



1. **DESCRIPTION:** Teams will design and test a Tower using SkyCiv structural analysis software that meets requirements specified in these rules to achieve the highest structural efficiency while withstanding multiple vertical and lateral loads.

A TEAM OF UPTO: 2

EVENT TIME: 45 minutes

2. **EVENT PARAMETERS:**

- a. Each participant may bring one stand-alone non-programmable, non-graphing calculator, a writing utensil and unmarked scratch paper.
- b. This event will take place on an internet-connected computer with browser access to SkyCiv. Each team will need a SkyCiv license.

3. **CONSTRUCTION PARAMETERS:**

- a. The Tower must be a single structure constructed by connecting members made of the material available when using the SkyCiv Science Olympiad add-on. The cross-section of individual members must be rectangular with minimum cross-sectional dimensions as specified in SkyCiv of 1.5 mm by 1.5 mm.
- b. The xz-plane ($y = 0$) will be defined as the Testing Base. All nodes of the Tower must be on the non-negative-y side of the xz-plane prior to load testing. The Tower must be supported using exactly four supports placed in the plane of the Test Base ($y = 0$); two must be “Horizontal Rollers in X” with x-coordinates ≥ 20.0 cm and two must be “3D Pin Supports” with x-coordinates ≤ -20.0 cm, without restrictions on z-coordinates.
- c. The Tower must be designed to support multiple Area Loads, each in the negative y-direction over a 5.0 cm by 5.0 cm rectangular area.
 - i. The number of Area Loads the Tower must support is two for Regionals, three for State, and four for Nationals.
 - ii. One Area Load must have nodes at ($x = \pm 2.5$ cm, $y = 50.0$ cm, $z = \pm 2.5$ cm) for Division B and ($x = \pm 2.5$ cm, $y = 60.0$ cm, $z = \pm 2.5$ cm) for Division C.
 - iii. ± 2.5 cm, $y = 60.0$ cm, $z = \pm 2.5$ cm) for Division C.
 - iv. The other Area Load(s) will have nodes at coordinates specified by the Event Supervisor in the range (-20.0 cm $\leq x \leq 20.0$ cm, $12.5 \leq y \leq 37.5$ cm, $z = + 2.5$ cm) for Division B and (-20.0 cm $\leq x \leq 20.0$ cm, $15.0 \leq y \leq 45.0$ cm, $z = + 2.5$ cm) for Division C. The y-coordinates for all nodes in an Area Load must be the same.
- d. To simulate lateral loading, each of the four nodes of the Area Load in 3.c.ii. must have a Point Load in the positive-z direction with magnitude 5–25 N, the same magnitude for all Point Loads.

4. **THE COMPETITION:**

- a. The Event Supervisor will determine the coordinates, to the closest 0.1 cm, of nodes for the additional Area Load(s) (3.c.iii.) and the magnitude, to the closest 1 N, used for the Point Loads (3.d.). At the beginning of each session, the Event Supervisor will tell teams these parameters. The same parameters will be used for all teams at the tournament.
- b. Before receiving the event parameters from the Event Supervisor, students must turn on Competition Mode in the SkyCiv Science Olympiad add-on.
- c. After being told the parameters in 4.a. and prior to building, participants must submit their Estimated Load Supported to be used as a tiebreaker.
- d. Participants will have 45 minutes to build, test, and submit their Tower in SkyCiv. Participants may test their Tower any number of times.
 - i. With Competition Mode enabled, the SkyCiv Science Olympiad add-on will not display scores. Participants are encouraged to use the “Solve” function to evaluate and improve their Tower before submission.
- e. SkyCiv will load all Area Loads evenly and stop loading when failure occurs. Failure is defined as any member of the Tower buckling or experiencing stress exceeding the parameters of that member.
- f. The maximum Load Supported across all Area Loads is 15,000 g.



For Event Supervisors Only - Do Not Post DIGITAL STRUCTURES (CONT.)

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.



5. **SCORING:**

- a. High score wins. $\text{Score} = \text{Load Score (g)} / \text{Mass of Tower (g)}$.
- b. The Load Score = Load Supported (4.e.) + Bonus.
- c. Towers that have a Load Supported of 15,000 g will earn a Bonus of 5,000 g.
- d. Towers will be placed in three tiers as follows:
 - i. Tier 1: Holding any load and meeting all construction parameters and competition requirements
 - ii. Tier 2: Holding any load with any violations of the construction parameters and/or competition requirements
 - iii. Tier 3: Unable to hold any load and will be ranked by lowest mass
- e. Ties are broken as follows:
 - i. Estimated Load Supported closest to, without exceeding, the actual Load Supported
 - ii. Ranked by lowest Tower mass
- f. Example score calculations:
 - i. Device 1: Mass = 10.12 g, Load Supported = 12,134 g; Score = 1,199
 - ii. Device 2: Mass = 12.32 g, Load Supported = 15,000 g + Bonus (5,000 g) = 20,000 g;
 - iii. Score = 1,623

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries a variety of resources to purchase for this event; other resources are on the Event Pages at soinc.org

This event is sponsored by SkyCiv



GENERAL RULES

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

GENERAL RULES, CODE OF ETHICS, AND 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. 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). Failure by a participant, coach, or guest to abide by these codes, accepted safety procedures, or rules below, may result in an assessment of penalty points or, in rare cases, disqualification by the tournament director from the event, the tournament, or future tournaments.

1. Actions and items (e.g., tools, notes, resources, supplies, electronics, etc.) are permitted, unless they are explicitly excluded in the rules, are unsafe, or violate the spirit of the problem.
2. While competing in an event, participants may not leave without the event supervisor's approval and must not receive any external assistance. All electronic devices capable of external communication as well as calculator applications on multipurpose devices (e.g., laptop, phone, tablet) are not permitted unless expressly permitted in the event rule or by an event supervisor. Cell phones, if not permitted, must be turned off. At the discretion of the event supervisor, participants may be required to place their cell phones in a designated location.
3. Participants, coaches and other adults are responsible for ensuring that any applicable school or Science Olympiad policy, law, or regulation is not broken. All Science Olympiad content such as policies, requirements, clarifications/changes and FAQs on www.soinc.org must be treated as if it were included in the printed rules.
4. All pre-built devices presented for judging must be constructed, impounded, and operated by one or more of the 15 current team members unless stated otherwise in the rules. If a device has been removed from the event area, appeals related to that device will not be considered.
5. Officials are encouraged to apply the least restrictive penalty for rules infractions - see examples in the Scoring Guidelines. Event supervisors must provide prompt notification of any penalty, disqualification or tier ranking.
6. State and regional tournament directors must notify teams of any site-dependent rule or other rule modification with as much notice as possible, ideally at least 30 days prior to the tournament.



For Event Supervisors Only - Do Not Post CHEMISTRY RECOMMENDED LAB EQUIP.

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

Each team may bring any or all of the items listed below for use in Division C Chemistry Events requiring laboratory equipment. Teams not bringing these items will be at a disadvantage as Event Supervisors will not provide the listed lab equipment. A penalty of up to 10% may be given if a team brings prohibited lab equipment to the event.

Item & Expected Use	Likely to be used in:			
	Chemistry Lab	Forensics	Environmental Chemistry	Materials Science
Box - Containing all of the kit materials	X	X	X	X
Graduated Cylinders (10 - 100 mL) - Measuring volumes	X		X	
Beakers (50 - 500 mL) - Doing reactions, developing chromatograms	X	X	X	X
Erlenmeyer Flasks (10 - 250 mL) - Doing reactions	X		X	
Test Tubes - Mix Chemicals, heat chemicals	X	X	X	X
Test Tube Brush - Clean Test Tubes	X	X	X	X
Test Tube Holder - Holds test tubes for heating	X	X	X	
Test Tube Rack - Hold Test Tubes	X	X	X	X
Spot Plates - For semi-micro scale reactions, testing solubility, pH	X	X	X	
Petri Dishes - Doing reactions, developing chromatograms	X	X	X	X
Slides - To put hairs, crystals, or fibers on for use with a microscope		X		
Cover Slips - To cover & prevent items from coming off slides		X		
Droppers - Add small amounts of liquids to reactions	X	X	X	X
Spatulas or spoons - Getting small amounts of solids out of containers	X	X	X	X
Metal Tongs, Forceps, or Tweezers - Holding & retrieving objects	X	X	X	X
Stirring Rods - Stirring mixtures	X	X	X	X
Thermometer - Determining the temperature of a solution	X	X	X	
pH paper/meter - Test acidity or alkalinity of solution	X	X	X	
Hand Lens - Magnification of small items for identification		X		
Flame Loop - For identification of ions in a compound		X		
Filter Paper - Filter solids from liquids	X		X	
Funnel - Hold Filter Paper	X		X	
9V battery - Electrolysis	X		X	X
Alligator Clip Wires - Connecting meters to metals	X		X	X
Nail - Electrolysis	X		X	X
Piece of Cu metal - Electrolysis	X		X	X
Piece of Zn metal - Electrolysis	X		X	X
Multimeter - Measuring current, voltage, and resistivity	X		X	X
9V or less Battery Conductivity Tester - Determining ionic strength of solution	X	X	X	X
Calipers-mechanical, not digital - Measuring lengths very precisely	X			X
Paper Towels - Cleaning	X	X	X	X
Pencil - Writing, Marking Chromatogram		X		
Ruler - Measuring lengths		X		
Magnets - For extraction and identification of iron filings	X	X	X	X
Cobalt Blue Glass - To filter out any sodium that might contaminate flame test from hands		X		

The following document was prepared to offer some guidance to teams as they select calculators for use in different Science Olympiad events. By no means are the calculators listed here inclusive of all possible calculators; instead they are offered as common examples. The decisions of the event supervisors will be final.

Class I - Stand-alone non-graphing, non-programmable, non-scientific 4-function or 5-function calculators

are the most basic type of calculators and often look like the one shown to the right. These calculators are limited to the four basic mathematics functions and sometimes square roots. These calculators can often be found at dollar stores.

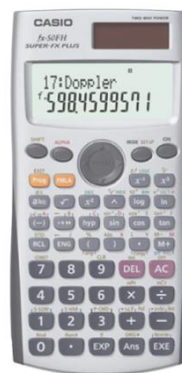


Class II - Stand-alone non-programmable, non-graphing calculators look like the calculator to the right or simpler. There are hundreds of calculators in this category but some common examples include: CASIO FX-260, Sharp EL-501, and TI-30X.



Class III- Stand-alone, programmable, graphing calculators and stand-alone non-graphing, programmable calculators, often look like the calculator shown on the right. Some examples are: Casio 975 0/9850/9860, HP 40/50/PRIME, and TI 83/84/89/NSPIRE/VOYAGE.

To identify a stand-alone non-graphing, programmable calculators Are look for the presence of the 'EXE' button, the 'Prog' button, or a 'file' button. Examples include but are not limited to: Casio Super FXs, numerous older Casio models, and HP 35S. A calculator of this type with the buttons labeled is shown to the right.



PROG Button



EXE Button

Class IV - Calculator applications on multipurpose devices (e.g., laptop, phone, tablet, watch) are not allowed unless expressly permitted in the event rule.





For Event Supervisors Only - Do Not Post EYE PROTECTION GUIDE

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

This resource was created to help teams comply with the Science Olympiad Policy on Eye Protection adopted on July 29, 2015 and posted on the Science Olympiad Website (soinc.org).

Participant/Coach Responsibilities: Participants are responsible for providing their own protective eyewear. Science Olympiad is unable to determine the degree of hazard presented by equipment, materials and devices brought by the teams. Coaches must ensure the eye protection participants bring is adequate for the hazard. All protective eyewear must bear the manufacturer's mark Z87. At a tournament, teams without adequate eye protection will be given a chance to obtain eye protection if their assigned time permits. If required by the event, participants will not be allowed to compete without adequate eye protection. This is **non-negotiable**.

Corresponding Standards: Protective eyewear used in Science Olympiad must be manufactured to meet the American National Standards Institute (ANSI) standard applicable at its time of manufacture. The current standard is ANSI/ISEA Z87.1-2015. Competitors, coaches and event supervisors are not required to acquire a copy of the standard. The information in this document is sufficient to comply with current standards. Water is not a hazardous liquid and its use does not require protective eyewear unless it is under pressure or substances that create a hazard are added.

Compliant Eyewear Categories: If an event requires eye protection, the rules will identify one of these three categories. Compliance is simple as ABC:

CATEGORY A

- Description: Non-impact protection. They provide basic particle protection only
- Corresponding ANSI designation/required marking: Z87
- Examples: Safety glasses; Safety spectacles with side shields; and Particle protection goggles (these seal tightly to the face completely around the eyes and have direct vents around the sides, consisting of several small holes or a screen that can be seen through in a straight line)

CATEGORY B

- Description: Impact protection. They provide protection from a high inertia particle hazard (high mass or velocity)
- Corresponding ANSI designation/required marking: Z87+
- Example: High impact safety goggles

CATEGORY C

- Description: Indirect vent chemical/splash protection goggles. These seal tightly to the face completely around the eyes and have indirect vents constructed so that liquids do not have a direct path into the eye (or no vents at all). If you are able to see through the vent holes from one side to the other, they are NOT indirect vents
- Corresponding ANSI designation/required marking: Z87 (followed by D3 is the most modern designation but, it is not a requirement)
- Example: Indirect vent chemical/splash protection goggles

Examples of Non-Compliant Eyewear:

- Face shields/visors are secondary protective devices and are not approved in lieu of the primary eye protection devices below regardless of the type of vents they have.
- Prescription Glasses containing safety glass should not be confused with safety spectacles. "Safety glass" indicates the glass is made to minimize shattering when it breaks. Unless these glasses bear the Z87 mark they are not approved for use.

Notes:

1. A goggle that bears the Z87+ mark and is an indirect vent chemical/splash protection goggle will qualify for all three Categories A, B & C
2. VisorGogs do not seal completely to the face, but are acceptable as indirect vent chemical/splash protection goggles