Which Balloon Car Runs Farther?

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About The Experiment

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Why did I choose balloon car as my project?

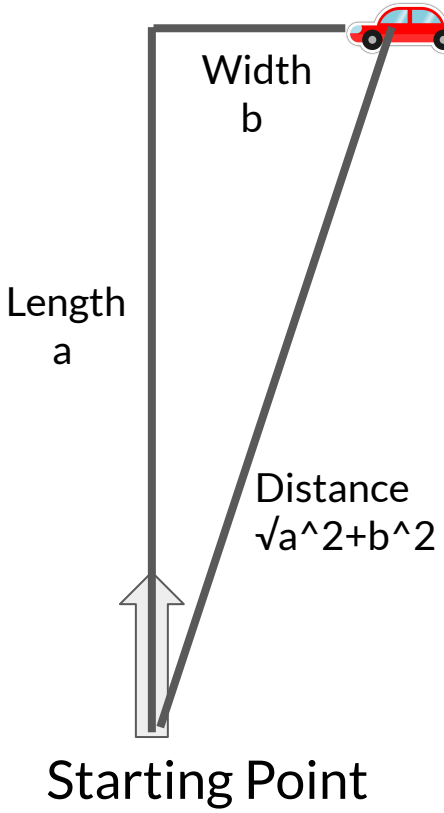
When I was young I loved playing toy cars and see how fast, how far they could go. I'm always interested about the science behind motion, speed, and distance. Because of these reasons, I decided to do this experiment.

How did I make my balloon cars?

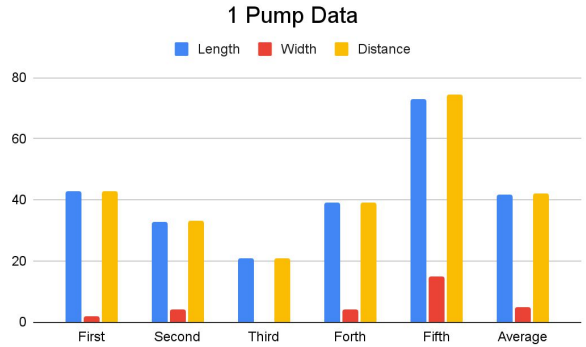
I cut out the same shape for each car, plastic straws and thin sticks as axles, and bottle caps for wheels. I put them and balloon together using tapes and hot glue gun. The car and axles ratios are reference to Tesla Model X
Car: 15x6cm Axles: 3.5 and 2.5cm from each end of the car

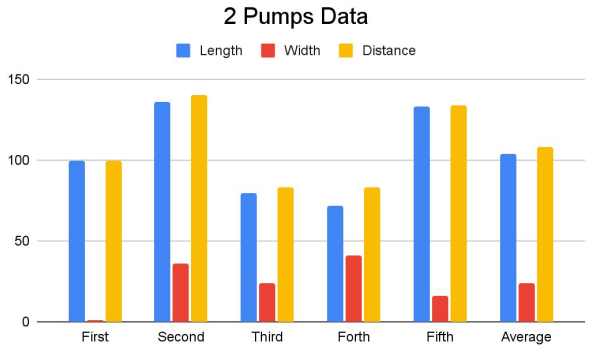
How I Did The Experiments

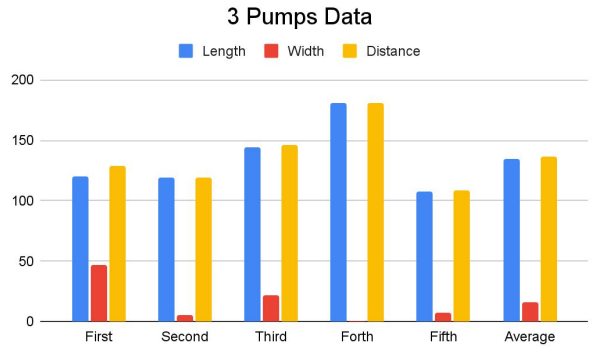
1. Pump the air pump several times (depends on how many times the experiment requires) to inflate the balloon on a chosen car with chosen wheels.
2. Hold the balloon so it doesn't deflate and put the car at the starting point on the ground.
3. Adjust the direction and let the car go.
4. When the car stops, record the length and width it traveled from the starting point and calculate the distance using pythagorean theorem.
5. Use the data and organize it into a graph.

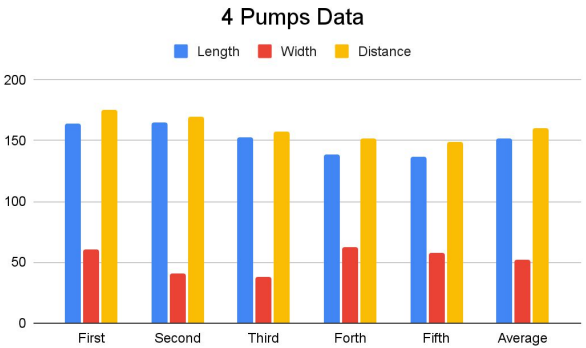


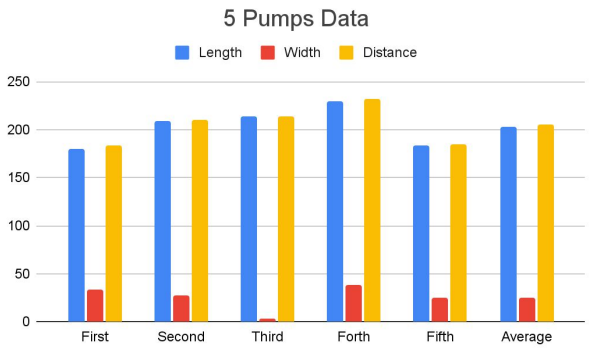
Different Air Pumps

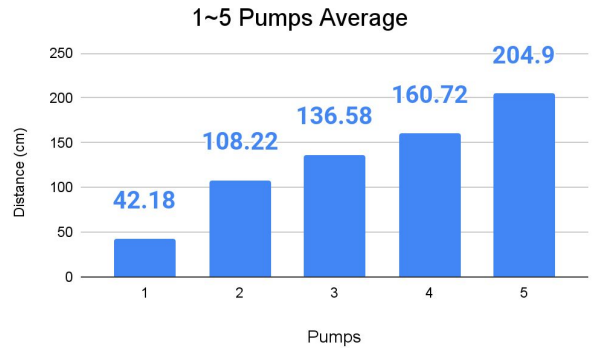






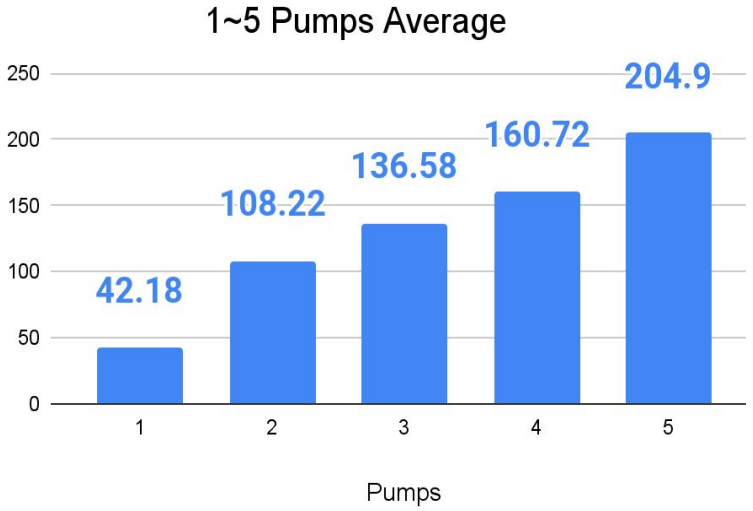


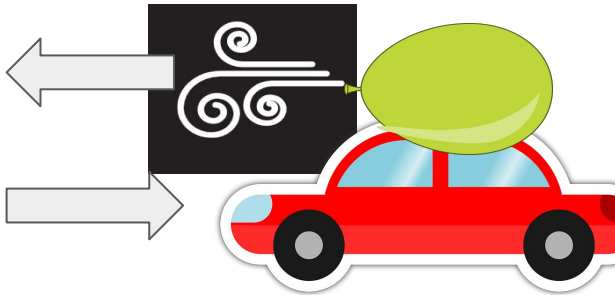




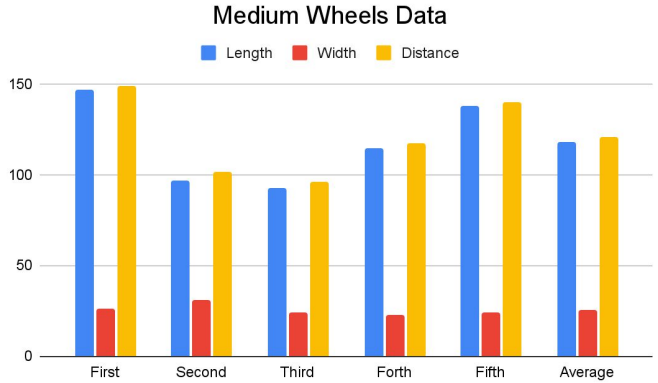
Impact of Amount of Air on Travel Distance

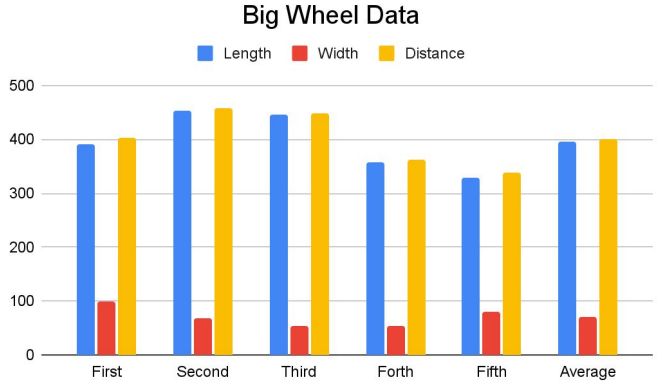
More air means farther traveled distance. The reason why 2-pump is 2 times longer than 1-pump is because there is less air, or weaker pushing force, in the 1-pump balloon. Most of the pushing force is used on making the car start moving, so even less force is used to push the car forward. Other pumps balloons have the same logic, but they have more than enough air to make the car start moving, so the differences are not as big. It's same as rocket science: **Balloon blows air, blown air pushes the normal air, and because Newton's third law, the normal air pushes back in opposite direction, which causes the car to move.**

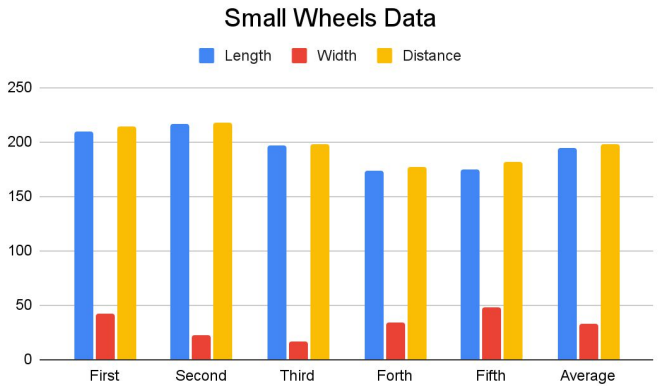


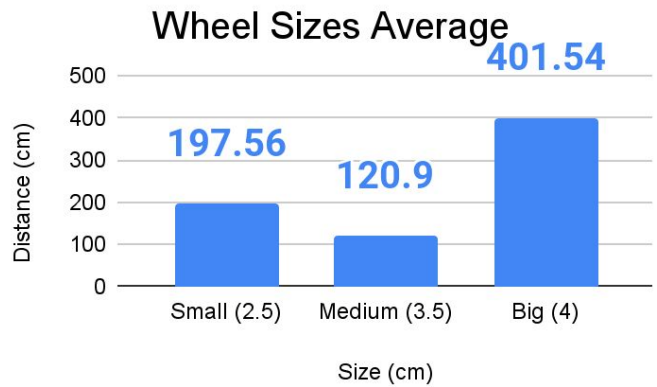


Different Wheels Sizes



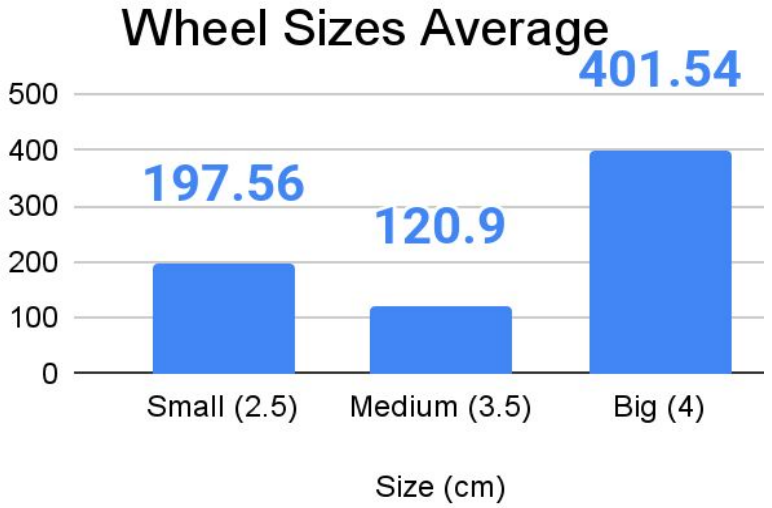




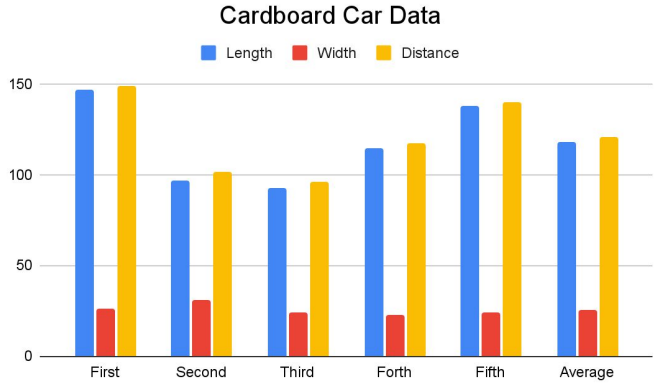


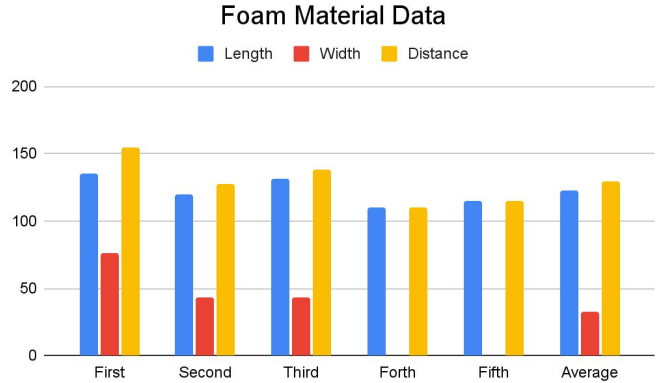
Impact of Different Wheel Sizes on Travel Distance

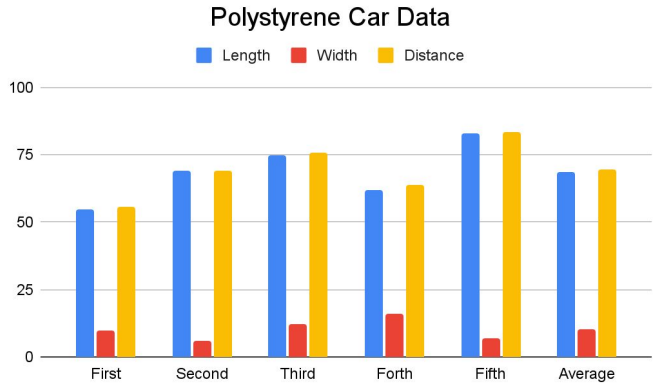
Travel distance is NOT directly related to car wheels' size. Distances are different because the wheels have different weight, grip, and axle contact smoothness. Small wheels(6g) are not very smooth, like medium wheels(12g). But they spin faster than medium wheels because of their size, which makes small wheels better than medium wheels. Big wheels are better because they are lighter (10g) than other wheels and have smoother contact with the axle, which decreases the friction and makes the car go farther.

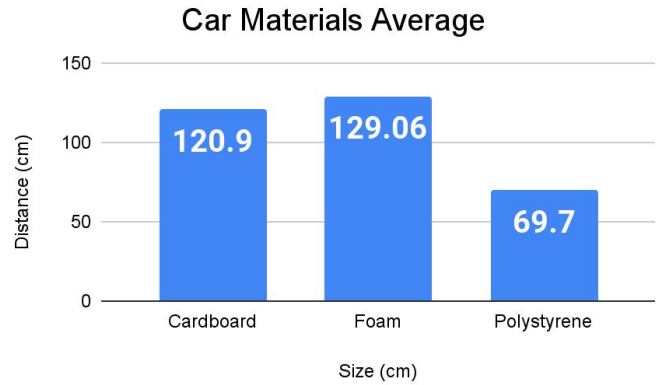


Different Car Materials



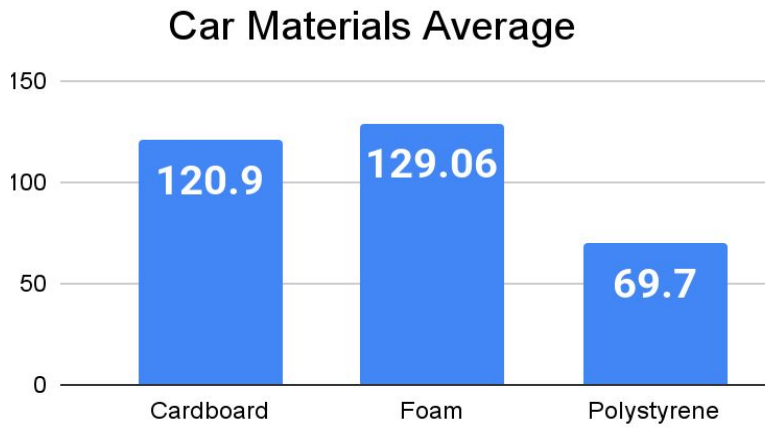






Impact of Different Car Materials on Travel Distance

Traveled distance is NOT directly related to car material. Foam car has the longest distance because it's the lightest, weighing only 5g. Because the car is lighter, it needs less force to push the car forward, so it can travel longer. Polystyrene car is also 5g, but the friction between car and wheels is very high, it cancels the pushing force. Cardboard car is heavier (6g) which needs more pushing force, resulting a shorter distance.

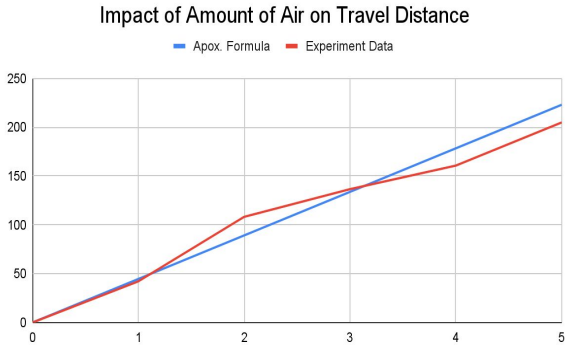


Conclusion

Two major factors impact the distance of a balloon car.

1. **More air means farther travel distance**

   More air means more speed when air is escaping, more air speed means more pushing force, which means farther travel distance because of Newton's Third Law of motion. The distance, D, is approximately $D=44.6a$, where a is number of pumps of air.



2. **Heavier car means less travel distance**

   The heavier the car is, the more force it needs to cancel the inertia of the car (Newton's First Law of motion), because of that, less force is left to continue push the car forward, which means less travel distance.

Video