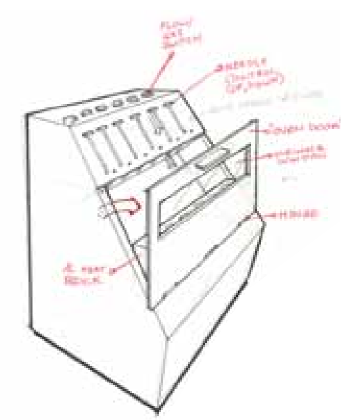
Sketching

An evaluation chart comparing these concepts can be found in Appendix 5

Overhead Concept:

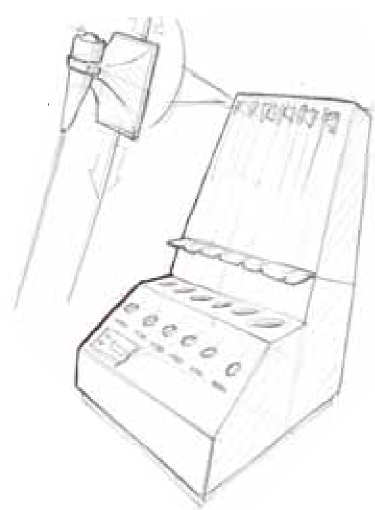
This concept was developed as a way to eliminate the obstruction of controls by the hoses on the front of the machine. In this concept, the tubes are simply placed directly vertical above the heating ports. This setup allows the tubes to rest within their specified heating port when not in use. Another driving goal of this concept was to relocate and centralize all of the controls to isolate them from the sample testing space as well as the heat produced by the heating block. However, the tubes themselves were not constrained, and the spaghetti effect would occur. This is why this concept scored a 2 out of 4 for 'managing injection tubes'. However the flexibility allows different tube geometries to be facilitated by the flow mechanisms. This flexiblity allows for clearance of flow injectors. Ventilation was a part of this concept, but the inclusion of a fan within the system was not considered, which is why this concept scores low on the scale. The positives of this design were the minamilistic appearance, reducing footprint and adding to the modern design aesthetic of the device.



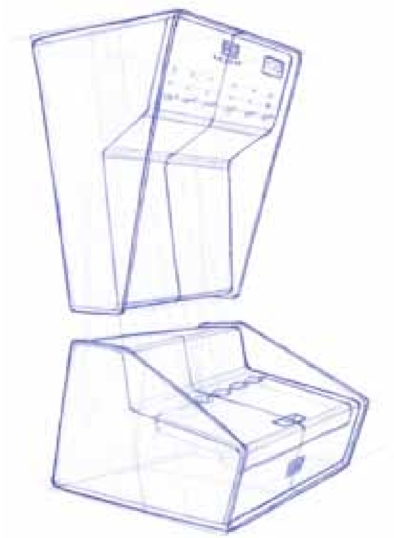
Oven Door Concept:

The oven door concept was develped in reponse to the need to eliminate the adapters used in the current machine by capturing the hot air within the sample prep system. The positives of this design include the elimination of adapters and the improvement of human interface. The use of tube sliders was ideated through this design. This development allows single handed operations. As this concept is boxy, and the closure of the oven compartment detracts from the minamalist design, this design lost points in the modern appearance section. The concept also showed a major flaw in that the flow injector tracks were not long enough to provide the necessary clearance without making the machine much larger. A new solution was needed.

Tracked Concept without Insulated drawer:



This tracked concept addressed the requirement for a longer track to facilitate the clearance of the injectors within the sample tubes. The centralized control location was maintained at the lower part of the device. This posed a potential hazard and also non-ideal conditions for the components that would be installed in this area, as it gets hot. This is why this design lost points in isolating heat sources from users. The large rear section of the device created a bulky appearance and detracted from the modern appearnce of the device. Also, this design did not provide any improvements in cooling time and throughput which detrimented this concept.



Final Concept/Prototype:
This final design was the culmination of a series of prototypes and sketches which incorporated the tracked design as well as a modification of the oven door concept to manage the tubes well as well as heat the samples well without the use of adapters. This model also included a cooling fan and specially designed insulation with cooling channels which greatly improved throughput. The floating rear panel design was decided upon to reduce the bulkiness of the device while still providing the necessary clearance for tube insertion. This enhanced the modern appearance of the device. This device is large at approximately 29”, which is why points were lost in the footprint section, but since the machine was still narrow and shallow on the lab table surface, it still maintained the footprint requirements. The height is also comparable to the other Micromertics devices, typically installed nearby.

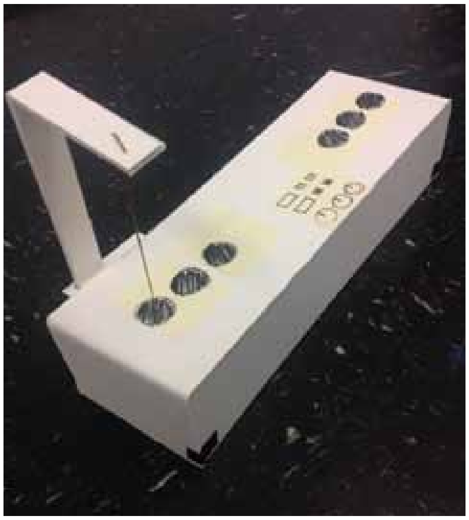
Physical 3D Models

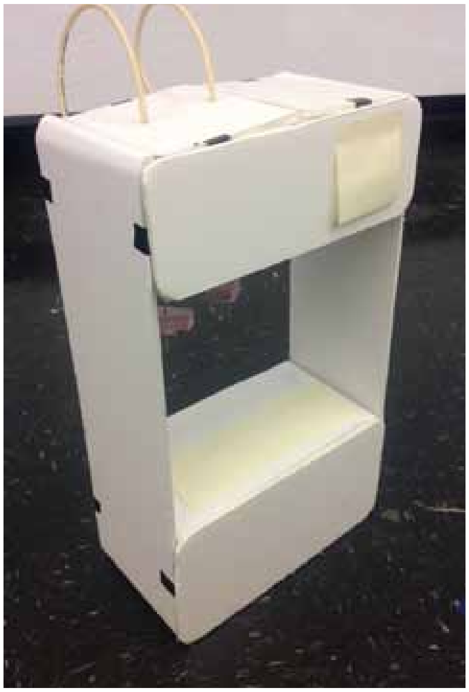
Due to the manufacturing capabilities of Micromeritics and their desire for us to produce a final prototype that represented a product they could produce with their current production line we utilized modeling techniques that resembled working with sheet metal as closely as possible relevant to the application of the model being created. This resulted in a majority of studies of foam core board, cut and bent to form, as well as some models crafted from chipboard. Our initial models explored what forms could be created from cut and bent sheets of foam core, providing a quick and accurate representation of what could be created from sheet metal without complex curvature. A detail of particular note that we discovered while conducting this initial stage of modeling was the potential value aesthetically and structurally of two sheets of material, bent to U shapes, mated together to enclose all 6 sides. This would be a detail that we revisited later in combination with the rounded corners from the juniors’ previous design with our final prototype.

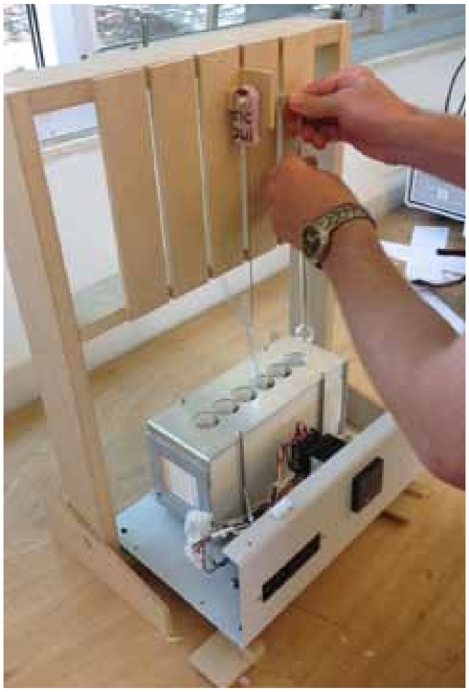
After the initial phase of form exploration through physical modeling had subsided we began to utilize the foam core and chip board to represent and test particular functions we knew to be integral to our redesign. The most useful application of this came through the iteration and testing of various methods of tube management. The earliest outstanding model of this was a chipboard sketch of a completely enclosed sample tube. The function being tested was the potential of an oven-like chamber for each individual sample tube which would pivot open towards the user from a hinge located at the bottom to allow ingress and egress and, when closed, would lock the sample tube into position. From this locked position the flow needle or vacuum cap could be lowered with a sliding handle from the exterior of the instrument. While this completely sealed sample tube area was deemed incompatible with our design goals, this concept of locking the sample into place and sliding to lower a fixed needle into the tube would be represented in our final prototype.

The next physical model with an evident impact upon our final prototype’s outer appearance and function was another potential solution to the issue of tube management. A full-scale mockup of an enclosed heating block was constructed from foam core and several semi-poseable arms were mounted to the back. The flow and vacuum are routed through these arms. The arms are bent and a 90 degree angle towards the user with the flow needle descending into the heating block from the end of the arm. What this model illustrated was a concept of a needle and arm mechanism with two degrees of freedom: up and down as well as towards the user and towards the instrument. This allowed for the construction of the instrument to eliminate the need for tube management through rube rigidity while allowing for all sizes of tubes to fit onto the needle and into the heating block. Again, these features (especially the new hinge function) would be present in our final prototype.

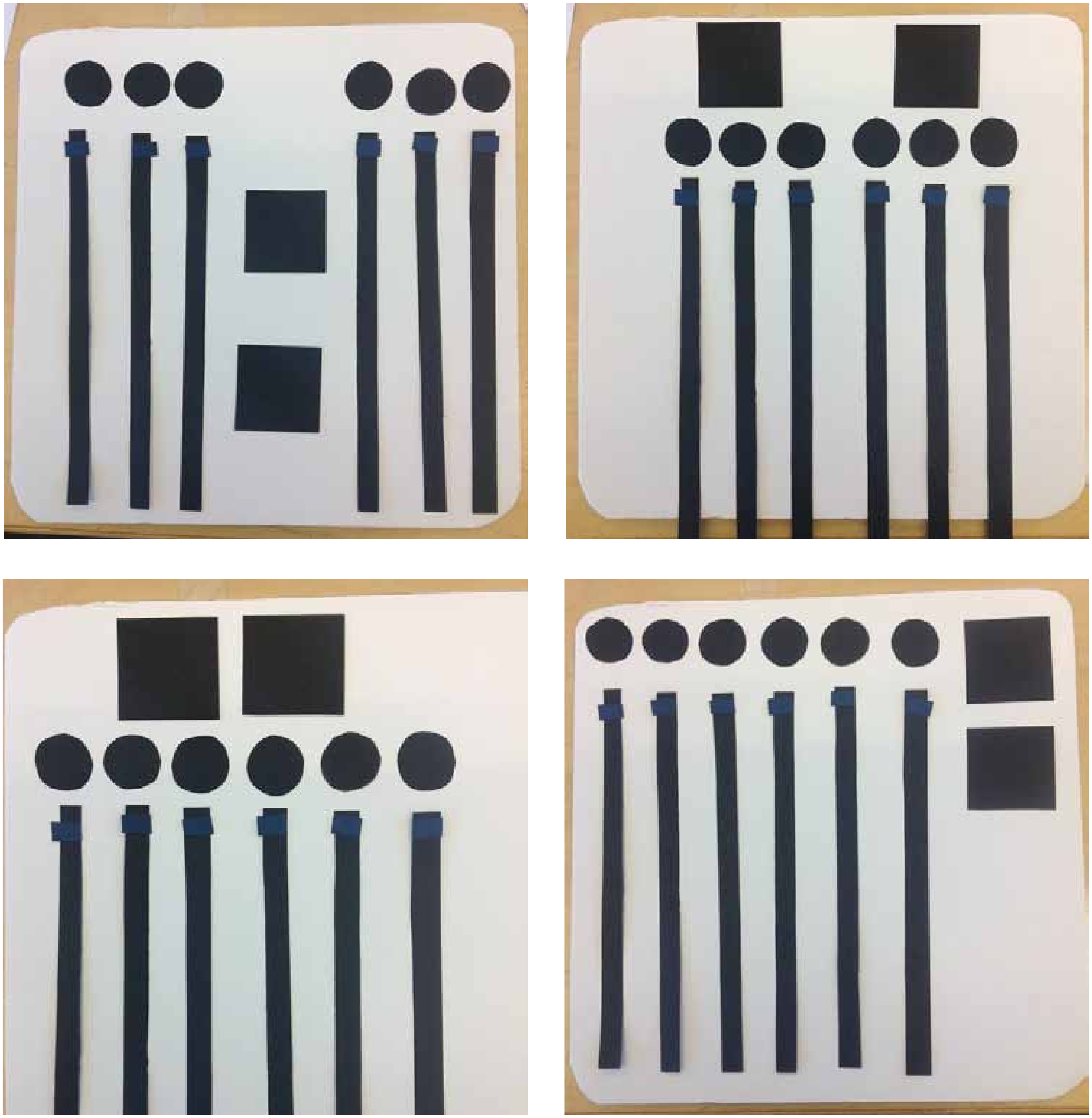
Appendix 8: Physical Models







Appendix 9: Paper Interface Modeling



This visualization exercise examines a variety of control and track configurations for the device. Included are a switch for each track (circle), temperature control and vac gauge (squares), and sliders (in blue).

Appendix 11: Manufacture