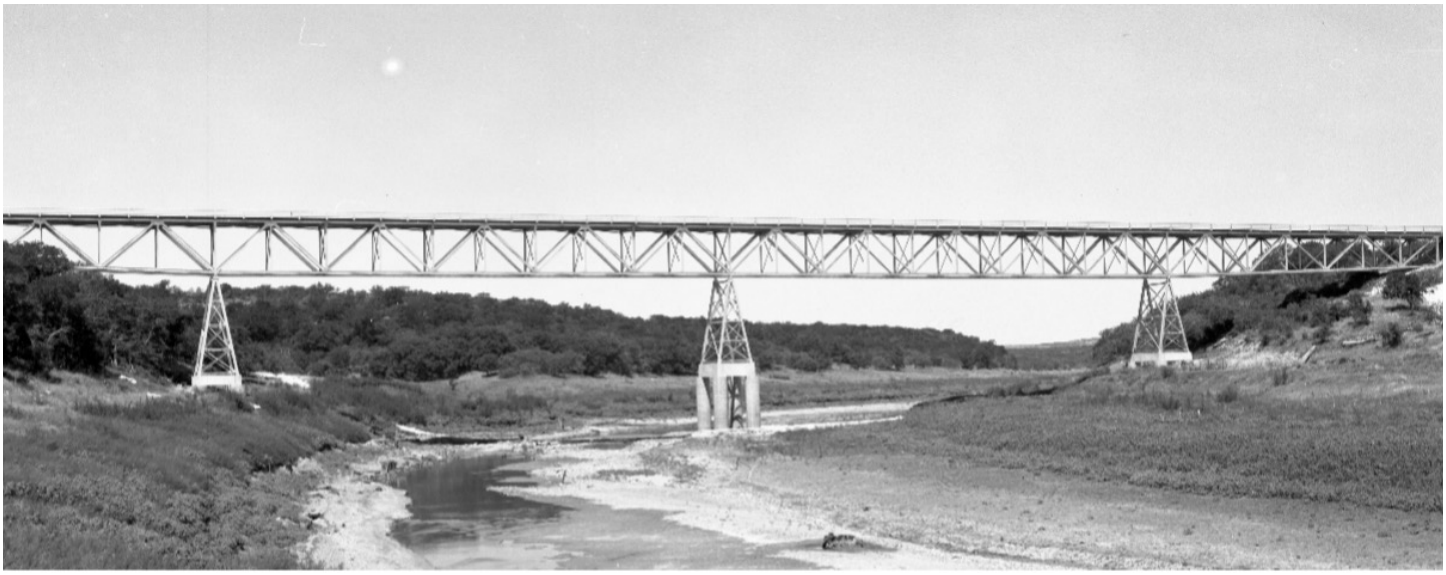
BRIDGING SUCCESS

A LESSON IN TxDOT'S INNOVATIVE BRIDGE DESIGN



After World War II, Texas grew. Our state gained new people and had an economic boom. Unfortunately, a lack in both the quantity and quality of roads and bridges throughout the state made it difficult for families to travel and businesses to transport goods. Texas needed to find a way to quickly build more and better roads and bridges to provide for the state's growing population.

Texas engineers and builders led the way in bridge innovation after the war. The state and country needed roads, highways, and bridges to connect communities and move the economy forward. The Texas Highway Department (now Texas Department of Transportation or TxDOT) delivered with new materials that created longer, stronger bridges. They implemented newer, more functional designs to quickly scale production and build bridges across the state faster than ever before. Our state's engineers and builders pushed the limits of technology to connect towns and cities and to secure growth across Texas and the country.

Today, TxDOT continues to maintain and inspect many of these bridges. The bridges continue to serve as vital links in our road system.

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Objective

In this activity, students will learn about different designs, materials, and innovative techniques used across Texas bridges following World War II. Students will explore the physical qualities of different materials and work toward designing their own bridge by making observations, asking questions, and using the appropriate materials for each task. Students will also research international bridges in Texas to understand how bridges play a role in both progress and preservation. This is a multi-day activity.

Applicable Elementary School TEKS

Science: 2B, 5A (K); 2B, 3B, 5A (1st); 2B, 3B, 5A & C-D (2nd); 2A, 5A (3rd); 2A (4th & 5th)

Math: 6A & F (K); 6F (1st); 8 (2nd); 6C (3rd); 5D, 6 (4th); 4H, 5 (5th)

Applicable Middle School TEKS

Science: 2A, 3A (6th); 2A-B, 3A (7th); 2A-B, 3A (8th)

Math: 8B & D (6th); 9C & D (7th); 1A (8th)

Materials

1. Paper Towels
2. Paper
3. Cardboard (could also use a firm paper plate or Styrofoam plate)
4. Small cup for water
5. Paper towel or toilet paper cardboard tubes
6. Toy Car (or similarly weighted object like coins or dice)
7. String
8. Jell-O
9. Playdough
10. Paper or Styrofoam cups
11. Any other building materials you may have around your activity space, like Legos, toothpicks, popsicle sticks, coffee stirrers, plastic straws, etc.
12. TxDOT YouTube Bridge Videos linked below in the activity guide.

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Day 1 Procedure

Pre-Activity Assessment

1. Ask: what are bridges used for? Why are bridges important? Can you think of a bridge in your community?
2. Ask students to draw a picture of a bridge on a scrap piece of paper. Compare: Does everyone's bridge look the same? What is different?
3. Either together or individually, brainstorm a list of materials you think are used to build bridges. Are there any unusual materials on your list?

Provide: Give each student or group of students a box of Jell-O and a paper or Styrofoam cup.

1. Have students mix the Jell-O and pour small portions into each Styrofoam cup.
2. Complete the appropriate bridge math worksheet about concrete. This worksheet is also available for middle school students.
3. Let the Jell-O cool overnight. Have students write or discussion a prediction about what will happen to the Jell-O overnight.
4. In the morning, have students peel away the cup and notice that the Jell-O holds its shape. Use this as your pre-activity assessment for the next bridge lesson.
5. Explain that this is the same thing that happens when using a pan-formed girder bridge mold.

Post-Activity Assessment

6. 1. Ask: What are bridges used for? Where might you find a bridge? Can you name some common materials used to build bridges in Texas? Why was there a boom in bridge and road construction in the mid-twentieth century?

Middle School Activity Answer Key

1. 510 feet
2. 72 Feet
3. 50,673.37
4. 14.4 bags, 331.2 pounds total,
5. 99.96 Feet

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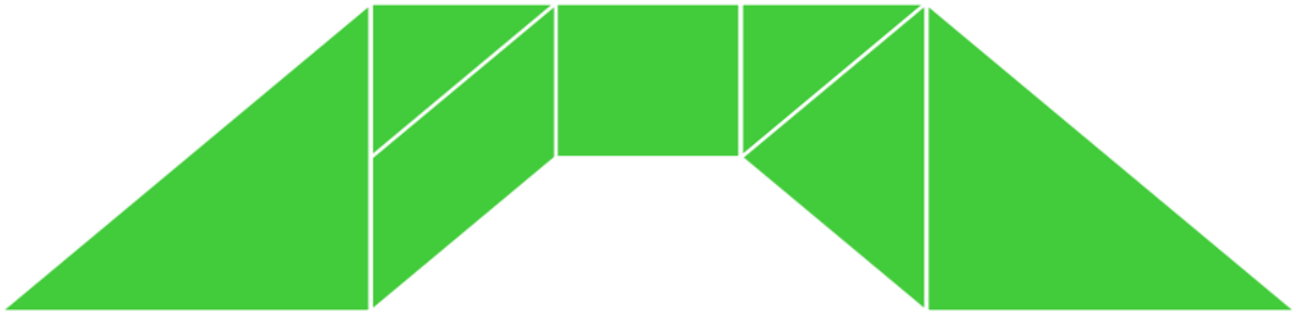
Day 2

Sample Solution

Try more tangram puzzles at https://mathigon.org/tangram



Middle School

Demonstrate: Have two students stand facing each other and press their palms together at an equal force. Explain that when forces are balanced, the bridge remains safe. Then, have one of the students stand on one foot and press palms together again (theoretically the student on one leg will struggle to maintain balance). Explain that when forces are unbalanced, a bridge isn't as safe.

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Day 3

1. This activity is geared toward elementary students but can be adapted for middle school students. Each group (or individual) will be given three different materials. Make 3 copies of Day 3 worksheet, one for each materials experiment.
    a. First, you will need to write a prediction whether each material will be able to hold the toy car and if it will be water resistant.
    b. Then, you will need to test the bridge and record any observations and results; use the "Making Predictions" worksheet. For an added challenge, give students coins or dice and have them measure how much weight each bridge can hold, adding a coin or dice to the bridge until the bridge collapses or you run out of materials.
2. This activity is geared more toward upper elementary and middle school students but can be adapted to meet your individual student(s)'s needs. Ask students to design a beam, arch, or truss bridge using the "Design a Bridge" worksheet. They will use materials in your activity space to create a bridge that holds the most weight possible. Have students use the Historic Bridge Foundation's website (https://historicbridgefoundation.com/bridge-types/) to explore the different bridge types. For an added challenge, see if your bridge can hold a certain amount of weight for 5 minutes!

Provide

Give each group (or individual) with a regular piece of paper, cardboard, and single paper towel. Handout the ability-level appropriate worksheet. Demonstrate for the class (or individual) how to set up a sample bridge. Use books to hold the material, for example: