Broken String Experiment

Reasons Why I Chose This Experiment

I’m interested in engineering, I wanted to learn more about how different types of fibers can be used in real-world structures. I was especially curious about how strong and durable different strings are, and how their properties affect what they can be used for.

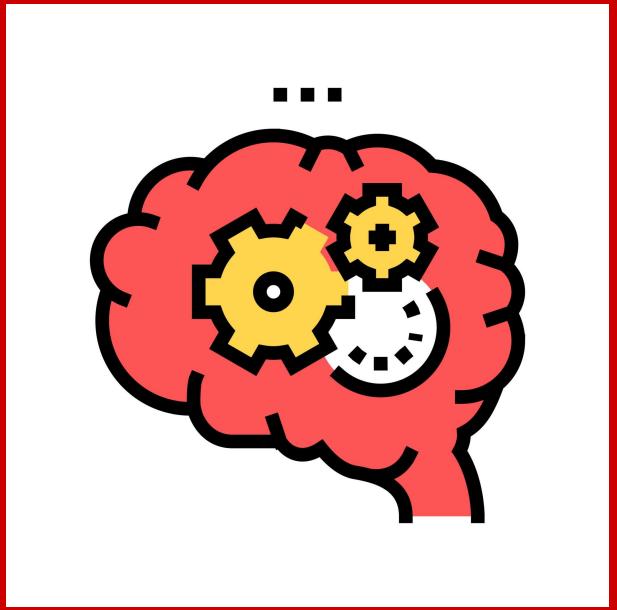
For example, certain types of string and rope are used in construction projects, such as building rope bridges. Engineers have to carefully choose the right materials to make sure the bridge is strong, safe, and able to hold weight without breaking. This made me wonder: which type of fiber would work best for different engineering applications?

Investigation Question:

How does the strength of synthetic fibers compare to the strength of natural fibers?

Hypothesis

If synthetic fibers are made using modern manufacturing processes that create strong molecular bonds and fewer structural defects, then they will be stronger than natural fibers.



Research

In my research, I learned that synthetic (artificial) fibers are often stronger than natural fibers. They are designed through modern manufacturing processes that create strong molecular bonds and make the fibers very consistent, with fewer weak spots. This is why synthetic fibers like nylon or polyester are often used in products that need to be very strong and durable.

However, natural fibers also have important advantages. They are biodegradable, which means they can break down naturally in the environment. Some natural fibers also perform better under prolonged tension, meaning they can handle being stretched or holding weight over time without snapping quickly. The structure of natural fibers is very complex and unique, which helps give them strength and flexibility in different ways.

Materials

1. Bucket
2. 1-pound rock
3. Two 2-pound dumbbells
4. Two 5-pound dumbbells
5. Cotton string
6. Wool string
7. Acrylic string
8. Polyester string

Procedures

1. Cut a piece of string that is the same length for each trial.
2. Tie one end of the string securely to the handle of a bucket.
3. Tie the other end of the string tightly to a sturdy PVC pipe.
4. Make sure the string is pulled tight and there is no slack.
5. Place a small amount of weight (such as 1 pound) into the bucket.
6. Carefully lift the bucket so the string holds the full weight.
7. Observe the string for a few moments to see if it breaks.
8. If the string does not break, gently lower the bucket and add more w
9. Lift the bucket again and observe.
10. Repeat this process, adding more weight each time, until the string breaks.
11. Record the total amount of weight the string held before breaking.
12. Repeat the same steps for each type of string, making sure to keep the length and testing method the same for a fair comparison.

Variables

Independent Variable (What I Changed):

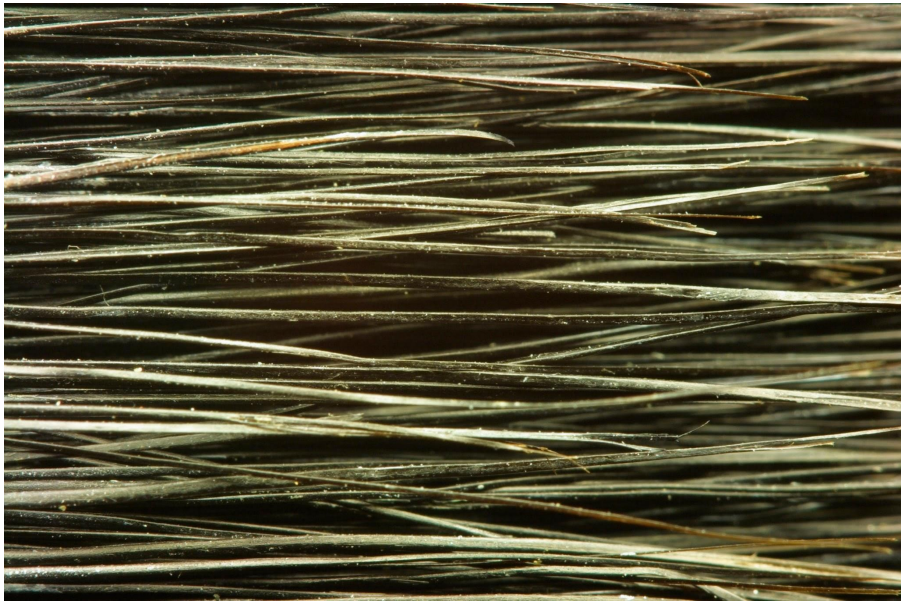
- The type of fiber in the string (cotton, wool, acrylic, or polyester)

Dependent Variable (What I Measured):

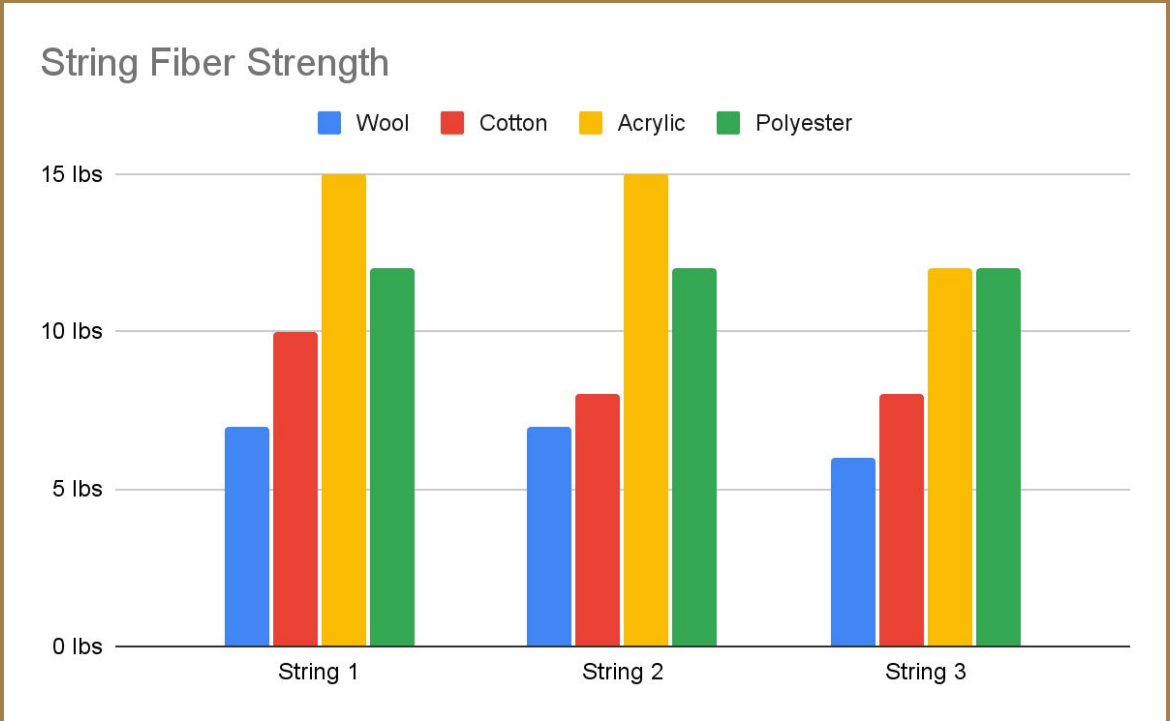
- The amount of weight the string held when it broke

Controlled Variables (What I Kept the Same):

- The diameter (thickness) of each string
- The type of knots used
- The length of each string
- The same bucket
- The same PVC pipe



Results


String Fiber Strength
Wool
Cotton
Acrylic
Polyester
15 lbs
10 lbs
5 lbs
0 lbs
String 1
String 2
String 3

Results Explained

The acrylic string was the strongest. It held up to **15 pounds** before breaking.

The wool string was the weakest and broke at an average of **7 pounds**, which was surprising.

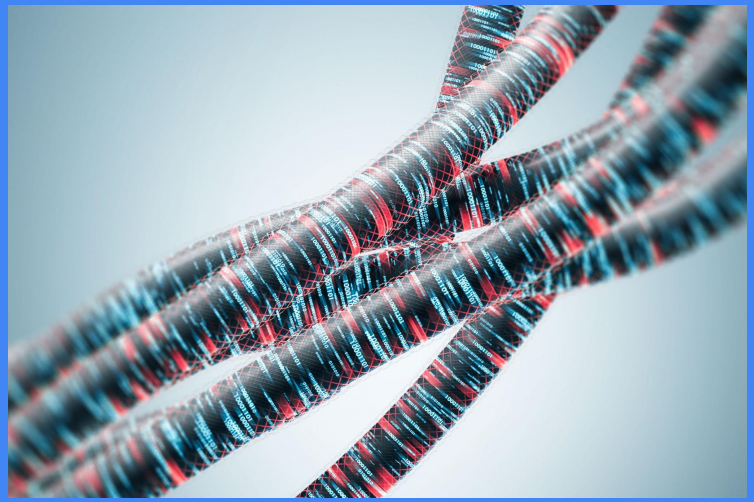
Overall, the synthetic (artificial) fibers held more weight than the natural fibers. The artificial fibers broke at an average of about **12 pounds**, while the natural fibers broke at an average of about **8 pounds**.

This shows a clear pattern: **synthetic fibers were significantly stronger than natural fibers in this experiment.**

Analysis

The data from my experiment supports my hypothesis: the synthetic (artificial) fibers were stronger than the natural fibers. Acrylic was the strongest, holding up to 15 pounds, while natural fibers like wool held much less, averaging around 7–8 pounds. This shows a clear difference in strength between synthetic and natural fibers.

This project could be continued in future years to explore more details, such as how small defects or variations in the molecular structure of fibers affect their strength. Studying these factors could help explain why some strings break earlier than others, even when they are the same type and size.



Data Conclusion

The synthetic fibers were stronger than the natural fibers by about 4 pounds on average. This supports my hypothesis that synthetic fibers would be stronger.

The results suggest that synthetic fibers have stronger molecular bonds and a more uniform structure because they are manufactured in controlled conditions. This likely makes them able to hold more weight before breaking compared to natural fibers.

Overall, my experiment showed a clear difference in strength between synthetic and natural fibers.

How should this topic be explored more?

Further Research Ideas:

My research focused on understanding why natural fibers are weaker than synthetic fibers. In the future, this experiment could be expanded by testing more samples to create a larger and more reliable data set.

Scientists could also explore how environmental factors, like heat, cold, or humidity, affect the strength of both natural and synthetic fibers. This would help show how different fibers perform under real-world conditions.

Resources

- https://www.iropes.com/blog/
- **https://pmc.ncbi.nlm.nih.gov/articles/PMC9077356/**
- **https://www.sciencedirect.com/science/chapter/bookseries/abs/pii/S0065323308605884**