Names: _____ **Date:** _____ **Class:** _____

Engineering Design Process Packet

Your Engineering Design Challenge
Imagine that you are a biomedical engineer and your friend has broken a bone so badly that you must "replace" the bone. You must find an alternative material to replace the natural bone. Keep in mind that this alternative material must be able to withstand the mass of the body. So, in addition to the material, you must consider its density, weight and size. Follow the steps of the engineering design process to help you findi a solution to this challenge. *Good luck!*

Problem Statement (Define the problem in detail) **Our BONE to replace:** _____

_____

_____

_____

_____

Functions (The action that the design or product is created for)

_____

_____

_____

_____

Objectives (The desired attributes of the design or product)

_____

_____

_____

_____

_____

Constraints (all requirements, restrictions and limitations)

_____

_____

_____

_____

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Background Research

Research the density of materials that the teacher has provided in the classroom. Keep a record of the materials, their densities and the website(s) you used for research. If you have difficulty finding the densities of certain materials online, use classroom tools to calculate the densities of those materials.

For which BONE is your implant? _____

What is its density? (from your *What Is the Density? Worksheet*) _____

Below, record the density of available implant materials:

Material	Density	How did you find the density? (researched OR measured/calculated; if researched, provide website URL)

Design Solutions

Brainstorm as a team come up with ideas. On a piece of graph paper, sketch three (minimum) possible design solutions. Discuss each design with team members. Create a pros and cons T-chart for each design on the back side of your design sketch. Decide on the best design for your prototype.

Prototype Creation (describe your selected design and why you chose it)

_____

_____

_____

_____

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Test Design

Develop a 3-4 question survey to evaluate your bone implant design. Design your questions to evaluate the strength of the bone and the ease of moving the bone around (how lightweight it is). Ideally a bone is strong enough to support weight without breaking, but also light enough to move around easily. Have five people evaluate your group's bone design.

Test Results

Write survey questions below. *Use complete sentences.*	**Survey 1**	**Survey 2**	**Survey 3**	**Survey 4**	**Survey 5**	**Average Score**

Results Evaluation (Based on the test results, was your design effective? How do you know?)

_____

_____

_____

_____

Future Recommendations (Based on the test results and your evaluation of the results, what design improvements do you recommend? Why would you make the selected changes?)

_____

_____

_____

_____

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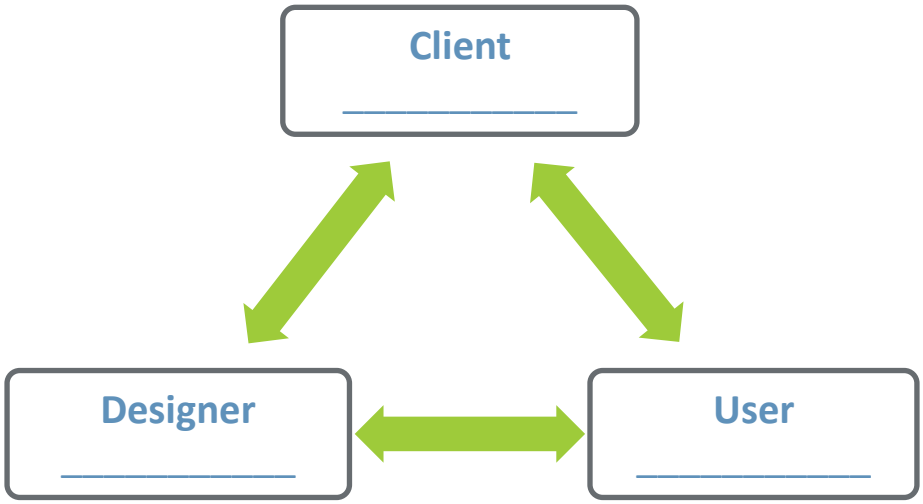
Sketch your final design in the space below, identifying all materials.

Identify the person(s) (or group) who filled each of the roles below during the design process.



Communicate: Your team's outline for a 5-minute presentation of your best bone implant prototype:

- Your bone (its requirements: density, functionality, requirements, limitations)
- Your design(s) (concept, sketch, materials, how combined, reasoning, pros/cons)
- Your testing (questions, lessons learned, key changes made)
- Your best prototype (final design, sketch and materials combination)
- Looking ahead (ongoing suggestions for improvement in order to make it viable for human use)

Summarize for the audience! Tell an interesting story of how your design evolved!