Resistance Through Internal Structure

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Science Fair Contract, Topics, and Questions - Draft
Assigned: October 27th ___/200
Due: Nov 5th

Background research and Hypothesis
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Due: Nov 17th

Materials, Procedures, and Variables
Assigned: Nov 20th ___/100
Due: Dec 2nd

Experiment, Results and Conclusion
Assigned: Dec.8th ___/200
Due: Dec 17 (Trial 1)
Jan 7th (Trial 2 & 3)

Rough + Final Draft Report
Assigned: Jan.12th ___/100
Due: Jan.27th

Final Project - Display Board Report
Assigned: Jan.12th ___/100
Due: Jan 27th

Science Fair topics template

TITLE A

Step-: 2 Project Ideas Proposal

Assigned: 10/27

Deadline: 11/05

1st Idea: Topic: Resistance Through Internal Structure

(Please circle one: engineering/science)

2nd Idea: Topic: Ink Spread Race

(Please circle one: engineering/science)

My Final idea: Resistance Through Internal Structure

Question: How does the interior of a building affect its chances of withstanding extreme/heavy wind?

Resource(s): None (so far)

Science Fair Topics - Draft

Write down the topic you chose:

Resistance Through Internal Structure

What made you want to pick this topic?

- The thing that made me want to pick this topic the most was because of my interest in engineering. Engineers have to know what should be done in order to make a building, such as a home, resistant to weather conditions like heavy wind. The interior can play a huge game-changing role in whether or not a home can still stand in similar scenarios.

Do you find these topics interesting? Why?

- Yes, I do find this topic interesting. I've done many engineering projects for the science fair in the past, but they have always been similar to one another. This year, I wanted to break away from that and come up with my own idea that could be tested.

Science Fair Topic and Question - Final

Which topic did you choose?

Resistance Through Internal Structure

What question(s) are you testing?

Testable Question: How does the interior of a building affect the chances of it withstanding weather conditions such as heavy wind?

How are you going to test your hypothesis?

- Hypothesis: A building with a strong interior will withstand heavy winds for a longer time than one with a weak interior.
- To test our hypothesis, houses constructed out of paper (with weak/strong interiors) will be placed against a fan for three trials (one trial for one level of strength). Depending on which house stands for a longer time in these tests, our hypothesis will be proven correct or inaccurate.

Step 3: Background Research Source 1

TITLE B

Source 1

Title: "How to Strengthen Homes Against High Winds."

Summary:

What's the big idea about the article?

- The article intends to inform readers about the techniques used in the construction of a home in order to ensure maximum resistance against strong winds.

In complete sentences, describe a few details (who, what, where, when, why, and how)

The article was published by the NAHB (National Association of Home Builders), on July 8th, 2020, and is easily reliable as it talks about skills engineers still use when building homes, further proving its credibility. Such mentioned techniques were to seal the roof and to provide a Continuous Load Path (CLP). Sealing the roof eliminates any chances of wind getting under it and tearing it off the structure. A Continuous Load Path, however, takes this one step further. It involves tying the home together, meaning that the home itself acts as one, strong structure, rather than separate, weak ones. Overall, this article talks about useful modern tactics that engineers use in order to make the building as wind-resistant as possible.

This source is a: Website _____ Other

Source 1 Bibliography

The URL is:
https://www.nahb.org/blog/2020/07/how-to-strengthen-homes-against-high-winds/

Last Date of Access: November 5, 2025

Title of Article: "How to Strengthen Homes Against High Winds."
Author's Name: The National Association of Home Builders (NAHB)
Date of Article: July 8, 2020

Step 3: Background Research Source 2

TITLE B

Source 2

Title: "Building Beyond the Storm: Structural Design for High Wind Resilience."

Summary:

What's the big idea about the article?

- The article dives further into the concept of structures and wind, thoroughly explaining multiple key ideas relevant to the matter.

In complete sentences, describe a few details (who, what, where, when, why, and how)

The article, published by the administration of GDI Engineering on October 5, 2023, goes into extreme detail on the ways that wind-resistant buildings are made, as well as the things that should be kept in mind during construction. Its reliability is almost noticeable after reading the introduction, further proving the company's extensive knowledge regarding this topic. Several key points are covered, some of which are the importance of wind resistance, the impact of high winds on structures, building codes/standards for said resistance, key considerations when designing such structures, and more. A lot is to be learned throughout this blog, to which those things have shown to be useful. Overall, the article is an excellent source of credible information, as it shows that structurally sound planning is key to making your building the most wind-resilient it can be.

This source is a: Website _____ Other

The URL is:
https://gdiengdesign.com/building-beyond-the-storm-structural-design-for-high-wind-resilience/

Last Date of Access: November 12, 2025

Title of Article: "Building Beyond the Storm: Structural Design for High Wind Resilience."
Author's Name: The Administration of GDI Engineering
Date of Article: October 5, 2023

Step 3: Background Research Source 3

TITLE B

Source 3

Title: "Built to Withstand: How Strong Interiors Weather the Storm."

Summary:

What's the big idea about the article?

- The article talks about the strategies that can be used to help make structures more durable in cases of extreme wind.

In complete sentences, describe a few details (who, what, where, when, why, and how)

- The article was published as a blog on the Applewhite Interiors website on October 10, 2025, and was written by Donna Key. It begins with the introduction of the hurricane season in states such as Georgia, and how the interiors of homes are critical to survival. In order for this to happen, however, it must be durable and structurally sound. One way of ensuring this is through the framework, with the most preferred type being metal. To further ensure a sense of safety in the inhabitants of the home, moisture-resistant drywall and ceiling systems are highly recommended. With this in place, the water will likely be kept out, eliminating any major chance of flooding. In summary, these two building materials are essential to a durable home able of withstanding heavy winds, therefore increasing the safety of the people living inside.

Source 3 Bibliography

This source is a: Website _____ Other

The URL is:
https://www.applewhiteinteriors.com/blog/built-to-withstand-how-strong-interiors-weather-the-storm

Last Date of Access: November 14, 2025

Title of Article: "Built to Withstand: How Strong Interiors Weather the Storm."
Author's Name: Donna Key
Date of Article: October 10, 2025

Science Fair Hypothesis

TITLE B

Hypothesis: Use your background research to help you create a HYPOTHESIS that predicts the outcome of your experiment

What is your Hypothesis?

- A building with pillars/a strong interior will withstand heavy winds for a longer time than one with a weak interior. Articles have stated that a home containing a structurally-sound inside will be more wind-resistant than one prone to collapse under said conditions. Through wind simulations, in which homes are tested for overall strength and resistance against varying wind speeds, this has been proven multiple times.

Tip: Make your Hypothesis after the background research

Materials

Make a list of all the Materials you used for this experiment

- Paper (A4)
- Hair Dryer
- Timer (can be used on the phone or by hand)
- Notebook (optional - used to record data)
- Scotch Magic Tape
- LEGO Bricks
- Cardboard
- Scissors

Make a list of all the Materials you used for this experiment

Procedure

What are the steps you followed during this experiment?

Write all of them down. Make sure they are exactly what you followed while doing the experiment.

Prior to Conduction:

- Before commencing the experiment, make sure to have the materials ready.

Constructing the Home with a Weak Interior:

- 1) Stack three pieces of A4 paper together and cut them vertically. This will create the walls of the structure. If necessary, take one more piece of uncut paper for its base.
- 2) Set out the piece of cardboard and tape the home together, making sure to seal major holes and structural hazards. Upon completing this step, you should have a basic outline of the building, excluding its roof and frontal part.
- 3) As the interior of this structure in particular is weaker, we will need to make an arch to slide into the middle of the building, or a wall containing such. First, measure the width and height of the structure as they will be your restrictions for how tall or long the arch will be. After this, gather some LEGO bricks. Using said pieces, design an arch-like structure, but keep in mind the boundaries of the design.
- 4) After construction, slide the newly-made arch into the estimated middle section of the building. Upon placement, make sure that other LEGO pieces are used to cover the space between the arch (walls).
- 5) To construct the roof, take two uncut pieces of A4 paper, tape them together, and use them to cover the top part of the building. It is recommended that to reduce the presence of major flaws, try to cover any significant holes.
- 6) Get out your notebook, if needed, and begin testing.
    - Have your hair dryer out and set it up to the first/low, then the second/high one. Record the time taken to fall, as well as whether it did so or not.
    - With every passing trial, move the device one inch closer to the building.
    - Repeat this step for a total of three times.

Procedure (Continued)

What are the steps you followed during this experiment?

Write all of them down. Make sure they are exactly what you followed while doing the experiment.

Constructing the Home with a Strong Interior:

- 1) Repeat steps 1 - 2, or, if you wish, use the same structure from the previous test (be delicate when removing the roof).
- 2) As the interior of this structure in particular is stronger we will need to make pillars to slide into the middle of the building. Once again, measure the height and width of the home. The construction of such architectural feats is simple: take some LEGO bricks and stack them high enough to fit the maximum height. However, depending on the width of the home, you may need to make more.
- 3) After construction, place the pillars in the middle section of the building, but make sure to make them an even distance from the walls and each other in order to ensure peak resistance.
- 4) Repeat step 5.
- 5) Repeat step 6.

After Experimentation (Optional):

- Upon the completion of the test, if you wish, you can take time to evaluate the data, as it will give you a more advanced understanding of engineering concepts.

Variables

What are the Variables of your experiment?

Dependent Variable?

- The Dependent Variable will be whether or not the structure withstood the winds inflicted onto it.

Independent Variable?

- The Independent Variables will the be type of interior (weak/strong).

Control Variable?

- The Controlled Variables will be:
  - The type of paper
  - The hair dryer used in place of wind
  - The distance the wind source moves towards the testing platform with every passing trial (1 in).
  - The levels tested for each trial (low, high).

Testing the Hypothesis - Experiment

DATA - TABLE

(Weak - Arch):	(Strong - Pillars)
Trial 1 (7 Inches): • Low (Stood) • High (Stood)	**Trial 1 (7 Inches):** • Low (Stood) • High (Stood)
Trial 2 (6 Inches): • Low (Stood) • High (Stood)	**Trial 2 (6 Inches):** • Low (Stood) • High (Stood)
Trial 3 (5 Inches): • Low (Stood) • High (Fell)	**Trial 3 (5 Inches):** • Low (Stood) • High (Stood)

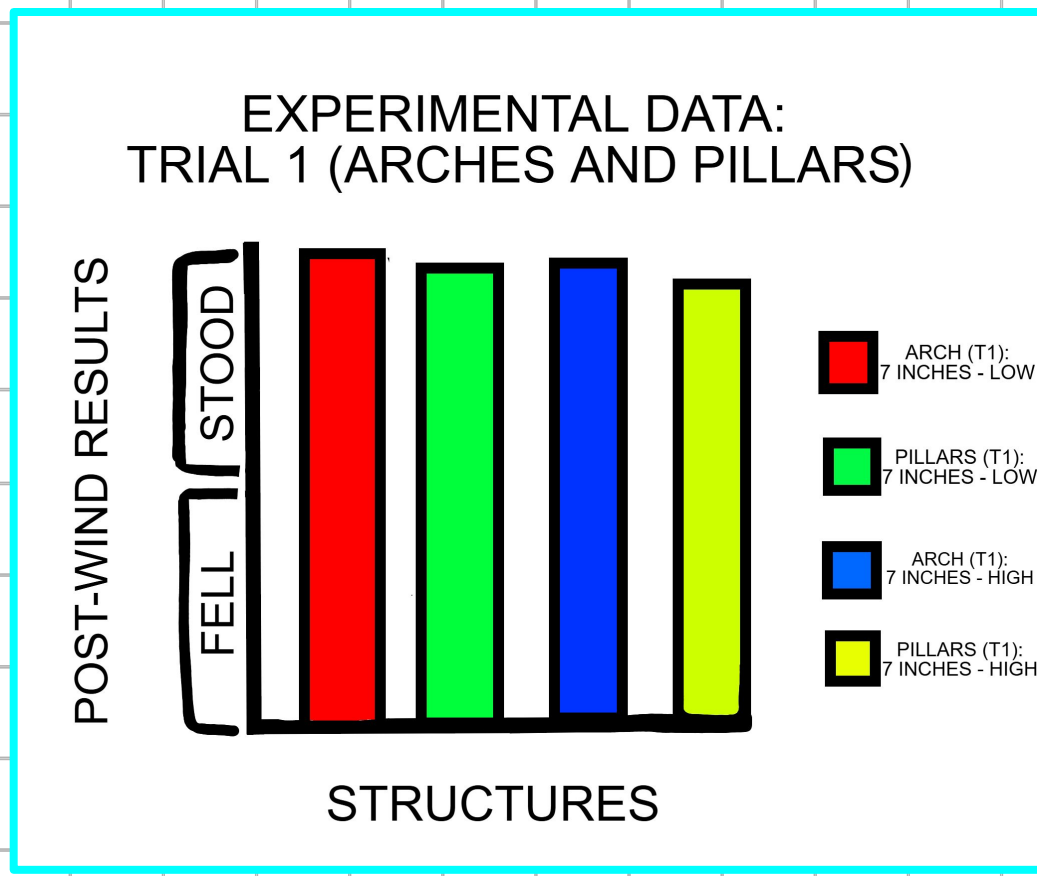
TITLE D

RESULTS:

- In the end, the pillars proved to be structurally sound and resistant as a result of the combined small margins of distance and wind strength.

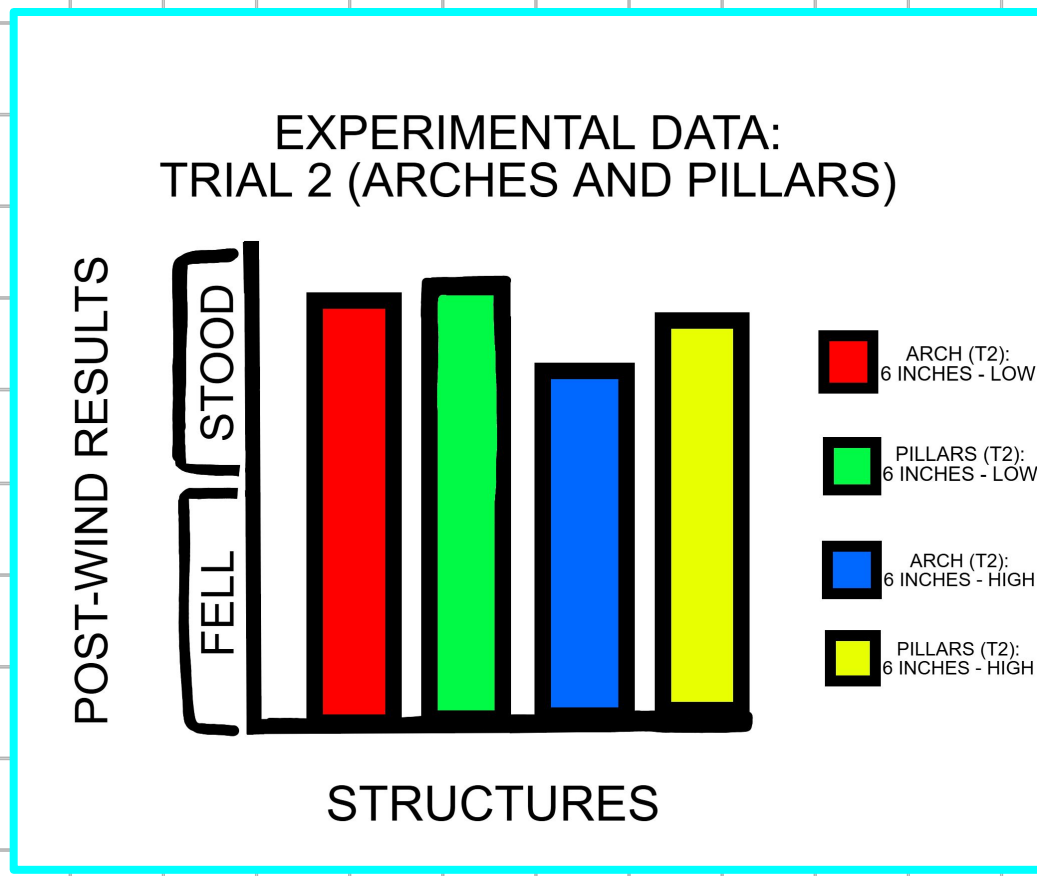
Results - Trial 1

GRAPH



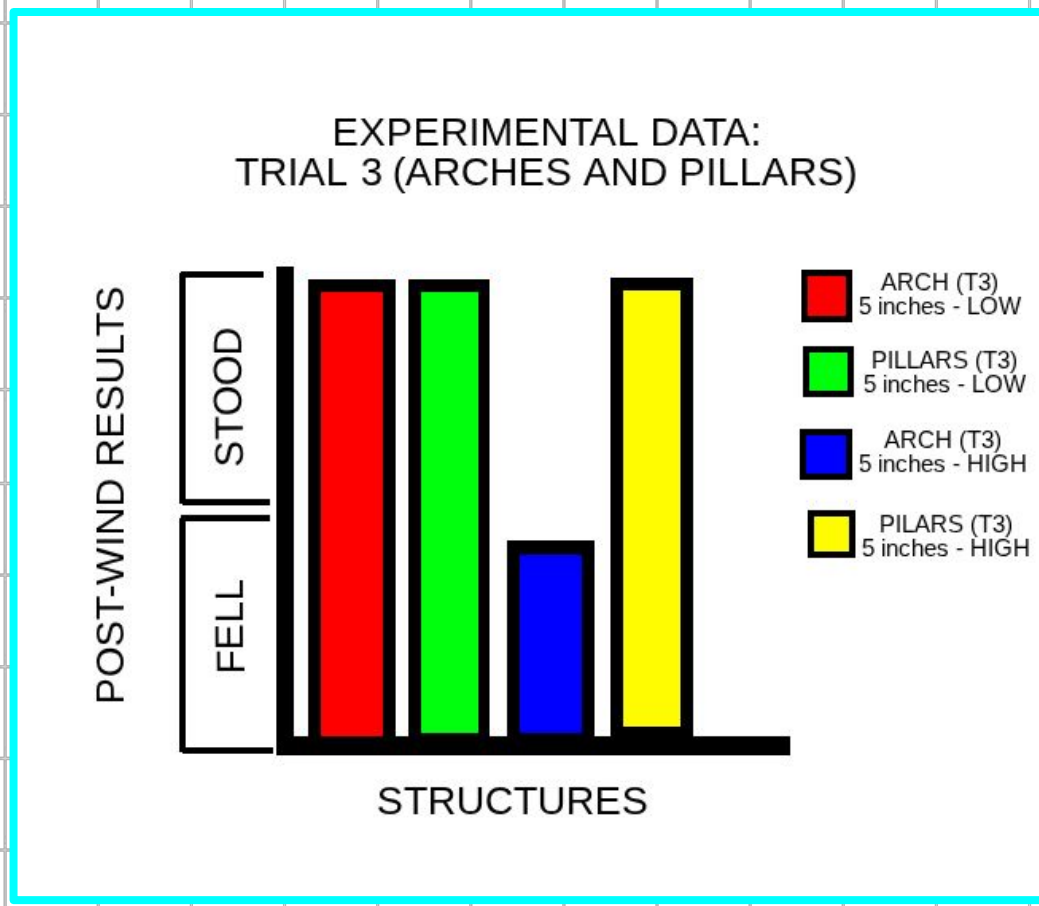
Results - Trial 2

GRAPH



Results - Trial 3

GRAPH



Photographs

Photographs

Photographs

Photographs

Conclusion - Q & A

Based on your results, what was the outcome?

- The experiment concluded with the pillars architecturally triumphing over the arch.

Does your data show that your hypothesis was correct?

- Yes, the data collected throughout the course of testing does prove our hypothesis correct.

What kinds of problems did you have?

- Although there were no major problems during the experiment, making it logically testable was a key obstacle we faced.

What would you do differently next time?

- For the next experiment, we should spend more time thinking it through, meaning that all of the options should be considered when designing an experiment ensured to produce valid data.

Conclusion - CER

Claim-Evidence-Reasoning Paragraph

- In our experiment, we chose the pillars as the strongest interior. Throughout the course of testing, its competitor, the arch, performed relatively well, but eventually fell due to the overwhelming pressure of the recurrent wind. This unexpected occurrence may have been caused by the abundance of airways found in the barred structure, to which the other was lacking this beneficial aspect. Connecting the dots, this would mean that the arch would experience intense forces constantly concentrated on key areas, wearing it down over time, while the pillars would continue to stand with ease. Furthermore, our findings are critical as they offer a deeper insight into the world of engineering. Overall, pillars are the recommended choice in terms of interiors as their gaps allow air to pass through, making them the better option in the case of residential safety.

Rough Draft Report

Resistance Through Internal Structure

INTRODUCTION:

Judges, I encourage you to picture the devastating aftermath perpetrated by dangerous winds. The damage would be costly, undeniably affecting a handful of people. Now, I ask you to shift your thoughts onto a different yet slightly similar topic, one of which reflects on the work that could've been done to prevent an incident such as the image that lies mentally in your mind. What if such an event had never occurred? If only the buildings themselves were given proper thought before construction. Perhaps their interiors could have been more structurally sound. In this experiment, I aim to build on this idea by comparing two models, each of which serve the same purpose in a residential building--internal support.

EXPERIMENTAL INTEREST:

My interest in pursuing an answer to such a topic began a few months ago. When asked to complete a project, I felt the desire to set this one apart from the others finished two years prior. While logically formulating an idea that would fit within the criterion I had made (testable, somewhat renewable, and cost-friendly), it came to me. LEGOs are oftentimes used as structural models in place of actual buildings, so why not do the same with other places of habitation? Even though my discoveries may be seen as small, they allow us to witness how wind affects stability in real-world scenarios. Before the investigation commenced, I hypothesized that the pillars were the stronger counterpart of an interior and would therefore succeed in all three trials.

Rough Draft Report (Continued)

VARIABLES:

There are three/four variables affiliated with this experiment, those of which are:

- **Independent:**
  - The type of interior (arch, pillars).
- **Dependent:**
  - The structure's position after the wind has finished blowing, or, in other words, whether or not the interiors withstood the winds inflicted onto them.
- **Controlled:**
  - The type of paper used for the creation of the model home (of which the interior goes into).
  - The hair dryer used in place of wind.
  - The number of inches the wind source is moved towards the platform with every passing trial (1 in).
  - The levels tested on the buildings (low, high) in each trial.

MATERIALS:

The following materials are required for an efficient conduction of the experiment:

- A4 Paper (8.5 x 11 in)
- Hair Dryer
- Timer (can be used manually or digitally)
- Notebook (optional - used to record data)
- Scotch Magic/Paper Tape
- LEGO Bricks (Classic Medium/Large Creative Box, is available for purchase from online markets such as Amazon, Target, and Walmart).
- Cardboard
- Scissors

Rough Draft Report (Continued)

PROCEDURE:

In order to ensure a successful test, it is highly recommended that the scientist follows the steps below:

- **Prior to Conduction:**
  - Before commencing the experiment, make sure to have the materials ready.
- **Constructing the Home with a Weak Interior:**
  - 1) Stack three pieces of A4 paper together and cut them vertically. This will create the walls of the structure. If necessary, take one more piece of uncut paper for its base.
  - 2) Set out the piece of cardboard and tape the home together, making sure to seal major holes and structural hazards. Upon completing this step, you should have a basic outline of the building, excluding its roof and frontal part.
  - 3) As the interior of this structure in particular is weaker, we will need to make an arch to slide into the middle of the building, or a wall containing such. First, measure the width and height of the structure as they will be your restrictions for how tall or long the arch will be. After this, gather some LEGO bricks. Using said pieces, design an arch-like structure, but keep in mind the boundaries of the design.
  - 4) After construction, slide the newly-made arch into the estimated middle section of the building. Upon placement, make sure that other LEGO pieces are used to cover the space between the arch (walls).
  - 5) To construct the roof, take two uncut pieces of A4 paper, tape them together, and use them to cover the top part of the building. It is recommended that to reduce the presence of major flaws, try to cover any significant holes.

Rough Draft Report (Continued)

PROCEDURE: (CONT.)

- 6) Get out your notebook, if needed, and begin testing.
  - Have your hair dryer out and set it up to the first/low, then the second/high one. Record the time taken to fall, as well as whether it did so or not.
  - With every passing trial, move the device one inch closer to the building.
  - Repeat this step for a total of three times.

- **Constructing the Home with a Strong Interior:**
  - 1) Repeat steps 1 - 2, or, if you wish, use the same structure from the previous test (be delicate when removing the roof).
  - 2) As the interior of this structure in particular is stronger we will need to make pillars to slide into the middle of the building. Once again, measure the height and width of the home. The construction of such architectural feats is simple: take some LEGO bricks and stack them high enough to fit the maximum height. However, depending on the width of the home, you may need to make more.
  - 3) After construction, place the pillars in the middle section of the building, but make sure to make them an even distance from the walls and each other in order to ensure peak resistance.
  - 4) Repeat step 5.
  - 5) Repeat step 6.

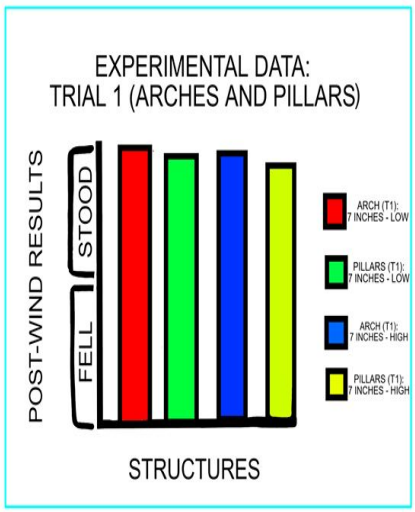
- **After Experimentation (Optional):**
  - Upon the completion of the test, if you wish, you can take time to evaluate the data, as it will give you a more advanced understanding of engineering concepts.

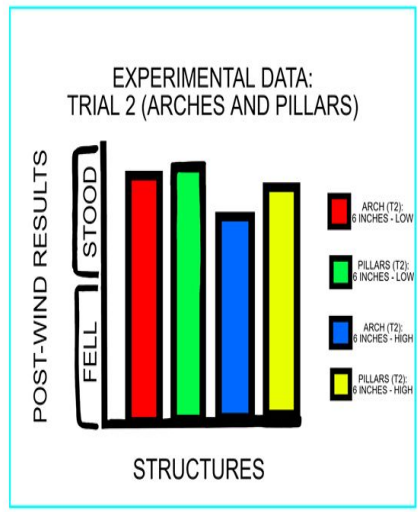
Rough Draft Report (Continued)

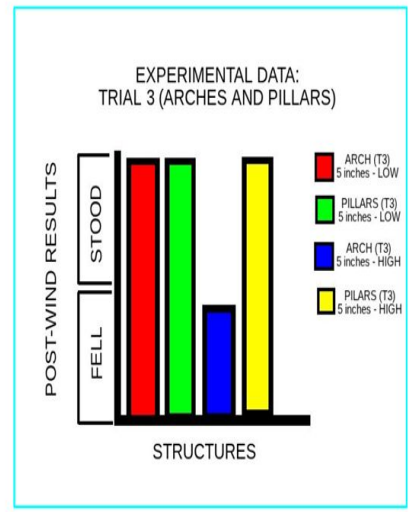
DATA:

Throughout the course of the experiment, sufficient data was collected, to which said results were converted into graph form subsequent to the conclusion of the experiment. These visualizations can be found below:

Statistics: Data Collected Throughout Trials 1 -3







CONCLUSION:

In my experiment, I chose the pillars as the strongest interior. Throughout the course of testing, its competitor, the arch, performed relatively well, but eventually fell due to the overwhelming pressure of the recurrent wind. This unexpected occurrence may have been caused by the abundance of airways found in the barred structure, to which the other was lacking this beneficial aspect. Connecting the dots, this would mean that the arch would experience intense forces constantly concentrated on key areas, wearing it down over time, while the pillars would continue to stand with ease. Furthermore, my findings are critical as they offer a deeper insight into the world of engineering. Overall, pillars are the recommended choice in terms of interiors as their gaps allow air to pass through, ultimately ascending them to the gold spot in the matters of residential safety.

TITLE

Final Draft Report

RESISTANCE THROUGH INTERNAL STRUCTURE

02/05/2026

Final Draft Report

Resistance Through Internal Structure

INTRODUCTION:

Judges, we encourage you to picture the devastating aftermath perpetrated by dangerous winds. The damage would be costly, undeniably affecting a handful of people. Now, I ask you to shift your thoughts onto a different yet slightly similar topic, one of which reflects on the work that could've been done to prevent an incident such as the image that lies mentally in your mind. What if such an event had never occurred? If only the buildings themselves were given proper thought before construction. Perhaps their interiors could have been more structurally sound. In this experiment, we aim to build on this idea by comparing two models, each of which serve the same purpose in a residential building--internal support.

EXPERIMENTAL INTEREST:

Our interest in pursuing an answer to such a topic began a few months ago. When asked to complete a project, we felt the desire to set this one apart from the others finished two years prior. While logically formulating an idea that would fit within the criterion we had made (testable, somewhat renewable, and cost-friendly), it came to us. LEGOs are oftentimes used as structural models in place of actual buildings, so why not do the same with other places of habitation? Even though our discoveries may be seen as small, they allow us to witness how wind affects stability in real-world scenarios. Before the investigation commenced, we hypothesized that the pillars were the stronger counterpart of an interior and would therefore succeed in all three trials.

Final Draft Report (Continued)

VARIABLES:

There are three variables affiliated with this experiment, those of which are:

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MATERIALS:

The following materials are required for an efficient conduction of the experiment:

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- Cardboard
- Scissors

Final Draft Report (Continued)

PROCEDURE:

In order to ensure a successful test, it is highly recommended that the scientist follows the steps below:

- **Prior to Conduction:**
  - Before commencing the experiment, make sure to have the materials ready.
- **Constructing the Home with a Weak Interior:**
  - 1) Stack two pieces of A4 paper together and cut them vertically. This will create the walls of the structure. If necessary, take one more piece of uncut paper for its base.
  - 2) Set out the piece of cardboard and tape the home together, making sure to seal major holes and structural hazards. Upon completing this step, you should have a basic outline of the building, excluding its roof and frontal part.
  - 3) As the interior of this structure in particular is weaker, we will need to make an arch to slide into the middle of the building, or a wall containing such. First, measure the width and height of the structure as they will be your restrictions for how tall or long the arch will be. After this, gather some LEGO bricks. Using said pieces, design an arch-like structure, but keep in mind the boundaries of the design.
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  - 5) To construct the roof, take two uncut pieces of A4 paper, tape them together, and use them to cover the top part of the building. It is recommended that to reduce the presence of major flaws, try to cover any significant holes.

Final Draft Report (Continued)

- 6) Get out your notebook, if needed, and begin testing.
    - Have your hair dryer out and set it up to the first/low, then the second/high one. Record the time taken to fall, as well as whether it did so or not.
    - With every passing trial, move the device one inch closer to the building.
    - Repeat this step for a total of three times.

- **Constructing the Home with a Strong Interior:**
    - 1) Repeat steps 1 - 2, or, if you wish, use the same structure from the previous test (be delicate when removing the roof).
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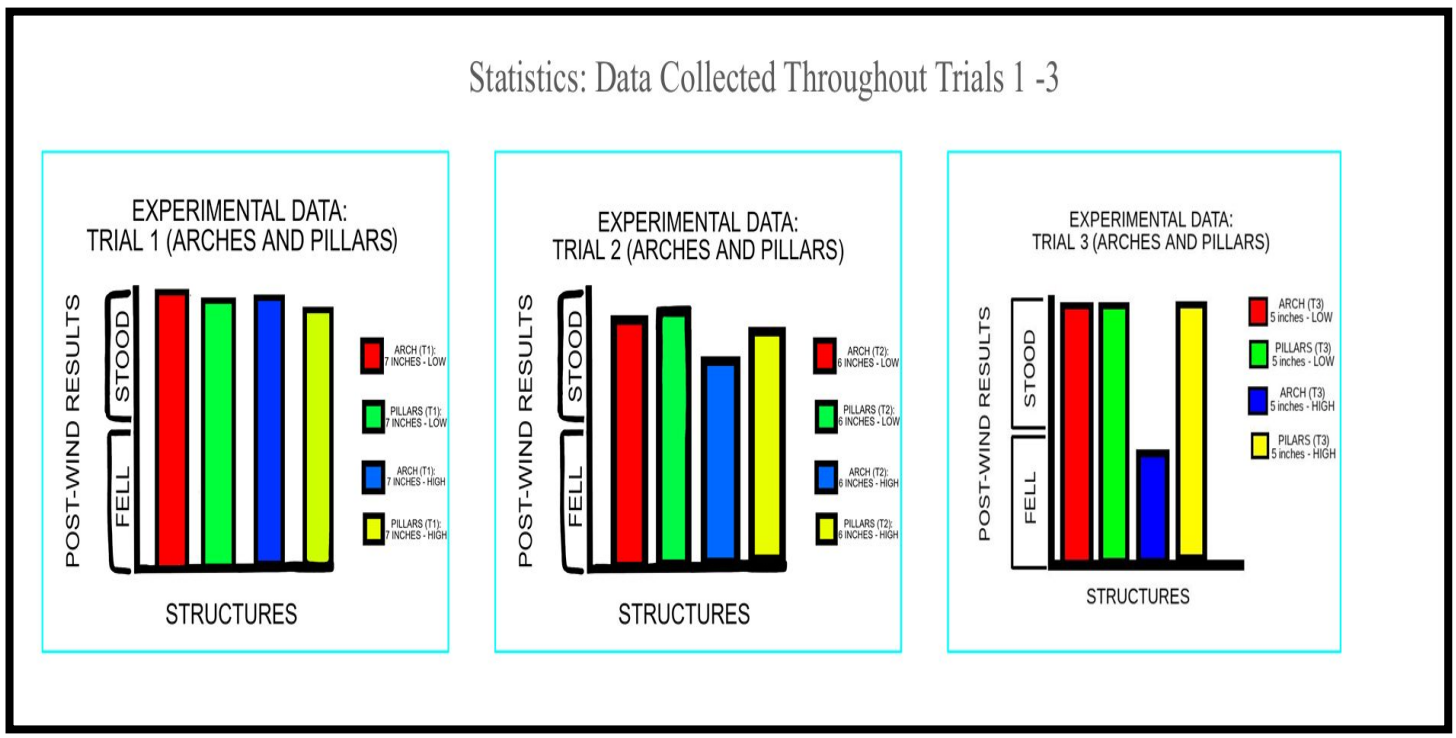
    - 4) Repeat step 5.
    - 5) Repeat step 6.

- **After Experimentation (Optional):**
    - Upon the completion of the test, if you wish, you can take time to evaluate the data, as it will give you a more advanced understanding of engineering concepts.

Final Draft Report (Continued)

DATA:

Throughout the course of the experiment, sufficient data was collected, to which said results were converted into graph form subsequent to the conclusion of the experiment. These visualizations can be found below:



ANALYSIS:

The data shown above supports the stated hypothesis clearly, as the pillars proved to be at a higher level of structural integrity when compared to the arch. When prolonged vision of said charts come into play, it can be further seen both were nearly identical in strength, while the small margins of wind strength and distance were the game-changing factors. These components helped to produce reliable results, helping to increase the validity of the experiment. That being said, there were a few aspects that could have been worked on a step further, with a primary concern being logical representation of data. Simply, the decision to design the graph in this way was due to the limited measurable aspects (stood/fell), as time did not play a huge role. Even with such flaws, this experiment generated results that still wait to be deemed useful.

Final Draft Report (Continued)

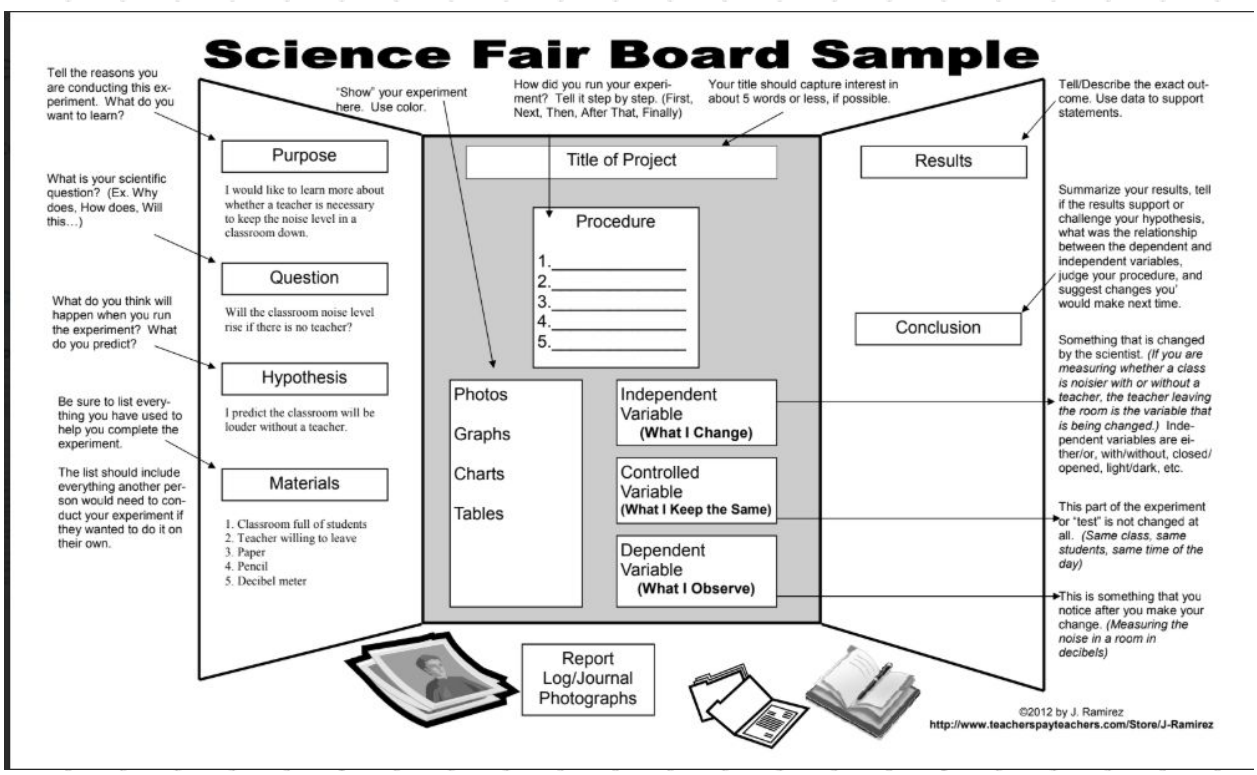
CONCLUSION:

In our experiment, we chose the pillars as the strongest interior. Throughout the course of testing, its competitor, the arch, performed relatively well, but eventually fell due to the overwhelming pressure of the recurrent wind. This unexpected occurrence may have been caused by the abundance of airways found in the barred structure, to which the other was lacking this beneficial aspect. Connecting the dots, this would mean that the arch would experience intense forces constantly concentrated on key areas, wearing it down over time, while the pillars would continue to stand with ease. Furthermore, our findings are critical as they offer a deeper insight into the world of engineering. Overall, pillars are the recommended choice in terms of interiors as their gaps allow air to pass through, ultimately ascending them to the gold spot in the matters of residential safety.

END OF REPORT

Final Project - Display Board Report

Make a Trifold Poster Board

Have it include all the components you have included in this Binder so far.

Your Finished Poster Board should look something like this: