More progress was made this week regarding practice composite testing. One of the goals of the week was to remove the composite layer off of the World War II helmet and try to clean it to bring it back to its original state. We were fairly successful in doing so. After prying off the composite sheets, there was plenty of epoxy and parting wax remaining on the helmet. With the use of a standard cleaning brush, soap and water, the helmet was scrubbed and cleaned to a more decent state. There still remains some epoxy residue and a little amount of parting wax. For the remaining amount, a knife and a wire brush may be used to grind off the very adhesive epoxy. The partially cleaned helmet can be viewed below in Figure 1.

Figure 1. World War II helmet partially cleaned after the composite test.

The composite piece pried off of the helmet stay in its form very well considering it only consisted of two layers of Kevlar. However, the piece was rather thick for only being two layers. Our final product may not consist of as many layers of Kevlar as we had originally planned on due to the thickness problem. In addition, there was a lot of excess epoxy on the composite along with a few wrinkles and bulges. These problems of finishing and contouring the surface will hopefully be worked out with more practice.
and get better with experience during the upcoming weeks. In addition, the composite was not put together properly as the directions were misread as will be discussed in the following section.

This week we decided to follow the directions for the composite more closely despite the time constraints. We used a metal slab to test the composite building on, along with the removal of it. This will help us judge how nicely we can make the composite layers along with how well we will be able to remove them without ruining the composite surfaces. The directions called for various layers of parting wax, PVA release film, and then the layers of epoxy resin and Kevlar sheets. Due to the proper length of drying time between these layers, we split up the steps into various meeting times among group members, so that we would not have to sit in the lab for 8 hours. On Friday during the design meeting time, Damian and Kristin started the new composite test on the metal slab. I came to the lab shortly after, returning from practice.

The first step in the pre-composite process was to add four coats of parting wax with an hour to dry in between each layer. The layers were applied with a plastic glove and rubbed on by hand equally among the slab. There were three coats of wax applied on Friday. Certain additional materials are needed and were ordered including:

- spray bottle
- gloves
- funnel
- beaker
- paintbrush

On the following Saturday morning, Kristin and I went to the lab to apply the final layer of parting wax. After an hour of drying, the first of three layers of PVA release film was applied. It is necessary to allow 30 to 45 minutes between coats. Proper application of the PVA release film is by spraying it on, however, since we did not have one yet, we spread it on by hand. The additional two layers would be applied by Damian in the next day or so. In Figure 2 below, the metal slab with the parting wax and PVA release film can be seen. In Figure 3, multiple composite layers added to the metal slab can be seen.
Figure 2. Metal slab with parting wax and PVA release film coats.

Figure 3. Composite layers added to metal slab.
Additional supplies were needed and ordered including:

- acetone (for cleaning)
- acetone brush
- resin pumps (for pumping out epoxy and other liquids)
- acetone dispenser
- plastic wedge
- 1 1/2" plastic putty knife

Additionally, wax paper was needed to line the lab bench to protect it from dripping epoxy and other liquids used. Wax paper was purchased at the local convenient store for this week’s testing.

Other issues considered this week were the locking mechanism for the chin guard and ideas for molds for the chin and neck guards. After researching ideas for ways to lock the chin guard in place, the best bet is for us to fabricate our own design and build it in the machine shop. The chin guard will rotate on a free swivel where it has full range of motion. However, it will have a release and lock mechanism at the top position (rest position) and in the down position (combat position). The locking mechanism will consist of a piece of metal shaped into a wedge, similar to a door stop, but much shorter. It will be hollow and have a spring inside of it which will press between the wedge and the helmet. The skinner end of the wedge will be on a simple swivel. The chin guard will be able to slide over the skinny edge of the wedge but will have to press the fatter end down into the spring. Once the chin guard passes over the wedge, it will spring back and prevent the guard from moving back in the other direction. To release this, the wedge simply has to be pressed down and the chin guard can be slid back over the top.

Molds are needed to make the chin and neck guards as well. One option is to use chicken wire as a skeleton to the mold and build the composite over this. Another option is to mold clay into the appropriate shapes and then build the composite off of this mold. These options both have to be researched more and tested.

Hours spent on the project this week include 4 hours in the lab and 1 hour of research.