# **Phase 4: Testing and Iterations Video Script (3 min, 49 sec)**

Setting: Science Laboratory. Two females in white lab coats are standing in front of a blackboard. They are looking at the camera and talking.

Transcript:

Emma:

During the Testing and Iterations Phase, we performed three types of tests, followed by a series of iterations.

1. We tested the Prototype’s individual biofunction sensor components to determine functionality.
2. We then performed the same test using commercial equipment to assess the prototype component’s accuracy.
3. Finally, we tested the operation of the entire Prototype.

Sarah:

For example, an individual component that we tested was graphene.

We applied an epoxy form of graphene to a sample of conductive fabric to see if it would strengthen its durability especially due to washing and human wear.

We washed the test fabric and a control sample 20 times in a bath of laundry detergent, allowed it to air, and then measured the tensile strength and elasticity after each wash.

We also visually observed the fabrics using a 2000x digital microscope to see if the graphene stayed intact and retained its conductivity and elasticity.

Emma:

We tested each of the sensors for accuracy and placement on the shirt.

Our test on the heart rate monitor was somewhat complex.

We first attempted to use conductive fabric as a skin contact sensor to measure this biofunction.

We tested several types of e-fabrics.

However, these tests returned excessive background noise, making heart rate peaks insufficiently detectable.

After some brainstorming, we decided to try a spectral sensor.

We wrote code to program the sensor and connected it directly to the prototyping board.

After testing and minor location adjustments, tests returned accurate heart rate measures.

We also tested the blood oxygen saturation sensor to determine the optimal location.

Our tests showed that measurements were most accurate using the finger rather than abdomen or ear locations

Sarah:

Once we determined that the Prototype’s components were functioning optimally, we tested the Prototype as a whole.

We did this at an Anatomy Lab at Mount St. Mary's University under the supervision of our project supervisor and a medical professional.

We tested the Prototype as I performed three activities: standing, walking, and climbing stairs.

Emma recorded the respiration rate, lung capacity, heart rate, and oxygen saturation after each activity as it was transmitted in real-time from the Prototype to the mobile application.

To determine the accuracy of the Prototype, we also measured these vital biofunctions after each activity using commercial grade equipment,

* 1. a BioPac Spirometer and
	2. a Santa-medical Blood Oxygen Saturation Monitor.

To assess respiration rate, the medical professional conducted a manual count.

Emma:

After the Prototype testing, we went through several iterations to improve sensor accuracy.

During the testing we found that the Vital Capacity sensor did not perform as accurately as we wanted. So we modified the mathematical equation that converts voltage to vital capacity measurements. When we retested, this refinement improved the sensor’s accuracy.

We also wanted to optimize the accuracy of the Prototype’s respiration rate measurements. We revised the original algorithm to better identify peaks in the voltage output of the conductive fabric. Upon retesting, we found that this enhanced the sensor’s accuracy.