Challenge E for Beginners

Structural Challenge

LEARNING OUTCOMES
- Architectural Design
- Structural Engineering
- Mathematics
- Material Science
- Theater Arts
- Musical Design & Acoustics
- Budget Management
- Presentation Skills
- Project Management
- Creative and Critical Thinking
- Teamwork
- Interpersonal Skills
- Perseverance
- Self-Directed Learning
- Digital Literacy
- Citizenship Skills

POINTS OF INTEREST
- Design and build a structure that both supports weight and is a musical instrument.
- Play a musical solo using the structure as a musical instrument.
- Tell a story with at least one musical character.
- Integrate the story with the weight placement testing of the structure.
- Create and present two Team Choice Elements that show off the team's interests, skills areas of strength, and talents.

DESTINATION IMAGINATION CHALLENGES ARE DESIGNED AS A FUN AND ENGAGING SYSTEM OF LEARNING to teach creativity, the creative process, and interpersonal and management skills, and help students achieve their highest potential. Each Challenge participant will gain knowledge and experience in areas including creative and critical thinking, project management, team building, conflict resolution, STEM, perseverance, and a completion mindset—the very skills needed to thrive in any chosen career. Instant Challenge plays an integral role in helping students achieve this goal, and accounts for 25% of a team's overall score at tournaments. But no one starts off being an Instant Challenge genius. For many, the ability to think critically and creatively on one's feet in a short period of time takes a lot of practice. Our Roadmap resource includes a variety of Instant Challenge challenges for teams to practice in order to improve their quick, creative, and critical thinking skills.
Challenge E: Session Overview

• Summary of Challenge
  • Structure
    • Wood, adhesive tape, aluminum foil, glue, latex gloves, balloons, fishing line, paper, straws, toothpicks, string, wax paper, wire.
    • Support pressure board and fit on tester
    • Play musical solo prior to testing structure

• Testing description

• Presentation elements
  • Story about how a musical character is inspired by music
  • Includes a musical costume

• Tips / Q&A for Structure Teams
Structure

• Read Challenge, Clarifications, Rules of the Road, Team Manager Guide

• Structure Specification Details
  • Structure: made of materials on prior slide
  • $7.5'' \leq \text{Structure height} \leq 9''$
  • Structure weight can not exceed 175 grams and Structure must be a single unit
  • Structure may only touch the Structure tester on the top surface, bottom of the pressure board, and the safety pole
  • An opening that can accept a 2” circular column must run the entire height of the structure
Tester setup

- Pressure Board
- Team Designed Structure
- Floor surface
- Traditional Tester
- 7” to 9”

Structure Under Test

Tester Provided at Tournament
Musical Solo

- Once the time begins
- A musical solo on the structure must be performed for a minimum of 15 sec
  - Solo means that the structure must be playing on its own with no accompaniment by a voice or other instrument
- Bonus for a solo that lasts 30 sec
- A solo can be attempted as many times as the team chooses prior to structure testing starts
- Time is monitored by the timekeeping appraiser.
Presentation

• Story – How a Musical character that is inspired my music
  • Creativity of story of musical character
    • Originality of story
  • Creativity of musical character’s costume
  • Integration of structure part removal with the story

• Two Team Choice Elements

NOTE: Cost of all items on stage ≤ $125
Simultaneous Testing & Performance

• Setup, performance and structure testing, all within 8 min.
• Team decides how performance and testing is staged.
Structure Check in Procedure

• Check in appraisers will always avoid touching the structure.
• Team places structure on scale
  • No more than 175.0 grams
• Team places structure on representation of tester base, placing over a 2” pole.
• Appraiser measures the height of the structure
  • $7.5 \leq \text{Height} \leq 9”$
• Appraisers will examine structure and ask team about their building process and the materials that they used.
• It is always helpful to have the team bring samples of their building materials.
• Structure will be stored in team provided container.
Close up of a Tester

- Up close of tester

Safety shields will be removed
Team will need safety goggles when working with structure
Structure Scoring

• Structure’s weight held ratio (WHR)
  • Total weight held / Initial structure weight
Tournament Day

- Bringing in Props, fixing everything
- Check-in (Structure checked in & weighed)
- 8 minute Presentation
- Instant Challenge
- Closing ceremonies
General Hints & Comments

• Insure that team correctly interprets requirements stated in Challenge
• If they are unsure, use team specific clarifications and ask!
• Try to get a parent or teacher to build a tester or see if you can do a test somewhere else (contact Regional Challenge Master). (guide for building Structure Tester available at www.madikids.org)
• The cost of materials used solely for testing & experimentation (i.e., test structures) is NOT included in your Challenge budget for tournament
Intro to Teaching Basic Structure

• List of Structure Materials
• Glue
• Tools
• Construction Area
• Forces
• Designing
• Jigs
• Summary
Structure Materials

**Materials:** The Structure must be made entirely and only of the materials listed below, in any combination. If the Appraisers are not able to verify all the materials that are used in the Structure, the Structure may not comply with this requirement.

**Adhesive Tape:** Any of the commercially available varieties of the following combination – a backing material such as paper, plastic film, cloth, or metal foil, coated with a “Sticky” adhesive, used for the purpose of connecting other materials together without the use of heat, water, or any type of accelerant.

**Aluminum Foil:** Commercially available Aluminum Foil sold in rolls or sheets from which pieces can be cut. Aluminum Foil that is less than or equal to 200 micrometers (0.008in) in thickness is acceptable. Most regular and heavy duty Aluminum Foil available in retail stores meets these requirements.

**Glue:** Any commercially available adhesive material applied in a liquid form capable of creating a permanent bond - e.g. two part epoxy, Gorilla Glue, super glues, wood glue, hot glue, glues that use an accelerant, etc.

**Latex Free Rubber Gloves:** Commercially available non-porous elastic rubber hand coverings. Original packaging must be provided.

**Latex Free Rubber Bands:** A commercially available continuous loop of rubber, used to hold items together. Thickness/width: 1/32in to 1/8in (0.75mm to 3.0mm); unstretched loop length: 1in to 6in (25mm to 150mm); unstretched length when cut: 2in to 12in (50mm to 300mm). Original packaging must be provided.

**Monofilament Fishing Line:** Any commercially available single-strand non-metallic fishing line, of any weight or diameter. Original packaging must be provided.

**Paper:** Material manufactured in thin sheets from the pulp of wood, used for writing, drawing, or printing on, or as wrapping material.

**Plastic Drinking Straws – 1/4in (6 mm) in diameter or smaller:** Commercially available thin tubes of plastic (such as polypropylene and polystyrene) used for stirring liquids and/or transferring them from a container to the mouth of a drinker.

**Plastic Toothpicks – 3in (75mm) long or smaller:** A commercially available pointed plastic instrument used for removing food particles from the teeth.

**String – 0.05 in (1.29mm) in diameter or smaller:** Material consisting of threads of natural or synthetic fibers twisted together to form a thin diameter.

**Waxed Paper:** Commercially available paper that has been manufactured with wax to make it waterproof, used especially in cooking and the wrapping of foodstuffs.

**Wire – 16 gauge (1.29 mm) or thinner, uncoated:** Made from any metal. Original packaging must be provided.

**Wood:** A natural substance found under the bark of any type of tree. The Wood used in the structures must be 100% natural. The following are NOT acceptable: Bamboo, Cork, and man-made substances that simulate natural Wood (examples: plywood, commercially available laminates or fiberboard).
Structure Materials

• Factors to consider
  • Weight
  • Strength
  • Ease of use
Helping teams learn about glue characteristics

• Glue
  • Expose team to many different types of glue, read directions
    • Hot glue (fast prototyping method)
    • Super glue (CA glue)
    • Wood glue (Gorilla glue)
    • Epoxy
    • Carpenter’s wood glue (Elmer’s)
  • Factors to consider
    • Strength
    • Drying time
    • Weight
    • Ease of use

Provide Adequate Ventilation!
Tools & Safety

• Tools such as saws, X-acto knives, and razors can be used to cut. When any sharp tool is used, sharp edges should always be directed away from flesh.

• Let team members experiment with cutting, sawing, and sanding materials with various tools. Encourage them to explore any tool they think will allow them to build better/easier.
Useful tools

• X-acto fine tooth razor saw
• Plastic holder holding a single edge razor blade

Other useful building items:
• Flat tile or mirror
• Building square
• Emery boards, sand paper

• small aluminum mitre box for razor saw

All tools should be readily available to consumers and of the team’s own choosing
Other Useful Things to Have

• Gram scale accurate to 0.1 grams
  • Permits weighing pieces and completed structures
  • Ohaus has a low-cost one (<$90) but you can probably borrow or get access to one (school lab, workplace, post office, police station (ask for confiscated scales)).

• Hair Dryer
  • Speeds up glue drying
More Useful Things to Have

- Structure Tester
- TM or other parents are allowed to construct a tester for the team
  - Instructions are available (www.madikids.org)
  - Try borrowing a tester
Construction Area

- A large open table, where team can place building jigs, weigh materials, saw and cut materials, assemble, & finish structures
- Cover the table top (sheet of thick plastic or masonite) (unless you like scratch marks to give it that antique look).
- Make sure that work areas are kept well ventilated, especially when teams are using glues with harmful vapors.
Forces at Work

- Compression

- Tension

- Shear
Qualities of good structures

• **Strength**
  • Buckling is a failure mechanism where long thin members loaded in compression end up “bowing” (& eventually breaking) near the middle (Depends on length, cross-section and material)

• **Stability**
  • Many structures “fail” because they start to lean -- and the leaning loads one side of the structure more than the other.
Basic structure design

• Sources for basic design ideas
  • Any books with pictures of structures (water towers, antennas, watch towers, cell telephone towers, power line towers, etc.). Take them on field trips.
  • Introductory structure books (see list later in presentation)

• Small scale experiments for basic single structure
  • Give teams short-term challenges such as structures out of soda straws and tape to hold up books
  • Focus on BASIC principles, such as which structural members hold up weight, and which pieces provide stability
Real World Examples

Keywords:
Water tower
Electrical tower
Construction crane
Building to a plan

• Plans
  • Can be drawn on graph paper or more consistently using a computer
  • Plans take design ideas and provide a blueprint for building
  • Allows them to keep records of designs and performance
  • Team manager should encourage team to brainstorm alternate assembly orders/processes. However team decides which they like best.
Using Jigs

• It would be Interference for a Team Manager to insist the team use a jig, but it is OK to expose them to the concept of jigs.
• “construction jigs” to hold pieces in place for gluing,
  • Simple foam squares (thick pink insulation) (with aluminum square or other straight edges)
    • pin drawings to foam (Dress T-pins are easy to use)
    • pin material to drawing and against square forms
  • Metal background and magnets to hold pieces
  • Custom wooden frame jigs
• Teams must build the jigs that they use
Experiment

- Let team build and test structures
- Help them learn what broke
- Remind them to keep a log
- Let them figure out how to improve design
- Keep experimenting
Thoughts on Structure Teamwork

• Try and involve all team members early on
  • Everybody can contribute design ideas
  • Have team explore their skills and competencies in all areas related to the challenge
• As season progresses, insure that everyone is involved with some aspects of solution
Final Thoughts

• Keep it simple, straight, level, and well-glued

• The goal of ALL DI problems is to encourage the kids to learn, stretch themselves and have fun. Kids that really enjoy the structure problem will begin to see the structure in everything around them. They will question WHY things they see were designed the way they were. This awareness, appreciation and curiosity is perhaps the greatest benefit this problem has to offer.
Good Texts to Teach Kids Structure


These can be hard to find in bookstores or libraries. However, they all can be ordered on the web from www.amazon.com

Check out our MADI sales table for books on structures and building
Useful Websites for Information

http://structure.texasdi.org
  great tutorial site for new structure teams (Diary of a Balsa Goddess)

http://www.farnorthdi.org/ResourcePages/Structure/Structure_Team_Resources.htm
  lots of great tips and resources for structure teams

http://www.pbs.org/wgbh/buildingbig/lab/index.html
  Great interactive tools for kids to learn about structure and forces

http://www.madikids.org
  Resource links for this presentation, Intro presentation and How-to guide for building your very own tester