Heading

Title

**Introduction**

**Purpose** To investigate force & motion by designing the fastest balloon rocket.

**Discussion**

Force produces motion and this relates to speed. Speed is a “scalar” quantity described by a magnitude (or numerical value) alone based on the distance an object travels in a certain amount of time.

Velocity is a “vector” quantity described by both a magnitude and a direction and can be mathematically defined as:

Velocity = displacement / time … V = d/t

Your mission (*“should you decide to accept it*”) is to design a rocket using a balloon, straw, and tape. You can create this rocket and challenge your fellow aerospace engineers (peers, siblings) to a race across the room on fish line.

**Hypothesis**

If balloon rockets are raced the same distance, then the rocket with the balloon in the center of the straw will win because it travels with less friction than the other rockets.

**Materials** 1 large balloon 1 Short Straw 1 Longer Straw Meter stick

Masking tape Scissors Stop watch/timer 5 m Fish Line

<https://somup.com/c3hDDytn2U> (1:12) Great Balloon Race

**Procedures**

1. There will be three to four different kinds of “rockets” produced: (1) longer straw a) with balloon at front; b) balloon in center; c) balloon at end; (2) shorter straw.

2. Cut a 5 m length of fish line or use a previously cut line.

3. Obtain a balloon, straw, tape and meter stick.

4. Design your own rocket system by using the balloon and TAPING it to the straw.

* Do NOT overfill your balloon or it will pop.
* Do NOT tie your balloon off!

5. Thread the fish line through the straw. The fish line is the “track” for the rocket to move.

6. The best scenario is to attach the fish line to the wall on opposite sides of the room. Designate one end “start,” and the other “finish.”

7. Hopefully, you have challenged a peer or a sibling to RACE at least two different “rockets”. You may practice “racing” beforehand and adjust your rocket’s shape, the slope of the “track”, etc.

8. Measure the distance your rocket travels for each to the nearest TENTH of a meter.

9. Measure the time it takes to go the distance to the nearest TENTH of a second.

**Calculations and Data**

1. Draw a sketch below of three rocket systems used. Give a brief description below the rocket system (length of straw, slope of line, etc.)

Balloon at Front Balloon in Center Balloon at End

2. Complete the chart below and fill in data as you run each trial.

|  |  |  |  |
| --- | --- | --- | --- |
| Rocket Type | Distance (m) | Time (s) | Speed (d/t) |
| Balloon in front (long straw) |  |  |  |
| Balloon in middle (long straw) |  |  |  |
| Balloon at back (long straw) |  |  |  |
| Balloon on (short straw) |  |  |  |

3. Calculate the speed of your rocket by dividing the distance (m) traveled by the time (s) it took to travel that distance. Put your answer to the nearest TENTH. (*record your answer in the third column of the chart above*) SHOW WORK BELOW:

4. Determine the average speed of one rocket in miles per hour (*nearest 1 mile/hr*).

\_\_\_\_\_ m/s x 60 s/min x 60 min/hr = \_\_\_\_\_ m/s x 1 km/1000 m = \_\_\_\_\_ km/hr

\_\_\_\_\_ km/hr x 1 mile/1.6 km = \_\_\_ mph

**Conclusions and Questions**

1. What “rocket” design worked best to reduce the time it took to travel the distance across the room?

2. Name three kinds of forces that were acting on your rocket system?

a.

b.

c.

3. What other variables could you use to increase the speed of your rocket?

4. In order for the rocket to move, what was needed?

5. Was there energy available in your rocket just prior to starting your race? Was this energy causing motion?

**Calculations and Data**

1. Draw a sketch below of your rocket system for each variable you tried:

System 1 System 2 System 3

Long straw long straw, balloon at end short straw

Balloon in middle

2. Copy the chart below and fill in data as you run each trial.

|  |  |  |
| --- | --- | --- |
| Distance (m) | Time (s) | Speed (d/t) |
| 4.8 m | 1.2 s | 4.0 m/s |

3. Calculate the speed of your rocket by dividing the distance (m) traveled by the time (s) it took to travel that distance. Put your answer to the nearest TENTH. (*record your answer in the third column of the chart above*) SHOW WORK BELOW:

*V = d/t = 4.8 m / 1.2 s = 4.0 m/s*

4. Determine the average speed of one rocket in miles per hour (*nearest 1 mile/hr*).

4 m/s x 60 s/min x 60 min/hr = 14,400 m/s x 1 km/1000 m = 14.4 km/hr

14.4 km/hr x 1 mile/1.6 km = 9 mph

**Conclusions and Questions**

1. What design worked best to reduce the time it took to travel the distance across the room?

*The longer straw with the balloon in the middle because of less friction.*

2. Name three kinds of forces that were acting on your rocket system?

a. *friction (straw on fishing line)*

b. *propulsion (balloon exhaust)*

c. *force of attraction due to gravity*

3. What other variables could you use to increase the speed of your rocket?

*Use 2 balloons at various positions on straw*

*Use different lengths of straw*

*Slope the race course*

*Shape of the rocket*

4. In order for the rocket to move, what was needed?

*Energy (an outside, unbalanced force)*

5. Was there energy available in your rocket just prior to starting your race? Was this energy causing motion?

*Potential energy was in the filled balloon, but there was no motion.*