



MESA DAY CONTEST RULES

2019 – 2020

Stick Together

| | |
|-----------------------------|---|
| LEVEL: | Grades 6 and 7/8 |
| TYPE OF CONTEST: | Team |
| COMPOSITION OF TEAM: | 2-3 students per team |
| NUMBER OF STUDENTS: | Preliminary – As determined by your local MESA Center Regional – 1 for 6 th Grade per Center; 1 for 7 th /8 th Grade per Center |
| SPONSOR: | Luis Topete, Director, San Diego State University MSP Jeanette Espino, Director, Imperial Valley MSP |

OVERVIEW: Students will use math and science to implement engineering concepts in the design and construction of a model bridge from your own plans that will carry a maximum load while using as few craftsticks as possible; stressing neatness, craftsmanship, and creativity. **Participation logistics, limits, and competition facilities may vary by host site. Advisors and students are responsible for verifying this information with their center director.**

The purpose of the Engineering Lab Book is for students to more closely follow the practices of an engineer in the completion of their MESA Day projects. The Engineering Lab Book will encourage students to take a purposeful and sustained approach to building their devices. MESA projects are not designed to be completed in a single class period or day, but to be the result of thoughtful research, planning, analysis and evaluation. The lab book should provide a daily and constant written record of the thought and insight that a team is putting into their project, from initial ideas to the final completed project.

MATERIALS:

- Only solid untreated (no manufactured notches or holes), natural wood craftsticks (e.g. popsicle sticks) with the following approximate dimensions may be used:
 - Length= 4 ½ inches (11.4cm)
 - Width = 3/8 inches (0.95cm)
 - Thickness = 1/16 inches (0.2cm)
- Maximum number of sticks allowed, including partial sticks, is 200. Each piece of stick, regardless of size, will be counted as one structural member.
- Only water-soluble Elmer's-type white glue must be used.
- There are three format options for lab book submittals (See Engineering Lab

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Book Rules). Please check with your local center director for the format required for your preliminary event. Electronic submissions will be required at the Regional/State level.

GENERAL RULES:

- 1) Stick Together structures should be labeled with team members' names, school, and MESA Center. There will be a 10% penalty in the strength to weight score for improper labeling.
- 2) No kits are allowed.
- 3) A maximum of 50% of a craft stick's total wide/flat surface may be glued. Both sides of each stick can be considered in the 50% calculation. e.g. 100% of side 1 and 0% of side 2; 75% of side 1 and 25% of side 2. NOTE: if a whole craft stick is divided into smaller pieces, then this rule also applies to those members.
- 4) Glue (water soluble Elmer's type white glue) must only be used at joints, and must not be used on the surface of the roadway.
- 5) No coatings of any kind, including glue, paint, cement, epoxy; etc. may be applied to any surface of the bridge. The Bridge will be disqualified if it is coated with any substance.
- 6) The bridge **MUST** meet the following dimension restrictions:
 - a. Maximum horizontal length = **17 inches (43.2 cm)**
 - b. Maximum width = **5 inches (12.7 cm)**
 - c. Maximum height above the top of the roadway = **7 inches (17.78 cm)**
 - d. Maximum depth below the top of the roadway = **3.5 inches (8.89 cm)**
 - e. Minimum horizontal length = **15 inches (38.1 cm)**
 - f. Minimum width **at every point** = **4 inches (10.16 cm)**
 - g. Minimum width of open roadway across entire bridge length = **3.5 inches (8.89 cm)**
- 7) The bridge must be open at the top to allow insertion of testing apparatus.
- 8) The bridge must have a clear and unobstructed roadway at least 3 ½ inches wide, running the full length of the bridge, as if automobile traffic were going to cross it. The roadway shall be considered a roadway if a toy model car or truck freely rolls from one end to the other. The toy car/truck can be provided by the entrant. If a car is not provided by the entrant, a standard "Hot Wheels" or "Matchbox" car will be used.
- 9) The bridge may not have a roof, covering or any other object that will interfere with the 3½ x 3½ inch test plate that is placed directly on roadway at mid span to apply the force for load bearing capacity.
- 10) I-beams are illegal.
- 11) T-sections and longitudinal lamination may be used on the roadway only.
- 12) The bridge must rest on the tester support blocks in a stable manner, i.e. bridge substructure may NOT interfere with testing apparatus.
- 13) Project must be the original work of student(s). Judges may ask questions to confirm provenance.
- 14) Please remember that the purpose of this contest is to use creativity to build the best structure within the framework of the rules. The purpose is not to break the rules and see if you can get away with it.
- 15) Lab books are meant to clearly demonstrate and illustrate evidence of the application of the Engineering Design Process in the MESA project.

*The Engineering Lab Book must be properly labeled (names, school, center, grade level, etc.) and contain and cover the following sections using the template provided:

1. ***IDENTIFY THE PROBLEM** (at least 2 sentences for each question below)
State what is the challenge being worked on? What are the limits/constraints? How do you think you can solve it?
2. ***EXPLORE**
Find out what others have done (research). Clearly list at least 5 sources (web pages, books, etc.). Identify (cite) and describe them.
3. ***DESIGN**
Brainstorm ideas (at least 3 ideas) and record them. Each idea should be represented by a sketch or drawing. Select one idea and create a plan (at least 5 sentences) to build a prototype from. Generate a list of materials for your prototype.
4. ***CREATE**
 - i. Using your plan, build your prototype; describe the building of prototype (at least 5 sentences). Include a picture of the actual project prototype.
5. ***TRY IT OUT**
Test your idea/prototype. Attempt at least 3 trials/attempts of your test. Measure the results of your test (e.g., accuracy, time, kinetic energy, potential energy). Provide evidence of the use and application of at least 2 appropriate mathematical concepts in your tests, for example:
 - i. Calculate the height, length, and width proportional to your bridge if it is to be built to fit an 8ft wide standard size sedan vehicle.
 - ii. If craft stick has a cost of \$1.38 per inch, calculate the amount it would cost to build your bridge.
6. ***MAKE IT BETTER**
Describe how you can make the project better and what modifications you will be making (at least 5 ways you can improve project). Build and prepare competition ready project. Include a picture.

JUDGING:

- 1) The bridge is examined and measured by the judges to check whether it conforms to contest rules and specifications.
- 2) Any bridge that does not meet the requirements will be disqualified.
- 3) The bridge is weighed and its weight recorded.
- 4) The bridges are judged for neatness, craftsmanship, and creativity by a team selected by the Host Center prior to testing.
- 5) The bridge will be supported by two wide blocks (each >1 inch) 14 inches apart (see Testing Setup & Apparatus)
- 6) A 3½ x 3½ inch test plate is lowered onto the bridge at mid span so that it rests on the roadway.
- 7) The test plate is loaded until a point of maximum load is reached as determined by judges. The maximum load recorded by the load testing machine will be used as the load capacity of the bridge, regardless of when failure begins.
- 8) Individuals' bridges are not limited in the number of categories they may win.
- 9) Disqualified bridges are not eligible for awards in any category; however, they may be tested, time permitting.
- 10) Strength-to-Weight Ratio: Determined by dividing maximum load at failure by weight of bridge. Bridge with greatest load bearing capacity compared to its weight wins.

Example: Maximum load = 220.0 pounds
 Bridge weight = 50.0 grams
 Ratio = $1997.8 * [220 \text{ pounds} \times 454\text{g/pound}]/50\text{g}$

- 11) Creativity & Engineering Design: Finest workmanship, including neatness and innovation of design.

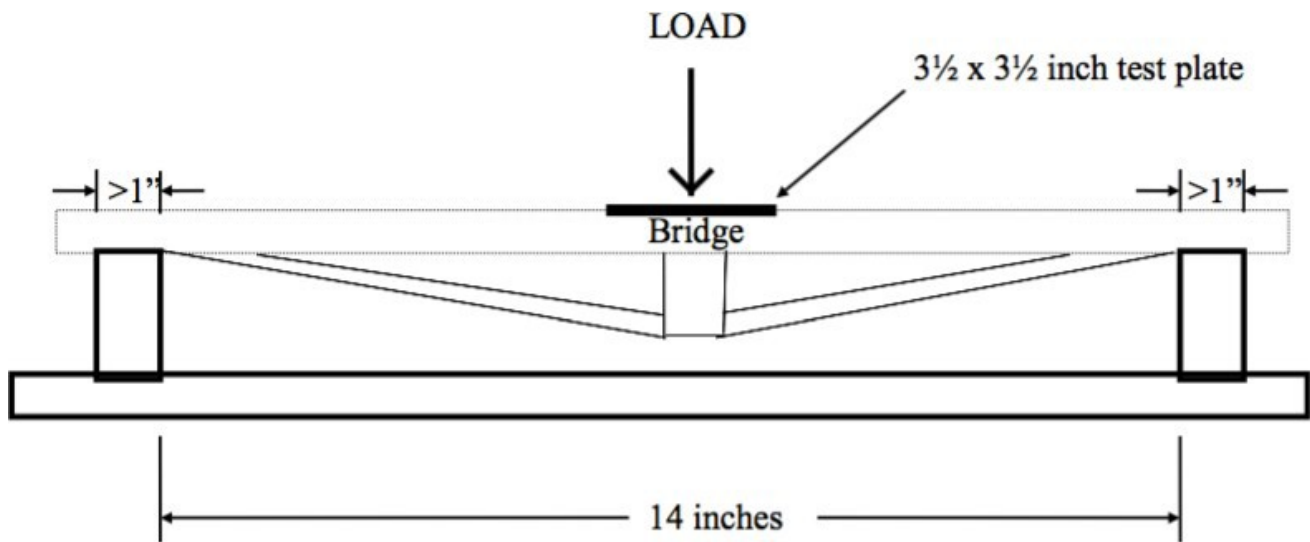
AWARDS:

- Awards will be given per grade level: 6th grade and 7th/8th grade.
- Medals will be awarded for 1st, 2nd, and 3rd place based on the best Strength-to-Weight Ratio
- Ribbons will be awarded for Creativity and Engineering Design.
- Only teams placing in the Strength-to-Weight category will advance to Regional MESA Day.

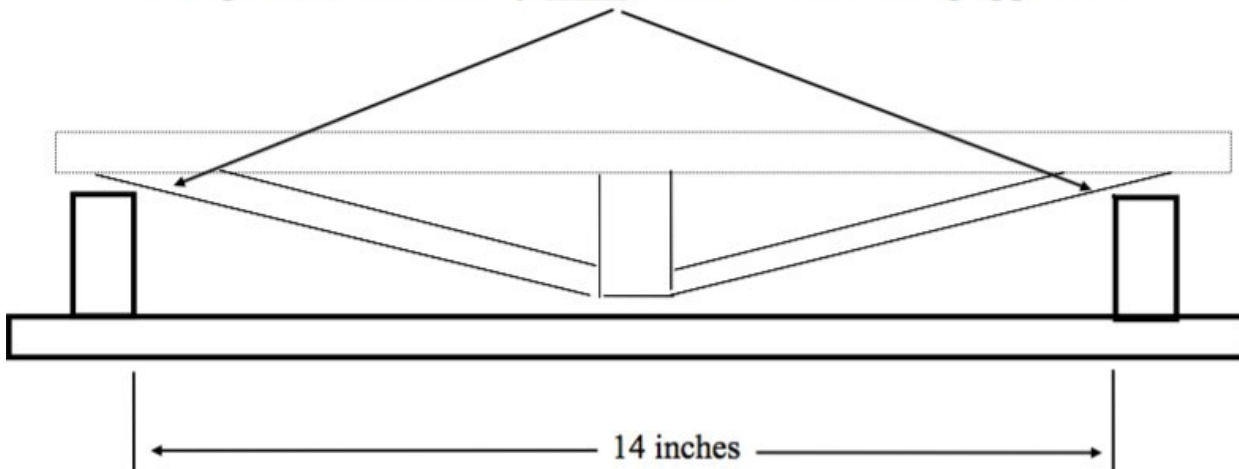
ATTACHMENTS/APPENDIX:

- Testing Setup & Apparatus
- Definitions/Samples
- Specification Checklist
- Engineering Lab Book Rubric

TESTING SETUP & APPARATUS

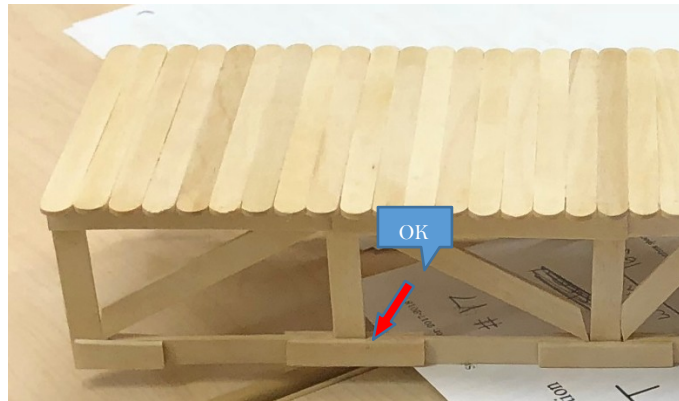


Bridge **MUST** rest on tester support blocks;
Bridge substructure may ***NOT*** interfere with testing apparatus



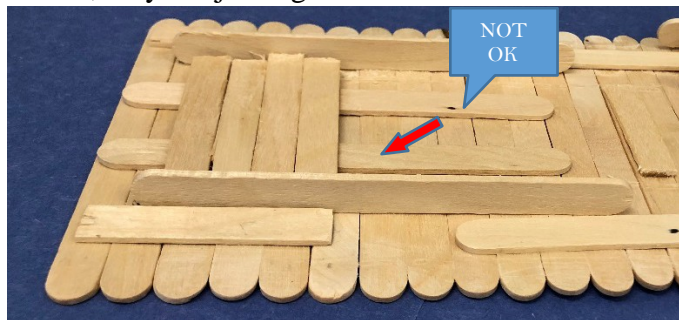
Definitions/ Samples

Per Rule #3

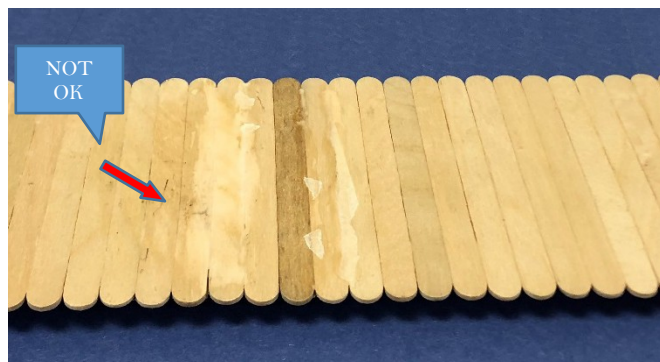


Top: Because the member that is covering 50% of its area are not in contact with any other member, it is considered legal.

Bottom: The members are already 50% in contact with the roadway and are also in contact with other members. Therefore, they are joining with member at more than 50% of its area.



Per Rule #4 & 5



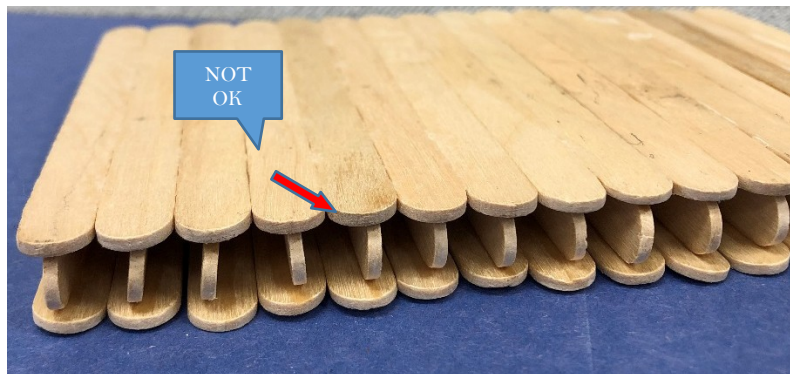
Glue is visible on areas other than the joints and the remains of wax paper left on the roadway are considered coating. Easy way to fix this is to sand off the excess glue or wax paper.

Per Rule #7, 8 & 9



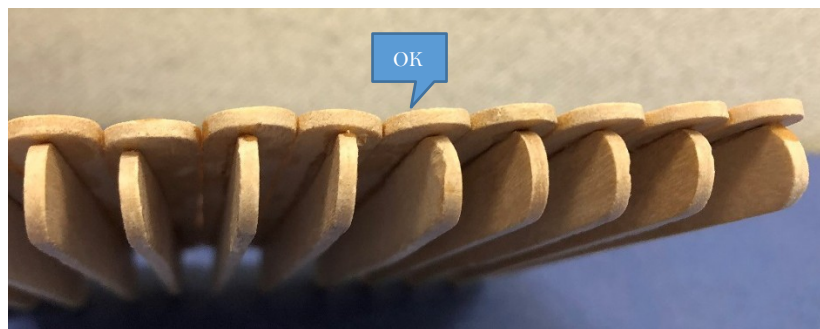
The bridge is open and allows testing apparatus to be placed, the roadway created is clear, gapless and unobstructed, and lastly it does not have a roof.

Per Rule #10



I-Beams are illegal in the bridge's structure.

Per Rule #11



Top: T- Beam are only allowed to be elements of the roadway.
Bottom: Longitudinal lamination may be used on the roadway only.



Specification Checklist

**Note: As the name above implies, this list is intended simply as a guide for meeting the required competition specs. It should not be treated as an official judging document.*

- q Bridge is properly labeled with team members names, school, and MESA Center
- q Material is solid, natural wood craft sticks (popsicle sticks)
- q Glue is water soluble Elmer's-type white glue
- q Maximum length ≤ 17 inches (43.2 cm)
- q Maximum width ≤ 5 inches (12.7 cm)
- q Maximum height above top of roadway ≤ 7 inches (17.78 cm)
- q Maximum depth below top of roadway ≤ 3.5 inches (8.89 cm)
- q Minimum length ≥ 15 inches (38.1 cm)
- q Minimum width ≥ 4 inches (10.16 cm)
- q Minimum width of roadway ≥ 3.5 inches (8.89 cm)
- q Roadway runs entire length of bridge
- q Maximum number of members (sticks and/or partial sticks) ≤ 200
- q Glue only at the joints
- q Each stick glued $\leq 50\%$
- q No I-beams
- q T-sections on roadway only
- q Sticks are not painted or treated
- q Bridge open at the top (no roof or covering)
- q Bridge has open $3\frac{1}{2}$ inch area for placement of the test plate on roadway
- q Bridge has supports suitable for placement on testing fixture
- q Bridge substructure does not interfere with testing fixture

***ENGINEERING LAB BOOK REQUIREMENT RUBRIC**

Please use this rubric to assess lab book entries. An **incomplete** lab book (i.e., missing 1 to 2 specified criteria) will lead to a 20% deduction from the total project score. A **missing** lab book (i.e., not submitted OR missing 3 or more specified criteria) will lead to a 50% deduction from the total project score and will make team ineligible to place.

| Criteria | | YES | NO |
|--|---|-----|----|
| | Is the lab book properly labeled? (<i>Names, Grades, School, MESA Center</i>) | | |
| 1 | Identify the Need (at least 2 sentences for each) <i>State what is the challenge being worked on? What are the limits/constraints? How do you think you can solve it.</i> | | |
| 2 | Explore <i>Conducting research (listing 5 cited/referenced sources), gathering materials, try using materials</i> | | |
| 3 | Design <i>Brainstorming ideas (at least 3 iterations) each represented by a picture, sketch or drawing. Creating a plan for selected idea (at least 5 sentences). A list of materials for the prototype.</i> | | |
| 4 | Create <i>Building a prototype. Describing the building of the prototype (at least 5 sentences). Including a final picture of the project.</i> | | |
| 5 | Try it Out <i>Testing idea/prototype. Attempting at least 3 trials/attempts. Measuring each trial result (by specific performance criteria like distance traveled, time, etc.). Providing evidence of the use and application of at least 2</i> | | |
| 6 | Make Better <i>Evaluate results. List at least five ways project can be improved</i> | | |
| TOTAL | | | |
| Lab Book Complete (mark with X) | | | |

Is this considered an **incomplete** lab book – missing 1 or 2 criteria listed?**NO** **YES** (-20%)

Is this considered a **missing** lab book – missing 3 or more criteria listed?**NO** **YES** (-50%)