Kiewit Build Like a Girl: Building Bridges

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girl scouts of colorado

Discover the exciting world of construction and engineering with Girl Scouts of Colorado's Build Like a Girl program, powered by Kiewit. In partnership with one of North America's leading engineering and construction organizations, this unique on-demand experience brings hands-on activities led by Kiewit experts through engaging video tutorials. Girl Scouts will explore concrete crafting, structural design with spaghetti towers, and/or bridge construction to learn critical engineering concepts—all while gaining insight into careers in this dynamic field. Upon completion of one activity, Girl Scouts will earn their exclusive Build Like a Girl patch, but Girl Scouts may complete as many of the Build Like a Girl Activities as they would like.

Introduction

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When engineers design buildings or bridges, they must think about both strength, weight and stability. These structures need to support their own weight as well as additional forces from things like gravity, wind, or earthquakes, all without collapsing. The term "critical load" refers to the amount of weight or force that causes a structure to fail.

The truss bridge, built using triangular shapes, is known for its efficient use of materials while maintaining structural integrity. This activity demonstrates the steps to construct a truss bridge using popsicle sticks.

Materials Per Team

- Popsicle sticks
- Hot glue gun
- Glue sticks

Materials For Load Testing:

- 1 mask
- Canned food or other weights
- Two sturdy items (chairs/boxes/stack of books) of the same height

Watch this video explaining the activity: https://vimeo.com/1031298656

Relevant Terminology

Relevant Terminology

- Truss Bridge: A bridge design using triangular shapes to provide structural stability.
- Overlap Lengths: Additional material used at joints to strengthen connections.
- Strength: The ability of a structure to support its own weight and additional forces without collapsing.
- Weight: The force exerted by the mass of the structure and any additional loads.
- Critical Load: The maximum amount of weight or force a structure can withstand before failing or collapsing.
- Efficient Structures: Designs that are both strong and lightweight, optimizing material use.
- Structural Integrity: The ability of a structure to withstand its intended load without breaking or deforming.
- Civil Engineers: Engineers who solve problems related to pollution, traffic, water, energy, and urban planning.
- Structural Engineers: A specialized type of civil engineer who focuses on designing buildings and structures that can support their own weight and external forces.
- Dead Load: The constant weight of a structure itself, including all materials used in its construction.
- Live Load: The variable weight a structure supports, such as people, furniture, and equipment, which changes over time.

Engineering Connections

Engineering Connections:

Civil engineers help solve problems related to pollution, traffic, clean water, energy needs, city growth, and community planning. Structural engineers are a special type of civil engineer. They design strong buildings that can hold their own weight and the weight of everything inside them. They also make sure buildings can handle wind, weather, temperature changes, and even earthquakes.

For example, the Royal Gorge Bridge in Colorado is one of the highest suspension bridges in the world. It spans the Royal Gorge over the Arkansas River at an elevation of approximately 956 feet above the river. Engineers who design structures like these have to think about the building's "critical load"—the amount of weight that would cause it to collapse. Buildings that are both strong and lightweight are called "efficient." Engineers designing structures in cold climates also have to think about the weight of snow on the roof. They have to make sure the building can hold up even under heavy snow, like during a blizzard!

Science Connections

Science Connections:

When engineers design strong structures, they think about the properties of the materials they use. Is the material strong? Tough? Lightweight? Elastic? These words might sound similar, but they mean different things to engineers.

For example:

- Strong materials don't bend easily.
- Tough materials are hard to break.

So, a material might be strong but not tough, meaning it could break suddenly. Or it could be tough but not strong, meaning it might bend under a heavy load but won't break. Another property is elasticity—like a rubber band, elastic materials can stretch or flex under pressure and then return to their original shape once the load is removed. Materials that aren't elastic might not bend much but could break suddenly.

Engineers measure all of these properties to find the best combination of strength, toughness, and elasticity for each project.

Instructions

1. **Prepare the Side Frames:**
   - Create two long pieces for the sides of the bridge frame. These will be the primary supports for your structure.
   - Each side frame should be approximately three popsicle sticks in length.
   - Consider overlapping the sticks slightly at joints to add strength.
   - Make two identical side frames.
2. **Build the Top Rail:**
   - Construct the top rail for each side frame. Each rail should be about two popsicle sticks long.
   - Ensure that one top rail is made for each side of the bridge.
3. **Assemble the Side Frames:**
   - Attach the top and bottom rails to one long side frame piece.
   - Use additional popsicle sticks to connect these rails, forming a triangle shape. This design enhances the structure's strength and stability.
   - Repeat the process for the second side frame.
4. **Dry and Reinforce:**
   - Allow all glued components to dry completely before proceeding.
   - Connect the two side frames using horizontal popsicle sticks. These will act as braces to hold the bridge together.
   - Add horizontal braces to the top and bottom of the bridge for extra strength.
5. **Test Your Bridge:**
   - Once the bridge is fully assembled, test its strength by adding weight incrementally.
   - Experiment with different weights to determine the bridge’s maximum load capacity.

Discussion

Activity Variations

- Turn it into a Competition: Track the top designs of the day on a whiteboard. If possible, offer prizes for the best structures.
- Add a Challenge: Set a minimum height, length or material requirement for the structures.

Discussion Points

1. What shapes were used in the design, and why are triangles effective in providing strength?
2. How does overlapping popsicle sticks at joints improve the bridge's load-bearing capacity?
3. Where do you think your structure might break? How can you make those weak spots stronger?
4. How could the design be modified to hold even more weight?

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Congratulations! You finished the Kiewit Build Like a Girl patch program. We hope you take this information you learned about engineering and share it with your friends and family.

Click here to request your FREE Kiewit Build Like a Girl patch!

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