Pull-Toy Project

You have been studying forces and motion, types of movement, speed and rotation, and the way gears work. You will be divided into groups of three, and each group is to act as an engineering firm. The engineering firms have been asked to create a prototype pull-toy for children. A pull-toy is pulled along the ground and a movement is produced—for example, a head nods, a tail wags, or a figure bobs up and down. The pull-toy will be built using VEX Robotics parts and must include the following: four-wheel chassis that can be pulled across a table or floor, use of a gear mechanism to simulate movement, and artwork to make the pull-toy look realistic. At the conclusion of the builds, the engineering teams will review the other teams' pull-toy designs and decide on the best pull-toy design.

Project Tasks

1. With your knowledge of mechanisms, you and your partners will work as an engineering firm to design and build a mechanism that will meet the following criteria.
   - The mechanism is to be built entirely from VEX parts provided in the lab.
   - The mechanism is to be built on a small four-wheel chassis capable of being pulled across a tabletop surface. The movement of the wheels will set the toy in motion.
   - A gear mechanism attached to the wheels will make another part of the pull-toy move.
   - A printed illustration or photograph should be added to the pull-toy to interact with the working mechanism as the toy is moving.
2. To begin this process, use the templates to document your design process. First, complete the "Design Brief" template to define the problem. In the Design Statement section, describe the design of your pull-toy and how you tested it. Identify how you met the project's constraints in the appropriate section. After you test your prototype, explain how you made adjustments to your pull-toy in the Modifications section. In the Deliverables section, list the hardware, design documents, and other products your team created for your final prototype.

   Then, use isometric graph paper to create detailed sketches with metric measurements. All measurements must be listed.
3. Create a parts list. Keep a detailed list of the parts used to construct your pull-toy. Engineers do this to help with mass production. Be sure to include the measurement of each part used.
4. When all groups have completed their pull-toy, you will use the project rubric to review the pull-toys other groups built.

Note: Engineering firms use design briefs to communicate with each other as they may be working in different departments and not side by side. The document is used as a template for what is being created and also describes the constraints that must be followed to properly complete the task. For engineering firms, it can be difficult to meet the constraints, but this is a requirement for safety and customer happiness. This is helpful for organization while completing the project.

Design Brief

As a group, come up with a name for your engineering firm, and list that in the Designer row. The client should be the target audience you plan to market your toy to. Identify the problem you are seeking to resolve with your pull-toy prototype. Describe how your group designed, tested, and modified your pull-toy in accordance with the project's constraints. Prepare and list the deliverables that you will share with your client.

Client	
Designer	
Problem Statement	
Design Statement	
Constraints	
Modifications	
Deliverables	

Scoring Rubric

Objective 1: Students will design and create an original pull-toy with a gear assembly for children.				
	1 SIGNIFICANT REVISION NEEDED	2 SOME REVISION NEEDED	3 PROFICIENT	4 EXCEEDS EXPECTATIONS
Design Brief	Design brief is less than 50 percent complete.	Design brief is 50 percent complete.	Design brief is 80 percent complete.	Design brief is complete and includes all required information, including client, designer, problem statement, design statement, constraints, and deliverables.
Design Sketches	Sketches are not complete. Heading information is not complete and is inaccurate. Sketches are not created with pencil.	Sketches are missing more than half the identification of the components. More than half the heading information is not complete or is inaccurate. Most designs are completed in pencil.	One or two sketches are incomplete and are missing important information, such as measurements. Some heading information is incomplete or inaccurate. All designs are unique and are completed in pencil.	Three sketches are complete and annotated to show all important information. Heading information is complete and accurate. All designs are unique and are completed in pencil.
Research	There is no research other than what is available from the textbook or lecture notes.	Research is randomly completed with little or no documentation of sources.	Research is documented on some topics. One or two do not have proper citation information. Research is limited to two or three resources.	Research is documented with appropriate citations. Research shows a variety of resources and is not limited to two or three sources.
Test and Evaluate	Student tests and evaluates prototype. Modifications are not completed, and changes are not documented.	Student tests and evaluates prototype. Some modifications are completed, but changes are not documented.	Student tests and evaluates prototype. Student makes modifications if necessary, but changes are not documented.	Student tests and evaluates prototype, makes modifications if necessary, and thoroughly documents changes.
Prototypes	A significant difference exists between the final product and the final design. No apparent attempt was made to follow the design. Prototype is in poor working condition with frequent errors.	A significant difference exists between the final product and the final design, but an attempt was made to follow the design. Prototype is in adequate working condition with some errors.	A slight difference exists between the final product and the final design. Prototype is in working condition with few errors.	The final product exactly matches the final design. Prototype is in excellent working condition with no errors.

The student engineering firms will use the following rubric when critiquing the work of other students. All engineering firms had to follow the constraints while building the prototype of their pull-toy. Student input was used while creating this rubric.

Objective 2: Students will critique the design and engineering process classmates use to decide the most innovative pull-toy the engineering teams create.				
	1 SIGNIFICANT REVISION NEEDED	**2 SOME REVISION NEEDED**	**3 PROFICIENT**	**4 EXCEEDS EXPECTATIONS**
Professionalism	Student does not act as a critic. Questions are off topic or inappropriate.	Student takes the role as a critic moderately seriously. Some questions are off topic. Student asks only one question about the group's prototype design.	Student takes the role as a critic seriously and judges the prototype with a professional approach. Student asks two questions about the group's prototype design.	Student takes the role as a critic seriously and judges the prototype with a professional approach. Student asks the group three or more questions about the group's prototype design.
Objectivity	Student shows bias while critiquing the work of other student groups and provides no positive feedback.	Student is somewhat objective and gives one example of positive feedback.	Student is objective and shows no bias to any other students' work. Student provides two examples of positive feedback while critiquing student work.	No bias is evident. Student takes the viewpoint of a consumer and provides three or more examples of positive feedback while critiquing student work.
Design Process Notes	The design process notes do not describe work done at each step of the design process.	Some design process notes are missing or incomplete.	The project design process notes do not explain all steps thoroughly.	The project includes a detailed step-by-step description of the design process.
Teamwork	Student does not listen to other team members, does not show respect for varying opinions, and does not effectively communicate ideas and opinions or engage in compromise. Student completes some of his or her portion of the project on time.	Student does not always effectively listen to team members or show respect for varying opinions. Student does not always communicate ideas and opinions or engage in compromise. Student completes most of his or her portion of the project on time.	Student generally listens to team members, respects varying opinions, communicates ideas and opinions effectively, and engages in compromise. Student completes his or her portion of the project on time.	Student consistently listens to all team members, respects varying opinions, communicates ideas and opinions effectively, and engages in compromise. Student completes his or her portion of the project on time.