



Prosthetic Arm and Hand 7th Grade – Group Project

Team – Names First, Last

Goal-

Develop a Prosthetic Arm and Hand using common materials and 3D printing. Students will explore design, construction, teamwork, and materials selection and use. Groups will follow the Engineering Design Process.

Activity-

Step 1. Define-

Follow the Engineering Design Process

Participating teams of three or four students are provided with a material listed below. Each team must use the materials to design and build a working robot arm. The robot arm must be at least 12 inches in length and be able to pick up an empty Solo cup carry it 50 centimeters then turn it over. Students may not use their fingers inside the prosthesis to make the prosthesis fingers pick up the cup.

Teams of students must agree on a design for the robot arm and identify what materials will be used. Student groups will draw a sketch of their agreed upon design before construction. Resulting robot arms are then tested and checked for range of motion and satisfaction of the given criteria, criteria, and rubric. Students must have at least one 3D printed part.

Each team member will be given a specific job to complete in the project.

1A- Team Leader and Folder Manager

2B- Knowledge/ Design Lead

3A- Research and Design

4B- Material Manager and 3D Printer

Step 2. Research-

Each team will have the following available but will only receive material they can show they need in design; groups may ask for additional material if they can proof of need;

Popsicle sticks

String

Tape

Cardboard

Hangers

Rubber bands

Required 3D printed parts that make the arm functional

List at least 3 Research Links that were used to understand prosthesis.

Research Link #1 _____

Research Link #2 _____

Research Link #3 _____

Step 3. Brainstorm Possible Solutions

What is needed:

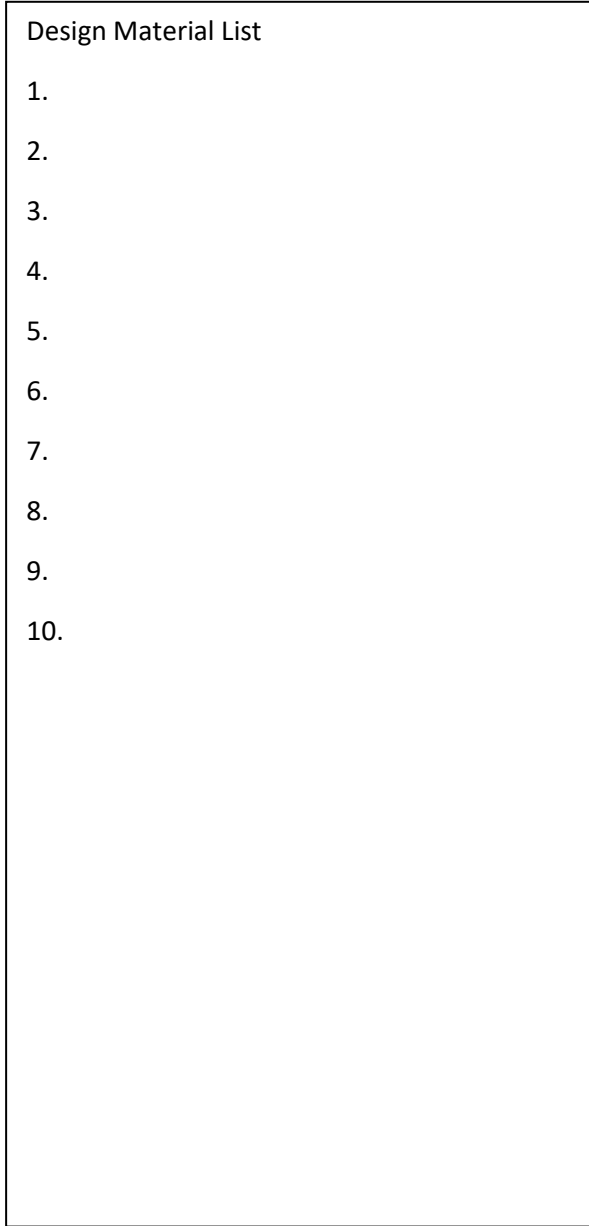
- a. It remains intact when being used.
- b. Simple to use but cannot be operated by fingers
- c. Can pick up and carry a Solo Cup
- d. Operates simply

Design drawing



Design Material List

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.



Step 4. Choose the best Solution Team Design

Discuss your ideas as a group. Decide on a team design that meets the engineering criteria and constraints. Then sketch your design in the space below. Please label the dimensions (height, diameter, radius, and so forth) on your diagram.

Final Chosen Design - Use the Rubric for Engineering Drawings provided by your teacher to check the quality and completeness of your drawing.

STOP – Must have EDP Steps 1-4 reviewed and approved by Mr. Williams. Do not start building until the team design has been approved.

_____ **Approved – Begin construction of the prothesis.**

_____ **Not approved – Complete requested changes before starting construction for prothesis.**

Step 5. Build your Porotype Design -

Collect all the necessary materials and build your model according to the solution your team chose in step 4. As your team builds the model, write down any changes to your original design. Use the;

1. Rubric for Prototype/Model provided by your teacher to assess your work.
2. What changes needed to be made?

What did your team actually build that is different from your intial design?

Changes from orginal design made?

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

STOP – Must have EDP Step 5 Reviewed and Approved by Mr. Williams. Do not start testing until the team design has been approved.

_____ **Approved – Begin testing the prothesis.**

_____ **Not approved – Complete requested changes before starting testing of prothesis.**

Step 6. Test your Design!

Perform the following tests on your model. For each test, check “yes” if your prosthetic hand passes the test and “no” if it fails. Use the Rubric for Test, Communicate, and Redesign Steps provided by your teacher to assess your work on the next few pages as a guide.

Strength Test

Pick up and carry the Solo cup. Does your hand stay intact?

yes no

3D printing Test

Does your arm have 3D printed parts that are functional?

yes no

Freestanding Test

Is your arm able to function without the use of human fingers?

yes no

Evaluate Your Design

1. Based on the three tests, how well did your arm meet the design criteria?

2. What are some areas where you can improve your arm design?

Step 7. Communicate your Solution

Teams will now pair up to share their designs and provide feedback and suggestions.

Class does a Gallery Walk to view all builds.

Nominate one person to be your Docent in your group to describe your model and share your evaluation. (from step 6) with the other team.

Each member of the other team should provide one suggestion for how to improve your design.

Please record these suggestions in the space below.

Suggestion 1:

Suggestion 2:

Suggestion 3:

Any other Suggestions.

Step 8. Redesign your Prothesis

As a group, review the other team’s suggestions.

1. Based on their suggestions, how will you change or improve your design?

2. The class will vote on which team’s Prothesis Arm they would most likely vote the best design. Before the vote, describe the necessary improvements, and prepare a persuasive argument about why your team’s design should be chosen.

3. Consider the prothesis that was voted on by the class. Why do you think this arm was chosen over the others?

Step 9. How Hard Did I Work Hand Out? Complete and return directly to Mr. Williams.

10. Final individual student essay – Complete a 3 Paragraph essay using the attached rubric on how your team used the Engineering Design Process to design and build a prosthesis. Student Essay resulting in 50% of the student grade to show understanding of the process and build. See attached rubric.

11. Final Folder -

Must be turning in as following -

1. Cover sheet with Project Name, Student names with seat assignments, and date.
2. Handout in order
3. Individual Essay’s
4. The How Hard Did We Work hand out will be turned in to directly to Mr. Williams.
5. Failure to follow these instructions will result in a NO Grade on the Project.

| Criterion Performance Levels | | | |
|---|--|--|---|
| CRITERIA | Minimal performance 1-4 points | Adequate performance 5-8 points | Exemplary performance 9-10 points |
| Evaluators: Using minimal (1-4 points), adequate (5-8 points), or exemplary (9-10 points) performance levels as a guideline, record the scores earned for the event criteria in the column spaces to the right. The X1 or X2 notation in the criteria column is a multiplier factor for determining the points earned. (Example: an "adequate" score of 7 for an X1 criterion = 7 points; an "adequate" score of 7 for an X2 criterion = 14 points.) A score of zero (0) is acceptable if the minimal performance for any criterion is not met. | | | |
| Documentation and Final Student Essay (50points) | | | |
| Portfolio See Regulation C (X1) | Portfolio is unorganized and/or is missing three or more components. | Portfolio contains most components and is adequately organized. | Portfolio has one or no components missing, and content and organization are clearly evident. |
| Definition and explanation of the issue and solution (X2) | Unclear definition and explanation of the issue are evident; it is difficult to understand the solution being communicated; an illogical explanation is presented. | Issue is defined and explained adequately; an explanation of the solution is adequately communicated. | There is evidence of a clear and concise definition and explanation of the issue; explanation is presented and communicated in an organized, clear, and concise manner. |
| Research, references, and resources (X1) | Documentation lacks an adequate research base, and/or very few credible sources are referenced. | Research is conducted appropriately, with adequate credible sources. | Comprehensive research base that includes credible sources is evident. |
| Explanation of impacts (X2) | Explanation is missing a discussion of the issue's relevance to environmental, economic, social, and/or ethical considerations. | Explanation addresses some of the issues relevant to environmental, economic, social, and/or ethical considerations. | Explanation includes a full discussion of the issue's relevance to environmental, economic, social, and/or ethical considerations. |
| Supporting information (X1) | Support information does not help to clarify documentation, and/or it is of little significance to the issue. | Support information is appropriate and helps supplement the documentation by providing clarity to the issue. | Support information is highly effective and of excellent quality. |
| DOCUMENTATION SUBTOTAL (50 points) | | | |
| DISPLAY SUBTOTAL (40 points) | | | |
| Model/Prototype 40 points) | | | |
| CRITERIA | Minimal performance 1-4 points | Adequate performance 5-8 points | Exemplary performance 9-10 points |
| Communication of issue (X1) | It is difficult to understand the issue being communicated; an illogical explanation presented. | The issue is communicated and thoughts are organized somewhat concisely. | The issue is communicated in an organized, clear, and concise manner. |
| Communication of solution (X1) | It is difficult to understand the solution being communicated; an illogical explanation is presented. | The solution is communicated and thoughts are organized somewhat concisely. | The solution is communicated in an organized, clear, and concise manner. |
| Creativity (X1) | The model/prototype lacks creativity; no, or very few, design principles are integrated in the display. | Some elements of creativity exist in the model/prototype, and essential design principles are generally evident. | The model/prototype exudes creativity; essential design principles and elements are well integrated. |
| Aesthetics and artisanship (X1) | Work is unorganized and sloppy; model/prototype seems to be an afterthought or thrown together. | Model/prototype shows an organized presentation of the issue. | Model/prototype is exemplary in logically communicating important data. |
| MODEL/PROTOTYPE SUBTOTAL (40 points) | | | |
| How Model/Prototype 10 points) | | | |
| CRITERIA | Minimal performance 1-4 points | Adequate performance 5-8 points | Exemplary performance 9-10 points |
| Communication of issue (X1) | It is difficult to understand the issue being communicated; an illogical explanation presented. | The issue is communicated and thoughts are organized somewhat concisely. | The issue is communicated in an organized, clear, and concise manner. |
| MODEL/PROTOTYPE SUBTOTAL (10 points) | | | |

