The main goal of the week was to solve the problem of how to cut the Kevlar sheets into pieces that will contour the curved shape of the helmet appropriately. Simply using a large sheet of Kevlar to cover the helmet will not work practically at all. The Kevlar will bunch up at curves which will induce folds, air pockets, and a poor structure. For the best way to contour Kevlar for the making of a helmet, an army engineer contact was emailed at a helmet engineering lab in Massachusetts. We thought we may get some insight on how the build the helmet; however, a response was never received in the past few days.

Earlier on in the week, the ACH was prepared in lab by applying the appropriate layers of polish and wax. The PVA release film was added the following day to finalize the preparation for the shell to be added. This process took a total of approximately 5 hours.

After researching composite processing on contoured surfaces online for some time, I finally ran across a patent for contouring rigid composite structures and methods. The main point of the article discussed that cutting the Kevlar fabric into smaller triangles would allow the material to contour better to the curved surface and allow for interlocking pieces. The article indicated that the “advantages include lightweight, moldable multilayer laminated performs that
do not crease, wrinkle, fold, or overlap to create non-uniform surface regions before, during, or after processing; as such, the present invention provides superior structural uniformity and performance characteristics.” In addition, this method does not require a great deal of patterning or creating cut-out regions, which would save time when molding the shell.

The following day was spent testing our ideas of triangular, octagonal, and other cutout types on the helmet using another piece of fabric bought similar to the Kevlar. It appeared that the triangular pieces would work the best in the process and that the octagonal and another star-shaped cutout would not be sufficient.

Finally, we decided that it would be beneficial to build a few shells so that we would gain experience with practice and make them better as we go. In case of any accidental cuts or holes drilled, having multiple shells would be very beneficial. Most recently, the Kevlar fabric was cut into triangular pieces. Epoxy was then mixed, and the Kevlar pieces were added and assembled to the mold. A total of three layers were applied. After multiple layers were added, the shell began to look better than when it was initially started. More layers have yet to be added by other group members. In Figures 2 through 5 below, the steps followed can be seen.

Figure 2. Preparing triangular pattern for cut out.
Figure 3. Cutting out pattern.
Figure 4. After mixing of epoxy, application of the triangular Kevlar pieces to the mold.

Figure 5. Shell after three layers of Kevlar fabric is added.