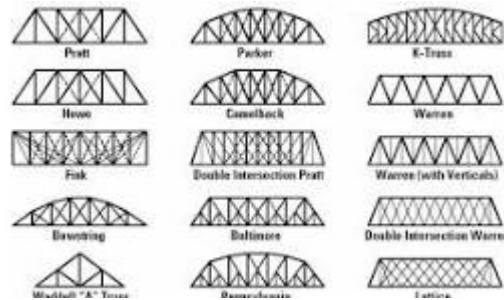


Bridge Building (Coach Scheduled Testing - 45 Minutes)



Page 1 of 4

Description: Each team will **build the tallest Truss Bridge** to span a 30-centimeter distance while holding a 300-gram mass or 500-gram mass for 30 seconds. They will also answer questions on a written assessment about the techniques for building bridges and the types of bridges.



Participants per assigned Team Number: 2

- If your school has 1 team you will send 2 students
- If your school has 2 teams you will send 2 students per team number; team numbers may not intermix
- If your school has 3 teams you will send 2 students per team number; team numbers may not intermix

Spirit of the Problem:

- The goal of competition is to give one's best effort while displaying honesty, integrity, and good sportsmanship. Everyone is expected to display courtesy and respect (see Science Olympiad Pledges below). Teams are expected to make an honest effort to follow the rules and the spirit of the problem (not interpret the rules so they have an unfair advantage).
- It is a rules violation if coaches, parents, mentors, or spectators enter the competition area or communicate with the team members at any time during the competition. Violation of this rule will place the team below all other teams.

Safety Teams Must Bring:

- Safety glasses labeled ANSI Z87+ (impact rated)
- All competitors must wear their eye protection during any competitor's flight phase of the competition.
- If a team does not have the required eye protection, they will be given the opportunity to obtain it, time allowing, but will not receive extra time.
- If a team is unable to obtain eye protection, the team will not compete and will receive a no-show score.

Teams must bring:

- Pencil, pen or marker, a ruler or straight edge, and one pair of scissors for each team member.

Materials Provided at Event:

- 30 ≈ 20 cm paper drinking straws
- 1 meter of 2.54 cm tape
- 2 objects with masses of 300 and 500 grams
- 2 ≈ 5 cm x 9.5 cm x 30.5 cm support structures
- 1 ≈ 5x5x0.6 cm loading block with a mass of 20 grams

1. Construction Phase: Timed 25 Minutes

Category B: Impact Safety Glasses Required



Eyeglasses are not safety rated!

a. Building

- i. Each team constructs one truss bridge to span a 30.0 cm gap between the two support structures while supporting a 300- or 500-gram mass placed on a loading block at the top and center point of the truss.
 - ii. The bridge must be constructed entirely of the provided straws and tape. The straws and tape may be cut into any shape or size and the straws may crimped to slide inside each other.
 - iii. The bridge must have a width of at least 10.0 cm at its center point, outside edge to outside edge.
 - iv. The bridge may not have any cross members on the inside that would prohibit a loading block sized piece of wood from passing through its entire length in any orientation
 - v. Both masses will be used to test the bridge, starting with the smaller one. The bridge must support at least one of the masses for 30 seconds
 - vi. Teams using tools or materials other than those listed above will be ranked below all other teams
- b. Written assessment:** The pair of participants will answer the assessment questions **concurrently with the 25-minute construction phase**. The assessment will contain questions on types of bridges, building techniques, and forces within bridges

2. Competition Phase:

- a. The Event Supervisor (ES) will place the 2x4 inch lumber supports parallel to each other and 30.0 cm apart on a level flat surface
- b. The competitors will set their bridge across the support structures. No sticky part of the tape may touch the top or sides of the supports
- c. The Event Supervisor (ES) will verify and record that the bridge spans the gap, the width is at least 10.0 cm, and the loading block can pass through the length of the bridge. The ES will also measure and record the bridge's height at the center to the nearest millimeter and the number of unused, complete straws.
- d. The competitors will place the 5cm by 5cm loading block on the top chord of their truss at the center point between the supports. They will then place the 300-gram mass on the loading block, and the ES will start the timer. Once they place the mass, the competitors may not touch their bridge.
- e. Testing for a mass will end when the bridge fails to hold the mass, any part of the bridge sags and touches the tabletop, or 30 seconds elapses.
- f. If the bridge supports the 300-gram mass for 30 seconds, the ES will repeat the test with the 500-gram mass.

3. Event Supervisor Records:

- a. Whether the bridge spans the gap
- b. Whether the width is at least 10.0 cm
- c. Whether the loading block can pass through the length of the bridge
- d. The total height of the bridge at the center to the nearest millimeter
- e. Number of unused, complete straws
- f. Time to structural failure for each mass

4. Scoring:

- I. Acronyms
 - a. Competition Height Score (CHS) = the height of the tallest bridge for all teams
 - b. Competition Assessment Score (CAS) = the highest assessment score for all teams
 - c. Team Assessment Score (TAS) = team score on the written test
 - d. Team Height Score (THS) = the height of the bridge in the center, measured to the nearest millimeter
- II. Team's Score = $0.5 \times (\text{THS} \div \text{CHS}) + 0.5 \times (\text{TAS} \div \text{CAS}) \times \text{any multipliers listed below}$
- III. If the bridge supports the 500-gram mass for 30 seconds, the height score will be multiplied by 1.2
- IV. If the bridge width is less than 10.0 cm or the loading block cannot pass through the bridge, the height

score will be multiplied by 0.5

- V. If the bridge cannot span the gap, the height score is 0

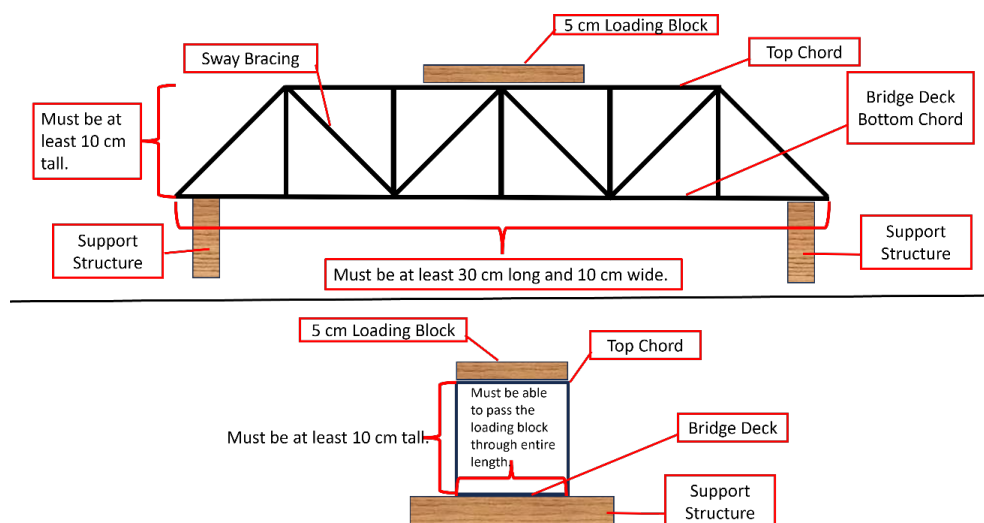
5. Tiebreakers

- Largest number of unused, complete straws remaining
- Time to structural failure in the 500-gram test
- Time to structural failure in the 300-gram test

Study Resources: Division A will not release previous tests, or the exact resources used by the Event Supervisor or test writer for any events. The listed resources are meant as a starting point. It is up to the competitor to research further.

- <https://scioly.org/wiki/index.php/Bridge>
- <https://www.youtube.com/watch?v=oVOnRPefcno>
- <https://thestemlaboratory.com/straw-bridges/>
- <https://www.stem-inventions.com/truss-bridge> (This site uses materials that are different from the one used for this event.)

Competition Diagrams:



Truss Bridge Study Outline

Caution, this is a sample outline. It was Gemini AI generated and is meant as a starting point! It may or may not contain topics occurring on the written test.

- Introduction to Truss Bridges
 - What is a truss bridge?
- Basic components of a truss bridge:
 - Verticals
 - Diagonals
 - Chords (top and bottom)
- Advantages of truss bridges
- Disadvantages of truss bridges
- Types of Truss Bridges
 - Simple Truss Bridges:**
 - Pratt Truss
 - Howe Truss
 - Warren Truss
 - Parker Truss

- b. Complex Truss Bridges:**
 - i. K-Truss
 - ii. Bowstring Truss
 - iii. Through Truss
 - iv. Deck Truss
6. Construction Techniques
7. **Planning and Design:**
 - a. Load calculations
 - b. Material selection
 - c. Structural analysis
8. **Foundation Construction:**
 - a. Pier and abutment construction
 - b. Soil testing and preparation
9. **Erection of the Truss:**
 - a. Methods of erection (crane, cantilever, etc.)
 - b. Connection techniques (bolting, riveting, welding)
10. **Deck Construction:**
 - a. Placement of the deck on the truss
 - b. Waterproofing and paving
11. **Finishing Touches:**
 - a. Painting and maintenance
 - b. Safety inspections
 - c. Forces in Truss Members
12. **Tension and Compression:**
 - a. Understanding the forces acting on truss members
 - b. Identifying members in tension and compression
13. **Method of Joints:**
 - a. Analyzing forces in truss members using equilibrium equations
14. **Method of Sections:**
 - a. Analyzing forces in truss members by cutting sections through the truss
 - b. Real-World Applications
15. **Famous Truss Bridges:**
 - a. Golden Gate Bridge
 - b. Brooklyn Bridge
 - c. Other notable examples
16. **Modern Innovations in Truss Bridge Design:**
 - a. Use of advanced materials (e.g., composite materials)
 - b. Innovative construction techniques
 - c. Sustainable design principles
17. **Study Tips:**
 - a. **Visual Learning:** Use diagrams and images to understand the different types of truss bridges and their components.
 - b. **Hands-on Activities:** Build a model truss bridge to visualize the concepts.
 - c. **Practice Problems:** Solve problems involving force analysis in truss members.
 - d. **Review Key Terms:** Familiarize yourself with the vocabulary related to truss bridges.
 - e. **Create Flashcards:** Use flashcards to memorize key concepts and definitions.
 - f. **Study Groups:** Discuss the material with classmates and ask questions.