Group Names: _____ Period: _____ Date: _____

Prosthetic Leg Engineering Project

Learning Objectives:

Upon completing this project, students should be able to:

- *Describe the steps of an engineering process needed to develop and build a working leg prosthesis.*
- *Detail important features and characteristics necessary for building a prosthetic leg.*
- *Analyze and evaluate a completed prosthetic leg to suggest areas of improvement.*

Engineering Connection:

For one reason or another, many people require replacement body parts. Those who need artificial legs must have a structurally stable one to replace a critical part of the skeletal system. One specialty of biomedical engineering is designing and creating new and better prostheses (replacement body parts). Biomedical engineers are continually improving the strength, durability, longevity and lifelikeness so amputees can lead full lives (Teaching Engineering.org, n.d., para. 2).

PRE-ACTIVITY

With your group, begin brainstorming, be sure that all ideas are listened to respectfully. Take an uncritical position, encourage wild ideas and discourage criticism of ideas. Solicit, integrate and summarize your peer's responses, and record your ideas in the spaces provided on this worksheet. Remember that a large part of your grade is how well you document the engineering and designing process. Some questions to ask in your group:

- What features would make a useful prosthetic lower leg?

- How can you achieve some of these qualities, using the provided resources?

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2. You will design and create your own prosthetic lower leg. Your group will test you *prototypes* by bending one group member's knee and resting it on the prosthesis. The goal is to provide all the important features that have been discussed — *strength, durability, longevity, shock absorption, lifelikeness and comfort*. You will need to figure out the best way to connect your prostheses to a body using everyday materials. The prosthetic leg must be worn and used to walk across the front of the classroom 10 feet, unaided, without collapsing or falling apart.

3. Remember when engineers design a new or improved product, they work in groups and follow the steps of the *engineering design process*:

1) understand the problem or need
2) come up with creative ideas
3) select the most promising idea
4) communicate and make a plan to describe the idea
5) create or build a prototype or model of the design
6) evaluate and refine what has made.

Materials List:

Brainstorm as a group and make a list of materials here that your group thinks will work to build a prosthetic leg.

Materials Needed:	Use?	Alternative Material

Safety: *Be careful when testing prostheses. Have "spotters" positioned around your teammate who is testing the prosthesis to catch him/her if s/he falls.*

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ACTIVITY

1. Your group should discuss ideas and complete the first page of this worksheet.
2. Choose one teammate to be the patient so that you can make the prosthesis to fit them properly. Measure his/her lower leg from where it bends at the knee and record this measurement in your chart, along with the foot size.
3. You will need to collect all of your other materials to begin creating your prototype, while creatively addressing the requirements of strength, stability, durability, longevity, shock absorption, lifelikeness, comfort, etc.
4. Your group will present your prosthesis to the rest of the class and briefly explain your design concepts and choice of materials.
5. Your designated patient will need to demonstrate the prototype's strength by walking (while bending his/her knee and wearing the prosthesis) across the front of the room the designated distance.
6. Your presentation should be considered appropriate for presenting at an engineering conference and should include in their presentation:
   - List of materials and purpose of each
   - How they came up with the design
   - Important design features
   - Estimated cost
   - Demonstration of use
7. Be sure to allow time for your classmates to ask questions and to evaluate your project and presentation. Some questions to ask while calculating your evaluation of other groups:
   What solutions did the group devise that was particularly clever?
   What problems did the group encounter?

Assessment *(See attached Rubric)*

Worksheet. Your write-up of the design process and your brainstorming sessions will be part of your final grade.

Presentation. I will evaluate your group and so will your peers.

Concluding Discussion Questions: You should answer the following questions and turn them in with your presentation for a formal lab grade.

1. What improvements could be made to your prototype?
2. What other materials would help improve your design?
3. What would be different if you had to make the whole leg, including the knee?
4. What design constraints or limitations might be different for biomedical engineers developing real prostheses?