

Training 010: Stable Structures

Developed by Allie Ososkie, Director of Detective Training

Biblical Integration

“Therefore, everyone who hears these words of mine and puts them into practice is like a wise man who built his house upon the rock.” Matthew 7:24

Objective

Using the critical superhero strengths of perseverance and patience, design and construct a structure with a foundation strong enough to support increasing amounts of weight.

Vocabulary

- **Structural engineer:** an engineer who designs buildings, roads, bridges, towers and other structures which support or resist weight loads
- **Force:** a push or pull
- **Gravity:** an invisible force that pulls objects to the center of the Earth
- **Compression:** the force of squeezing or pressing something together
- **Tension:** the force of stretching something, or the state of being stretched
- **Foundation:** the lowest level of a building or structure

Materials

- A building toy such as Magna-Tiles, Legos, or wooden blocks
- (Alternative: Popsicle sticks and masking tape)
- Pencil
- Data Sheet
- Ruler or yard stick

Lesson: Stable Structures

A **structural engineer** designs skyscrapers, as well as other buildings and roads. A building must be able to withstand three natural **forces**.

- **Gravity** is an invisible force that pulls objects toward the center of the Earth.
- **Compression** is the force which squeezes or presses something together.
- **Tension** is the force of stretching an object.

When these three forces are balanced, a building can reach impressive heights—as evidenced by the world’s record-breaking skyscrapers—while retaining strength and stability. But the most impressive part of these structures is the portion we can’t even see: the **foundation**.

A structure’s foundation spreads the weight from these forces evenly along the structure’s walls. This spreading of weight is crucial for the building to stay intact. You could say that a foundation must persevere through the weight of the forces!

When superheroes are called to save the day, they too face great oppositional forces. The hero must be patient and persevere.

Being **patient** means you can tolerate being delayed without getting upset or angry. **Perseverance** means you will keep going, even when you have a hard time meeting your goal.

In one of Jesus’ parables, he emphasized the importance of building your life on the strong foundation of God’s Word. Just as a building’s foundation gives strength to weather storms, weight, and tension, only a relationship with God can help us weather life’s storms and weight.

Today, use the materials listed above to build a strong structure which can withstand weight.

Challenge Parameters

Your structure must stand at least 6 inches tall and hold the weight of a small picture book. Your goal is to engineer the strongest structure possible, paying particular attention to the foundation. If you are successful, your structure should be able to withstand additional weight.

Procedure

#1. Begin by designing the shape of your foundation. On the **data sheet** provided, circle the shape you intend to use. Remember that the forces of gravity, compression, and

tension must be balanced; choose a shape that will evenly spread the forces along the walls.

#2. Next, draw your structure. Think about how wide and tall it should be. This will be your **first draft**.

#3. Gather your building materials and construct! Make sure it's high enough to meet the challenge parameters. If you encounter setbacks, use the superhero qualities of perseverance and patience. Answer question 3 on your data sheet.

#4. If your first structure met the challenge parameters, skip to #6. If it did not, go to step #5.

#5. Engineers often have to craft a second draft of their design if their first one fails. A failed design does not make the engineer a failure. It only means the structure needs to be refined. Look at your first draft drawing. What could be improved? Answer question 4 on the data sheet.

#6. Even if your structure met the challenge parameters, an engineer's first draft is rarely the final one. What can you add to make your tower stronger? Add extra weight (such as more books or canned food) and assess the results. Complete question 4 on the data sheet.

#7. After drawing your second draft, construct the new design. Test it by adding more weight. Answer question 5 on the data sheet.

#8. If you would like to redesign the structure again, use a fresh piece of paper. Engineers often go through many drafts before their project is complete. Answer question 6 on the data sheet.

#9. Read Matthew 7:24-27. Answer question 7 on the data sheet.

Data Sheet

1) **Hypothesis:** Which shape will you choose for the foundation of the tower? Circle your answer.

Square

Circle

Triangle

H shape

Hexagon

2) Draw the first draft for your structure here.

3) Did the structure from your first draft meet the challenge parameters? YES or NO

4) Draw your second draft here.

5) **Analysis:** Was your hypothesis correct? YES OR NO? Which shape worked best to hold the most weight?

6) What part of the structure was the most important?

- 7) Read the Bible verse. As we make decisions throughout our day, we choose to build our foundation on Jesus or on worldly things. How can you build the foundation of your life on Jesus?

Conclusion

Now that you know the foundation is the most important part of the structure, it's not hard to imagine that the material a foundation is built on is also important.

If a structure is built on sand or gravel, extra weight might make it slide or crumble. Similarly, if we do not build the foundation of our lives on Jesus, it is harder for us to withstand the weight of the world. Make a plan for what you can do each day to build your foundation on Jesus.

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