

# BYF Session Curriculum

## Session 3: Bridge


### Materials:

- Paper plans for bridges
- Small popsicle sticks
- Half paint stirring rods
- Crafty glue
- Scissors
- Something for bridge to hold



### Objectives:

- Students will construct a bridge that shows structural integrity.
- Students will exhibit engineering skills by building the tallest tower they can

<p><b>Greeting Activity - 10min</b></p> 	<p>Slide 2 Huckle Buckle Beanstalk</p> <p>Choose an item to hide around the room. The object of the game is to be the first to find the hidden object without showing the other players where that object is hidden.</p> <p>Have all students put their heads down and close their eyes so they don't see where the item is hidden. The person hiding the item – the hider – can throw the other students off by making noises in different corners of the room. The item must be hidden where it can be seen without moving any objects around.</p> <p>When the hider says go, the rest of the students can get out of their seats and look for the item.</p> <p>When a student sees the item, they quietly sneak back to their seat, sit down, and say “Huckle Buckle Beanstalk!”</p> <p>They now get to hide the item in the next round.</p> <p>After about half of the students have found the item – turn it into a hot and cold game. The students in their seats can give clues to those still searching.</p>
<p><b>Objective Preview - 10min</b></p>	<p>Slides 3-6 Life Skill:</p> <ul style="list-style-type: none"><li>• Problem Solving<ul style="list-style-type: none"><li>○ Working through problems until they are solved</li><li>○ <b>Today you are going to be presented with a series of problems and it will be your job to find a solution. Practicing problem solving will mean that you stick with the problem until you find a solution.</b></li></ul></li></ul>



- Critical Thinking
  - To evaluate the solutions you are going to try so that you can choose the best one
  - **Even as we work to solve problems, we can't just take the first solution that comes along. Critical thinking means that we are going to try and choose the BEST solution to our problems.**

Construction Skill:

- Structural integrity
  - **We are going to build two different kinds of bridges with two different materials today and evaluate their strengths and weaknesses. This means that we will need to experiment with how much weight our structures can hold. That is structural integrity.**
- Engineering
  - **Engineering is using what we know to solve new problems in creative ways. There is a lot of engineering in construction! Everything from how much weight a crane can hold, roof shapes for houses, how tall a skyscraper can be, and how long a bridge is safe. We are going to use a lot of those skills in our problem solving today.**
- Vocabulary
  - Tension: stretches the beam
  - Compression: squishes the beam together
  - Deck of a bridge
    - The flat part of a bridge the cars drive on and people walk on
  - Pier of a bridge
    - The pieces of land on which a bridge rests

**Pre-Teach - 10 min**



Materials/Tool Handling:

- We're going to build beam bridges and gusset bridges

Safety Expectation: (Slide 7)

- Everyone is responsible for their own part of the project.
  - **Project managers be sure you communicate well with your group members to get an accurate vision for your project. Remember the game we played in session 1? Use your communication skills today!**
  - **Also make sure that we are listening to our group members and validating their ideas. Use critical thinking – someone else in your group might have a better solution than you do to the problems your group will face.**

**Focus Activity - 1hour**

Distribute paper building materials and scissors to students



Ask a student volunteer to come draw a bridge on the board.

- Continue to have student volunteers draw bridges on the board until students have eliminated the variety they can recognize.

**There are lots of different kinds of bridges that people build for different reasons.**

Ask students to list different materials they have seen bridges made out of.

- Probable answers: wood and metal

**Civil engineers choose materials to go with their bridge designs for a variety of different reasons. Building a bridge is like a puzzle. It's important to choose the right design with the right material to make the most effective bridge possible.**


The Beam Bridge (Slide 8)


**A beam bridge is the most simple of bridges: Two vertical entities with one horizontal beam across the top.**

- Turn and Talk: **What do you think the advantages and disadvantages might be of a beam bridge?**
  - Share what groups talked about.
- Tension and Compression
  - Tension: stretches the beam
  - Compression: squishes the beam together
  - Tension and compression are what break the beam if they are too much.
  - **How do you see tension and compression at work in a beam bridge?**
- Try it out: Instruct student groups to build a beam bridge with their paper pieces using any stable surfaces as the vertical pieces (stack of books, desks pulled apart, etc.)
  - Fold and glue into a T shape.
  - Glue two T shapes together to make one I beam.
  - Line I beams up horizontally to make the deck of the bridge.
- How many **quarters** can your beam bridge hold?
- Now build the beam bridge out of popsicle sticks
  - First just lay popsicle sticks side by side across the piers.
    - How many quarters can it hold?
  - Glue the popsicle sticks together to form an I for the beam.
  - Line the beams up horizontally to make the deck of the bridge.
- How many quarters can the wooden beam bridge hold?
  - **So how do we choose materials with which we build our bridges?**

The Warren Truss Bridge (Slide 9)

- **The Warren Truss bridge uses triangles to fight the tension and compression in the beam bridge.**
- **When you push down on top of the triangle, all the weight gets divided up instead of being all in one place. It is the difference**

	<p><b>between carrying a heavy log by yourself vs with five other friends.</b></p> <ul style="list-style-type: none"> <li>• Have students build the popsicle stick model in their groups using the provided plans.</li> <li>• <b>How many quarters can this one hold?</b></li> <li>• <b>Could it hold more or less weight if it was made from paper?</b></li> </ul> <p><b>So what are some important things to think about when building and designing a bridge?</b></p>
<p><b>Job Exploration - 20min</b></p> 	<p>Slides 11-19</p> <p>Awareness of careers in commercial construction:</p> <ul style="list-style-type: none"> <li>• <b>Residential</b></li> <li>• <b>Civil</b></li> <li>• <b>Commercial construction is the branch of construction that builds big buildings like you see in cities. This often includes large bridges and skyscraper towers. Building these big projects takes a lot of specialized work.</b> <ul style="list-style-type: none"> <li>○ Welder           <ul style="list-style-type: none"> <li>▪ <b>Welders use heat to work with metal and strengthen its connections. This particular career involves lots of sparks!</b></li> </ul> </li> <li>○ Ironworker           <ul style="list-style-type: none"> <li>▪ <b>Ironworkers place and install iron or steel girders, columns and other construction materials to form the infrastructure all around us. Ironworkers must always be paying attention to details to check vertical and horizontal alignment. This often means balancing from the top of new skyscrapers!</b></li> </ul> </li> <li>○ Tower crane operator           <ul style="list-style-type: none"> <li>▪ <b>These craft professionals use their knowledge of load calculations and crane operations to hoist heavy materials off the ground and to significant heights.</b></li> </ul> </li> <li>○ Civil engineer           <ul style="list-style-type: none"> <li>▪ <b>Civil engineers design, construct, supervise, operate and maintain large construction projects and systems including roads, buildings, airports, tunnels, dams, bridges and systems for water supply and sewage treatment.</b></li> </ul> </li> </ul> <p><b>Now, let's hear from a real industry professional who can tell us about their career in residential construction!</b></p> <ul style="list-style-type: none"> <li>○ Introduce a community partner if applicable.</li> <li>○ If no community partner can attend introduce the video.</li> <li>• Show slide with general salary information on it.</li> </ul> </li></ul>

	<ul style="list-style-type: none"><li>• Open the floor for students to ask their own questions of the industry professional.<ul style="list-style-type: none"><li>○ Note: If no industry professional is available ask students what their questions would be and make a list. Send this list to your Coordinator and they will try to get those questions answered.</li></ul></li></ul> <p>Videos: Inside the hard hat Welder: <a href="https://youtu.be/BOzERXpnP00">https://youtu.be/BOzERXpnP00</a> Inside the hard hat Ironworker: <a href="https://youtu.be/ELeycZxidWY">https://youtu.be/ELeycZxidWY</a> Inside the hard hat Tower Crane Operator: <a href="https://youtu.be/fDfsMZhMg4U">https://youtu.be/fDfsMZhMg4U</a></p> <p>Questions for industry professionals:</p> <ul style="list-style-type: none"><li>• What soft skills are important in your job?</li><li>• What does your “office” look like? Work Environment?</li><li>• What education did you need to get this job?</li><li>• What is your favorite part of your job?</li><li>• What is some good advice to someone who wants to go into your field?</li></ul>
<p><b>Wrap-Up - 10 min</b></p> 	<p>Slide 20</p> <p>Students answer this question as an exit ticket: <a href="https://forms.gle/td3U54QoQzh2SrUB9">https://forms.gle/td3U54QoQzh2SrUB9</a></p>