



Ignite 2021-2022

Ela Savas 24'

Background & Description

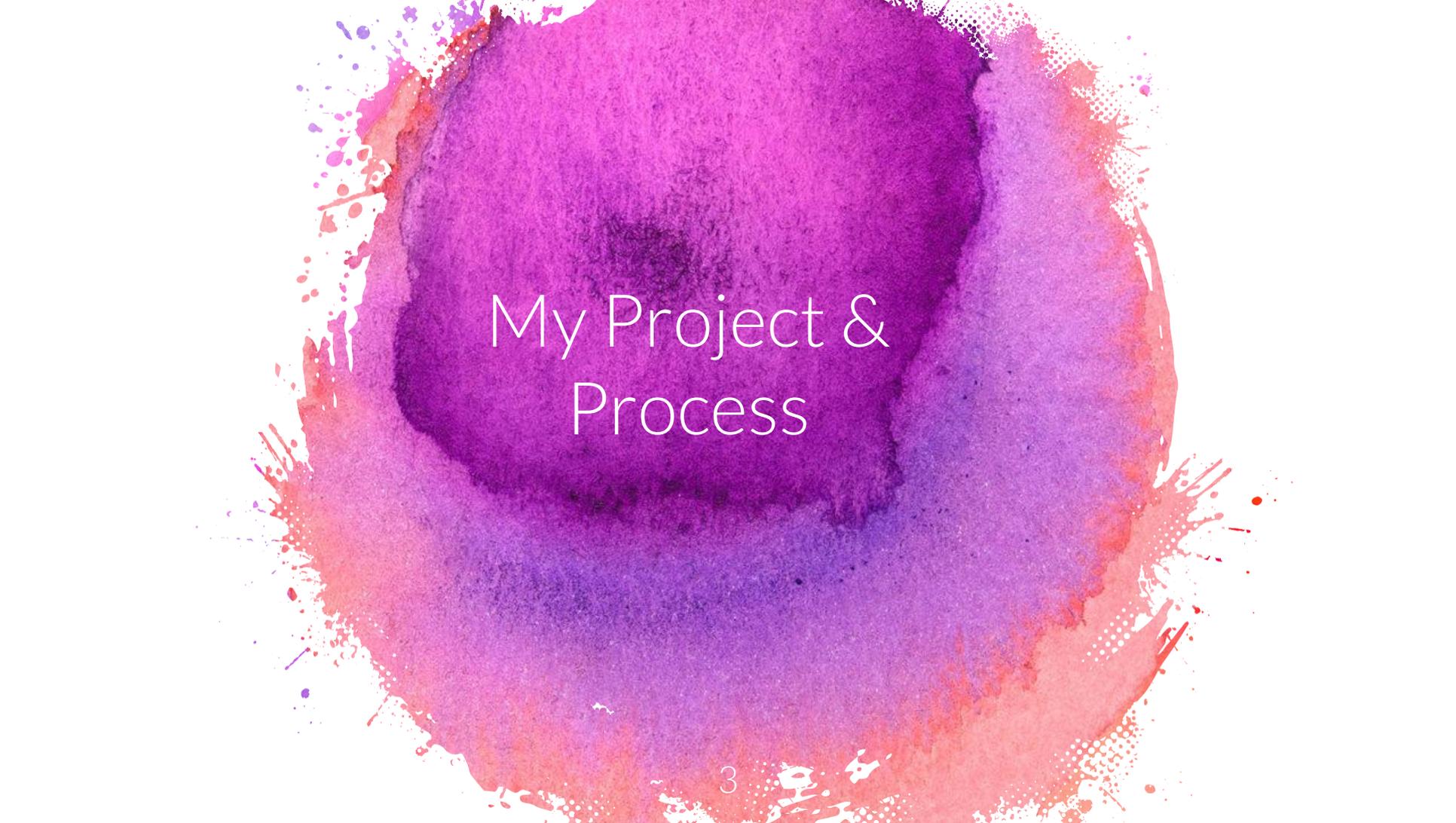
How?

- Duke Pre-college Summer Program!

Why?

- Wanted more exposure to Biomedical Engineering
 - Wanted to expand and narrow down my area of interest





My Project & Process

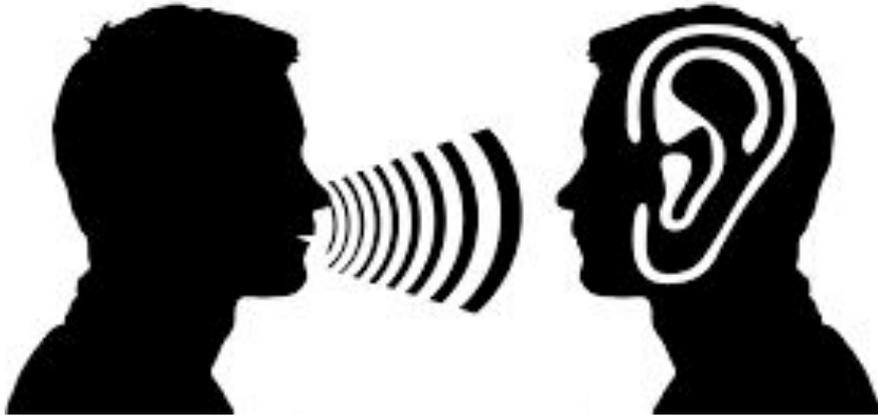
Process & Journey

- Willingness to learn + have patience
 - Timing is not accurate
 - More than half of the engineering process alone could be finalizing a decision of what to do
 - Redoing the same steps within the design process is normal
 - Insight from experts within the field of study is important
 - Able to provide directions in terms of which path is reasonable



Hear Phase

- Research and gather as much information as possible in order to grasp the subject and potential further steps



Research

Cancer research:

- I decided to focus on chemotherapy
- I formed a chemotherapy need statement by finding out what it was and how it damages the body
- I continued doing more research and found out the basics
 - Who is involved?/who is affected?/who is taking part in the initiative?
- Formed an updated need statement
 - Narrowed my focus to solving a problem regarding motor nerve damage in limbs

Chemotherapy need statement:

Chemotherapy is a long and unpleasant way of treating cancer patients, and over time it can cause nerve damage which ultimately leads to stopping the treatment which decreases chances of improving through treatment. Not only can it cause damage to the body itself, but it can also cause extreme pain during and after the treatment which causes future immunity levels to decrease, again, limiting your chances of getting better.

Who is involved, who is affected, who is taking part in the initiative?

- Over 50% of all people being treated for cancer receive chemotherapy, which is used either alone or provided before, after, and in some cases during cancer surgery.

-Medical oncologist specializes in diagnosing and treating cancer with chemotherapy and other drugs -> different than surgical oncologist... uses surgery

Instead: pick one -> either nerve damage or immunity -> specific type of patient? specific provider to monitor patients? way for monitoring immune response? which types of chemotherapy drugs cause more nerve damage? which gender/age group does it affect most? What nerves does chemotherapy affect? drug dependent or site of tumor dependent?

More detailed/specific chemotherapy need statement:

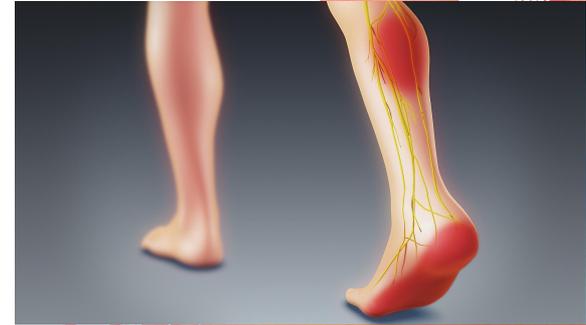
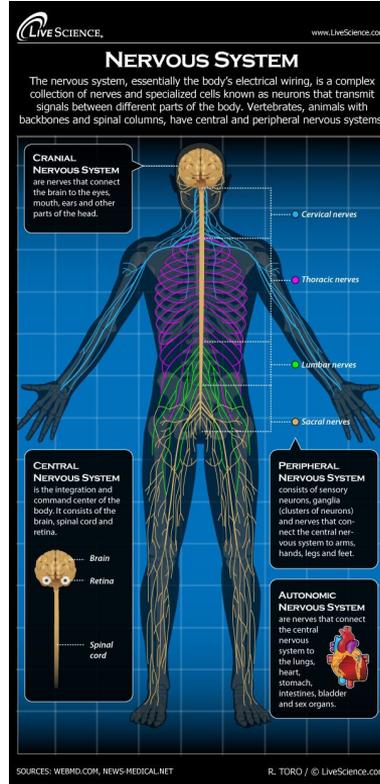
Chemotherapy can cause damage to nerves that connect the spinal cord to muscles, skin, and internal organs which are all key components of the properly functioning human body. The likelihood that a person will develop neuropathy after cancer treatment varies widely, and is largely dependent on what kinds of chemotherapy drugs were given and the dosage that was used. Neuropathy is a nerve-damaging side effect of antineoplastic agents within chemotherapy. The specific types of chemotherapy drugs that cause neuropathy include platinum drugs, such as oxaliplatin; taxanes, such as docetaxel; vinca alkaloids, such as vincristine; and myeloma treatments, such as bortezomib. Some examples of cancers that cause this damage are lung cancer, myeloma or lymphoma cancer. To prevent more damage than what is possible, it is important to monitor blood, kidney, and liver functions. Imaging techniques such as x-ray, ultrasound, CT scans, MRI, and positron emission tomography (PET) can assist in locating damage and keeping up with stages of development. According to recent studies, genetic or hormonal differences between men and women determine the effect of chemotherapy. Until today, animal studies and clinical trials investigating chemotherapy showed sex imbalance. Women experience higher toxicities, including stomatitis, leukopenia, alopecia, and diarrhea, more frequently and severely than men. But, children tend to respond better to chemotherapy treatments given the differences in the cancers themselves, as well as the lack of other health problems that adults with cancer might have, which can often get worse with treatment. When talking specifically about what types of nerves chemotherapy affects most, chemotherapy most commonly affects the nerves of your hands and feet and people often develop CIPN. Cancer Institute shows that about 30 to 40 percent of people develop CIPN while undergoing chemo treatment. Chemotherapy is "dose-dependent," meaning that the risk is small with lower doses, but goes up as the total amount of the drug used gets higher.

Design around limbs with nerve damage

Decision

What will I do?

- Had to decide what path I wanted to take
 - Raise awareness/Fix the problem
 - Looked at current treatments
- Narrowed down focus to motor nerve damage (CIPN) within the legs
 - > feet

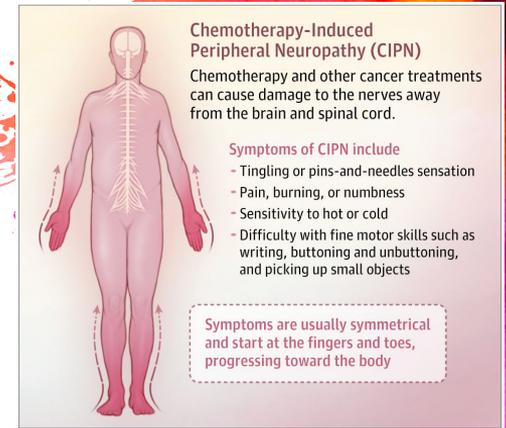


What is Peripheral Neuropathy?



Insight

- Interviews
 - Ability to receive professional information, opinions, and feedback
- Conducted 1 interview
 - Kristin Barth -> bracing and prosthetics
 - Gave me insight on ...
 - Standards/requirements that need to be met when treating a patient
 - Build a physical prototype of something or create an app to track...(ex: degradation of nerves over time)
 - How to assess if device is working correctly

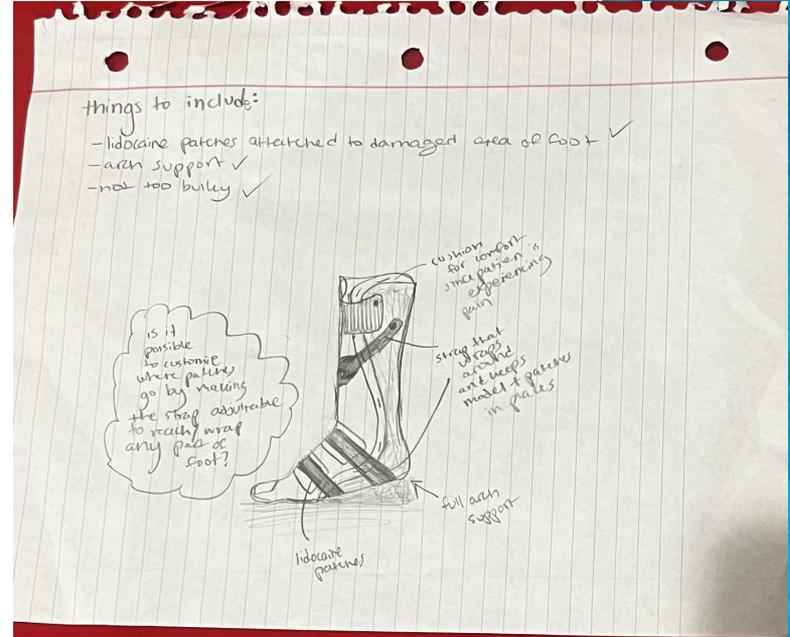
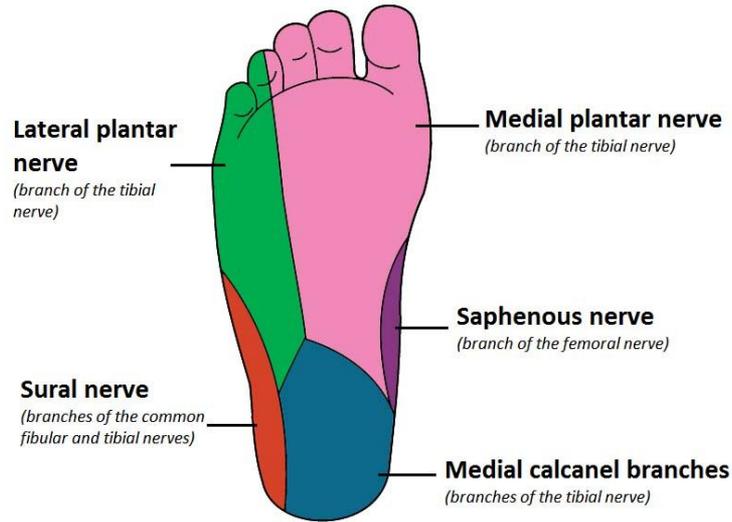


Create Phase

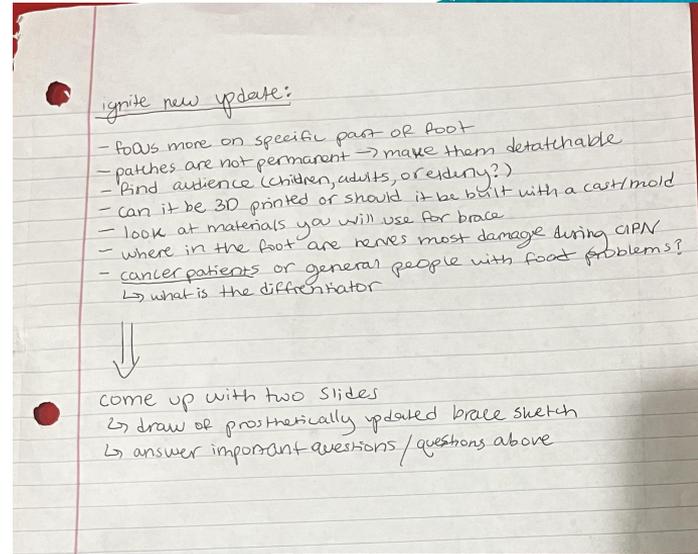
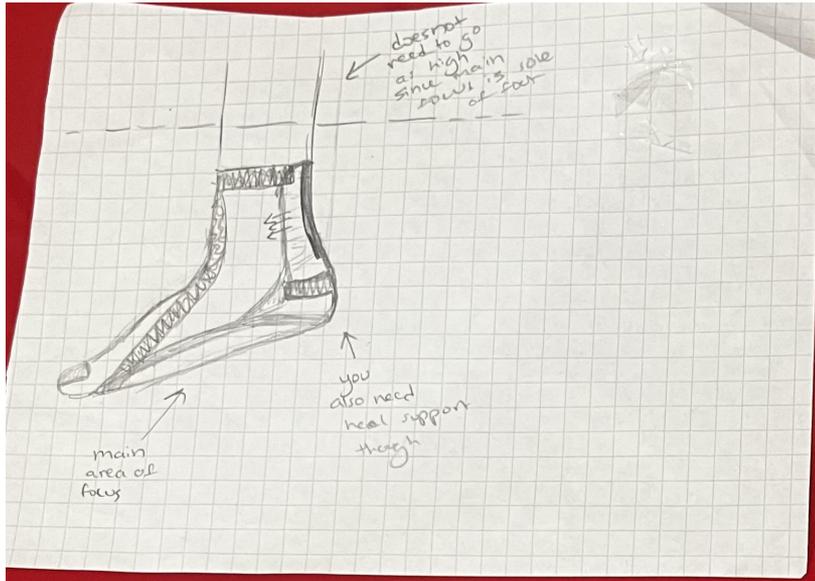
- Define the problem -> brainstorm possible solutions



First Sketch + Feedback



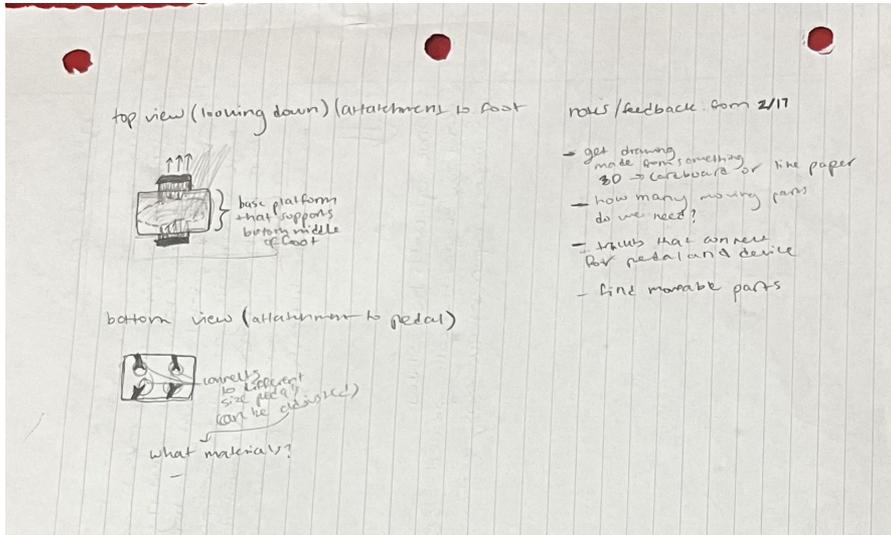
Second Sketch + Feedback



SWITCH IN FOCUS



Third Sketch + Feedback



Next Step - Switched Focus

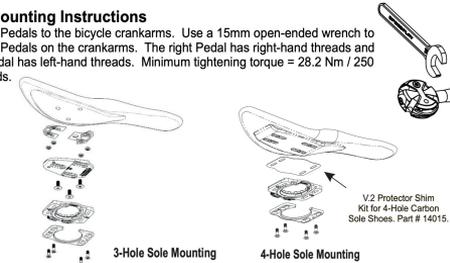
What and why?

- Carbon brace that connects to speedplay cleats
- Dimensions of brace
 - 5 different sizes
 - Dimensions I will use for design to showcase is (wom 10.75 inches = footplate length // 15 inches = brace height) -> average foot brace length
- Materials
 - Which materials need to be considered for a higher fidelity prototype?



Pedal Mounting Instructions

Mount the Pedals to the bicycle crankarms. Use a 15mm open-ended wrench to mount the Pedals on the crankarms. The right Pedal has right-hand threads and the left Pedal has left-hand threads. Minimum tightening torque = 28.2 Nm / 250 inch pounds.



F3 AFO FITTING GUIDE				
				
	US WOMEN'S SHOE SIZE	US MEN'S SHOE SIZE	FOOTPLATE LENGTH (inches)	BRACE HEIGHT (inches)
XS	6-8.5	5-7	9"	13"
S	9-10	7.5-9.5	9 ^{3/4} "	14"
M	10.5-12	10-11	10 ^{3/4} "	15"
L	12.5-14	11.5-13	11"	16"
XL	14.5-16	13.5-15	11 ^{3/4} "	17"

FITTING RECOMMENDATIONS ARE BASED ON PREFABRICATED SIZES WITHOUT MODIFICATION



Conclusion

Adjustments/Changes:

- I would focus on researching the different types of cleats and figuring out if I can expand my design further to reach other diverse demands

What did I get out of this?

- First time designing a possible prototype from my own creativity
- Learned the different steps within the engineering design process

