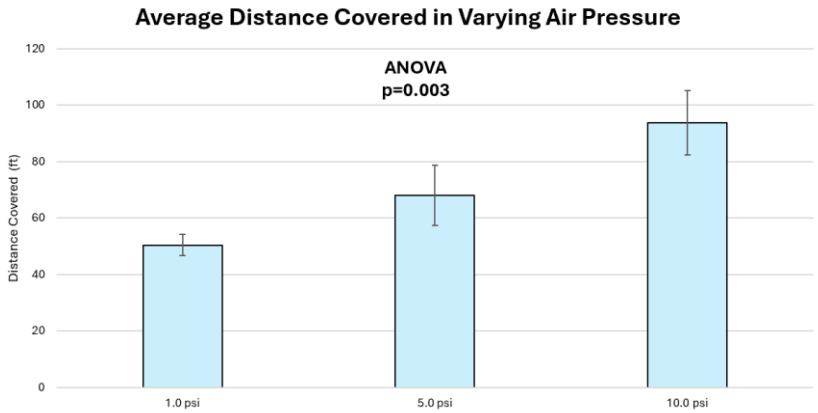
The Impact of Varying Air Pressure on the Range of A Soccer Ball

Research Questions

General problem:
This research aims to investigate whether air pressure affects the distance of a soccer ball
Specific problem:

- Does pressure level affect the distance of a ball?
- Which pressure gets the ball the farthest?

Results



Methods

1. We set the ball to have different air pressure (1.0 psi, 5 psi, and 10.0 psi)

2. We asked volunteers from our class to kick the ball.
3. We measured the distance that the ball covered with different air pressure.
4. We organized and analyzed the data.

Discussion and Conclusion

- The results showed a clear trend where increasing the soccer ball's air pressure led to longer kicking distances for all participants.
- This likely occurred because higher pressure made the ball firmer, allowing more efficient energy transfer from the foot to the ball during the kick.
- Although the distances increased with pressure, differences between students suggest that kicking strength and technique also influenced the final results.

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Physics

All photos and graphs were taken/created by the student unless otherwise noted

The Evolution of Soccer

History of soccer

Soccer began as ancient ball games played in China, Greece, and Rome, but evolved into “mob football” across Europe. In 1863, England’s Football Association formalized the rules, separating soccer from rugby and laying the foundation for the modern game. Over the 20th century, soccer exploded globally, with the FIFA World Cup becoming a cultural phenomenon and the sport now uniting billions across continents.

Famous soccer players

Famous soccer players in 2025 include seasoned stars like Lionel Messi, Cristiano Ronaldo, and Mohamed Salah

https://en.wikipedia.org/wiki/Cristiano_Ronaldo

https://www.bbc.com/sport/football/articles/clynxlqr3g1o

How much the soccer industry?

The global football industry generates billions of dollars in revenue each season.

Air pressure And Distance Of A Ball

- Air pressure

Air pressure is the force created by the weight of air pushing down on the Earth. At sea level, there are more air molecules, so the pressure is higher. As you go higher up, like on a mountain, there are fewer air molecules, so the pressure gets lower. This happens because there's less air above you pressing down the higher you go

https://unsplash.com/s/photos/soccer-ball

- Distance and pressure of a ball

When a soccer ball rolls on the ground, it faces a type of friction called rolling friction. This happens because the ball is rolling instead of sliding. Rolling friction is different from sliding friction, where two surfaces rub directly against each other. The amount of rolling friction depends on things like the roughness of the surface, the ball's material, and the air pressure inside the ball. A soccer ball with more air pressure tends to have less rolling friction because it doesn't squish as much when it hits the ground, so it rolls more easily and goes farther.

Importance of a inflated ball in soccer

- An inflated ball in soccer is crucial for optimal gameplay, as it ensures the ball bounces, rolls, and flies with predictable consistency. The proper air pressure allows players to control, pass, and strike the ball with precision and power. Without the right inflation, the ball would be too hard or too soft, affecting the overall performance and fairness of the game.

https://ecosports.com/products/eco-footprint-soccer-ball-size-5?srsltid=AfmBOoqbLAPrWAjwqTIA8rIWMk0IAKiiJ6xRiQii8eGJsnEEGHPEAD

Statement of the Problem

General problem:

- This research aims to investigate whether air pressure affects the distance of a soccer ball

Specific problem:

- Does pressure level affect the distance of a ball
- Which pressure gets the ball the farthest

Hypothesis

If a ball is inflated to an optimal pressure, it will travel a greater distance because the increased internal pressure enhances energy transfer, reduces deformation, and minimizes air resistance.

Independent variable	**Dependent variable**
Ball inflated to different pressure	Travel a certain distance

Constant variable

Type of ball, type of floor, kick power

Methods

Our School Backyard

For our project, we decided to conduct it in our school's grass area so we have enough space to launch the ball

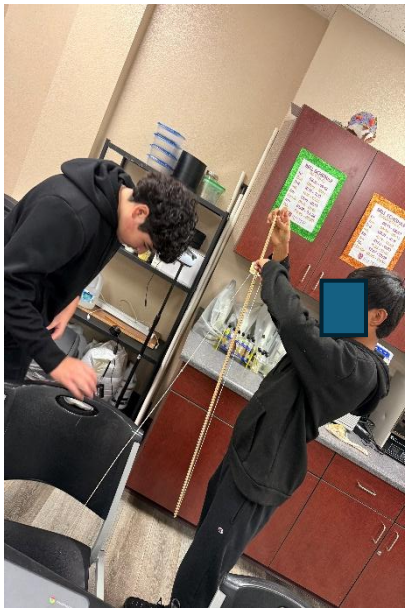
Pumping the Air

We use a digital ball inflater and set the pressure inside the soccer ball. We set it to 1.0, 5.0, and 10 psi

Kicking the Ball

We asked our classmates to kick the ball multiple times, and we recorded the distance the ball covered

Methods

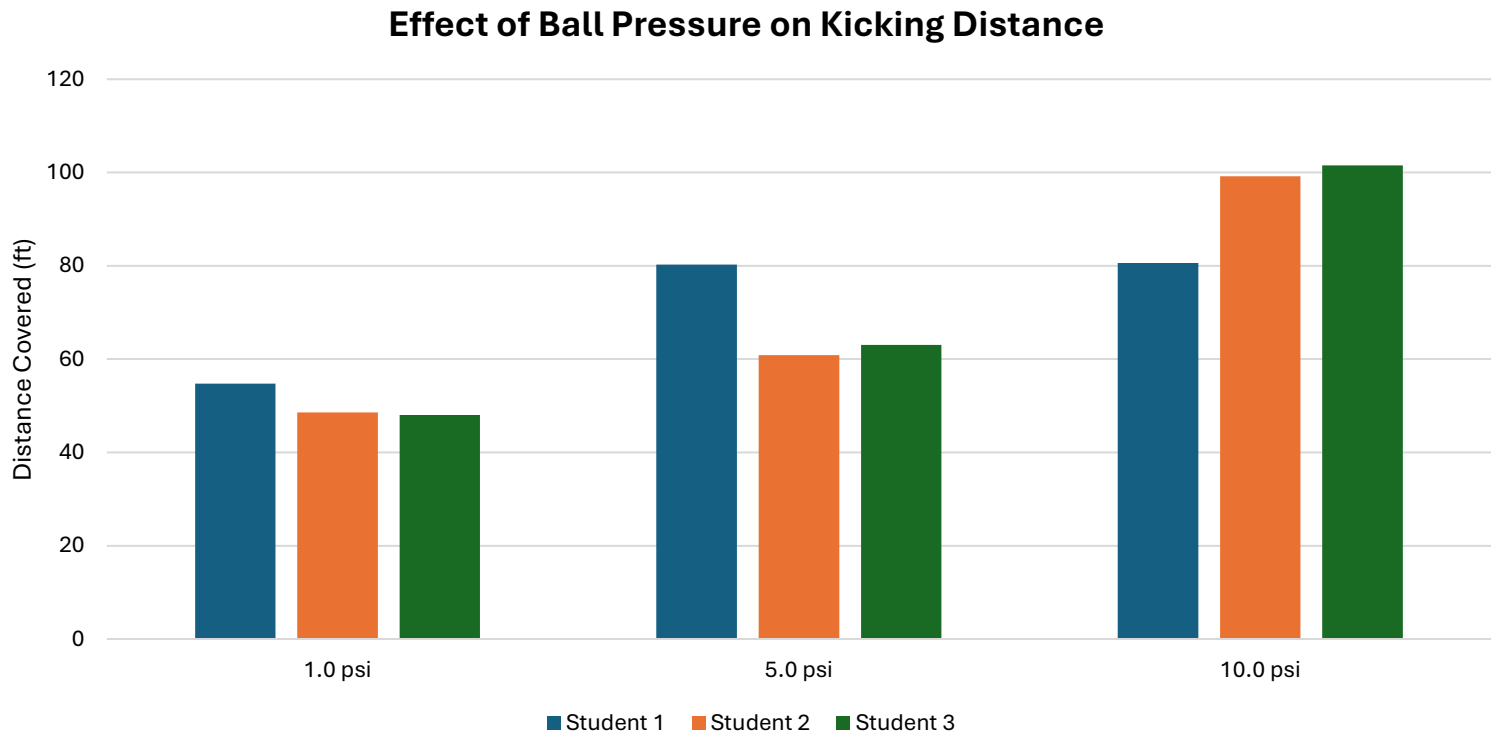


A challenge we conquered!

To measure the distance that the ball covered, we use a long string. This was a bit challenging, as we had to do it multiple times. We also have to be careful when retrieving the string to avoid it from getting tangled.

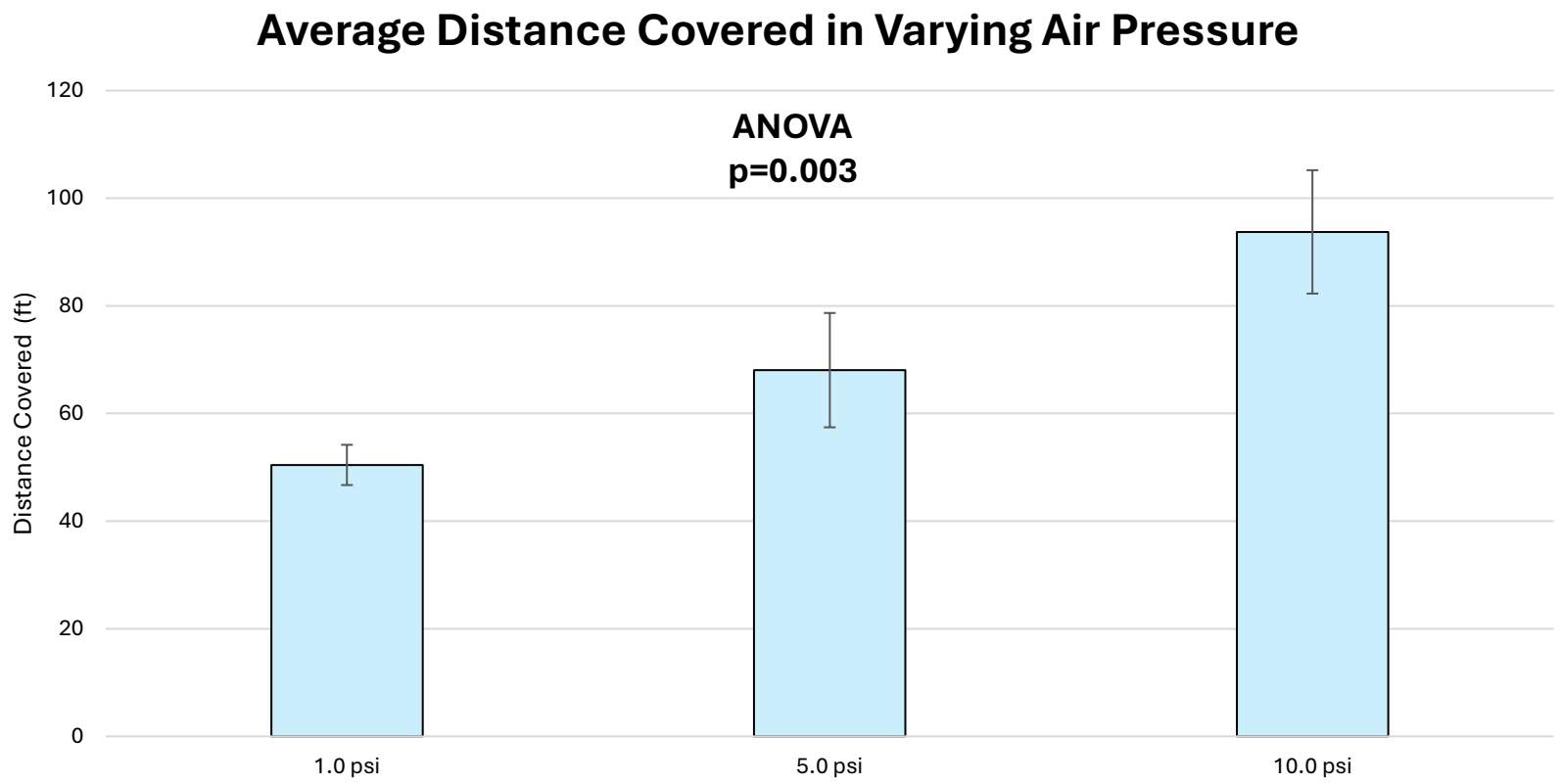
After that, we go inside the classroom to measure the length of the string using a yard stick. We measured it in inches.

Results



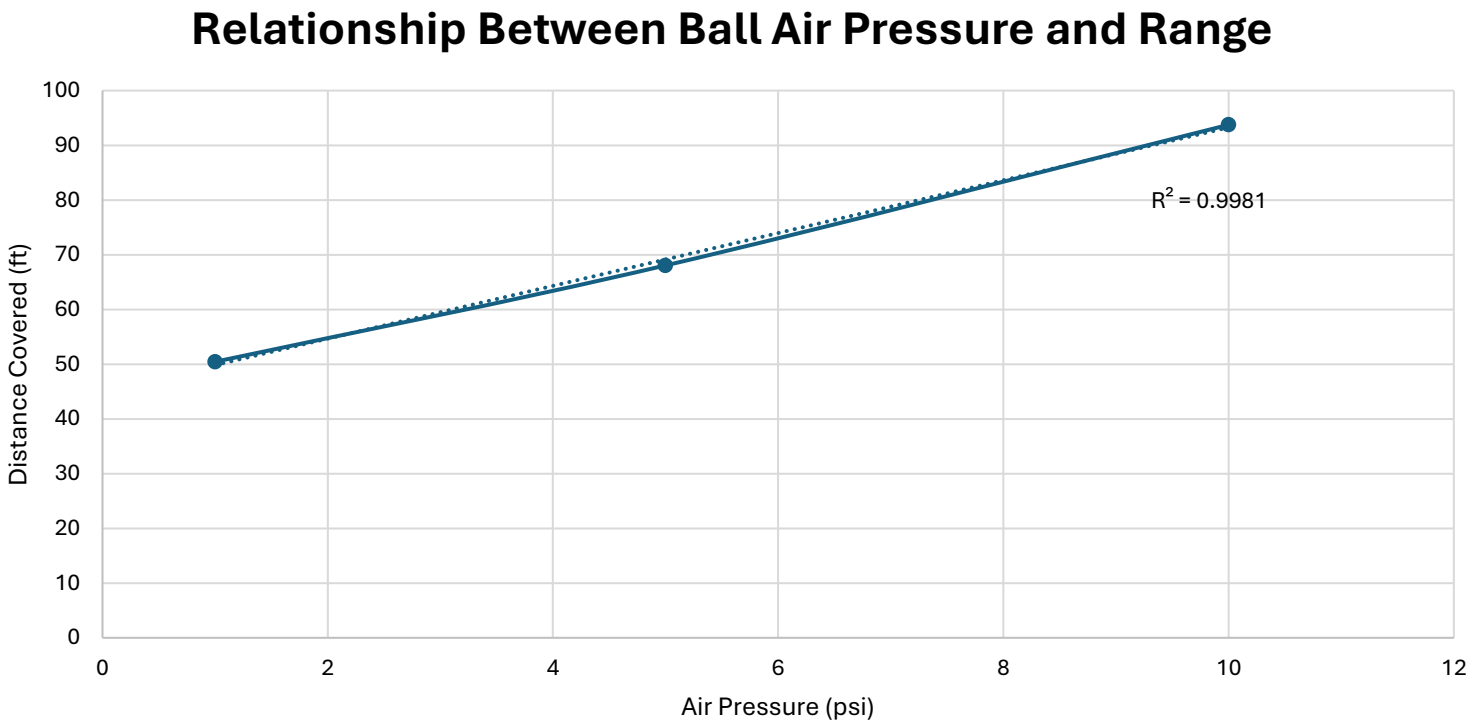
- The results show that as the soccer ball pressure increased, the kicking distance generally increased for all three students.
- At 1.0 psi, the ball traveled the shortest distances, while at 10.0 psi, all students achieved their longest kicks.
- This suggests that higher air pressure makes the ball more rigid, allowing more energy transfer during the kick and resulting in greater distances.

Results



- The average kicking distance increased as the air pressure inside the soccer ball increased from 1.0 psi to 10.0 psi.
- The ANOVA result (p = 0.003) shows that the differences in distance between the pressure levels are statistically significant.
- This indicates that ball pressure has a measurable effect on performance, with higher pressures producing longer kicking distances.

Results



- The graph shows a strong positive relationship between ball air pressure and the distance the ball traveled.
- As the pressure increased from 1.0 psi to 10.0 psi, the average distance also increased steadily.
- The high R^2 value (0.9981) indicates a very strong linear relationship, suggesting that air pressure is a major factor affecting kicking range.

Discussion

- The results showed a clear trend where increasing the soccer ball's air pressure led to longer kicking distances for all participants.
- This likely occurred because higher pressure made the ball firmer, allowing more efficient energy transfer from the foot to the ball during the kick.
- Although the distances increased with pressure, differences between students suggest that kicking strength and technique also influenced the final results.

Conclusion

Increasing the air pressure of a soccer ball results in greater kicking distance, showing that ball pressure significantly affects performance.

Possible Sources of Errors

- Differences in kicking strength and technique between students could have affected the distance.
- Inaccurate air pressure measurements if the gauge was not precise or the ball lost air during testing.
- Uneven or inconsistent ground surface, which could change how the ball rolled or bounced.
- Wind or environmental conditions that may have influenced the ball's travel distance.

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