

Project 1.1.6 Compound Machine Design – VEX

Introduction

Mechanical systems often require a combination of mechanisms to complete a given task. Any time two or more machines are combined, the result is a compound machine. If many mechanisms are combined, the machine may even be referred to as a complex machine. Compound machines can range in complexity from a crane or automobile to a simple manual can opener. A bicycle is an example of a compound machine. The pedals, brakes, handle bars, and sprocket systems are just some of the mechanisms on most bicycles. In this activity you will work in teams to design and build a compound machine to accomplish an instructor-specified task.



Equipment

- VEX® PoE kit, including gears (sprockets), chains, belts, axles, and support pieces
- Rope for pulley systems (masonry line works well)

Design Constraints

- The applied effort force may only be provided by a single human input that the customer can run (teacher or judge).
- The final design must include a minimum of three mechanisms including any of the simple machines: a gear system; a belt and pulley system; and/or a sprocket and chain system. They must utilize at least two different simple machines.
- The compound machine must have a mechanical advantage greater than 1 at a minimum, but more is desirable.

Procedure

1. Determine the instructor-assigned task in detail, including all required operations and time constraints. **The instructor must sign off.**
2. Investigate available equipment components and possible configurations.
3. Brainstorm ideas for accomplishing the assigned task, and record at least three ideas in your engineering notebook.
4. Use a decision matrix to decide which idea (or ideas) will be used including a brief description of the reason for the selection.
5. Using isometric grid paper or 3D modeling software, sketch and annotate a preliminary design solution including the individual mechanism's mechanical advantage and the drive ratios.

6. Build, test, and modify your compound machine design.
7. Using isometric grid paper or 3D modeling software, sketch and annotate your final design solution including the individual mechanism's mechanical advantage and the drive ratios.
8. Use the tables below in your engineering notebook to document and illustrate the mechanical advantage and drive ratios of the individual mechanisms utilized within your final compound machine solution. Show work and units throughout.

Mechanism 1 Type		
<i>Illustration: Include proper documentation such as force, distance, direction, and key mechanism features.</i>		
Mechanical Advantage / Ratio Calculations		
Formula	Substitute / Solve	Final Answer

Mechanism 2 Type		
<i>Illustration: Include proper documentation such as force, distance, direction, and key mechanism features.</i>		
Mechanical Advantage / Ratio Calculations		
Formula	Substitute / Solve	Final Answer

Mechanism 3 Type		
<i>Illustration: Include proper documentation such as force, distance, direction, and key mechanism features.</i>		

Mechanical Advantage / Ratio Calculations		
Formula	Substitute / Solve	Final Answer

9. Calculate total/overall system mechanical advantage.

Formula	Substitute / Solve	Final Answer

Conclusion Questions

1. For which mechanism was it the easiest to determine the mechanical advantage or drive ratio? Why was it the easiest?
2. For which mechanism was it the most difficult to determine the mechanical advantage or drive ratio? Why was it the most difficult?
3. At what value would you estimate the input and output forces of your compound machine? How did you arrive at your estimated values?
4. What modifications could you make to your compound machine to make it more mechanically efficient?