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Prosthetic Limb/ Prosthesis

As we were brainstorming for the project, we discussed how we wanted to learn how each organ systems interact each other to keep the homeostasis. We want to learn the functions of organ systems more in-depth. We initially wanted to build and demonstrate what other organs contribute to contracting the heart or in sending signals to the brain for movements, However, as we were researching more about the organS, we detected a problem on how varied parts of organs sometimes become defective and must be replaced by an artificial organ or a prosthetic device. Therefore, we decided on turning our focus on the prosthetics, especially building a prosthetic limb. Also, we found a really good mentor who can help us in learning more about prosthetics and get materials to build one of those. For our senior engineering project, we hope to build a prosthetic limb.

A prosthesis is responsible for replacing a body part that is missing and giving at least partial functionality. From studies, it is stated that the latest prosthetic limbs have proven to be even more effective than natural limbs. Another example would be prosthetic legs. Studies proved that they were more efficient than the normal legs, using 25% less energy. Therefore, prosthetic limb or other parts has become a more effective option in improving the body's function further than its natural limitations.

Our mentor, Brad LaPoint specializes in the prosthesis. He does a prosthesis that implants inside the body, which join replacements. Most common are knee, hip, and shoulder prosthetic replacements. When we talked to him on the phone, he suggested us to meet one of the representatives of the prosthetic

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company to ask questions, watch surgical videos, does a jawbone(taking an artificial bone that looks like a knee or hip), so we might get a chance to build a prosthesis. The difference between the two is that prosthetics is an artificial limb which is visible from the outside and prosthesis is a replacement or implant inside the body, such as a joint replacement. We are most likely going to direct our focus to prosthesis because that is what Mr. LaPoint works with and we will hopefully have access to the needed tools.

Prosthetic limbs can be very expensive, although they are typically covered by health insurance. Without health insurance, a prosthetic limb will typically cost anywhere from $10,000 for a basic one, to $50,000 for a more advanced, computerized one. Each limb is custom fit. Factors involved in creating a limb include the location and level of the amputation, the condition of the remaining limb, one's activity level, and one's specific goals and needs.

Technology is advancing and there are more possibilities in life. Our group wants to bring change and help give amputees the opportunity to have functioning limbs and try to figure out different ways to potentially make the prosthetic part last longer.

Problem:

A well-made prosthesis can last anywhere from a few months to a few years; three years is about average. A prosthesis may become worn out faster due to heavy use. A prosthesis used for athletics may need to be replaced sooner than a prosthesis used for basic tasks. People outgrow their prostheses and sometimes, the limb may change size after amputation, which could mean replacing the prostheses if it no longer fits properly.

"The challenge of prosthetics is that we are putting dead things on living people," says Riley Alley, a prosthetist, and a below-the-knee amputee. The goal of an interface is to ensure maximum energy

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transfer and control between the living stump and the manufactured body part. Alley also said, "The socket is paramount over all other components. If the leg hurts you, I don't care how technologically advanced all the components are, the amputee will have a hard time wearing it day to day." Improperly fitted sockets can cause problems in other body parts and painful sores on residual limbs.

Another problem is in the traditional sockets because the bone underneath the flesh moves independently from the surrounding tissue. The bone moves first, then the flesh, then the interface response. Through this long process, the transfer energy is lost. This is caused from the socket conforming to the shape of the flesh.

Need:

There are many needs in working on this project. First, we more information on what has already been done to know what to improve on to make a better product. We will be meeting up with our mentor in January to know more about prosthetics/prosthesis by visiting a prosthetic center near Berkeley. Secondly, we need to research more on the materials and the costs in making these prosthetic parts. We also need to know a timeline for building prosthetics and how long it could potentially take. The prosthetic fitting process includes the casting, fabrication, and fitting. Our mentor knows a company where we can contribute to actually making the products, but we need to talk to our mentors more about it. Third, we need to know how prosthetic parts interact with our body systems/other organs. For now, we know that improperly fitted sockets can cause problems in other body parts. However, we don't know if there's any other chemical or biological interactions.

Target Market:

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Our potential market is amputees because they are the ones who have prosthetic limbs and our possible competitors are other prosthetic companies. Clients look for businesses that will provide them with the longest lasting and most efficient, comfortable product, so we must make our product comfortable, as well as sturdy, lighter rather than heavy, visually appealing, and well functioning. We aim to try and help our potential customers gain independence again after an amputation, and allow them to be able to do the same hobbies and activities that they had been able to do before.

Basic Parts of Prosthesis:

- **Socket: encases the remaining limb. MUST fitted perfectly for functionality**
- **Suspension System: binds the socket to the body. It can be made in form of belts or straps. This system depend on whether the prosthesis is above or below the joit.**
- **Pylon: the skeleton of the prosthetic limb. It maintains the structure of the limb. It can also act as a replacement for bones. It should be lightweight(Heavier metals are NOT usually used).**

Materials

- **Socket**
    - **Fabric socks**
    - **nylon**
        - **Amide group (covalent bonds within chains and lateral hydrogen bonds give the material its strength and strong use**
    - **Fiberglass**
        - **A fabric that weaves many different fibrous polymers together in different orientations. It is strong in every direction making it a rigid material.**

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    - **Kevlar**
        - **Fibers with long chains of monoamines. It makes an even stronger fiber and keeps it straight.**
    - **Thermoplastics: Polyesters, Acrylics, Epoxis**
- **Plylon**
    - **Aluminum**
        - **It is commonly used because it's the lightest strong metal on the periodic table**
    - **Polypropylene**
    - **carbon fiber(For Pylon)**
        - **It has an exceptional strength and light weight. It is tightly packed, random, and disorganized fashion gives it an exceptional strength**
- **Silicone**
- **PVC**
- **Thermoplastics**

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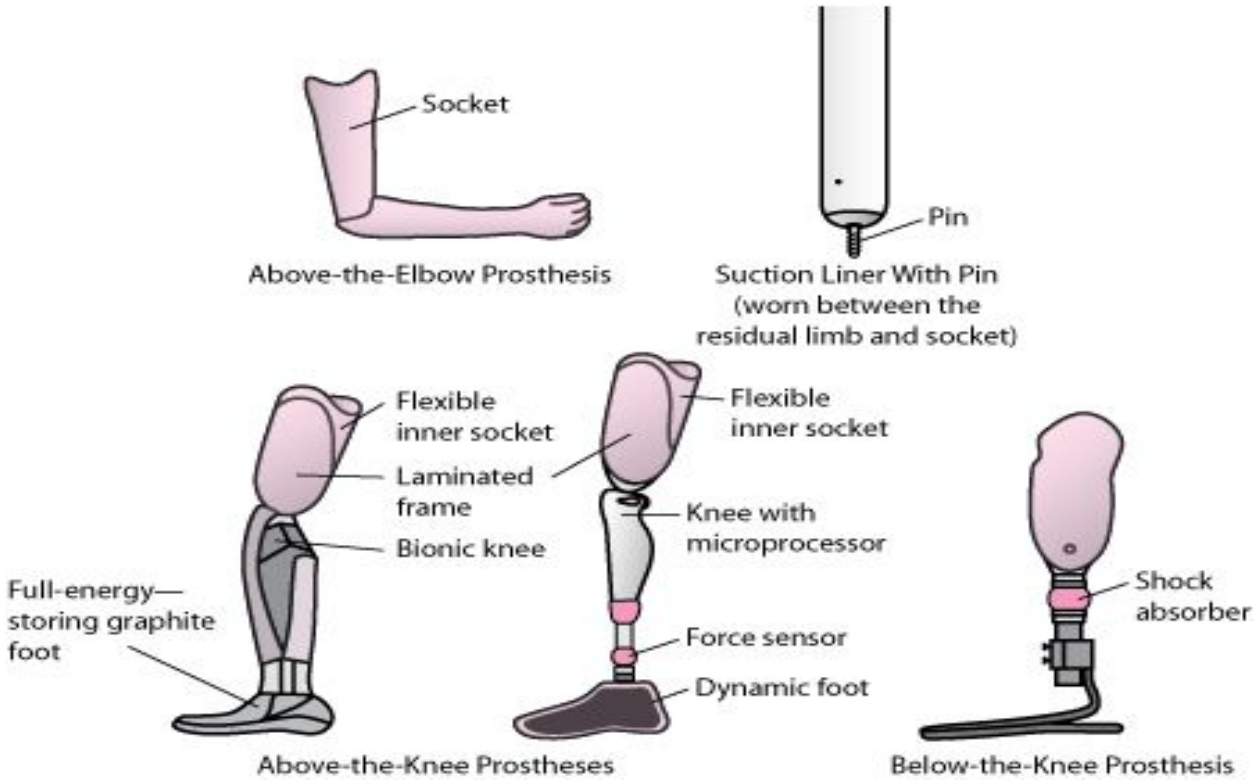

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