60 minutes

Grades 3–5, 6–8

Human Suspension Bridge

Create a bridge with your body.

Instructions

Students create a suspension bridge with their bodies and experience the forces that make a suspension bridge work.

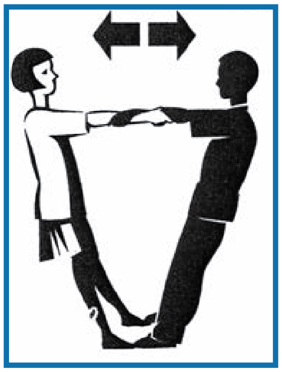
1 Introduce the activity by showing different examples of suspension bridges, if available.

2 Next, demonstrate the force of tension. Let students know they will be making contact via their arms and get whatever consent is needed. Ask students to pair up and stand facing their partner. Have each team member grasp the other's forearms. Both students lean back. Their arms should stretch out between them. Go around to several pairs and lean gently on top of their arms to test their structure. Explain that when you lean on them you are pushing down and causing their arms to stretch, or be put into tension.

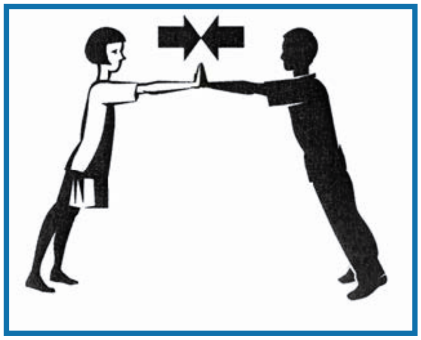
Materials

PER CLASS:

- ☐ Two pieces of sturdy, wide rope, each 10–12 feet
- ☐ Photographs of various suspension bridges (optional)

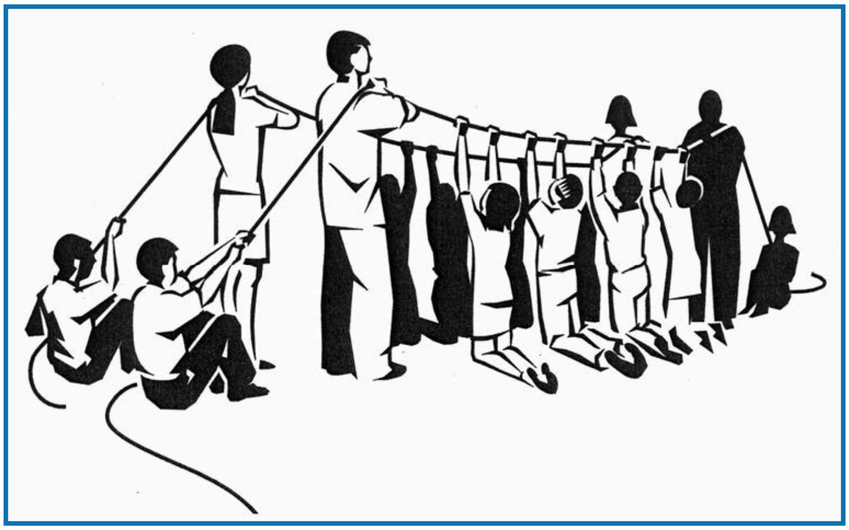


3 Now demonstrate the force of compression: Have partners press the palms of their hands together and lean toward one another, making an arch with their bodies. Go around to each pair and push on top of the arch. Explain that when you push down you cause them to push together, or to be put into compression.



4 To build the human bridge, select 16 students. Arrange students like so:

- Two pairs of taller students—the "towers"—stand across from each other and hold the ropes (the cable) on their shoulders.



- Four students act as anchors. Each one sits on the floor directly behind each tower and holds the ends of the cables.
- Eight students can act as suspenders. Put four in a straight line between each opposing tower. They can kneel or sit while pulling the cables down toward the floor.
- Optional: Have the rest of students role-play as cars with the floor as the roadway.

5 Discuss what forces are at work on the different areas of the bridge.

6 As time allows, invite students to try out the different positions—tower, anchor, suspender—to experience how tension and compression affect that area of the bridge.

Engineering & Science Connections

- Bridges are considered to be among the greatest feats of civil engineering. One of the sturdiest, longest, and most elegant types of these structures is the suspension bridge. The longest suspension bridge in the world is the Akashi-Kaikyo Bridge in Japan, which spans 2.5 miles!

- The forces of compression and tension are present in all bridges. Tension is a stretching force that pulls on a material, while compression causes a material to be pressed together. All bridges are designed to use compression and tension forces however possible for stability, while withstanding any forces that would cause it to collapse.

- Suspension bridges are typically found in large cities with lots of boat traffic. They can be built high above sea, or land, with a large span between their towers, leaving the waterway clear for boats. The Golden Gate Bridge in San Francisco is a famous example of this.

- In 1940, the Tacoma Narrows Bridge in Washington collapsed. Although the suspension bridge was designed well to span the required distance and hold the appropriate gravity loads on the bridge, the forces of wind were not taken into account sufficiently. The bridge collapsed from swaying due to strong crosswinds. Engineers learned a lot from this disaster and have since changed the way they design suspension bridges.

Guiding Questions ?

For the towers: What force is at work on the cable over your shoulder?

For the anchors: What force do you feel in the cable?

What would happen to the bridge if it had no anchors?

What would happen if it had no suspenders? Or fewer suspenders?

What would happen if the towers were lower? Higher?

This activity was provided by the National Building Museum (NBM) in Washington, D.C.