Lesson 6: Workplace Safety

Arizona Science Standards

7.P2U1.3 – Plan and carry out an investigation that can support an evidence-based explanation of how objects on Earth are affected by gravitational forces.

Crosscutting Concepts: Patterns, Cause and Effect, Scale, Proportion and Quantity, Systems and Sy stem Models, Energy and Matter, Structures and Function, Stability and Change.

Background Information : There is gravitational force between two masses, but it is very small except when one of both objects have large mass. On **Earth**, gravity results in everything being pulled down towards the center of the Earth. We call this downward attraction the ***weight*** of an object. The object pulls the Earth as much as the Earth pull the object, but because the Earth's mass is **much** bigger, we observe the resulting motion of the object, not of Earth.

Hello, welcome to Engineers of the Future remote learning. My name is Scott Tollefson, and I am an engineer with Valley Metro. I am going to be your mentor for today's lesson.

Our program is going to teach you about science, technology, engineering, and math. It is called **STEM learning**.

We will get to the fun project; it is a **BRIDGE BUILDING BONANZA.** We will learn more about **BRIDGES, FORCES, LOADS, AND CIVIL ENGINEERING** in just a few minutes, but first I want to tell you more about **WORKPLACE SAFETY.**

Why is Workplace Safety Important?

Definition of safety is: "Freedom from the occurrence or risk of injury, danger or loss. To avert and not cause injury, prevent injury and avert danger."

Health and safety are the key factor for all the industries to promote the wellness of both employees and employers.

Workplace safety refers to the working environment at a company and encompasses all factors that impact:

- Environmental hazards
- Unsafe working conditions or processes
- Drug and alcohol abuse
- Workplace violence.

Workplace safety is very important for our engineers, construction teams, craftsman, and other workers helping to build light rail here in Phoenix.
Let us take a closer look at some of the criteria not only for light rail but other industries to.

- **Injury Reduction** – it is important to have a safety and wellness place to keep your employees safe.
- **Company Losses** – It could mean property damage, slowed production, loss of moral legal and medical expenses

- **Worker Productivity Increases** – It is key to finding a balance between **productivity** and **safety** is with the enforcement of **safety** culture.
- **Service or Product Quality Improves** - **Safety** should be integrated into process management. **Safety** is good for business. Plus, protecting workers is the right thing to do.
- **Reputation/Company Image Improves** - **Safety** is of the utmost importance to protect employees and the business. As **safety** increases, the **company's reputation** improves. When a **company** puts its employees first, it shows that they care about that person's well-being.
- **Production loss/worker distraction** - A **safe** and healthy workplace not only protects workers from injury and illness, but it can also lower injury/illness costs, it reduces absenteeism and turnover, increase **productivity** and quality, and raise employee morale.
- **Training costs/replacement worker** - The **average training cost** per **employee** is more than $1,200. Money is not the only thing you will spend on **training a new employee**. You also need to put in your time.
- **Safety Rules** - They address behaviors and work practices that can lead to accidents and injuries. Each Employees should become familiar with and follow General and Departmental **Safety Rules.**

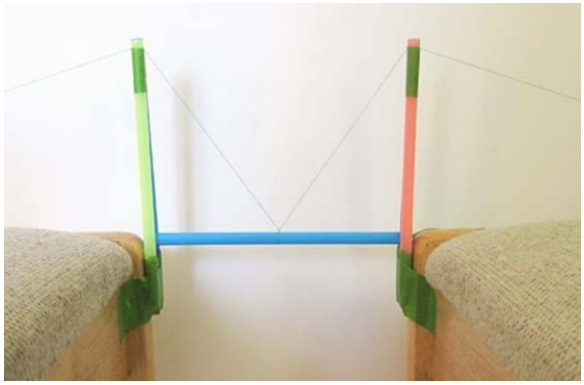
Before we go here is just a brief recap of the 5 core elements of successful safety programs”

- SAFETY CULTURE
- EMPLOYEE TRAINING AND EMPOWERMENT
- HAZARD IDENTIFICATION AND CONTROL SYSTEMS
- FOCUS ON COMPLIANCE
- CONTINUOUS IMPROVEMENT

- **LEADERSHIP** AND ORGANIZATIONAL BUY-IN
- THE SAFETY MANAGER ROLE

Now, it is time to begin our **BRIDGE BUILDING BONANZA**. We are going to learn about key concepts such as: **BRIDGES, FORCES, LOADS and CIVIL ENGINEERING.**

Credit: Teisha Rowland, PhD, Science Buddies



- Suspension bridges, with their tall towers, long spans, and gracefully curving cables, are beautiful examples of the work of civil engineers.
- How do the cables and towers carry the load that is on the bridge, which includes you and the car you are in when you cross the bridge? Can a suspension bridge carry a greater load than a simple beam bridge?
- You can try to answer these questions in this science activity!

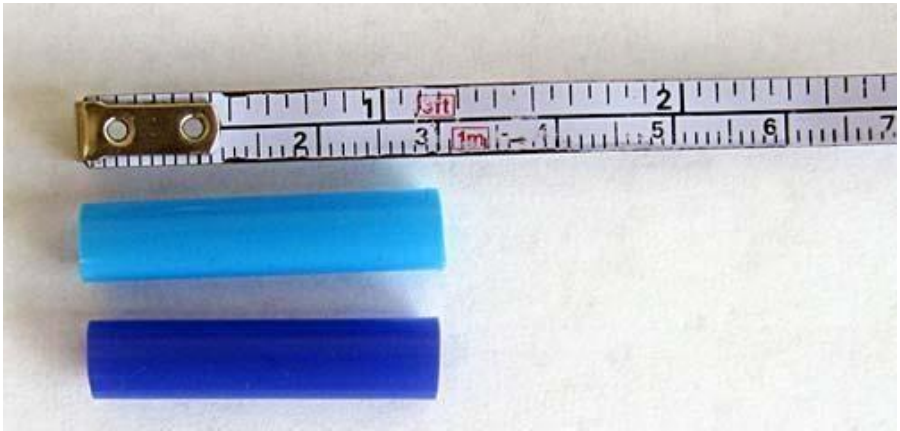
These are the Materials:

- Drinking straws (7) • Paper cup, at least 8-oz.
- Masking tape or painter's tape
- Thread
- Scissors
- Paper clips (4). At least two should be large ones.

Procedure

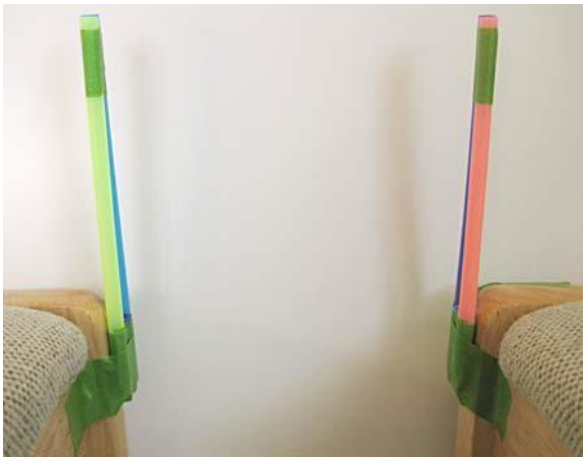
1. If your straws are the flexible type, cut the flexible part off (so that you are left with a long, straight, non-bendable straw piece). Cut a total of six straws this way. Make sure they are all the same length; trim some if necessary.

2. Cut a seventh straw to make two short pieces of straw, each about one inch long. Make sure they are both the same length.



3. Tape two long straws on either side of one of the short pieces of straw. Do this at one end of the two long straws. (If you are using flexible straws, the "long" straws will be the ones you just cut the flexible parts off. If you are using non-flexible straws, use uncut straws for the long straws.)
4. Then, tape the long straws together at the other end. You should end up with an elongated triangle shape. This is a tower for your suspension bridge.

5. Repeat this process with two long new straws and the other short straw piece to build a second tower.
6. Tape one tower to the edge of a desk, table, or chair. The short straw piece should be at the bottom of the tower (and the end without a short piece should be at the top). Tape the second tower to a second piece of furniture at the same height. Position the towers far enough apart so that you could fit a straw between them.



7. Place a long straw between the towers so that its ends rest on the short pieces. This straw is the bridge deck. You now have a simple beam bridge.

Can you see how this is a beam bridge? How do you think it would be different from a suspension bridge?

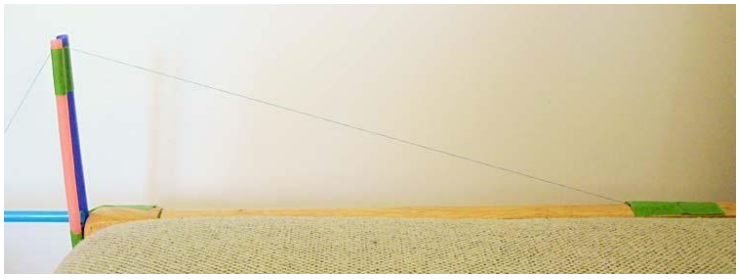
8. Make a load tester for your bridge by unbending a large paperclip into a V shape. Poke the ends of the paperclip into opposite sides of a paper cup, just below the thick rim at the top.

9. Use a second large paperclip to hang the load tester over the bridge deck. Do this by attaching the two large paperclips together, and then sliding the new one around the bridge deck straw. Slide the cup to the middle of the straw.

10. Add coins (all the same type) one at a time into the load tester.

How many coins does the cup hold before the bridge fails? How does the bridge fail?

11. Now start changing the beam bridge into a suspension bridge. Cut a piece of thread that is about three feet long. Tie the center of the piece of thread (which is acting as your bridge cable) around the middle of a new bridge deck straw (a new, long straw). Place the straw between the towers as before.
12. Pass each end of the thread (i.e., cable) over a tower and down the other side. To anchor the suspension bridge, tie each end of the cable around a paperclip. Slide the paperclips away from the towers until the cable pulls tight. Then tape the paperclips firmly to the furniture.



13. Attach the load tester as you did before. Again, add coins (all the same type as before) to the cup, one at a time.

How many coins does the cup hold before the bridge fails this time? How does the bridge fail?

14. Overall, which bridge design is stronger? Is it a little stronger, or a lot stronger?

Why do you think you got the results that you did?

What Happened?

- Did the suspension bridge hold a greater number of coins compared to the beam bridge?
- In this activity you should have seen that the suspension bridge was able to hold more coins.
- When the beam bridge failed, this was likely because the bridge deck straw bent downward as more coins were added until it bent so much that it slipped down between the two towers. As coins were added to the suspension bridge, the cable (i.e., thread) was under tension and reinforced

the bridge deck straw, pulling it upwards (while compressing the towers) and allowing the bridge to hold more coins.

- When the suspension bridge eventually failed, the bridge deck straw likely similarly bent into a V-shape, but because it was attached by the thread, the straw could not fall and instead the cup may have slipped off of the straw.

Thank for watching today's lesson.

- Thanks for watching today todays lesson.
- We will have more mentor lessons on the Engineers of the Future YouTube Channel.
- Bye for now.