Marshmallow Blowguns

Safety Precautions

- You MUST wear safety glasses or safety goggles if you are near or participating in this experiment!
- Use ONLY miniature marshmallows in the blowgun.
- NEVER fire the blowgun at anyone or anything.
- Use ONLY in open, clear spaces.
- Keep the blowgun AWAY FROM young children.

Vocabulary

- mean - the average of a set of numbers
- median - the middle number in a set of sorted numbers if there is an odd number of numbers in the set; if there is an even number of numbers in the set the median is the average of the two middle numbers
- mode – number that appears most frequently in a set of numbers
- projectile - an object launched on a path through the air or through space
- trajectory - the path taken by a projectile

Materials and Equipment

- safety glasses or safety goggles
- miniature marshmallows
- 2 ½ inch PVC elbows
- 1 PVC t-connector
- 1 PVC end cap
- 1 8 ½ inch piece of ½ inch PVC
- 1 5 inch piece of ½ inch PVC
- 1 4 inch piece of ½ inch PVC
- 1 2 inch piece of ½ inch PVC

Construction

1. Cut the PVC as indicated.
2. Attach the 4 inch piece to the bottom of the t-connector.
3. Attach the end cap to the bottom of the 4 inch piece.
4. Attach the 8 inch piece to the left side of the t-connector.
5. Attach the 5 inch piece to the right side of the t-connector.
6. Attach one of the elbows to the 5 inch piece so that it is facing up and to the right.
7. Attach the 2 inch piece to the elbow.
8. Attach the other elbow to the 2 inch piece so that it is pointing to the right.

Questions

1. At what angle should the marshmallow be launched to maximize its landing distance?
2. Is there anything in the environment that might interfere with your marshmallows' *trajectory*?
3. What was the mean landing distance?
4. What was the median landing distance?
5. What was the mode landing distance?

Dr. Denise Meeks, tucsonkosmicgirl@gmail.com

Research

Algebra, calculus, and experimentation demonstrate that the farthest landing distance occurs when projectiles are launched at an angle of 45^0. Objects launched at angles that are the same number of degrees from 45^0 have the same landing distance. For example,

$45^0 - 20^0 = 25^0$ $45^0 + 20^0 = 65^0$

Objects launched at 25^0 and 65^0 land at the same location, but you can substitute any angle measurement between 0^0 and 45^0 for 20^0 to get the same landing results.

Hypothesis

What is your hypothesis? Be sure to include your "best guess" answers to the 5 questions above.

1.

2.

3.

4.

5.

Experiment

1. Launch 10 miniature marshmallows, one at a time, at different angles and record the launch angles and landing distances. You will need to approximate the launch angle. Ask another student to watch you from the side as you launch them.

Data and Observations

Launch number	Launch angle in degrees	Landing distance in meters
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Dr. Denise Meeks, tucsonkosmicgirl@gmail.com

Analysis

1. Sort the data by shortest to longest landing distance.

Launch number	Launch angle in degrees	Landing distance in meters
	total distance:	

Which launch angle provided the maximum landing distance?

2. What, if anything, in the environment interfered with your marshmallows' *trajectory*?

3. Calculate the *mean* landing distance. Divide the total distance by the number of launches.

4. Calculate the *median* landing distance. The median landing distance will be the average of the 5^{th} and 6^{th} landing distances of the sorted data.

5. Calculate the *mode* landing distance. The mode will be the landing distance that is listed more than any other distances.

Conclusions

The miniature marshmallows launched at angles closest to 45^0 had the greatest landing distances.

Additional Questions

1. If you were launching a different projectile, other than a marshmallow, would you get the same landing distances for the same launch angles?

Dr. Denise Meeks, tucsonkosmicgirl@gmail.com

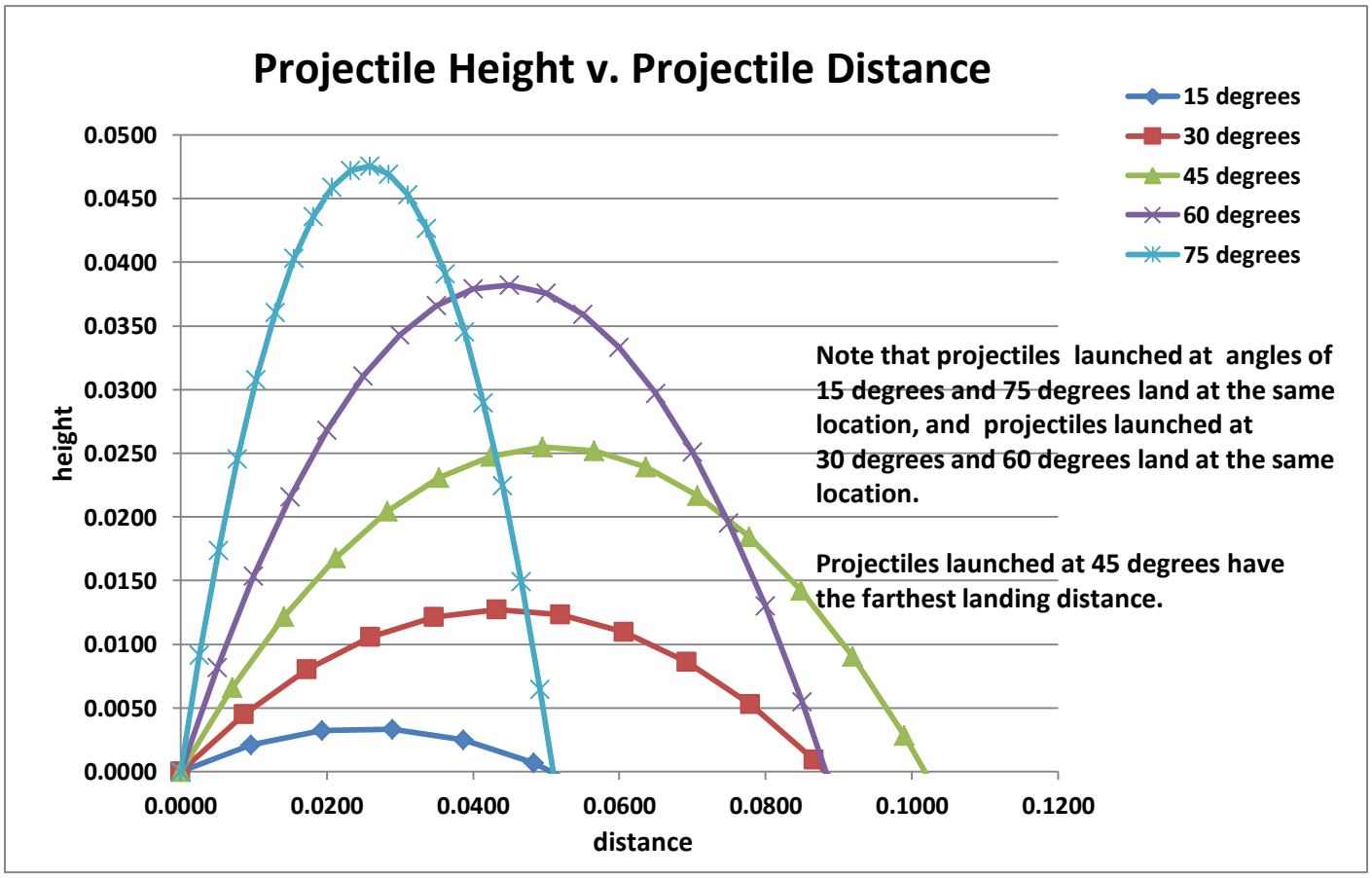
Science and Math (optional information)

The equations that determine the location of a projectile are:

$$\text{x (distance)} = v_0 cos\theta$$

$$\text{y (height)} = v_0 t\ sin\theta - \frac{1}{2} g t^2$$

v_0 = initial velocity
t = time
g = acceleration of gravity, 9.81 meters/second^2
θ = angle in degrees
sin and *cos* are calculator functions



Dr. Denise Meeks, tucsonkosmicgirl@gmail.com