

# Marble Down

## Flinn STEM Design Challenge™

### Introduction

Have you ever moved furniture and thought there had to be an easier way? After moving a few objects, you realize that using a two-wheel hand truck is more efficient to move multiple boxes at once or placing sliding disks under the feet of the couch makes it extremely easy to push it across the room. Whether you realized it or not, you were practicing engineering design!

### Concepts

- Engineering design
- Acceleration due to gravity
- Friction

### Background

The engineering design process is a series of steps engineers go through to arrive at a solution to a given problem. Engineering design is a cyclical process—meaning that steps are continuously repeated and changes are made until the desired outcome is reached. See Figure 1 for an overview of the engineering design process.

Design criteria are specific requirements that are used to make decisions about what the possible solutions will be and are based on what we want the solution to include. Criteria define the function of the product and its physical design features. Constraints are needs that put limits on the engineer's design. Some typical constraints are cost, time, and materials that may be used. Good design solutions meet the criteria within the limits defined by the constraints.

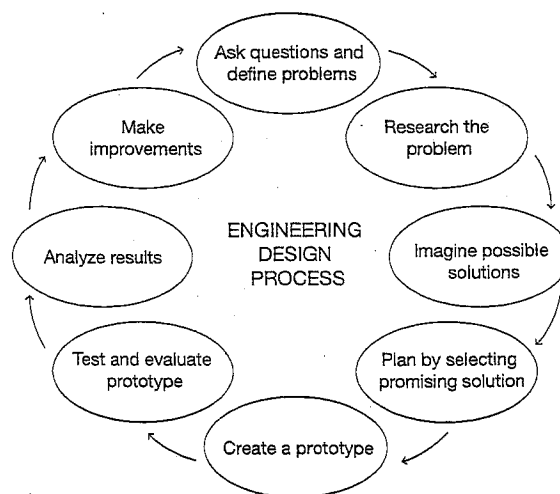


Figure 1.

The engineering design process begins by asking questions and defining a problem. This step includes determining criteria for a successful solution and identifying constraints. The next step is research to determine possible existing strategies to solve the problem or portions of the problem. Imagining possible solutions or brainstorming as a team allows a collective gathering of any and all options. After all options have been shared, the team selects the option that is logically most likely to solve the problem within the written constraints. The next task involves building a prototype to bring the idea to life! Building the prototype often allows engineers to see if the model is indeed on the path to solving the problem at hand. The prototype is then tested and evaluated. Does it work the way it was intended to work? Where did it work exceptionally well? Where did it fall short? By answering these questions, improvements and design changes can be made so that the prototype more effectively achieves the original goal. The cycle continues until the desired outcome is achieved.



### Marble Down Energy Post-Lab Questions

1. What forces act on the marble as it rolls down the track?
2. Did you choose a portrait or landscape orientation for the pegboard? Provide reasoning for your choice.
3. What improvements were made to the track design after testing and analyzing results?
4. What other strategies would you try if you were allowed to use additional materials?
5. Describe a practical application where the principles used in designing this track could be implemented.
6. Mountain roads have numerous switchbacks when traveling. What is one advantage and one disadvantage of these switchbacks?