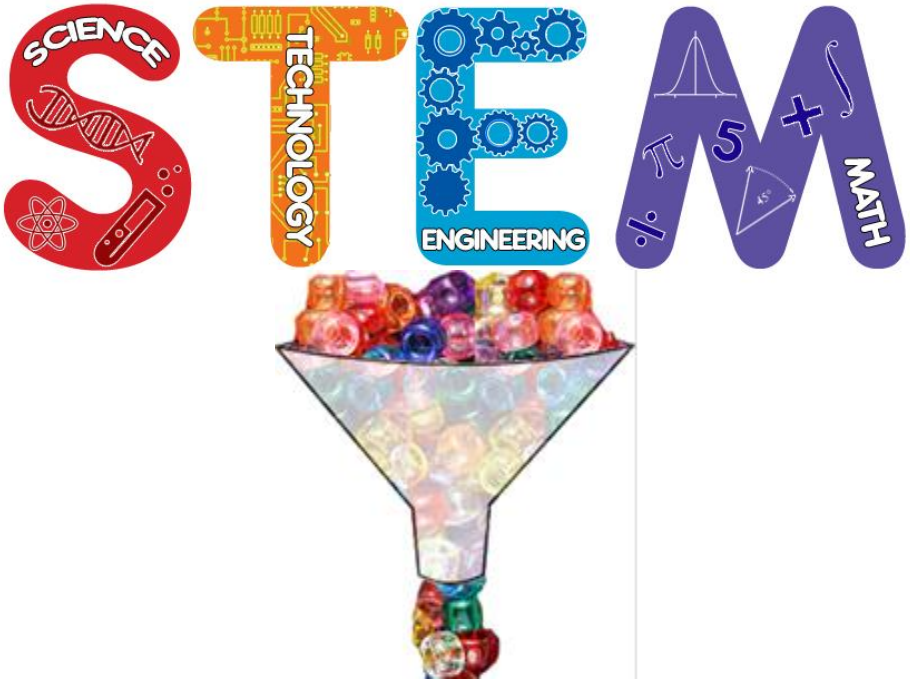
The Beadery® Bead Flow Rate

Materials Needed:

- Craft Beads (in a variety of shapes and sizes)

Tools Needed:

- Large Opening Funnel
- Measuring Cup
- Calculator
- Stop Watch
- Large Bowl



Skills Learned:

- Physics
- Liquids and Solids
- Flow Rates

Background:

When many individual solid particles, called grains, are in close contact with each other, they sometimes move and behave like liquids. This movement of grains is called granular flow and is used to describe many things from salt pouring from a saltshaker to dirt and rocks crashing down a mountainside in a landslide. It is also used by engineers while packaging materials such as cereal, candy or beads into boxes, bottles or bags.

This experiment allows students to investigate how several factors affect the granular flow rate of particles. They will be able to change some variables, such as bead size (6mm, 8mm, 12mm), shape (round, faceted, oval) or initial volume to see how the volumetric flow rate changes. At the end they will be able to compare their initial predictions to what they calculated for different beads and see if they can find the correlations.

Instructions:

1. Have the students make their predictions on the worksheet by circling weather they think the beads will flow faster, slower or the same depending on the size, shape or volume variables.

2. If you do not have a plastic funnel with a 1.25” (3 cm) opening, this can be made by forming a piece of heavy paper or card stock into a cone with a large opening and taping it or by having an adult cut the top and bottom off an empty plastic bottle.

3. Use the measuring cup to carefully measure out 1 to 2 cups of craft beads. Record the amount of beads in the ***Volume of Beads*** column of the data table on the worksheet.

4. Have one student hold the funnel over the bowl while blocking the small opening with their hand to stop any beads from getting through and have another student fill the funnel with the beads from the measuring cup.

5. Get the stopwatch ready.

6. Have the student remove their hand from the small end of the funnel as the other student times how long it takes for the funnel to empty. Record this time in the ***Time to Empty Funnel*** column of the data table on the worksheet.

7. Calculate the ***Volumetric Flow Rate*** of the beads and record it in the data table. This will tell you how fast the beads move through the funnel opening.

$$Volumetric\ Flow\ Rate = \frac{Volume\ of\ Beads}{Time\ to\ Empty\ the\ Funnel}$$

For example, if you had 2 cups of beads that poured out of the funnel in 5 seconds,

$$Volumetric\ Flow\ Rate = \frac{2\ cups}{5\ seconds} = 0.4\frac{cups}{second}$$

8. Empty the beads from the bowl to be reused.

9. Repeat the experiment using several different types of craft beads to see how the size or shape of the bead or the starting volume of beads effects the final volumetric flow rate.

10. Look at the calculated volumetric flow rates and see if they agree with the predictions made in step 1.

The Beadery® Bead Flow Rate Worksheet

Name: _____

My Predictions:

Smooth beads will flow:	***Slower***	***Faster***	***The Same***	as faceted beads
Small beads will flow:	***Slower***	***Faster***	***The Same***	as large beads
Larger volumes will flow:	***Slower***	***Faster***	***The Same***	as smaller volumes

My Data Table:

Trial	Bead Shape	Bead Size	Volume of Beads	Time to Empty Funnel	Volumetric Flow Rate
1					
2					
3					
4					
5					
6					

$$Volumetric\ Flow\ Rate = \frac{Volume\ of\ Beads}{Time\ to\ Empty\ the\ Funnel}$$

My Conclusion: Were my predictions correct?