SCIENCE OLYMPIAD™

Exploring the World of Science

Division B Rules Manual

Division B (Gr. 6-9)

WELCOME TO THE 2026 SCIENCE OLYMPIAD!

This Rules Manual will help you prepare to compete in Invitational, Regional, State and National Tournaments held across the United States annually. Each Science Olympiad event has a corresponding page on the Science Olympiad national website complete with free resources, training handouts and useful links. All users of this manual are subject to the Terms of Use Agreement. To compete, users must first join the Science Olympiad program in their home state and become registered members.

See our website for info on Membership, Policies and Terms of Use at www.soinc.org

Division C (Grades 9-12) Membership Rules

A team may have up to fifteen (15) members. A maximum of seven (7) 12th grade students is permitted on a Division C team.

Division B (Grades 6-9) Membership Rules

A team may have up to fifteen (15) members. A maximum of five (5) 9th grade students is permitted on a Division B team. Because middle schools that do not have grades 7, 8 or 9 are at a slight disadvantage, they may invite any combination of up to five (5) of their last year's 6th, 7th or 8th grade students to be part of the team. Possible examples can be found on the Science Olympiad website.

Students Below Grade Level Designations

Science Olympiad encourages students to participate in the Division that matches current Science Olympiad grade level designations. However, to support the inclusion of students who wish to participate in Science Olympiad, schools with grade levels lower than those stated in a Division are permitted to invite members below the grade level designations. Participation is limited to age-appropriate events (as determined by a coach, principal or tournament director) and prohibited where safety is a concern (such as the use of chemicals). See Team Qualifications for more information.

Science Olympiad Team Membership

Science Olympiad requires that all teams (up to 15 members) competing in any Science Olympiad Tournament (Invitational, Regional, State or National) must be a member of Science Olympiad and pay the national fee (currently $75, paid as part of the state membership). There is no exception to this requirement, regardless of what teams from the same school are called (Varsity, JV, Alternate Team, Extra Team, Team Two, Team B). No school, region or state Science Olympiad organization is allowed to alter or amend these national membership requirements. Please see the Science Olympiad Copyrights and Use Statement outlining use of Science Olympiad Rules and procedures at sanctioned tournaments.

Find more Science Olympiad team information under the Policies section of the national website: Code of Ethics & Rules, Scoring Guidelines, Home & Virtual Schools, Small Schools, All Stars, Copyrights and Use, Lasers, Building Policy, Eye Protection, Significant Figures and Wristband Procedures.

SCIENCE OLYMPIAD
DIVISION B RULES MANUAL

Table of Contents

- Please read the General Rules on the next page as they apply to all events. Note: all changes are in bold.
- Please visit the official Science Olympiad web site: www.soinc.org for Membership Information, Team Size Requirements, Rules Corrections, Rules Clarifications, New Store Items, news, tips, resources, and other valuable information.

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 as outlined in the 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, rule corrections and rule clarifications 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. During the tournament, participants are only permitted to practice with any built or designed device at a Tournament event venue prior to competing if the Tournament Director makes the facilities open to all teams to practice.
6. 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.
7. 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.

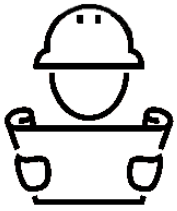
EVENT TYPE DESCRIPTIONS

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

While a Science Olympiad tournament typically consists of 23 different events, those 23 events can be classified into one of four event types. This information is being provided so that Science Olympiad participants more easily can identify events that they may enjoy competing in regardless of the event content, coaches can approach coaching from the perspective of event type as opposed to event content, and teams can be aware of how the format of the tournament they are intending to compete may affect available events. The symbol to the left of each description has been added to the upper right-hand corner of each Event Rule to identify the event by event type.

Core Knowledge Event: An event where participants are given a set of topics that they are expected to research and master the factual content. Mastery is demonstrated at a tournament by taking a paper-pencil, station, or computer test.

Core Knowledge Events can be run regardless of the tournament format that has been chosen by the Tournament Director.



Build Event: An event where participants are given some specifications about a device or object they are expected to design, create, and test in advance of the tournament. The devices or objects are often modified on site to account for an unknown parameter prior to testing or evaluation.

In some cases, Build Events may or may not be run depending upon the format of Science Olympiad tournament being conducted. The Tournament Director will make these decisions to ensure safety and fairness for all teams. If a Build Event is not to be run at a tournament, the Tournament Director will notify all teams in advance of the given tournament.

Laboratory/Hands-On Event: An event where participants are given a general topic in which they will be expected to deepen their content knowledge of the topic and associated research techniques prior to the tournament. At the tournament they will be assessed by the completion of a hands-on task, which may or may not require a written report, within a defined timeframe.

Depending upon the format of Science Olympiad Tournament being held, there may be some alterations to or cancelation of Lab Events. To the greatest extent possible, Tournament Directors will work to ensure Lab Events are conducted; though, that may mean in some cases participants will be working with previously collected data and hands-on activities will be omitted. The Tournament Director will make these decisions to ensure safety and fairness for all teams. If a Lab Event is altered or not to be run at a tournament, the Tournament Director will notify all teams in advance of the given tournament.

Hybrid Event: An event which contains elements from two, or more, of the above event types in combination. The most common combination mixes elements of a Core Knowledge event with elements of a Building or Lab event.

As with the previous events, Hybrid Events may be altered to fit the format of the Science Olympiad Tournament being held. This may mean that Lab or Build elements of the event are modified or not conducted. The Tournament Director will make these decisions to ensure safety and fairness for all teams.

If a Hybrid Event is not to be run at a tournament, the Tournament Director will notify all teams in advance of the given tournament.

ANATOMY & PHYSIOLOGY B

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

1. **DESCRIPTION:** Participants will be assessed on their understanding of the anatomy and physiology for the **nervous, special senses, and endocrine systems of the human body.**

   A TEAM OF UP TO: 2 **APPROXIMATE TIME: 50 minutes**

   CALCULATOR: Class II

2. **EVENT PARAMETERS:**
   a. Each team may bring writing utensils.
   b. Each team may bring two Class II calculators.
   c. Each team may bring one (1) 8.5" x 11" sheet of paper that may contain information on both sides in any form and from any source. The sheet of paper may be laminated or placed in a sheet protector to increase durability. Affixed labels, as well as multiple sheets of paper (whether in a single sheet protector or not) are prohibited.
3. **THE COMPETITION:** This Event may be administered as a written test or as a series of lab-practical stations which can include but are not limited to experiments, scientific apparatus, models, illustrations, specimens, data collection and analysis, and problems for students to solve. **Content topics will include:**
   a. **Nervous System: All levels should understand:**
      i. Central Nervous System (CNS)
         (1) The Brain: understand the detailed structure and function of the cerebrum and its role in cognition, sensation, movement, memory, and language. Understand a general overview of structure and function of the cerebellum and brainstem
         (2) Spinal Cord: Understand a general overview of organization of the spinal cord and nerve roots.
      ii. Identification of simple encephalographic waveforms
      iii. Neural Physiology - understand cellular anatomy and physiology of neurons, compare the types of glial cells and their respective functions, identify and understand synapses and neurotransmitters, action potential generation and propagation, ionic basis of the cellular membrane potential
      iv. Peripheral Nervous System – neural ganglia, action and physiology of sensory and motor neurons, organization of sympathetic and parasympathetic neurons, understand differences in and purposes of parasympathetic, sympathetic, somatic, and sensory systems, reflex arc physiology
      v. Disorders: Epilepsy, Alzheimer's Disease, Multiple Sclerosis, Parkinson's Disease, Cerebral Palsy, Stroke, Amyotrophic Lateral Sclerosis (ALS)
      vi. Effects of the drugs: alcohol, caffeine, nicotine, and marijuana on the nervous system

   State & National Level Only:
      vii. The Brain: Understand the detailed structure and function of the brainstem and cerebellum, including specific nuclei clusters and tracts.
      viii. Cranial Nerves: Understand cranial nerve pathways, classification, and clinical assessments of their functions.
      ix. Spinal Cord: Understand the detailed structure and function of the spinal cord, including specific ascending and descending tracts and their respective roles in sensation and motor function, as well as clinical assessments of their functions.
      x. General Senses: Understand the mechanisms for the general senses of touch, pressure, pain, temperature, itch, and proprioception and their relation to spinal cord tracts and the peripheral nervous system.

   National Level Only:
      xi. The Brain: Understand the detailed structure and function of the cerebral vasculature, including the internal carotid arteries, vertebral arteries, basilar artery, Circle of Willis, anterior cerebral artery (ACA), middle cerebral artery (MCA), posterior cerebral artery (PCA), superior cerebellar artery (SCA), anterior inferior cerebellar artery (AICA), and posterior inferior cerebellar artery (PICA).
      xii. Treatments and prevention for all conditions listed above (risk factors, medications, surgical treatment, etc.)

b. **Special Senses: All levels should understand**
   i. Anatomy and Physiology of Sight
      (1) Identify and describe the major parts of the eye: cornea, lens, iris, pupil, retina, optic nerve, and their functions.
      (2) Explain how light enters the eye and is focused on the retina, and the role of rods and cones in detecting light and color.
   ii. Anatomy and Physiology of Hearing and Balance
      (1) Identify the major parts of the ear: outer ear (pinna, ear canal), middle ear (eardrum, ossicles), inner ear (cochlea, semicircular canals) and their functions.
      (2) Describe how hair cells and the cochlea detect sound frequency and amplitude
      (3) Describe the semicircular canals and vestibular system in the inner ear and how they contribute to balance and spatial orientation.
   iii. Anatomy and Physiology of Smell
      (1) Identify the major structures involved in smell: the nasal cavity, olfactory epithelium, olfactory receptor cells, and olfactory bulb.
      (2) Describe how odor molecules bind to olfactory receptors in the nasal cavity, initiating the sense of smell.
   iv. Anatomy and Physiology of Taste
      (1) Identify the major structures involved in taste: tongue, taste buds, papillae, taste receptor cells, and gustatory nerves.
   v. Disorders: myopia, hyperopia, presbyopia, nyctalopia, astigmatism, conjunctivitis, color blindness, otitis externa, otitis media, types of deafness, anosmia/dysosmia, dysgeusia

State & National Level Only:

   vi. Anatomy and Physiology of Sight
      (1) Explain the pathway of visual signal transmission from the retina through the optic nerve, optic chiasm, and optic tracts to the lateral geniculate nucleus (LGN) and visual cortex.
      (2) Describe how the visual fields are processed in each hemisphere of the brain and how damage at different points along this pathway (e.g., optic nerve, optic chiasm, optic tract) can lead to specific visual field defects like monocular blindness, bitemporal hemianopia, or homonymous hemianopia.

National Level Only:

   vii. Anatomy and Physiology of Sight
      (1) Describe the neural pathway involved in pupillary control, including the role of the pretectal nucleus, Edinger-Westphal nucleus, and oculomotor nerve in the pupillary light reflex.
      (2) Explain how light entering the eye triggers constriction of the pupil (miosis) through the parasympathetic system, and how dilation (mydriasis) occurs via the sympathetic pathway.
   viii. Additional Disorders: Diabetic Retinopathy, Macular Degeneration, Glaucoma, Otosclerosis, Presbycusis, Meniere's Disease
   ix. Treatments and prevention for all conditions listed above (risk factors, medications, surgical treatment, etc.)

c. **Endocrine System: all levels should understand**
   i. Identify and compare and contrast three classes of hormones – steroids, peptides, and amines
   ii. Understand the mechanisms of hormone action – nuclear vs. cytoplasmic
   iii. Endocrine related problems – hypersecretion, hyposecretion
   iv. Identify, compare, and contrast hormones and their respective functions secreted by the hypothalamus, pituitary gland, pineal gland, thyroid, parathyroid, thymus, adrenal glands, pancreas, and gonads.
   v. Disorders: diabetes mellitus, hypoglycemia, hyperthyroidism (including Graves' disease), hypothyroidism (including Hashimoto's disease), goiter

State & National Level Only:

   vi. Identify hormones and their respective function secreted by additional organs (limited to the liver, kidneys, heart and adipose tissue)
   vii. Endocrine cycles and negative feedback, Autonomic nervous system control of endocrine function
   viii. Additional Disorders: Cushing's Syndrome, Addison's Disease

National Level Only:

ix. Explain the endocrine system's role in the stress response
x. Additional Disorders: Myxedema, Acromegaly
xi. Treatments and prevention for all conditions listed above (risk factors, medications, surgical treatment, etc.)

4. **SCORING:**
   a. High score wins.
   b. Selected questions will be used to break ties.

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

B

BOOMILEVER B

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

1. **DESCRIPTION:** Teams will design and build a cantilevered beam or truss structure that extends from a vertical Testing Wall and supports a load at a specified distance from the Testing Wall. The structure must meet the requirements specified in these rules to achieve the highest score, which is a combination of structural efficiency and Load Scored Bonus.

   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 10 minutes

   EYE PROTECTION: B

2. **EVENT PARAMETERS:**
   a. Only one Structure designed and built by the team may be entered, built prior to competition.
   b. Eye Protection B protective eyewear must be worn during competition (required ANSI marking: Z87+).
   c. Design Knowledge: Participants must be able to answer questions on design, construction & operation.
   d. Test Apparatus will be supplied by the Event Supervisor. Participants may not measure or adjust Test Apparatus or bring any equipment, tools or instruments.

3. **CONSTRUCTION PARAMETERS:**
   a. Single Structure: no separate, loose or detachable parts or pieces.
   b. The structure is constructed of wood, bonded by adhesive (7.a. – 7.d.). No other materials permitted.
   c. Structure attaches to the testing wall by resting on the Mounting Bolt Assembly (6.b.v.).
   d. Structure supports only the Loading Block of the Loading Assembly (6.c.i.) which supports the balance of the Loading Assembly.
   e. Structure supports the Loading Assembly (6.c.) with the centerline of the chain being:
      i. at least 40 cm but no more than 45 cm when measured horizontally from the Testing Wall (6.b.).
      ii. no more than 2-1/2 cm horizontally from either side of a perpendicular line extending from the centerline of the Testing Wall.

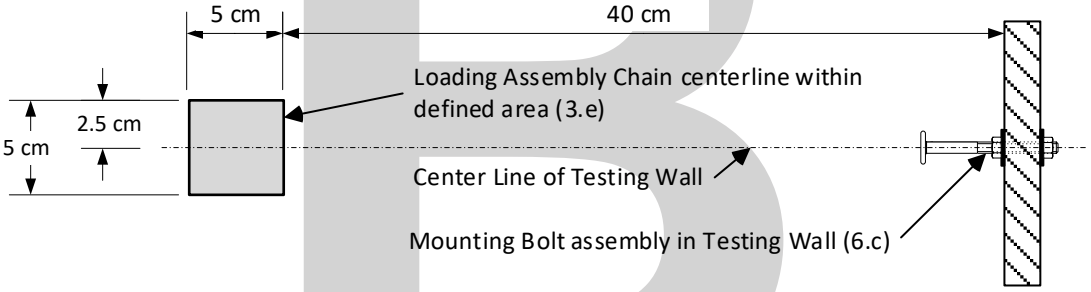


Figure 1: Top view of Test Wall (not to scale)

   f. During the Competition testing, the Boomilever may ONLY touch the Testing Wall INSIDE the Vertical Contact Width Lines.
   g. Base vs. Load Scored Bonus Options:
      i. Base Option:
         (1) During the Competition testing, the Boomilever may ONLY touch the Testing Wall BETWEEN the 15 cm and 20 cm Horizontal Contact Depth Lines (6.b.) and
         (2) Prior to loading sand, the bottom of the Loading Block must be supported ABOVE the horizontal plane extending from the 20 cm Horizontal Contact Depth Line (6.b).
      ii. - OR - Load Scored BONUS option scored if the following requirements are met in place of 3.g.i.:
         (1) During the Competition testing, the Boomilever may ONLY touch the Testing Wall ABOVE the 15 cm Horizontal Contact Depth Line (6.b.) and
         (2) Prior to loading sand, the bottom of the Loading Block must be supported ABOVE the horizontal plane extending from the 15 cm Horizontal Contact Depth Line (6.b.) and
         (3) The structure must hold 15 kg.

4. **COMPETITION:**
   a. Prior to competition, the Event Supervisor will:
      i. Verify all Test Apparatus are available and properly set-up per section 6.
      ii. Verify the mass of the Loading Assembly meets requirements of 6.c.v.
      iii. Verify that the combined mass of the Loading Assembly (6.c.) and sand (6.d.) is at least 15,100 g. but no more than 15,200 g.

b. Check-in:
   i. Once participants begin check-in they may NOT leave or gain any outside assistance, materials or communications (including cell phone communication) until Testing is completed.
   ii. No alterations may be made once check-in begins.
   iii. Event Supervisor or Assistant will begin check-in:
      (1) Verify participants have proper Eye Protection (2.b.).
      (2) Inspect Structure design and construction materials (3.a., 3.b.).
      (3) Teams will submit their Estimated Load Supported (4.c.vi.) to be used as a tie breaker (5.e.).
      (4) Participants place structure on the Structure Scale (6.f.) so the Event Supervisor or Assistant can determine the structure mass to the nearest 0.01 gram or best precision available.

c. Testing
   i. Teams will have 6 minutes to set up and test their Structure on the Testing Wall with the Loading Assembly. If necessary, participants may disassemble the Loading Assembly but must reassemble in the same order as presented by the Event Supervisor (6.c.). The bucket must be mounted to allow enough clearance above the floor for the bucket to tilt or the Structure to deflect.
   ii. The Event Supervisor will check before loading with sand begins:
      (1) Conformity to the requirements 3.c., 3.d., 3.e., 3.f.
      (2) Conformity to requirements 3.g.i. or 3.g.ii. to determine if structure meets construction requirements for Load Scored Bonus.
      (3) The bucket is suspended to have clearance above the floor for testing.
   iii. Structure may not be adjusted once loading of sand has begun.
   iv. Participants will load sand. Bucket may only be stabilized from movement by the tips of Bucket Stabilizing Sticks (6.e.).
   v. Loading stops immediately when the Structure fails, the load is supported by anything other than the Structure, or time expires. At the Supervisors discretion, sand may be removed from the bucket if pouring continued after the Structure fails or time expires.
   vi. Load Supported is determined and recorded to the nearest gram. Load Supported is the combined mass of the Loading Assembly (6.c.) and Sand (6.d.) in the Bucket, with any parts of the Structure in the Bucket removed prior to measurement.
   vii. The Minimum Load Supported is the mass of the Loading Assembly (6.c.). If a Structure cannot hold the Loading Assembly (6.c.), the Structure is placed in Tier 3, unable to be loaded.
   viii. The Maximum Load Supported is 15,000 g.
   ix. Test Data Review. The Event Supervisor will review with the team the data recorded on their scoresheet. Once data is acknowledged by the team, the Testing is complete.
   x. Teams who wish to file an appeal must leave their structure with the Event Supervisor.

5. **SCORING:**
   a. High Score Wins. Score = Load Scored (5.c.)/ Structure Mass (4.b.iii.4.).
   b. Load Scored Bonus: meeting the Load Scored BONUS construction parameters (3.f.ii.). Bonus = 5,000 g.
   c. Load Scored = Load Supported (4.c.vi.) + Load Scored Bonus (5.b.).
   d. Structures will be placed in one of 3 tiers.
      i. Tier 1: meeting all construction and competition requirements.
      ii. Tier 2: NOT meeting any one or more of the construction and/or competition requirements.
      iii. Tier 3: Unable to be loaded, not supporting the minimum load (4.c.vii.), or no eye protection. Ranked by the mass of the structure from lowest structure mass to heaviest.
   e. Tiebreakers
      i. Estimated Load Supported: closest to actual load supported.
      ii. Lowest Structure mass.

6. **TEST APPARATUS:**
   a. In-Person tournaments: The Event Supervisor will provide all Test Apparatus. At the Event Supervisor's discretion, more than one Test Apparatus may be used.
   b. The Testing Wall
      i. Solid and rigid surface at least 40.0 cm wide x 30.0 cm high. Constructed of ¾" grade plywood or other suitable material, with a smooth, hard, low friction surface that does not bend when loaded. The Testing Wall must be adjusted to be plumb vertical by the Event Supervisor utilizing a 9" torpedo level or similar method.

ii. One Mounting Bolt hole no larger than 0.266-inch diameter must be drilled through the wall located approximately 5.0 cm below the top of the Testing Wall and halfway between the sides of the wall. The horizontal and vertical centerlines of the Mounting Bolt hole must be marked on the face of the Testing Wall.

iii. Horizontal Contact Depth Lines must be clearly visible on the Testing Wall. They must be drawn at 10 cm, 15 cm, and 20 cm and below the center of the Mounting Bolt hole.

iv. Two vertical Contact Width Lines must be clearly visible on the Testing Wall. They will be drawn 4.0 cm to the right and left side of the center of the Mounting Bolt hole.

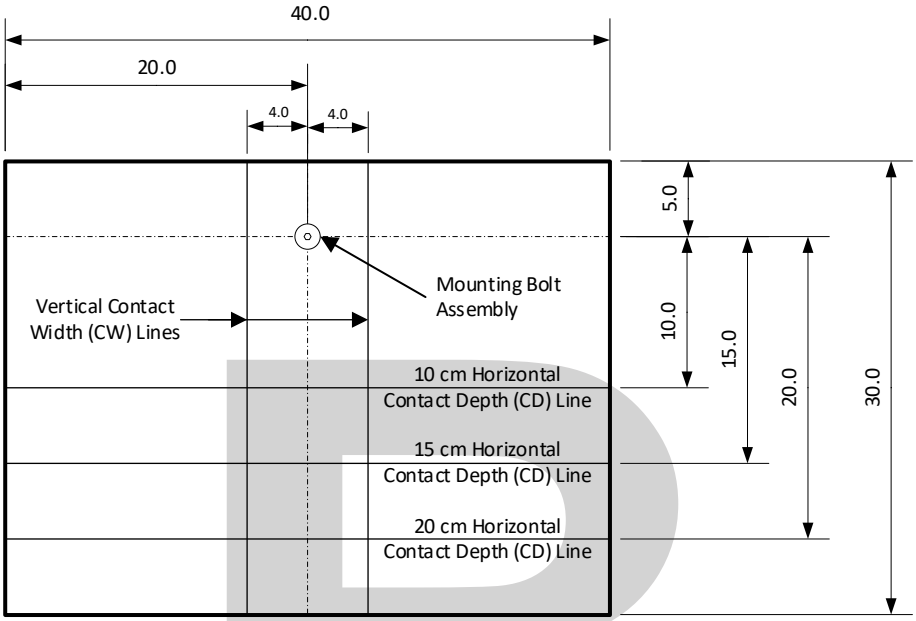


Figure 2 – Testing Wall (not to scale, dimensions in cm)

v. The Mounting Bolt Assembly

(1) The Mounting Bolt Assembly will consist of:

(a) Connector Bolt, ¼ -20 x 2.36 inches (60 mm) long, with a 0.66-inch (17 mm) diameter head and 0.78 inch (20 mm) unthreaded section, 1 required.

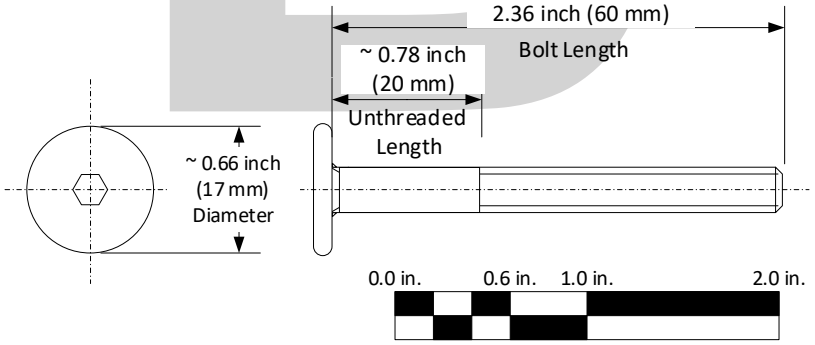


Figure 3 - Connector Bolt, ¼ -20 x 2.36 inches (60 mm) long

(b) Hex Nut, American National Standard, 1/4 – 20, 0.23-inch-thick maximum, 2 required.

(c) Flat Washer, USS ¼ inch, approx. 3/4 inch outside diameter x 0.09-inch-thick maximum, 2 required.

(2) The Mounting Bolt Assembly will be secured in place on the Testing Wall by the Event Supervisor as follows:

(a) The Connector Bolt will have a hex nut and flat washer on the front side of the Testing Wall and a hex nut and flat washer on the back side of the Testing Wall.

(b) Connector Bolt is installed to allow 3.0 cm +/- 0.1 cm (1.18 inch +/- 0.03 inch) clearance between the closest face of the Connector Bolt to the Testing Wall and the Testing Wall face (Figure 4).

(c) The nuts must be tightened firmly to hold the bolt in place during the competition.
(d) Teams may not adjust or disassemble the Mounting Bolt Assembly.

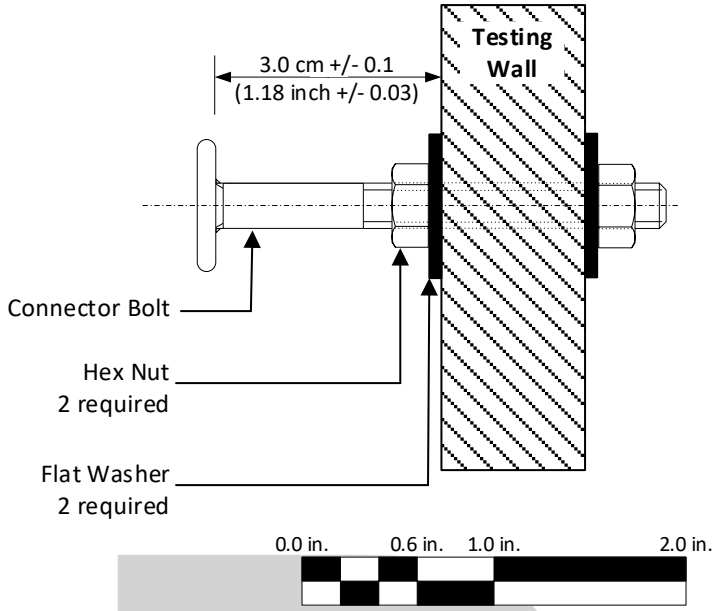


Figure 4 – Mounting Bolt Assembly in Testing Wall

c. The Loading Assembly will consist of:
   i. A square Loading Block measuring 5 cm x 5 cm x approximately 2 cm high with a hole no larger than 0.266-inch diameter drilled in the center of the 5 cm x 5 cm faces for a ¼" threaded eyebolt.
   ii. A ¼ inch threaded eyebolt (1-inch nominal eye outside diameter) with an overall length no longer than 3 inches, and a ¼ inch wing nut. The Loading Block must be mounted on the eye bolt and be trapped between the "eye" of the eye bolt and the wing nut.

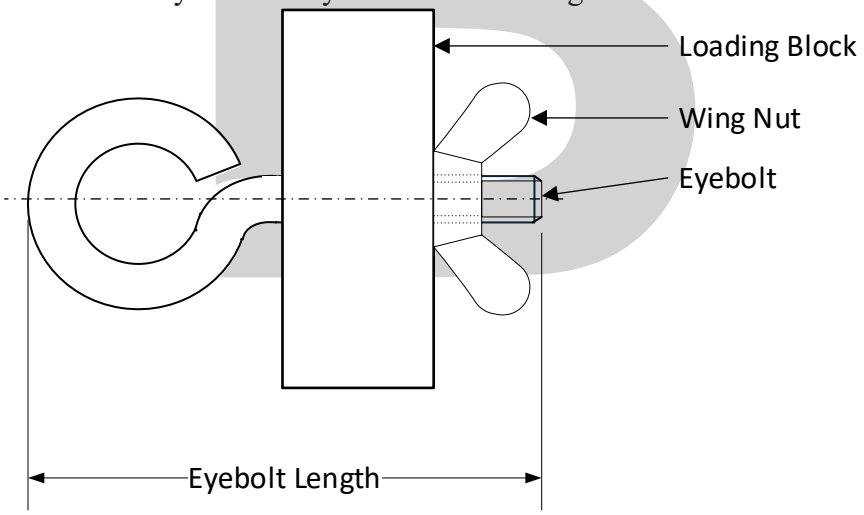


Figure 5 – Loading Block with eyebolt and wing nut (not to scale)

   iii. A chain and S-hook that are suspended from the eyebolt on the Loading Block.
   iv. A five-gallon plastic bucket with handle and hook to be suspended from the chain.
   v. The total combined mass of the Loading Assembly may not exceed 1,500 g.

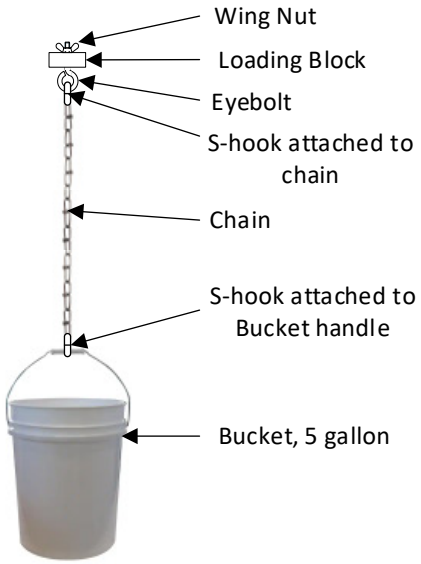


Figure 6 – Loading Assembly (not to scale)

d. Sand: Load will be applied using sand.
e. Two (2) Bucket Stabilizing Sticks each made from a piece of ½" dowel approximately 18 inches long with a spring-type doorstop screwed into one end.

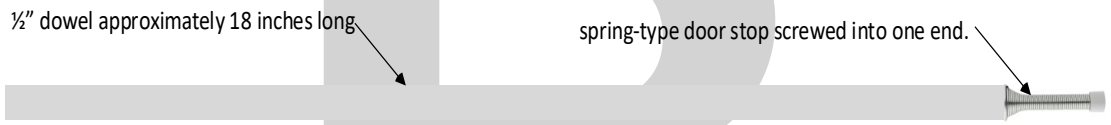


Figure 7 – Stabilizing Stick (not to scale)

f. Structure scale: Must be a digital scale. The scale is recommended to have a minimum range of 0 to 100 grams with a recommended resolution of 0.01 gram and minimum resolution of 0.1 grams.
g. Sand scale and load verification: Must be a digital scale. The scale is recommended to have a range of 0 to 25,000 grams and a minimum range of 0 to 16,000 grams. The scale is recommended to have a resolution of 1 gram and a minimum resolution of 10 grams.

7. **DEFINITIONS:**

a. *Wood* is defined as the hard, fibrous substance making up the greater part of the stems, branches, trunks, and roots of trees beneath the bark. Wood does NOT include bark, particleboard, wood composites, bamboo or grasses, paper, commercially laminated wood (i.e., plywood), or pieces formed of sawdust, wood shavings, and adhesive. Wood may never be painted, soaked, or coated in glue, chemically modified, color enhanced, or have tape/preprinted/paper labels affixed. Ink barcodes or markings from the construction process may be left on the wood.
b. *Wood Size:* There are no limits on the cross-sectional sizes of individual pieces of wood.
c. *Lamination:* multiple layers of wood may be glued together by the team without restriction. Commercially laminated wood is not allowed.
d. *Adhesive* is a substance used to join two or more materials together and may be used only for this purpose. Any commercially available adhesive may be used (e.g., glue, cement, cyanoacrylate, epoxy, hot melt, polyurethane, and super glue). Adhesive tapes are not allowed.
e. *Connector Bolt* can be found at several stores including Ace Hardware, Fleet Farm, Home Depot, Lowes, Menards, and Amazon. The bolt is sold under the following brand names: Hillman, Everbilt, and Midwest Fastener. The Connector Bolt is typically in the specialty fasteners section in a drawer labeled "Furniture Parts". The bolt comes in at least 4 finishes: Black, Brass, Bronze and Nickel. The black finish being preferred, but any of the listed finishes may be used.
f. *Sand* is defined as a clean, dry, free-flowing material of a similar density and flowability characteristics to play sand.

This event is supported by Cleveland-Cliffs Foundation and SkyCiv

CIRCUIT LAB B

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

1. **DESCRIPTION:** Participants must complete tasks and answer questions about electricity and magnetism.
   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes
   CALCULATOR: Class III

2. **EVENT PARAMETERS:**
   a. Each team may bring a collection of notes and resources, written/printed on paper, of any size containing information in any form and from any source. Binders, notebooks, folders, sheet protectors, lamination, tabs, and labels are permitted. Participants are responsible for organizing and containing their notes efficiently. They may separate or remove the pages from containers for use during any part of the event.
   b. Each team may also bring writing utensils and two Class III calculators for use during any part of the event.
   c. Event Supervisors must provide all supplies and measurement devices required for the hands-on tasks.
   d. Participants may bring their own basic multimeters for use in place of provided ones at the discretion of the Event Supervisor.

3. **THE COMPETITION:**

Part I: Written Test

   a. The written test will assess the team's knowledge of electricity and magnetism.
   b. Unless otherwise requested, answers must be in metric units with appropriate significant figures.
   c. The test will consist of at least one question from each of the following areas only:
      i. Properties of electric charges/fields, sources/hazards of static electricity, Coulomb's Law, capacitance
      ii. Direct current (DC) characteristics, sources, uses, DC hazards
      iii. Alternating current (AC) characteristics, sources, uses, AC hazards, common household AC components
      iv. Concepts and units of current, voltage, resistance, power, energy, and using Ohm's law
      v. Magnetic poles/fields, electromagnets, transformers, motors/generators, right-hand rule
      vi. Electrical control devices including switches, relays, fuses, ground fault circuit interrupters, and breakers
      vii. Simple calculations, constructions, and configurations of a circuit and individual components, including simple circuit diagrams
      viii. Historical perspective of the electricity and magnetism discoveries made by Ampere, Coulomb, Kirchhoff, Volta, Ohm, Tesla, & Faraday
      ix. States/Nationals only:
         (1) Simple circuit analysis using Kirchhoff's Voltage & Current Laws
         (2) Fundamental characteristics and operation of a light emitting diode (LED)
   d. Topics not included in the competition are: semiconductors (beyond those listed above), AC circuit theory, frequency analysis, inductance, calculations involving direct use of calculus and/or differential equations, non-linear devices, 3 Phase Power, and oscilloscopes.

Part II: Hands-On Tasks

   a. The hands-on portion will consist of at least one task for the teams to complete.
   b. Participants must be familiar with the operation of breadboards and multimeters and how to use them. Participants may ask event supervisors for details of the internal wiring of any breadboards used for the tasks.
   c. The hands-on tasks, or stations, may include but are not limited to:
      i. Determine the value of a mystery resistor in a circuit using only voltage measurements.
      ii. Calculate the power supplied to a circuit.
      iii. Given some wires, batteries, resistors, and 2 LEDs, hook them up so the LEDs are equally bright.
      iv. Construct an electromagnet using some wire, a bolt and battery.
      v. Given a USB charger, read the label and provide details of the various output power levels it can provide and calculate how long it would take to charge a specific battery.

4. **SCORING:**
   a. High score wins.
   b. Points will be awarded for correct answers, measurements, calculations, and data analysis.
   c. The written portion of the competition will account for 50-75% of each team's score.
   d. The hands-on portion of the competition will account for the remaining 25-50% of each team's score.
   e. Ties will be broken using pre-selected task(s)/question(s) that may be noted on the written test.

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

CODEBUSTERS B

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

1. **DESCRIPTION:** Teams will cryptanalyze and decode encrypted messages using cryptanalysis techniques for historical and modern advanced ciphers.

   A TEAM OF UP TO: 3 **APPROXIMATE TIME:** 50 minutes

   CALCULATOR: Class II

2. **EVENT PARAMETERS:**
   a. Teams must bring writing utensils and may bring up to three Class I or Class II calculators
   b. No resource materials **or other tools**, except those provided by the Event Supervisor, may be used.
   c. The Event Supervisor will provide scratch paper for each team to use.
   d. The exam packet must be printed single-sided to facilitate separation and writing answers by individual team members. Using a separate answer sheet is not recommended.
   e. The exam packet will include a copy for each team member of a resource sheet with the Morse Code Table, English/Spanish letter frequencies, Porta Table, Atbash Table, Baconian mappings, and modulus inverse tables as needed for the questions on the exam.

3. **THE COMPETITION:**
   a. This event consists of participants decrypting ciphertext on a written or computer based exam.
   b. Teams will begin the event simultaneously at the indication of the Event Supervisor.
   c. Teams must not open the exam packet nor write anything prior to the "start" signal, nor may they write anything after the "stop" signal.
   d. Participants are allowed to separate the pages of the test to be free to answer the questions in any order, working individually or in groups, attempting whichever of the questions seem right for them.
   e. The code types that may be used at Division B Regional Tournaments are as follows:
      i. Monoalphabetic substitution using **K1 or** random alphabets as defined by the American Cryptogram Association (ACA) with or without a hint
         (1) **Aristocrats - ciphertext with spaces included.**
         (2) **Patristocrats - ciphertext with spaces removed and letters grouped in sets of 5 encoded using a K1 alphabet.**
      ii. The Baconian Cipher - decrypting ciphertext encoded with the a and b values represented as one or more letters, glyphs, symbols, or character rendering variations (e.g., bold, underline, italic). **Word Baconian Ciphers will include a "crib" of at least 4 plaintext letters.**
      iii. Xenocrypt **(maximum of 1) - a message in Spanish encoded using a K1 English keyword alphabet.**
      iv. Cryptanalysis of the Fractionated Morse Cipher - decrypting Morse code ciphertext encoded as letters and spaces with a "crib" of at least 4 plaintext characters.
      v. Cryptarithms - determining mapping values to letters in base 10 (decimal) mathematical equations and decoding a word or phrase using that mapping.
      vi. The Porta Cipher - Decrypting ciphertext given a key.
      vii. Cryptanalysis of the Complete Columnar Transposition Cipher - Decrypting ciphertext encoded in 9 columns or less given a "crib" which is no shorter than one less than the number of columns used.
      viii. The Nihilist Cipher - Decrypting ciphertext given the keys.
      ix. The Atbash Cipher (In English, not Hebrew).
      x. The Caesar Cipher, also called a shift cipher.
      xi. The Affine Cipher - Decrypting ciphertext given the a and b values.
      xii. **The 5x5 Checkerboard Cipher - Decrypting ciphertext given the Polybius key.**
   f. The code types that may be used on the exam at State and National competitions are as follows:
      i. All Regional code types.
      ii. Xenocrypt - at the State and National levels, at least one cryptogram **and no more than two** will be in Spanish **encoded using a K1 English keyword alphabet**.
      iii. Cryptanalysis of the Porta Cipher with a "crib" of at least 3 plaintext characters.
      iv. Cryptanalysis of the Affine Cipher with a "crib" of at least 2 plaintext characters.
      v. Cryptanalysis of the Nihilist Cipher with a "crib" that is no shorter than **double the length of** the keyword used.
      vi. **Cryptanalysis of the 5x5 Checkerboard Cipher encoded with two 5-letter keywords and a Polybius key given a "crib" of at least 5 characters.**

g. For Aristocrats, Patristocrats, and Xenocrypts, no letter can ever decrypt to itself.
h. The first question of the exam will be timed.
   i. The first question will be the decoding of an Aristocrat as defined by 3.e.i.(1).
   ii. A team member should signal when his or her team has broken the cryptogram.
   iii. Before the exam begins, the Event Supervisor will announce the nature of the signal that must be used (e.g., shouting "time", or quietly raising hand).
   iv. The time in seconds, to the precision of the device used, to solve the cryptogram will be recorded by the Event Supervisor or designee.
   v. If a team gets the timed question wrong, they may attempt to answer the question repeatedly without penalty. The timing bonus will be calculated from the start of the event until the question is successfully answered by the team with two or fewer errors, or until 10 minutes have elapsed. After 10 minutes, the timed question can still be answered but the timing bonus is zero.
i. Up to three questions which are not aristocrats, patristocrats, or xenocrypts will be marked on the exam as special bonus questions. **At least one special bonus question will use the 5x5 Checkerboard Cipher (3.e.xii. or 3.f.vi.).**
j. For Cryptanalysis problems providing a "crib" (3.e.ii., 3.e.iv., 3.f.iii., 3.f.iv., 3.f.v., 3.f.vi.) with the exception of the Complete Columnar Cipher (3.e.vii.), the placement of the "crib" on the ciphertext will be clearly identified.

4. **SCORING:**

a. The high score wins. Final Score = Exam Score + Timing Bonus + Special Bonus.
b. The scores for each question will be added together to determine the exam score.
c. Unless otherwise specified, the final points will be determined based on the number of errors found in the decoded plaintext as is appropriate to the question.
   i. Two or fewer errors will be scored as correct and result in full credit.
   ii. Each additional error results in a penalty of 100 points but the penalty will not exceed the value of the question. For example, a 400-point question with 5 errors earns 100 points [400 - 3(100)] whereas the same 400-point question with 7 errors would earn 0 points, not -100 points.
d. For answers to Cryptarithm (3.e.v) problems, the final points will be determined based on the number of errors found in the decoded word or phrase:
   i. Zero errors are required for full credit.
   ii. Each error results in a penalty of 100 points but the penalty will not exceed the value of the question. For example, a 500-point question with eight (8) errors would earn 0 points, not -300 points.
e. A Timing Bonus can be earned based on the number of seconds it takes a team to correctly decode the first question. The timing bonus is equal to 2 x (600 - number of seconds). For example, 6 minutes = 2x (600-360) = 480 points.
f. A special Bonus can be earned by solving any of the questions marked as special bonus questions with no penalty points. The bonus will be awarded as follows: One solved = 150 points, Two solved = 400 points, All three solved = 750 points.
g. Scoring example: Team A earns 3600 points on the exam and solved the timed question in 435 seconds and solved one Special Bonus question

Exam Score	=	3600 points
+ Timing Bonus 2(600-435)	=	330 points
+ Special Bonus (One=150)	=	150 points
Final Score		4080 points

h. Tiebreakers: For teams that are tied, select questions predetermined by the Event Supervisor will be used to break the tie using the following criteria in this order: score, degree of correctness and number attempted.

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

CRIME BUSTERS B

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

1. **DESCRIPTION:** Given a scenario, a collection of evidence, and possible suspects, students will perform a series of tests. Test results along with other evidence will be used to solve a crime and answer questions.

A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes

EYE PROTECTION: C **CALCULATOR:** Class II

2. **EVENT PARAMETERS:**
   a. Each Participant may bring one 8.5" x 11" sheet of paper, which may be in a sheet protector sealed by tape or laminated, that may contain information on both sides in any form and from any source without any affixed labels.
   b. Each Participant may bring a Class II calculator.
   c. Each team may bring any or all of the items listed on the Division B Chemistry Events Lab Equipment List, posted on soinc.org. Each Participant may have a stand-alone non-programmable, non-graphing calculator (Class II). Teams not bringing these items may be at a disadvantage. The Supervisor will not provide them. Items not listed are prohibited. The Event Supervisors will check each team's equipment, confiscate non-allowed items, and have the right to penalize the team up to 10% if additional equipment is brought to the event.
   d. Participants must wear goggles, an apron or a lab coat and have skin covered from the neck down to the wrist and toes. Gloves are optional, but if the host requires a specific type they will notify teams. Pants should be loose fitting; if the host has more specific guidelines they will notify teams in advance of the tournament. Shoulder length or longer hair must be tied back. Participants removing safety clothing/ goggles or unsafely handling materials or equipment will be penalized or disqualified.
   e. The Supervisor will provide:
      i. Iodine reagent (I_2 dissolved KI solution)
      ii. 1M HCl
      iii. Chromatography materials plus containers
      iv. Waste container(s)
      v. Wash bottle with distilled water (no more than 250 mL)
   f. The Supervisor may provide:
      i. Other equipment (e.g., microscope, probes, calculator, etc.)
      ii. Candle & matches if fibers given
      iii. Differential density solutions or other method of determining density of polymers if plastics given
      iv. Reagents to perform additional tests

3. **THE COMPETITION:**
   a. The competition will consist of evidence from Parts 3.c.-f. and analysis of the evidence in Part 3.g. Analysis or questions can only be on the evidence topics included in the competition. The amount of evidence included will be according to the following table:

Level	Part 3.c. (i-iii)	Limit on Mixtures from Part 3.c.i only	Part 3.d.	Part 3.e.	Part 3.f.	Part 3.g.
Regional	6-15	Up to 2 of 2 solids with *	5-7	1 type	1-2 topics	Required
State	10-18	2-4 of 2-3 solids with *	7-10	1-2 types	2-3 topics	Required
National	14-20	2-6 of 2-3 solids with *	10-15	1-3 types	2-4 topics	Required

   b. The collected evidence and other data given may be used in a mock crime scene.
   c. Qualitative Analysis: Participants will identify evidence (unknowns) by performing tests such as solubility, acidity, magnetic property, color, density, and odor. Every team will have the same set of unknowns (evidence). The scenario will identify which containers hold mixtures and if the mixtures are made of two or three materials. The unknown common materials will be taken from the following lists.

i. Solids: Anhydrous sodium acetate, yeast, vitamin C (ascorbic acid), *calcium carbonate (powdered limestone), *table salt (NaCl), *sugar (crystal), *flour, *calcium sulfate dihydrate (gypsum), *cornstarch, *baking soda, *powdered gelatin, *powdered Alka-Seltzer®, *sand (white).
ii. Non-Powdered Metals: aluminum, iron, zinc, magnesium, copper, tin.
iii. Liquids: lemon juice, rubbing alcohol (isopropyl), household ammonia (3%), water, vinegar, hydrogen peroxide (3%).

d. Polymer Testing/Natural and Man-made Substances: Participants will demonstrate their skill in analyzing evidence from a variety of sources such as:
i. Hair - the difference between human, dog, and cat; not specific kinds of hair like guard.
ii. Fibers - the difference between animal, vegetable, and synthetic; not specific kinds of fibers like silk.
iii. Recyclable Plastics - PETE, HDPE, non-expanded PS, LDPE, PP, PVC, PMMA. Burn tests will not be conducted but burn results may be provided.

e. Paper Chromatography: Participants will analyze evidence from paper chromatography (ink pens, juices, Kool-Aid®, etc.). The paper chromatogram(s) will be collected with the score sheet. Rfs will be performed.

f. Crime Scene Physical Evidence: Participants will also demonstrate their skill in analyzing evidence from a variety of other sources such as:
i. Fingerprints: Participants may be asked to identify different patterns on fingerprint evidence such as the difference between whorls, loops, and arches.
ii. DNA evidence: Participants may be asked to compare DNA chromatograms/electropherograms from materials found at the scene to those of the suspects.
iii. Shoeprints & tire treads: Participants may be asked to compare prints and make conclusions such as direction and speed of travel. No calculations are expected to be performed.
iv. Soil: Participants may be given the composition of soil found at the scene or on the suspects and asked to determine if this implicates any of the suspects.
v. Spatters: Analyze spatter patterns for speed and direction of impact. No calculations are expected to be performed.

g. Analysis: Participants will be asked to write an analysis of the crime scene explaining not only which pieces of evidence implicate which suspect and why the suspect(s) was (were) chosen as the culprit(s), but also why the other suspects were not chosen. They will also answer any other crime scene analysis questions posed by the Event Supervisor.

h. Teams will dispose of waste as directed by the Event Supervisor.

4. **SCORING:**

a. The team with the highest score wins. Time will not be used for scoring.
b. The score will be composed of the following elements (percentages given are approximate):
i. 3.c. = 50%
ii. 3.d. = 10%
iii. 3.e. = 5%
iv. 3.f. = 10%
v. 3.g. = 25%
vi. Actual point values may be shown at each question.
c. The tiebreakers in order are the score from:
i. Part 3.g.
ii. Part 3.c.
iii. Part 3.d.
d. A penalty of up to 10% may be given if the area is not cleaned up as instructed by the Event Supervisor.
e. A penalty of up to 10% may be given if a team brings prohibited lab equipment to the event.

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

DISEASE DETECTIVES B

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

1. **DESCRIPTION:** Participants will use their investigative skills in the scientific study of disease, injury, health, and disability in populations or groups of people.

   A TEAM OF UP TO: 2

   APPROXIMATE TIME: 50 minutes

   CALCULATOR: Class II

2. **EVENT PARAMETERS:**
   a. Each team may bring writing utensils.
   b. Each team may bring two Class II calculators.
   c. Each team may bring one (1) 8.5" x 11" sheet of paper that may contain information on both sides in any form and from any source. The sheet of paper may be laminated or placed in a sheet protector to increase durability. Affixed labels, as well as multiple sheets of paper (whether in a single sheet protector or not) are prohibited.
3. **THE COMPETITION:**
   a. This event addresses three topics related to disease, injury, health, and disability in populations or groups of people. Each part should count approximately equally towards a team's final score. Questions should be process-oriented and involve skills in evaluation and interpretation. Matching pathogens with specific diseases (i.e. – What causes X disease?) or knowledge of signs, symptoms or epidemiologic characteristics such as incubation or latency periods or infectious dose is not part of this event. However, it is appropriate to provide this information as background information and expect competitors to be able to use it.
   b. The topics for this event are as follows:
      i. Background & Surveillance
         (1) Understand the Clinical Approach (health of individuals) vs Public Health Approach (health of populations).
         (2) Understand the history and development of epidemiology.
         (3) Understand the roles of epidemiology in public health and the steps in solving health problems.
         (4) Understand the Natural History and Spectrum of Disease. Understand in broad terms the impact of infectious (bacterial, viral, fungal, protest and prion diseases) and noninfectious causes of disease (such as accidents, exposures, and toxicities).
         (5) Understand the basic epidemiological and public health terms found in the glossary of CDCs Principles of Epidemiology in Public Health Practice (e.g., outbreak, epidemic, pandemic, surveillance, risk, vector, etc.).
         (6) Understand the role of Surveillance in identifying health problems, the 5-Step Process for Surveillance, the types of surveillance and the attributes of a surveillance system.
      ii. Outbreak Investigation
         (1) Analyze actual or hypothetical outbreaks given in case scenarios.
         (2) Understand Experimental and Observational studies and the Types of Epidemiological Studies – (e.g., case control, cohort, ecological, cross-sectional). Know the advantages and disadvantages of each. Recognize various fundamental study designs and identify which is appropriate to use in analysis of presented outbreak scenarios.
         (3) Identify the Steps in an Outbreak Investigation and how they guide hypothesis generation.
         (4) Identify the problem using person, place, and time triad to formulate case definitions.
         (5) Interpret epi curves, line listings, cluster maps, subdivided tables, PFGE gels, SNP mapping and the PulseNet concept.
         (6) Understand the agent, host, environment triad and chain of transmission.
         (7) Evaluate data by calculating and comparing simple rates and proportions such as attack rate, relative risk, odds-ratio, and explain their meaning. Determine whether presented data support hypotheses of disease within scenarios, and revise hypotheses as appropriate.
         (8) Apply the Bradford Hill Criteria for Verifying the Cause of presented outbreaks. Compare the accuracy of Bradford Hill criteria, Koch's and Evan's postulates, and newer causality models such as Directed Acyclic graphs, Sufficient/component cause models, and GRADE methods.

iii. Patterns, Control, and Prevention
   (1) Identify patterns and trends of epidemiologic data in charts, tables and graphs.
   (2) Using given data, calculate disease risk and frequency ratio, proportion, incidence proportion (attack rate), incidence rate, prevalence death rate and mortality rate.
   (3) Understand the Strategies of Disease Control as they apply to given disease scenarios.
   (4) Understand Strategies for Prevention, including the Scope and Levels of Prevention.

4. **SCORING:**
   a. High score wins. Selected questions may be used as tiebreakers.
   b. Points will be assigned to the various questions and problems. Both the nature of the questions and scoring will emphasize an understanding that is broad and basic rather than detailed and advanced.
   c. Depending on the problem, scoring may be based on a combination of answers, including graphs/charts, explanations, analysis, calculations, and closed-ended responses to specific questions. Critical reasoning skills and data interpretation with hypothesis generation will be evaluated.
   d. Points will be awarded for both quality and accuracy of answers, the quality of supporting reasoning, and the use of proper scientific methods.

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

In partnership with the Centers for Disease Control (CDC)

B

DYNAMIC PLANET B - OCEANOGRAPHY

1. **DESCRIPTION:** Teams will complete tasks related to physical and geological oceanography.
   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes
   CALCULATOR: Class II

2. **EVENT PARAMETERS:**
   a. Each team may bring a binder of any size containing information in any form and from any source. Sheet protectors, lamination, tabs, and labels are permitted. If the event features a rotation through a series of laboratory stations where the participants interact with samples or displays; no material may be removed from the binder throughout the event.
   b. Each team may bring two Class II calculators.

3. **THE COMPETITION:** Participants will be tested over the following topics in the form of an exam and/or timed stations:
   a. Seawater properties' distributions and the processes affecting them:
      i. Temperature (e.g. thermocline, sea surface temperature)
      ii. Salinity (e.g. effect of water cycle, salt sources)
      iii. Pressure & density (e.g. three-layer model, stratification, mixing)
      iv. Other properties (e.g. nutrient concentrations, pH, chlorophyll)
   b. Surface circulation:
      i. Warm and cool currents
      ii. Coriolis effect
      iii. Surface convergence and divergence
      iv. Western intensification
      v. Ekman transport
      vi. Eddies
   c. Large-scale circulation:
      i. Thermohaline circulation
      ii. Global ocean energy transport
      iii. Water masses and fronts
      iv. Deep water formation
   d. Waves:
      i. Wave types (e.g. wind waves, tsunamis, storm surge) & their formation
      ii. Wave interaction with coasts (e.g. surf, wave shoaling)
      iii. Related properties, including but not limited to wave velocity, wave height, wavelength, period and fetch
   e. Tides:
      i. Diurnal/semidiurnal/mixed patterns
      ii. Spring/neap tides
      iii. Resonance
      iv. Tidal currents
   f. Coastal features and processes:
      i. Estuaries
      ii. Coastal erosional and depositional landforms
      iii. Formations of coral reefs; atolls
      iv. Longshore currents, rip currents
      v. Coastal upwelling and downwelling
   g. Geological oceanography:
      i. Tectonic processes in ocean basins (e.g. seafloor spreading and associated evidence, oceanic crust composition and evolution)
      ii. Ocean floor features (e.g. ridges, seamounts, trenches, continental rise/slope/shelf)
      iii. Oceanic sediment (e.g. sediment types, turbidity currents/turbidites, abyssal plains)
   h. Climate variability and change:
      i. Atmosphere/ocean variability, limited to El Niño Southern Oscillation, Pacific Decadal Oscillation, Southern Annular Mode
      ii. Ocean climate change effects (e.g. sea level rise, thermal expansion, coastal flooding, acidification, deoxygenation)

iii. Oceanic tools used for research (e.g. water samples, sediment cores, seawater velocity trackers, sonar and acoustic sensing, CTD devices)

4. **SCORING:** Points will be awarded for the quality and accuracy of responses. High score wins. Ties will be broken by the accuracy and/or quality of answers to selected questions.

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

In partnership with the National Oceanic and Atmospheric Administration (NOAA) and the North American Association for Environmental Education (NAAEE)

B

ENTOMOLOGY B

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

1. **DESCRIPTION:** Students will be asked to identify insects and selected immature insects by **indicated taxonomy (order, subclass, or family),** answer questions about insects, and use or construct a dichotomous key. **All specimens will be representatives of insects found in the Contiguous United States.**

   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. Each team may bring one 2" or smaller three-ring binder, as measured by the interior diameter of the rings, containing information in any form and from any source. Sheet protectors, lamination, tabs, and labels are permitted. If the event features a rotation through a series of laboratory stations where the participants interact with samples, specimens, or displays, no material may be removed from the binder throughout the event.
   b. Each team may also have one commercially produced field guide which may be tabbed or annotated.
   c. In addition to their resource binder and field guide, each team may bring one (1) copy of either the **2026** National Entomology List or a State or Regional Entomology List if issued.
   d. Each team may bring one hand lens or magnifying glass. The Supervisor will provide dissecting microscopes, if needed.

3. **THE COMPETITION:**
   a. Teams will be asked to identify an insect's Order, Subclass, Family or common name and answer a related question(s). Questions are limited to topics below and insects are limited to those listed on the 2026 National Entomology List, which is based on **the Insects of North America Princeton Field Guide (2023)**.
   b. Insect specimens or images (nymph or larva for selected orders and families) will be exhibited so that students will be able to see pertinent features with the unaided eye or a hand lens. **Students may be asked to use or formulate a simple dichotomous key to identify insects.**
   c. For each specimen, students will be asked correlated questions that pertain to the insect's internal and external anatomy, ecology, economic characteristics, or **systematics**.
   d. Ecological characteristics may include habitats, adaptations to the environment, behavior, relationships (e.g. symbiosis and competition) with animals, plants, and public health, as well as climate change impacts.
   e. Economic characteristics may include beneficial or detrimental aspects of insects such as sources of food, medicine, **disease**, chemicals, nutrients, and insects as nuisance species.
   f. **State and Nationals Only: For specimens, students may be asked questions that pertain to management. Such questions may pertain to pest/disease/invasive species concerns, Integrated Pest Management (IPM), conservation, and urban entomology. (IPM refers to preventing or suppressing damaging populations of insect pests by application of comprehensive and coordinated integration of multiple control tactics: chemical, biological, and cultural controls in context of their economic, environmental, and social consequences.)**

4. **SCORING:**
   a. The high score wins.
   b. Preselected questions will be used as tiebreakers.

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

2026 NATIONAL ENTOMOLOGY LIST

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

Specimens will be limited to those on the 2026 National Entomology List, made up of 26 orders, 2 subclasses and 113 families. **All specimens will be representatives of insects found in the Contiguous United States**

- Orders or Families marked by an "*" require that the participants be able to recognize larvae or nymph forms.
- Orders or Families designated in "*Italics*" are only to be used at the State and National levels of competition.
- The taxonomic scheme is based upon the Insects of North America Princeton Field Guide (2023)**.**

Class Entognatha

Order Protura - telsontails, proturans
Subclass Collembola - springtails, snow fleas
Order Diplura - diplurans

Class Insecta

Order Archaeognatha - bristletails,
Order Zygentoma - silverfish, firebrats
*Order Ephemeroptera - mayflies
*Order Odonata - dragon/damselflies
*Family Aeshnidae – darners
**Family Gomphidae - clubtails*
*Family Libellulidae - skimmers
*Family Lestidae - spread-wing
*Family Coenagrionidae - narrow-winged
Order Blattodea- cockroaches/termites
Family Termitidae – termites
Family Blattidae – household roaches
Family Cryptocercidae – brown-hooded roaches
Order Mantodea - mantids
Order Embioptera - webspinners
Order Dermaptera - earwigs
*Order Plecoptera - stoneflies
Order Orthoptera - grasshoppers & crickets
Family Tetrigidae - pygmy grasshopper
Family Acrididae - short-horned grasshoppers
Family Tettigoniidae - katydids
Family Rhaphidophoridae - camel crickets
Family Gryllidae - crickets/tree crickets
Family Gryllotalpidae - mole crickets
Order Phasmatodea - walkingsticks
Family Diapheromeridae - common walkingsticks
Order Psocodea - Book/Bark Lice
Order Hemiptera - true bugs
Family Corixidae - water boatmen
Family Notonectidae - backswimmers
Family Belostomatidae - giant water bugs
Family Nepidae - waterscorpions
Family Gelastocoridae - toad bugs
Family Gerridae - water striders
Family Cimicidae - bed bugs
Family Miridae - plant bugs
Family Reduviidae - assassin bugs
Family Scutelleridae – metallic shield bugs
Family Tingidae - lace bugs
Family Lygaeidae - seed bugs
Family Coreidae - leaf–footed bugs
Family Pentatomidae - Stink bugs
*Family Cicadidae - cicadas
Family Membracidae - treehoppers
Family Cercopidae - froghoppers, spittlebugs
Family Cicadellidae - leafhoppers
Family Fulgoridae - fulgorid planthoppers
Family Aphididae - aphids
***Family Pseudococcidae – mealybug**
***Family Coccidae – soft scale insect**
Order Thysanoptera - thrips
*Order Megaloptera - dobsonflies
Order Neuroptera - lacewings, Antlions
Family Chrysopidae - green lacewings
*Family Myrmeleontidae - antlions
Order Coleoptera - beetles
Family Carabidae - ground and tiger beetles
Family Dytiscidae - predaceous diving beetles
Family Gyrinidae - whirligig beetles
Family Hydrophilidae - water scavenger
***Family Psephenidae – water penny beetles**
***Family Elmidae – riffle beetles**
Family Histeridae - hister beetles
Family Staphylinidae - rove beetles
Family Silphidae - carrion beetles
Family Lucanidae - stag beetles
Family Passalidae - bess beetles
Family Scarabaeidae - dung beetles
Family Buprestidae - metallic wood-boring/ jewel beetles
**Family Elateridae - click beetles*

**Family Lampyridae - fireflies*
Family Cantharidae - soldier beetles
Family Lycidae - net-winged beetles
Family Cleridae - checkered beetles
*Family Coccinellidae - lady-bird beetles (ladybugs)
*Family Tenebrionidae – darkling beetles
Family Meloidae - blister beetles
*Family Cerambycidae - long-horned beetles
Family Chrysomelidae - leaf beetles
Family Curculionidae - weevils
Family Zopheridae – diabolical ironclad beetles
***Family Cucujidae – flat bark beetles**
Order Mecoptera - scorpionflies
Family Boreidae - snow scorpionflies
Family Panorpidae - common scorpionflies
Order Raphidioptera - Snakeflies
Family Raphidiidae - Raphidiid Snakeflies
Order Siphonaptera - fleas
Order Diptera - true flies
*Family Tipulidae - crane flies
*Family Culicidae - mosquitoes
*Family Chironomidae - midges
**Family Simuliidae - black flies*
Family Stratiomyidae - soldier flies
Family Tabanidae - horse flies
Family Asilidae - robber flies
Family Bombyliidae - bee flies
*Family Syrphidae - hover/flower flies
Family Tephritidae - fruit flies, husk fly
Family Drosophilidae - pomace flies, fruit/ vinegar flies
Family Muscidae - house flies
*Family Calliphoridae - blow flies
Family Tachinidae - tachinid flies
****Family Oestridae - botflies***
*Order Trichoptera - caddisflies
Order Lepidoptera - moths and butterflies
Family Sesiidae - clear winged moths
Family Tortricidae - Tortrix moths
Family Hesperiidae - skippers
*Family Papilionidae - swallowtails
Family Pieridae - whites, sulfurs
Family Lycaenidae - hairstreaks, blues
*Family Nymphalidae - brush-footed butterflies
Family Geometridae - geometer moths
****Family Lasiocampidae - tent caterpillar/ lappet moths***
Family Pyralidae - snout moths
Family Saturnidae – Giant Silkworm moths
*Family Sphingidae - sphinx/hawk moths, hornworms
*Family Erebidae - tiger/tussock moths
Family Noctuidae – owlet moths
Order Hymenoptera - bees/ants/wasps.
Family Tenthredinidae - common sawflies
Family Siricidae - horntails
Family Ichneumonidae - ichneumons
Family Cynipidae - gall wasps
Family Mutillidae - velvet-ants
Family Formicidae - ants
Family Vespidae - paper wasps, hornets, yellowjackets
Family Sphecidae - thread- waisted wasps
Family Braconidae – braconid wasps
Family Halictidae - Sweat bees
Family Megachilidae - leaf cutter bees
Family Apidae - bees

<u>Non Insect Arthropods</u>
Subclass Acari - Ticks
Family Ixodidae – Hardbacked tick

EXPERIMENTAL DESIGN B

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

1. **DESCRIPTION: Participants will be assessed on the ability to design, conduct, and report the findings of an experiment entirely on-site.**

   A TEAM OF UP TO: 3 **APPROXIMATE TIME:** 50 minutes

   EYE PROTECTION: C **CALCULATOR:** Class II

2. **EVENT PARAMETERS:**
   a. Participants must bring goggles and writing utensils. Experiments will not require any other safety equipment.
   b. Teams may bring one timepiece, one linear measuring device, and one Class II calculator. Teams CANNOT use any of these as part of the experiment - they must only be used for their intended function.
   c. The Event Supervisor will provide each team with identical sets of materials either at a distribution center or in an individual container.
   d. The Event Supervisor must provide the 2-part reporting packet posted on the event page at soinc.org for teams to record their experimental information and data. **This packet must be printed single-sided to facilitate separation by individual team members.**

3. **THE COMPETITION:**
   a. The teams must design, conduct, and report the findings of an experiment conducted on site that addresses the assigned question/topic area provided by the Event Supervisor. The assigned question/topic area should be the same for all teams and allow the participants to conduct experiments involving relationships between independent and dependent variables (i.e., height vs. distance).
   b. During the first 20 minutes of the event, participants will receive the assigned question/topic area, materials, and Part I of the report packet. Participants will focus on designing and conducting their experiment.
   c. After the first 20 minutes, participants will receive Part II of the report packet and will focus on analyzing their experiment and reporting findings. Participants may continue experimenting throughout the entire event.
   d. Each team must use at least two of the provided materials to design and conduct an experiment. Teams failing to use at least two items will have their final score multiplied by 0.95. The materials will be listed on the board or placed on a card for each team. If provided, both the card and the container will be considered part of the materials. The identity of the materials will be unknown until the start of the event.
   e. When a team finishes, all materials must be returned to the Event Supervisor including both parts of the report packet.

4. **SCORING:**
   a. High score wins. Scoring will be done using the Experimental Design Checklist found on the Science Olympiad website (soinc.org).
   b. Points will be awarded depending upon the completeness of the response. Zero points will be given for no responses as well as illegible or inappropriate responses.
   c. Ties will be broken by comparing the point totals in these areas of the checklist in the following order:
      i. Analysis of Claim/Evidence/Reasoning
      ii. Procedure and Set-Up Diagrams
      iii. Variables
      iv. Data Table
      v. Graph
   d. Any participant not following proper safety procedures will be asked to leave the room and will be disqualified from the event.
   e. Any team not using at least 2 of the provided materials will have their final score multiplied by 0.95.
   f. Any team not following clean-up procedures will have their final score multiplied by 0.95.
   g. Any team not addressing the assigned question/topic area will have their final score multiplied by **up to** 0.75 based on the extent to which the report deviates from the assigned topic.
   h. Any team not collecting data by conducting an experiment on-site **or falsifying/making up fake data** will have their final score multiplied by 0.25.

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

HELICOPTER B

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

1. **DESCRIPTION:** Prior to the tournament, teams will construct, collect data on test flights, analyze and optimize free flight rubber-powered helicopters to achieve maximum time aloft.

   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 15 minutes

2. **EVENT PARAMETERS:**
   a. Teams may bring up to 2 helicopters, Flight Log, transportation boxes, tools, and equipment.
   b. Teams must bring one or more Measurement Boxes; transportation and measurement boxes may be the same box.
   c. The Event Supervisor will provide all other measurement tools and timing devices for scoring purposes.
3. **CONSTRUCTION PARAMETERS:**
   a. Helicopters may be constructed from published plans, commercial kits, competitor's designs, and/or other sources of design. Kits, if used, must not contain any pre-glued joints or pre-covered surfaces.
   b. The uppermost part of the helicopter (the part that would touch a flat ceiling first during flight) must be a flat balsa wood disc, large enough to cover a dime. **The face of the disc must be the part that contacts the ceiling if the helicopter goes that high.**
   c. Any materials except Boron filaments may be used in construction of the helicopter and boxes.
   d. The helicopter, in its flight configuration, must fit fully into a team-provided Measurement Box without a lid/cover.
      i. The external dimensions of the Measurement Box must fit within a right, rectangular prism of 32.0cm x 24.0cm x 47.0cm, including any external protuberances on the lidless box.
   e. "Flight Configuration" means the helicopter is fully assembled and ready to fly. For example, no change in chord, span, length, or total lifting area can occur after removing the helicopter from its box and throughout the flight itself. Components that rotate during flight, such as propellers or rotors, may be rotated to allow the helicopter to fit into the box. The rubber motor(s) does not have to be on the helicopter or wound.
   f. The helicopter may use up to three fixed rotors. There is no minimum limit on the number of blades or their chord. Rotors are defined as one or more separate lifting surfaces, referred to as blades, that contribute lift by rotating on a common path around a vertical axis. There must not be any other lifting surfaces.
   g. Total mass of the helicopter, excluding the rubber motor(s), must be 4.0 g or more.
   h. Participants must be able to answer questions on design, construction, and operation of the device per the Building Policy found on www.soinc.org.
4. **THE COMPETITION:**
   a. **Prior to day of Tournament**
      i. An indoor location will be selected by the Tournament officials. The following will be announced:
         (1) The room dimensions (approximate length, width, and ceiling height).
         (2) Competition factors such as air currents.
   b. **Day of Tournament** and prior to the first time slot:
      i. The Event Supervisor will determine if:
         (1) Multiple official flights may occur simultaneously.
         (2) Practice flights may occur throughout the Competition, at the Event Supervisor's discretion, but must yield to any official flights.
         (3) No practice flights will occur in the final half-hour of the event's last period. (Teams that declare a trim flight during their 10-minute Flight Period may still fly).
      ii. Once participants enter the cordoned off competition area to trim, practice, or compete, they must not receive outside materials (except as permitted by the Event Supervisor), assistance, or communication. Only participants may handle helicopters until the event ends. Teams violating this rule will be ranked below all other teams. Spectators will be in a separate area.
   c. **Self-Check Inspection Station (Optional)**
      i. Prior to check-in with the Event Supervisor, a self-check inspection station may be made available to participants for checking their Measurement Box(es), and helicopters. Modifications may be made prior to check-in.

d. **Check-In**
   i. At check-in, participants will present their helicopters in Measurement Box(es) and Flight Logs for inspection immediately prior to their Flight Period.
      (1) **Teams from the same school can share the same Measurement Box.**
   ii. The Event Supervisor will verify the external dimensions of the Measurement Box(es) and that the helicopter fits fully inside the Measurement Box while in its flight configuration. The helicopter's overall dimensions must not change after being removed from the box. This may be verified by showing that the helicopter slides into and out of the box without changing shape at the discretion of the Event Supervisor.
   iii. The participants will remove the helicopter from the box to allow for the mass to be measured.
   iv. All motor(s) will be collected and returned to the team at the start of their 10-minute Flight Period.
   v. Only participants should handle the helicopters or Measurement Box(es).

e. **Flight Period**
   i. The 10-minute Flight Period begins when the Event Supervisor returns the motors to the team.
   ii. Any flight beginning within the 10-minute Flight Period will be permitted to fly to completion.
   iii. Participants may make adjustments/repairs/trim flights during their official Flight Period.
   iv. Before each launch, participants must indicate to the Timers whether a flight is an official flight or a trim flight. A flight is considered official if a team fails to notify the Timer(s) of the flight's status.
   v. Teams must not be given extra time to recover or repair their helicopter.
   vi. Teams may make up to a total of 2 official flights using 1 or 2 helicopters.
   vii. Time aloft for each flight starts when the helicopter leaves the participant's hand and stops when any part of the helicopter touches the floor, the lifting surfaces no longer support the weight of the helicopter (such as the helicopter landing on a girder or basketball hoop) or the Event Supervisors otherwise determine the flight is over.
   viii. Event Supervisors are strongly encouraged to utilize three (3) timers on all flights. The median flight time in seconds to the precision of the device used is the official Time aloft.
   ix. Participants must not steer the helicopter during flights.
   x. Students must be on the floor to launch from their hands. Artificial aids cannot be used to increase launch height.
   xi. In the unlikely event of a collision with another helicopter, a team may elect a re-flight. The decision to re-fly may be made after the helicopter lands. Timers are allowed to delay a launch to avoid a possible collision. The 10-minute Flight Period does not apply to such a flight.

f. If requested by the Event Supervisor, the participants must demonstrate that each helicopter still fits fully inside the Measurement Box(es) in the flight configuration. Teams may not manipulate the configuration of the helicopter in order to fit into the box except to rotate components that rotated during flight such as rotors. The helicopter's overall dimensions must not change after being removed from the box. Motor(s) may be removed from the helicopter or left in place during the demonstration.

g. The Event Supervisor will review with teams their data recorded at the end of their Event Time.

h. Teams filing an appeal must leave their Helicopter(s), Measurement Box(es), and Flight Log in the event area.

5. **<u>FLIGHT LOGS</u>:**

a. Teams may present a Flight Log of recorded data for a BONUS. This data must include 6 or more parameters (3 required and at least 3 additional) with data for 10 or more test flights prior to the competition.
   i. The required parameters are:
      (1) Motor Size before wind-up
      (2) Number of Turns on Launch or Torque at Launch
      (3) Flight Time
   ii. The team must choose 3 additional data parameters beyond those required (e.g. turns remaining at landing, estimated/recorded peak flight altitude, the motor torque at landing, propeller pitch, etc.)

b. All numeric data must include units which may be listed with the column headers of the log. Torque units may be "arbitrary" if an uncalibrated torque meter with arbitrary numbers is utilized.

c. All logs will be returned to teams after inspection.

6. **SCORING:**
   a. Highest Final Score wins. A team's Final Score is the larger of the team's Flight Scores.
   b. Flight Score for each official flight=Flight Time x Bonuses (6.c).
   c. Bonuses:
      i. Teams with a complete Flight Log will receive a 20% bonus multiplier (x 1.2)
      ii. Teams with a partial Flight Log will receive a 10% bonus multiplier (x 1.1).
      iii. Teams without a Flight Log will receive no Flight Log bonus multiplier (x 1.0)
      iv. **Teams competing with only two-bladed rotors receive an additional 10% bonus multiplier (x1.1).**
      v. **Example Score: For a flight time of 68.00 seconds with a completed Flight Log and using two bladed rotors the score would be : 68.00 x 1.2 x 1.1 = 89.76 points.**
   d. Teams that violate rule(s) under "CONSTRUCTION PARAMETERS" or "COMPETITION" that do not have a specific penalty will be ranked after all teams that do not violate those rules.
   e. Ties will be broken by the longest non-scored official Flight Score.

7. **DEFINITIONS:**
   a. *Event Supervisor (ES)* is responsible for ensuring the event runs correctly. The ES can assign one or more event helpers to perform various competition tasks.
   b. *Flight Configuration* means the helicopter is fully assembled and ready to fly. For example, no change in chord, span, length, or total lifting area can occur after removing the helicopter from its box and throughout the flight itself. Components that rotate during flight, such as propellers or rotors, may be rotated to allow the helicopter to fit into the box. The rubber motor(s) does not have to be on the helicopter or wound.
   c. *Rotors* are defined as one or more separate lifting surfaces, referred to as blades, that contribute lift by rotating as a unit around a vertical axis.
   d. *Blade:* A blade is a single aerodynamic surface that extends no more than 90 degrees around the axis of rotation of the rotor.
   e. *Trim Flight:* A test or practice flight that is not used for official scoring.
   f. *Steering:* Participants using something to control the direction of motion once the device is released. (ex. Balloons, poles, rods, air, etc.)

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

This event is sponsored by the National Free Flight Society (NFFS).

HEREDITY B

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

1. **DESCRIPTION:** Teams will answer questions, solve problems, and analyze data pertaining to classic and molecular genetics.

   A TEAM OF UP TO: 2

   APPROXIMATE TIME: 50 minutes

   CALCULATOR: Class II

2. **EVENT PARAMETERS:**
   a. Each team may bring writing utensils.
   b. Each team may bring two Class II calculators.
   c. Each team may bring one (1) 8.5" x 11" sheet of paper that may contain information on both sides in any form and from any source. The sheet of paper may be laminated or placed in a sheet protector to increase durability. Affixed labels, as well as multiple sheets of paper (whether in a single sheet protector or not) are prohibited.
3. **THE COMPETITION:** This Event will be administered as a written test which may be arranged in stations. **Questions will emphasize process skills such as quantitative reasoning, making calculations, analyzing and interpreting experimental results, and drawing evidence-based conclusions.** The Event will cover topics a.i. - a.v. without overemphasis on any one particular topic. The list of topics and subtopics should be considered exhaustive.
   a. For each of the following topics, participants will be expected to use quantitative reasoning and computational skills, analyze and interpret experimental results, and draw evidence-based conclusions.
      i. Mendelian Genetics:
         (1) Describe Mendel's Laws of Inheritance and their implications in heredity. State and Nationals only: Describe inheritance patterns which violate these laws (i.e. linkage, incomplete and codominance, complementation).
         (2) Use provided information to construct Punnett Squares of mono- and dihybrid crosses.
         (3) Predict genotypes and phenotypes of offspring and compute their likelihood based on Punnett Squares and experimental data using probability rules.
         (4) Evaluate pedigrees to predict modes of inheritance (i.e. dominant vs recessive traits and autosomal vs sex-linked traits) and construct pedigrees based on data from a case study.
         (5) State and Nationals Only: Understand recessive epistasis and its implications in predicting phenotypic outcomes.
      ii. Mitosis and Meiosis
         (1) Understand, compare, and contrast the major stages and key structures in mitosis and meiosis
         (2) Understand the steps involved in human karyotype analysis and be able to interpret a karyotype
      iii. Molecular Biology of DNA
         (1) Be able to identify and explain the components of DNA (i.e. structure of the nucleotides and backbone), directionality of DNA (5' and 3' ends).
         (2) Explain Chargaff's rules in the context of DNA structure and base pairing.
         (3) Understand the basic stages of DNA replication, with focus on DNA elongation and the processes that happen at the replication fork.
         (4) Identify and understand the organization of DNA structure, such as plasmids, chromatin complexes, euchromatin and heterochromatin, and chromosomes.
         (5) State and Nationals only: Identify, explain, and classify DNA mutations on the DNA level (i.e. chromosomal rearrangements, insertions, deletions, and substitutions), and the potential impact of the resulting protein sequence (i.e. frameshift, silent, missense, and nonsense mutations).
      iv. Gene & Protein Relationship
         (1) Be able to explain the Central Dogma of Molecular Biology.
         (2) Transcription: Understand and explain initiation, elongation, and termination stages of transcription, the mechanism of RNA polymerase, and how transcription is regulated by activators and repressors.
         (3) Translation: Understand and explain the initiation, elongation and termination stages of translation, the mechanism of the ribosome, and the role mRNA and tRNA play in translation.
         (4) State and Nationals only: Understand the function and mechanism of the lac operon.

v. Technology and Techniques
   (1) Polymerase chain reaction (PCR): Describe what occurs and which molecules are involved in the denaturation, annealing, and extension steps of a PCR reaction; Explain the role of temperature in PCR; Identify the components needed for a PCR reaction; Identify experimental questions which could be addressed by PCR.
   (2) State and Nationals only: Sanger sequencing: Describe how the steps and components in Sanger sequencing differ from a standard PCR reaction; Identify experimental questions which could be addressed by Sanger sequencing.

4. **SCORING:**
   a. High score wins. Selected questions may be used as tiebreakers.
   b. Points will be awarded for quality and accuracy of answers, quality of supporting reasoning, and the use of proper scientific methods.

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

B

HOVERCRAFT B

1. **DESCRIPTION:** Prior to the competition, participants will design, construct, and calibrate a self-propelled air-levitated vehicle that moves down a track.

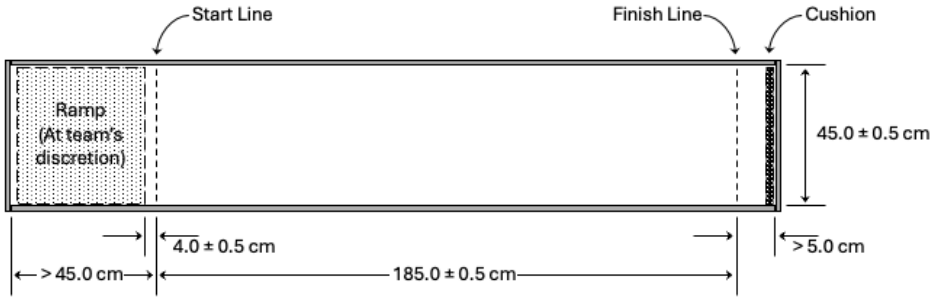
A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 10 minutes

EYE PROTECTION: B **IMPOUND:** Yes **CALCULATOR:** Class III

2. **EVENT PARAMETERS:**
   a. Each team must impound only one vehicle **and any papers/notes needed during the competition time.** The vehicle must be impounded with the batteries stored separately and presented to the Event Supervisor for inspection. **No additional papers/notes may be brought into the competition area after impound.**
   b. Teams may bring tools, supplies, **spare parts,** eye protection, and two Class III calculators. These items need not be impounded.
   c. Participants must wear eye protection during vehicle setup and operation. Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows.
   d. The Event Supervisor will provide the testing materials listed in the TRACK section. Teams should not bring their own track or ramp.
   e. Participants must be able to answer questions regarding the design, construction, and operation of the vehicle per the Building Policy found on www.soinc.org.
3. **CONSTRUCTION PARAMETERS:**
   a. The vehicle must fit into a 40.0 cm x 40.0 cm x 40.0 cm box when levitated **in the ready-to-run configuration**. Vehicles must not modify or damage the track.
   b. The vehicle must levitate on a cushion of air as it moves down the track. Participants may be asked to demonstrate levitation by pushing the vehicle slightly down. If it then rises, it is levitating. Continuous contact of the inflated skirt with the base surface, occasional contact of other vehicle components with the base surface, or any contact with the inside edge of the side rails is permitted.
   c. All propellers/impellers, including those under the vehicle, must have shielding that prevents a 3/8" dowel from touching them.
   d. Commercial batteries, including rechargeables, not exceeding **12.0V** as labeled, may be used to energize **each of** the vehicle's motors. The label on each battery must be the manufacturer's original and easily viewable by the Event Supervisor. Multiple batteries may be connected together as long as the expected voltage across any two points does not exceed **12.0V**, as calculated by their individual labels. The vehicle must not have any other energy sources. Batteries containing lithium or lead are prohibited.
   e. All motors must have a switch to permit safe starting and stopping. Relying on inserting batteries or twisting wires together to start is not allowed. If more than one motor is used, they may be combined on the same switch or wired on separate switches.
   f. Electrical components shall be limited to batteries, wires, **manually-operated** switches, resistors, potentiometers, capacitors, and **up to two** motors (including brushless motors). Integrated circuits (other than those that are an integral part of a commercial motor) are not permitted.
   g. For timing and measurement purposes, the vehicle must have a 1/4" or larger wooden dowel vertically attached within **3.0** cm of its front edge such that the top end is at least 20.0 cm above the track's surface when **levitated**. The dowel must be placed on the hovercraft so that it will be the first part of the vehicle to break a laser timing beam when the vehicle is traveling forward.
4. **THE COMPETITION:**
   a. **Once participants enter the event area to compete, they must not leave or receive outside assistance, materials, or communication until they are finished competing.**
   b. Vehicles violating rules 3.c., 3.d., or 3.e. or that are otherwise deemed unsafe in construction or operation by the Event Supervisor will not be allowed to run unless brought into compliance. **If the team is unable to bring the vehicle into compliance with 3.c., 3.d. and 3.e., the vehicle will not run and will receive a Final Score of zero (0). The Event Supervisor must complete the entire construction check on the vehicle to determine the total number of construction violations (which is used to break ties).**
   c. Event Supervisors will check the vehicle specifications before the team's testing period. Teams must be notified as soon as possible if a vehicle is out of spec. Teams may modify the vehicle to bring it into compliance during their testing period.

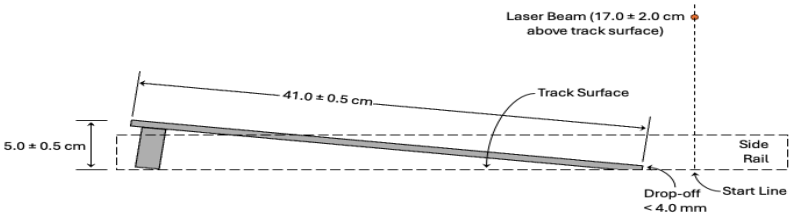
d. At the start of their testing period, each team will be given a Target Time (TT). The Target Time will be between 10.0-20.0 seconds in intervals of 2.0 seconds for Regionals, 1.0 second for States, and 0.5 seconds for Nationals. The TT will be the same for all teams.
e. Teams have a testing period of 8 minutes to adjust and repair their vehicle and make their test runs. Practice runs are not allowed. **If a team has 3 incomplete runs, their testing period is over. Once a team has one complete run, the team is allowed only one more run (the Final Run), regardless of the result of that run or whether the team has fewer than 3 incomplete runs.**
f. An incomplete run occurs if a vehicle fails to move for 3 seconds before crossing the finish line or the dowel fails to cross the finish line within (**2** x TT) seconds. Teams are not allowed to declare a run as incomplete.
g. If the vehicle's dowel does not cross the starting line within 3 seconds of launching, it does not count as a run (either complete or incomplete) and teams may reset. A run will be counted in the scoring as long as it is started before the 8-minute period has elapsed.
h. If any part of the vehicle falls off during a run, the team incurs a **competition** penalty for the run.
i. To begin a run, the team will place their vehicle on the track fully behind the start line against a wood block provided by and placed by the Event Supervisor. The team then activates their vehicle's motor(s).
j. If they choose, teams may utilize an Event Supervisor-provided ramp (as described in 6.e.) for the launching of their vehicle. In such cases, the Event Supervisor will place the ramp in the same position for all teams. Using the ramp will impact the team's score (7.c.iii.), and the time for placing the ramp will come out of the 8-minute period. The team may change this decision for each run.
k. The team will give a countdown of "3, 2, 1, launch"; then the Event Supervisor will remove the wood block. Timing starts when the vehicle's dowel crosses the start line and stops when the dowel crosses the finish line. If photogates are used, the dowel must be the first part of the vehicle to break the laser beams at both the start and finish lines.
l. The team must not touch their vehicle after the dowel crosses the starting line until the Event Supervisor **states they may do so**. If touched, the run is counted as a complete run with a DS and a TS of 0.
m. If a run is declared incomplete, the Event Supervisor will **place the starting block in front of the hovercraft at the point where the run was declared incomplete to prevent the vehicle from moving. The ES will ask the competitors to turn off their vehicle without moving it, and the ES will then** record the distance from the finish line to the position of the dowel. The team's testing period time will halt while the Event Supervisor makes measurements and will resume when the measurement time is done.
n. **If the team's run time on their first complete run is within 25% of the TT (to the precision of the time-keeping device), the team may request that their Final Run be for bonus points. Before the team makes that decision, the Event Supervisor will give the team the Bonus Target Time (BTT) for their consideration. The BTT must be different from the TT for that run. The Bonus Target Time (BTT) is subject to the same parameters as listed in 5.d. and will be the same for all teams. Teams may not use the ramp for a Bonus Run.**
o. The Event Supervisor will review with the team the data recorded on their scoresheet.
p. A team filing an appeal must leave their vehicle in the competition area.

5. **<u>THE TRACK</u>:**



a. The Event Supervisor will supply a 45.0 ± 0.5 cm wide and at least 240 cm long track on a non-carpeted **smooth** floor or other firm **smooth** base surface, such as a countertop or large board. The outside boundary of the track is composed of rails each with a height at least 30.0 mm (standard 2x4 framing studs **or steel framing studs** recommended). The Event Supervisor will also supply a cushioned barrier to stop vehicles and a wood block to hold the vehicle at the start line. Example setups are at www.soinc.org.

b. Each rail must be securely affixed to the floor, base, or each other.
c. The length of the timed portion of the track is fixed at 185.0 ± 0.5 cm. A start line must be marked that is at least 45.0 cm from the end of the track. The finish line must be marked 185.0 ± 0.5 cm from the start line and a cushioned barrier at least 5.0 cm past it must block the channel.
d. A photogate timing system is highly recommended. If used, the system will be installed at the start and finish lines with the beams at a height of 17.0 ± 2.0 cm. At least one manual timer should be used as a backup. If photogates are not being used, three timekeepers should be utilized with the median time used as the official Run Time; lasers are recommended to be placed at the start and finish lines so the timekeepers only have to watch for the flash of light as the dowel cuts through the laser beam. Time is recorded in seconds to the device precision if photogates are used, or to the tenth of a second if manual timers are used.
e. The Event Supervisor must provide a removable ramp that competitors may use for the launching of their vehicle. The ramp should have a smooth, flat surface and must span the width of the track between the rails. The height of the ramp is 5.0 ± 0.5 cm and the length of the ramp's surface is 41.0 ± 0.5 cm. When the ramp is placed on the track, the edge where the vehicle exits the ramp must be 4.0 ± 0.5 cm behind the start line. At the bottom of the ramp, where it meets the track surface, the transition should be reasonably smooth, with a drop-off from the ramp surface to the track surface of no more than 4.0 mm. See www.soinc.org for information on how to build a ramp and track.



f. At the Event Supervisor's discretion, more than one Track may be used. If so, the team may choose which Track they use but must use the same Track for all runs.

6. **SCORING:**
a. High score wins. Final Score (FS) = Highest Run Score (RS) + Bonus Score (BS), if any. A scoring spreadsheet is available at www.soinc.org.
b. Run Score = Distance Score (DS) + Time Score (TS)
c. Distance Score (DS):
   i. Complete Run: Distance Score = 30
   ii. Incomplete Run: Distance Score = 30 x (185 - distance from the finish line in cm / 185)
   iii. If the ramp is utilized, the Distance Score is multiplied by 0.5 for that run.
d. Time Score (TS):
   i. **Runtime = Time from the Vehicle dowel crossing the start line until the dowel crosses the finish line**
   ii. Complete Run: Time Score = 60 x (1 - abs(Runtime - TT)/TT)
   iii. Incomplete Run: Time Score = 0
   iv. The smallest possible Time Score is 0.
e. **Bonus Score (BS) = 15 x (1 - 1.5 x abs(Final Run runtime - BTT)/BTT)**
   i. **The smallest possible Bonus Score (BS) is 0.**
   ii. **If the vehicle does not cross the finish line on the bonus run, the Bonus Score (BS) is 0.**
f. **Teams without any runs will receive a Final Score of 0, with ties broken as indicated in 7.j. Ties are possible.**
g. The TS, DS, **and BS** for **each run** will be multiplied by **0.7** if the team misses impound.
h. The TS, DS, **and BS** for a run will be multiplied by **0.8 for each** CONSTRUCTION violation present during that run.
i. The TS, DS, **and BS** for a run will be multiplied by 0.9 **for each** COMPETITION violation present during that run.
j. Tiebreakers: 1st – **Best TS for the first complete run**; 2nd – **Fewest # Construction Violations**; 3rd – **Best BS**, 4th - 2nd Best Run Score

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

MACHINES B

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

1. **DESCRIPTION:** Teams will construct a lever-based measuring device prior to the tournament to determine the mass ratios between three test masses and complete a written test on simple and compound machine concepts.

   A TEAM OF UP TO: 2

   APPROXIMATE TIME: 50 minutes

   CALCULATOR: Class III

2. **EVENT PARAMETERS:**
   a. Each team may bring a collection of notes and resources, written/printed on paper, of any size containing information in any form and from any source. Binders, notebooks, folders, sheet protectors, lamination, tabs, and labels are permitted. Participants are responsible for organizing and containing their notes efficiently. They may separate or remove the pages from containers for use during any part of the event.
   b. Each team may also bring non-electronic tools and supplies, writing utensils, and two Class III calculators for use during any part of the event.
   c. Each team may bring one pre-constructed device.
   d. The Event Supervisors will provide the testing materials listed in the COMPETITION AREA section. Teams should not bring these materials.
   e. Participants must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org.

3. **CONSTRUCTION PARAMETERS:**
   a. The device must be a class 1 lever with a single "beam" that measures no longer than 80.0 cm. The "beam" is the bar that rests on the fulcrum and includes any attached components. Its length should be measured along the overall longest edge of the beam and is measured irrespective of the location of the test mass attachment points. It is measured without the supervisor-provided test masses attached.
   b. Springs, electric components, and electronic components are prohibited.
   c. The device must be constructed to accommodate the test masses as described in the COMPETITION AREA.
   d. Participants must not bring masses or include them in their device except when fixed in place prior to testing to obtain static equilibrium. Lightweight adjustable hooks that may be moved along the beam and are used solely to accommodate the test masses are allowed and need not be fixed in place.

4. **COMPETITION AREA:**
   a. The Event Supervisor will provide the testing materials listed below. The Event Supervisor must ensure that the mass measurements of the test masses and the ratios between those mass measurements are not revealed to any teams.
   b. Event Supervisors will supply three test masses labeled A, B, and C. A flexible loop, large enough to pass a standard golf ball through, must be tied to the top of each test mass. The loops may be made from fishing line, zip ties, string, etc. Each test mass, including the fully stretched out flexible loop, must be able to fit inside a 15.0 cm x 15.0 cm x 20.0 cm box. Each test mass, including the loop and container, must be between 20.0 g and 800.0 g. The ratio of the heaviest test mass to the lightest test mass must not exceed the following limits:

Regionals	States	Nationals
4.0	5.5	7.0

   c. The event supervisor may provide multiple testing stations, each with its own sets of test masses. The mass ratios between the test masses at each station must be identical to the precision that the Event Supervisor indicates in 5.II.g. The actual mass measurements of A, B, and C at each station must be roughly identical.
   d. An example where the Event Supervisor uses multiple stations and asks for a precision in the submitted ratios of one decimal point:
      i. Station 1: B1 has a mass of 300.0 g, A1 has a mass of 100.0 g. B1/A1 = 3.0
      ii. Allowed at Station 2:
         (1) B2 has a mass of 300.5, A2 has a mass of 99.8g.
         (2) B1/A1 = B2/A2 = 3.0 to the correct precision = Identical mass ratios. The actual masses are roughly identical. So this is allowed in 4.c.

iii. Disallowed at Station 2:
(1) B2 has a mass of 600.0 g, A2 has a mass of 200.0 g.
(2) B1/A1 = B2/A2 = 3.0 = Identical mass ratios. However, the actual masses are not roughly identical. This is not allowed in 4.c.

5. **THE COMPETITION:**

Part I: Written Test

a. Teams will be given a minimum of 25 minutes to complete a written test.
b. Unless otherwise requested, answers must be in metric units with appropriate significant figures.
c. The written test will consist of questions about simple machines in static equilibrium and include questions from each of the following topics as they apply to simple machines:
   i. Ideal and actual mechanical advantage
   ii. Efficiency, load, and effort
   iii. Potential and kinetic energy
   iv. Coefficient of friction
   v. States/Nationals Only: Each topic area may be expanded to apply to compound machines.
d. At least six of the following simple machines must appear in questions: First class levers, second class levers, third class levers, inclined planes, wedges, wheel and axle (including gears), pulleys (including rope and pulley systems), and screws.
e. Questions dealing with the topics listed above may require additional knowledge from the field of classical Newtonian mechanics, including Newton's laws of motion, inertia, force, action-reaction, position, speed, velocity, acceleration, momentum, kinetic and potential energy, and conservation of energy and momentum.
f. Questions on the test will use the following mathematical content:
   i. Standard arithmetic operations (including ratios).
   ii. Simple algebra manipulations, including solving one equation for one variable.
   iii. Basic 2D geometry required for resolving forces into component parts. For example, parallel & perpendicular lines, triangles (right, similar, & congruent), and the basics of vectors.
   iv. Simple trigonometric relations to enable use of trigonometric functions on a calculator. For example, to resolve forces into component parts. No angles in radians.

Part II: Device Testing

a. The objective is to quickly determine the ratios of the unknown masses of the three test masses using their simple lever. Teams may not submit a ratio guess that is based on visual inspection or hefting the test masses in their hands; teams must use their lever to make an honest attempt to measure the ratio. Otherwise teams will receive zero (0) ratio and time scores.
b. While all teams are working on Part I, the Event Supervisor will individually call each team for Device Setup and Testing. Depending on the room's space, this may be done where the team is working on their written test or at a separate station in the room. If possible, students should not be asked to move their devices after Setup. Multiple stations may be used subject to the limitations in 4.c.
c. When called, teams will begin their Setup Time (Regional - 5 minutes, States/National - 4 minutes). Their Setup Time includes unpacking, assembly, and calibration of the device. The Event Supervisor will pause the time to check the device specifications after the device is assembled. Teams must be notified as soon as possible if a device does not meet specifications.
d. Teams may modify the device to bring it into compliance with construction specifications during their Setup Time, but will receive no additional time for setup.
   i. If teams have brought a beam that is too long, they may measure out an "allowed beam length" and mark it with Event Supervisor-provided masking tape. The "allowed beam length" must meet the construction specifications in Section 3 and must include the fulcrum, means and space to attach the Event Supervisor-provided test masses, and any fixed masses. Teams may then test without penalty using only the "allowed" part of their beam.
   ii. If teams bring movable masses (in violation of 3.d.), they may, without penalty, fix them in place with the masking tape.
   iii. Modifications of the device, other than those listed here, may be performed during Setup.
   iv. The Event Supervisor does not pause the Setup Time for a construction re-check if the team has to fix construction parameters. If teams cannot bring their device into compliance with the Construction Parameters by the end of their Setup Time, the team may elect to reduce their allowed time in their Device Test time to continue to address the issue(s).

e. Teams will be given 4 minutes of Device Test time, minus any overage time from Setup, to calculate their mass ratios. Teams must not touch the test masses until handed them by the Event Supervisor. Test masses must not be handed to teams until their device is brought into specification.
f. Using the basic physical principles of a lever and adjusting only the relative positions of the test masses and/or fulcrum along the lever beam, teams must calculate the ratios of the masses of the test masses. Teams may work with either two or three test masses at a time. Teams may use their resources, calculators, and tools to determine the mass ratios.
g. Teams will submit their mass ratios in decimal form (ex. a ratio of 5:2 should be written as 2.5). The Event Supervisor will inform teams of the precision to which the team should give their answers. The Event Supervisor will also inform teams what action makes their ratios "submitted" for the time to stop (for example, writing the second ratio down on the scoresheet, announcing that their answers are final, ringing a bell, etc).
h. Teams must not mark on, attach anything to, or modify the test masses.
i. Part II timing stops when the team submits the calculated mass ratios A/B and B/C or their Device Testing Time has elapsed. Event Supervisors must record the elapsed time in seconds to the nearest tenth of a second. No changes are allowed to the calculated values once timing stops.
j. The Supervisor will review with the team the Part II data recorded on their scoresheet.
k. Teams filing an appeal regarding Part II must leave their device in the competition area.

6. **SCORING:**

a. High score wins; Final Score (FS) = ES + R1 + R2 + TS. The maximum possible FS is 100 points. A scoring spreadsheet is available at www.soinc.org.
b. Exam Score (ES) = (Part I score / Highest Part I score for all teams) x 45 points.
c. Time Score (TS) = ((240 - team's part II time in seconds) / 240) x 15 points.
d. Ratio Scores (R1 and R2) = (1 - (abs(AR - MR) / AR)) x 20 points.
   i. AR is the actual ratio of two of the test masses.
   ii. MR is the measured value of the ratio as submitted by the team.
   iii. R1 uses mass ratio A/B, R2 uses mass ratio B/C.
   iv. The smallest possible R1 and R2 is 0.
e. If a team violates a COMPETITION rule, their TS, R1, and R2 scores will be multiplied by 0.9.
f. Teams with no device, no ratio estimates, whose device cannot meet construction specifications, or that do not make an honest attempt to utilize a device of the prescribed type to determine the mass ratios receive R1, R2, and TS of 0. Such teams will be allowed to compete in Part I (the written test).
g. Tiebreakers: 1st - Best ES; 2nd - Best TS; 3rd - Best R1; 4th - Selected test questions.

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

METEOROLOGY B - EVERYDAY WEATHER

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

1. **DESCRIPTION:** Participants will use scientific process skills involving qualitative and quantitative analyses to demonstrate an understanding of the factors that influence Everyday Weather through the interpretation of meteorological data, graphs, charts and images.

   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes

   CALCULATOR: Class II

2. **EVENT PARAMETERS:**
   a. Each team may bring one three-ring binder of any size containing information in any form and from any source attached using the available rings. Sheet protectors, lamination, tabs and labels are permitted.
   b. Each team may bring two Class II calculators.
   c. If the event features rotation through a series of stations, no material may be removed from the binder during the event.
   d. Students are expected to have a U.S. map with the state names in their binder.

3. **THE COMPETITION:**
   a. The event may be either in a written exam format or teams may move from station to station, with the length of time at each station predetermined and announced by the Event Supervisor. Participants may not return to stations but may change or add information to their original answers while at other stations.
   b. At least fifty percent (50%) of the questions shall be based upon interpretation of weather data displayed in maps, graphs, images, photographs, charts, and/or tables to analyze Everyday Weather.
   c. The questions will address the following Everyday Weather topics:
      i. The atmosphere: structure including temperature profiles of the troposphere and stratosphere, including inversions, thickness, composition and atmospheric pollutants
      ii. Incoming solar radiation (insolation) & seasons: atmospheric influences on insolation, daily (diurnal) & seasonal temperature patterns, Earth's revolution, rotation and axial tilt
      iii. Properties of Water: specific heat, density, sensible & latent heat along with effects on the weather
      iv. Atmospheric moisture: relative humidity, dew point & wet bulb temperatures, water vapor, atmospheric rivers, virga, clouds, dew, frost & fog
      v. Clouds:
         (1) formation of high, middle & low clouds and clouds with vertical development
         (2) cloud types limited to the following: cirrocumulus, cirrus, cirrostratus, altocumulus, altostratus, nimbostratus, stratus, cumulus, stratocumulus, cumulonimbus, lenticular/cap, orographic and pyrocumulonimbus clouds
      vi. Fog types and formation limited to: advection, frontal, freezing (ice), precipitation, radiation, steam & valley
      vii. Precipitation:
         (1) intensity and how various types form, including: snow, snow grains, rain, drizzle, ice pellets (sleet), hail, graupel, freezing rain, & freezing drizzle
         (2) precipitation hazards: training thunderstorms, flooding (flash & river) and storms (snow & ice)
      viii. Atmospheric optical effects limited to: sunrise, sunset, sundogs, rainbows, halos, crepuscular rays, green flashes, auroras & mirages
      ix. Atmospheric pressure: horizontal & vertical gradients, troughs & ridges, cyclones (lows) & anticyclones (highs) with their circulations, including Coriolis Effect & the effect of friction
      x. Origin and characteristics of air masses:
         (1) maritime, continental, tropical, polar, Arctic
         (2) temperature, density, moisture & atmospheric stability
      xi. Types of fronts and their characteristics: warm, cold, occluded (complex) & stationary as well as dry line boundaries
      xii. Local winds: Chinook & Santa Ana winds, sea, lake & land breezes, and valley & mountain breezes
      xiii. Effects of topography on wind & precipitation patterns
      xiv. Storms and other hazardous weather not considered severe
         (1) cyclogenesis & cyclolysis
         (2) permitted types of weather events: Alberta Clippers, panhandle hook, nor'easters, Lake Effect snowstorms, ice storms, winter storms, blizzards, thunderstorms (not severe), fire weather, heat waves, drought, dust storms, & dust devils

(3) NOT permitted weather events considered severe, such as: tropical storms, hurricanes, typhoons, severe thunderstorms, derechos, downbursts, tornadoes & waterspouts

xv. Weather instrumentation & technology: thermometers, hygrometers, sling psychrometers, anemometers, barometers, satellite imagery (visible, infrared & water vapor), radiosondes, rawinsondes, Doppler radar, wind profilers, rain gauges, & snow boards

xvi. Weather data: meteograms, radiosonde soundings, station models & METAR observations

xvii. Interpretation of surface weather maps: highs, lows, fronts, dry lines, station models, isobars, isotherms, isohyets, & areas of precipitation

xviii. Upper air charts: 850, 700, 500 & 300 mb, location of jet streams, including amplitude and width of ridges & troughs

xix. Weather forecasting:

(1) use of weather forecast maps, isolines/isopleths, Doppler radar images, model predictions, radiosonde soundings & Stuve diagrams

(2) National Weather Service (NWS) non-severe forecast products: (e.g., Zone forecasts, Public Information Statements, Special Weather Statements)

(3) hazard maps, advisories, watches and warnings (e.g., dense fog, flooding, high winds, associated with non-severe weather).

(4) National Only: Skew-T/Log p diagram and Lifting Condensation Level (LCL)

xx. Temperature indices: wind chill, heat index, and heating & cooling degree days

xxi. Nationals only - Space Weather and its impact on Earth's atmosphere: limited to solar winds, coronal mass ejections, solar cycles and sunspots, solar radiation storms, and geomagnetic storms

4. **SCORING:**

a. High score wins.

b. Points will be awarded for the quality of responses, the quality of supporting reasoning, and use of scientific techniques.

c. Point values of each question or section may be specified.

d. Preselected questions/sections will be used as tiebreakers.

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

In partnership with the National Oceanic and Atmospheric Administration (NOAA) and the North American Association for Environmental Education (NAAEE)

METRIC MASTERY B

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

1. **DESCRIPTION:** Teams will estimate and then measure properties of identical objects including mass, area, volume, density, force, distance, time, and temperature. Teams will also perform metric unit conversions.

   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes

   CALCULATOR: Class II

2. **EVENT PARAMETERS:**
   a. The event will be divided into 3 sections. Sections One & Three combined will involve estimating and measuring properties of objects at stations.
   b. Participants will rotate through stations to make their estimations in Section One - Estimation, and then in Section Three - Measurement, they will use measuring devices to measure the same or identical objects at the stations. Some of the stations will ask for calculated measurements - measurements that require formula calculations (e.g., calculating the density of an object, surface area, velocity, etc). The number of calculated measurements will be based on the level of competition per the following:
      i. No more than 20% of the stations at the Regional level.
      ii. At least 20% but not more than 40% of the stations at the State level.
      iii. At least 40% but not more than 60% of the stations at the National level.
   c. Measuring devices must be kept out of sight during Section One - Estimation.
   d. The property to be estimated or measured and the units of measurement must be identified in the directions at each station. Prior to the competition supervisors must determine the acceptable measurement value with the same equipment that is to be used at each station.
   e. Participants must not bring watches, writing implements, electronic devices (with the exception of a calculator for Section Three), notes, or use any kind of measuring device (e.g., fingers, pieces of paper, pencils, clothing, etc.). Each team may bring two Class II calculators for use during Section Three.
   f. Supervisors must furnish writing implements, paper, and all measuring devices needed for the event.
   g. **All measurement and calculation units must be limited to the metric (SI) system.**
3. **THE COMPETITION:** For each part participants will be given an answer sheet to record their answers. Each answer sheet must be turned in prior to the next section or the team will lose their score for that section.
   a. **Section One - Estimation:**
      i. **Time Limit Expectations**
         (1) **Regional Tournaments will be a minimum of 60 seconds per station**
         (2) **State Tournaments will be a minimum of 45 seconds per station**
         (3) **National Tournaments will be a minimum of 30 seconds per station**
      ii. Participants must not touch or feel any of the objects, unless the station directions specifically state the object may be touched. Participants must be allowed to "heft" an object for estimated masses.
   b. **Section Two - Metric Unit Conversion:**
      i. This part must be after the completion of Section One and before beginning Section Three.
      ii. Participants will have 5 minutes to complete 5 Metric Unit Conversion problems.
      iii. Participants will be asked to convert 5 metric numbers to a specific different metric unit and must not be required to convert from one measurement system to another (e.g., metric to standard).
      iv. **At the regional tournament level event supervisors will provide students with a metric prefix chart including all needed prefixes for the given exam.**
   c. **Section Three - Measurement**:
      i. **Time Limit Expectations**
         (1) **Regional Tournaments will be a minimum of 90 seconds per station**
         (2) **State Tournaments will be a minimum of 75 seconds per station**
         (3) **National Tournaments will be a minimum of 60 seconds per station**
      ii. Measurements must be made using the supervisor-supplied instruments, expressed to the instrument's resolution (the smallest division/markings/graduations on its scale) plus one estimated digit (if appropriate/analog). **An estimated digit must not be provided for a digital measurement.**
      iii. To receive points, measurements must be expressed using the proper resolution and estimated digit appropriate for the instrument(s) provided, and the proper unit of measurement. **Example**: Correct answer = 9.0 cm. If the answer given by the team is 9 cm or 9.0, the answer will be marked wrong.
4. **SCORING:**
   a. High score wins. Final Score = Estimation Score + Metric Unit Conversion Score + Measurement Score.

b. **Section One - Estimation:**
   i. Scoring Expectations - To receive the number of points in the column, estimations must be within the following range:

Estimation Section Scoring

Tournament Level	5 points	3 points	1 point
Regionals	15%	30%	45%
State	10%	20%	30%
Nationals	5%	10%	15%

c. **Section Two - Metric Unit Conversions**: Answers must be with the correct unit written to receive 5 points. All other answers receive zero points. **Example**: Convert 14.56 mm to hm. Correct answer = 0.0001456 hm.

d. **Part Three - Measurements**:
   i. **Direct Measurements**: **Measurements (not involving calculations) will be scored according to the following table for analog measurements. Digital measurements will be scored at all levels as 5 points for +/- one final digit, 3 points for +/- two final digits, and one point for +/- three final digits.**

Direct Measurement Scoring

Tournament Level	5 points	3 points	1 point
Regionals	+/- 15 of Estimated Digit	+/- 20 of Estimated Digit	+/- 25 of Estimated Digit
State	+/- 12 of Estimated Digit	+/- 17 of Estimated Digit	+/- 22 of Estimated Digit
Nationals	+/- 10 of Estimated Digit	+/- 15 of Estimated Digit	+/- 20 of Estimated Digit

Example: At a regional tournament the Supervisor measured the width of a page as 209.1 mm using a ruler whose smallest divisions are 1.0 mm.
- **Five points would be awarded for a measurement between 207.6 mm and 210.6 mm**
- **Three points for a measurement between 206.1 mm and 212.1 mm**
- **One point for a measurement between 204.6 mm and 213.6 mm.**
- **No points would be awarded for a measurement outside of 204.6 mm and 213.6 mm.**

   ii. **Calculated Measurements**: **Measurements that require formula calculations will be scored using the same direct measurement scoring ranges provided above.**
   iii. **Calculated measurements are limited to area and volume of polygons/polyhedrons, density of contained liquids, solids, and powders, melting and boiling points of water, force, mechanical energy, displacement of liquid by a solid, time constants/periods of simple harmonic motion, mass of solids and liquids, and spring constants.**
   Example: At a state tournament, the Supervisor measured and calculated for an area: 13.45 cm x 22.32 cm = 300.2 cm^2.
   - **For five points: within -0.12: 13.33 cm x 22.20 cm = 295.9 cm^2, within +0.12: 13.57 cm x 22.44 cm = 304.5 cm^2.**
   - **For three points: within -0.20: 13.25 cm x 22.12 cm = 293.0 cm^2, within +0.20: 13.65 cm x 22.52 cm = 307.4 cm^2.**
   - **For one point: within -0.30: 13.15 cm x 22.02 cm = 289.6 cm^2, within +0.30: 13.75 cm x 22.62 cm = 311.0 cm^2.**
   - **Measurements outside the range of 289.6 cm^2 to 311.0 cm^2 will receive zero points.**

e. **Penalties**: Penalties, up to 10%, may be applied to teams who do not return measuring devices to their original locations, do not clean up spills, and/or intentionally alter or damage equipment or objects.
f. Ties will be broken using tiebreaker stations designated prior to the start of the event.

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

MISSION POSSIBLE B

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

1. **DESCRIPTION:** Prior to the competition, participants design, build, test, and document a Rube Goldberg®-like Device that completes required Start and Final Actions through a series of specific actions.

   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 40 minutes

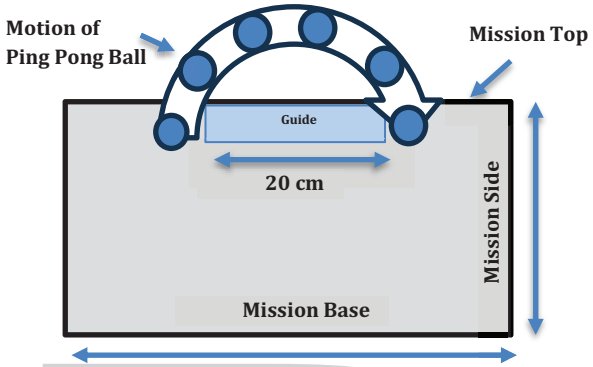
   EYE PROTECTION: C **IMPOUND:** State & National Only

2. **EVENT PARAMETERS:**
   a. Only one Device: One Device designed and built by the team prior to the competition.
   b. Impound: At State and National Tournaments only, the Team must impound their Device, Action Sequence List (ASL), and any tools or parts that they will use during their set-up time or run before the first time slot. Electric outlet access will not be available.
   c. Eye Protection: Class C is required (See Eye Protection policy on soinc.org).
   d. Event Time: Teams will have approximately 40 minutes to adjust, repair, and run their Device.

3. **CONSTRUCTION PARAMETERS:**
   a. During operation, the Device's outer dimensions must be no greater than **80.0cm x 80.0cm x 80.0cm**, in any orientation.
   b. All actions used for scoring must be visible and/or verifiable. The top and at least two vertical walls must be open or transparent for viewing all actions. Actions must be consecutive. Parallel and/or dead-end actions will not count for points. Any action in the Device not designed to contribute to the completion of the Final Action will not count for points.
   c. Each movable/adjustable physical object in the Device must be utilized by at most one assigned action. An object at the end of one action may initiate the next action **but must not be used in any further action.**
   d. Use of electricity is prohibited anywhere in the Device.
   e. Candles, flames, matches, hazardous liquids, lead objects (even if encased), gases, **pressure vessels (hydraulic or pneumatic)**, and hazardous materials (e.g. rat traps, combustible fuses, dry ice, liquid nitrogen) and unsafe handling of chemicals will not be permitted.
   f. **If actions 4.d.i. Wheel and Axle, 4.d.iv. Inclined Plane, and 4.d.xi. Paddle Wheel are used, the object must be easily detachable so the Event Supervisor (ES) can weigh the object.**

4. **DEVICE OPERATION:**
   a. Start Action: (100 points) - **Participants must quickly dump into the Device from above the Device, from a team provided 12-16 oz. commercially available plastic cup, a mixture of 10 wooden golf tees (nominal size range 1.5" to 2.75"), 10 metal paperclips (small size #1 or Jumbo), and 10 glass or ceramic marbles (size range 12mm to 42mm). All the mixture items must be commercially produced. The ES will shake the mixture in the cup, return the cup to the team prior to the competitor dumping it into the Device. The fall of the mixture must initiate the next action. Separation of the mixture may not begin until the Final Action. (Stalling is not permitted and may result in a penalty.)**
   b. Scorable Actions: (50 points each) – Participants may have up to 12 scorable unique actions to count for points. Simple machines required in the actions must be used as the simple machine name implies. For example, a wedge must be "wedged" against an object rather than used as a gate. An axle must turn a wheel or vice-versa for it to be considered a wheel & axle.
   c. The 12 unique scorable actions may be completed in any order. Other actions may be inserted between those that could count, but the inserted actions will not be scorable and must be included on the ASL.
   d. Each of the actions below may be attempted only once in the Device for points.
      i. **Use a wheel & axle, with an IMA of at least 2, to raise an object weighing at least 50g at least 15cm vertically before the object initiates the next action.**
      ii. Remove a wedge that keeps a golf ball from rolling, so that the golf ball rolls at least 20 cm horizontally before the golf ball initiates the next action.
      iii. **Use the IMA action of a screw to move an object 5cm horizontally before the object initiates the next action**.
      iv. Push or pull an object with a mass of at least 100g up an inclined plane with an IMA of at least **3** so that the object is vertically raised at least 10cm before it initiates the next action.
      v. Use a **combination of a 2nd class and 3rd class lever, in any order**, to raise an object **15cm** before the object initiates the next action.

vi. Operate a pulley system with IMA of **2** to raise an object at least **15cm** before the object initiates the next action.
vii. Use a marble to knock over a series of **5** dominoes so the last domino moves another marble to initiate the next action.
viii. **Use a 1st class lever to launch an unaltered ping pong ball completely out of the top of the Device, flies at least 20cm horizontally before re-entering the Device to initiate the next action. A guide of 20cm should be included at the top level of the Device to ensure compliance. The 1st class lever is considered part of the Device for Device dimension measurement.**



ix. Use a single marble to hit a chain of 5 touching marbles so that the last marble moves at least **15cm** horizontally and then initiates the next action.
x. Use water to raise a golf ball at least 5cm before the golf ball rolls out of the container to initiate the next action.
xi. Use more than one falling marble to turn a paddlewheel. **The paddlewheel must raise an object of at least 50g mass vertically 5cm before the object initiates the next action.**
xii. Use an Archimedes screw to raise a marble 20cm vertically before the marble triggers the next action. If the Archimedes screw is encased, the walls/tube must be transparent.

e. Participants may designate one sand timer, an action taking over 10 seconds, to be eligible for bonus points. This timer must not be one of the scorable actions.
i. A 1-point bonus will be awarded for every full second the sand timer runs before the Target Operation Time. The timer may run past the Target Operation Time but will not receive points for the duration after the Target Operation Time.
ii. The timer must successfully initiate the next action for any bonus points to count.
iii. For State/National tournaments, the team must demonstrate how this timer is adjusted to account for the increased length of Target Operation Time for the bonus points to count.

f. Final Action:
i. **After all other planned scorable actions have been attempted, the Device must separate the original mixture into three separate (marked by material) containers that are different from the original container where the mixture was dropped.**
ii. **After the last material reaches its container, the Device must ring a clearly audible bell to mark the end of the final task completion and the end of timing.**
iii. **Points will be awarded for each item from the original mixture that is in the correct marked container when the Device stops. Points will be deducted for each incorrect item from the original mixture that is in the wrong container. Bonus points will be awarded for each of the 3 marked containers that contain all 10 of the correct original items and no other original items.**
iv. **Team members will not be allowed to touch any of the original 30 items during Device operation.**

g. Action Sequence List:
i. Two printed copies of an Action Sequence List must be given to the Event Supervisor at the time of check-in (Regionals)/impound (State and National).
ii. The format should be the same as the one posted on the Science Olympiad website.
iii. Scoreable actions in the ASL and distances should also be labeled at the proper places within the Device.

5. **COMPETITION:**
   a. Impound before first time slot (Only for State and National tournaments).
      i. Teams must impound their Device, Action Sequence List (ASL), and any tools or parts that they will use during their set-up time or run.
      ii. **Inspections will NOT take place during impound as any of the 15 member team may impound.**
   b. **Before the first time slot begins**, the Target Operation Time will be selected by the ES. The Target Operation Time at a competition will be the same for all teams. Teams will be told the Target Operation Time at the start of their Setup Time.
      i. Regionals/Invitationals will be 60 seconds.
      ii. State tournaments will be 61 to 90 seconds.
      iii. National tournament will be 91 to 120 seconds.
   c. Check-In
      i. Only the participants will enter the event area. Once participants start the Check-In process, they must not leave or gain any outside assistance or materials until their Event Time is completed.
      ii. Teams will be instructed by the ES when to retrieve their impounded items (State & National).
      iii. Each Device must pass a safety inspection before operation. Devices with potential hazards, safety concerns **or use of electricity** must not be permitted to run unless safety concerns are resolved **and electricity removed** to the satisfaction of the Event Supervisor, otherwise they must receive only participation points.
      iv. **ES will take all measurements including dimensions and masses before or after the Device's Official Run at the ES discretion. ES may re-measure after the Official Run if the dimensions change.**
      v. Participants must be able to answer questions regarding the design, construction, and operation of the Device per the Building Policy found on www.soinc.org.
   d. Setup Time
      i. The ES will notify the participants when their time starts. The ES will record the team's start time for scoring.
      ii. Participants will start preparing their Device for an Official Run. Teams are permitted to adjust, repair, and test their Device during their Setup Time.
      iii. Participants must notify the ES when ready to start their Device for scoring. ES will record the number of minutes of Setup Time used.
   e. Official Run
      i. Timing and scoring begin when a participant starts dumping the Mixture into the Device. Timing stops when the bell is rung, or after 2x the Target Time in seconds have elapsed, whichever comes first. **No points will be earned after timing stops.**
      ii. Teams that have a run time of twice the Target Time will receive no (zero) points for running time.
      iii. If the Device stops, jams, or fails, the participants will be allowed to adjust it to continue operation up to three times. An adjustment may consist of multiple physical touches and is only completed once the Device runs again on its own. Obviously adjusting only to stall or impact operation time will result in disqualification.
      iv. If a participant completes a scorable action or makes an adjustment that leads directly to the completion of that action, then that action will not count for points, even if it is part of the Final Action.
      v. **Participants will not be allowed to touch the Device to release original items into a container.**
   f. The Event Supervisor will review with teams their data recorded at the end of their Event Time.
   g. Teams filing an appeal must leave their Device and ASL in the event area.

6. **SCORING:**
   a. High score wins.
   b. **Award 50 points if not more than 30 minutes to set up their Device.**
      i. **At State & Nationals only: Award 75 points if participants use not more than 15 minutes to set up their Device or 50 points if not more than 30 minutes**.
   c. Award 25 points if 2 printed copies of the ASL are presented at the proper time.
   d. Award 25 points if ASLs are in proper format.
   e. Award 25 points if all scorable and non-scorable actions are included and accurately described.

f. Award 25 points if the original number (column 1) in the ASL are properly labelled in the Device and the action number (column 3) is the roman numeral of the 12 optional intermediate tasks (i to xii).
g. Award 50 points the first time each unique action in Section 4. is successfully completed as described in the rules.
h. Award 100 points for completing the Start Action.
i. Award 10 points for each original item placed completely in the correct marked container.
j. Award 50 points for each marked container that holds all 10 of the original items and none of the other original items.
k. Award 100 points for ringing the bell after the last items are placed in their container and the Device stops.
l. Award 2 points for each full second (rounded down) of operation up to the Target Operation Time. Devices running twice the Target Time will receive zero time points.
m. Award 1 point per full second that a **sand** timer runs before the Target Operation Time if all conditions are met, and the next action is initiated by the timer.
n. Award 0.1 point for each 0.1cm that the Device dimensions are under **80cm x 80cm x 80cm**. The maximum score awarded for each dimension is 30 points, for a total of 90 points (Only at in-person tournaments.)
o. Award 75 points for a Device that has no adjustments during operation.
p. Teams receive only participation points for impounding a Device but not competing, unsafe Devices, or Devices that are remotely timed/controlled.

7. **PENALTIES:**
   a. Deduct 2 points for each full second (rounded down) that the Device operates past the Target Operation Time up to **2x the Target Time seconds**.
   b. Deduct 25 points:
      i. For each dimension of the Device that exceeds its limit of **80cm x 80cm x 80cm**.
      ii. If the top and 2 vertical walls are not open or transparent.
      iii. For each time the Device is adjusted during operation, up to 3 times. If the Device stops or fails after the third adjustment, scoring stops and the operation time will be **2x the Target Time** in seconds.
   c. Deduct 10 points for each original item that is in the wrong marked container.
   d. Deduct 50 points if any solid or liquid leaves the measured dimensions of the Device **with the exception of the ping pong ball in action 4.d.vii.**
   e. **Devices with any dimension greater than 85cm x 85cm x 85cm will be allowed to run but will be scored in Tier 2.**
   f. **Teams failing to impound their Device on-time will be scored in Tier 3.**
   g. **Teams failing to answer build questions will be scored in Tier 3.**
8. **TIEBREAKERS:**
   a. Ties are broken as follows: a) Fewest penalty points; b) Smallest overall dimensions (L+D+H) of the Device.
9. **DEFINITIONS:**
   a. *Event Supervisor (ES)* is responsible for ensuring the event runs correctly. The ES can assign one or more event helpers to perform various competition tasks.
   b. *Container*: Receptacle (such as a box or jar) for holding goods or items. A container needs sides to hold and protect its contents. The specific design and material of the sides and base can vary greatly depending on the container's purpose. The base does not need to be flat or solid. The base cannot be the Mission Device base.
   c. *Electricity*: A form of energy that results from the movement/flow of charged particles, electrons to create electric current. Electric current in any form (static or dynamic) is not allowed. This would disallow the use of batteries for electric current.
   d. *Marbles* used in the Device must be glass or ceramic. These cannot be metal. Must be commercially available and sold as a marble. Allowed marble size (12mm to 42mm).
   e. *Dominoes* must be commercially available, not 3-D printed, not homemade, etc.
   f. *Sand* must be a commercially available product and sold as sand.
   g. *Ping Pong Ball* must be a commercially available product and sold as a ping pong ball.

h. *Ideal Mechanical Advantage (IMA)* is a theoretical calculation of a machine's force-magnifying ability, assuming no energy is lost to friction or other inefficiencies.
i. *Action Sequence List (ASL)*The list must include all sequential actions in the machine including but not inclusive of this list:
    i. Indicate the Start, the action initiated by the mixture, the Sand Timer (if one is included), the sequence of unique scorable actions, all non-scorable actions, and the action that rings the bell, etc.
    ii. ASL column 1 should be an ordinal number that matches the number in your Mission Possible Device for easy tracking.
    iii. ASL column 2 should specifically call out the object by name in 4.d.i. to 4.d.xii. that is to be moved.
    iv. ASL column 3 should be the specific task that the points are to be requested (e.g. 4.d.iv.).

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

B

POTIONS & POISONS B

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

1. **DESCRIPTION:** This event is about chemical properties and effects of specified toxic and therapeutic chemical substances, with a focus on household and environmental toxins or poisons.

   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes

   EYE PROTECTION: C **CALCULATOR:** Class II

2. **EVENT PARAMETERS:**
   a. Each participant may bring one 8.5" x 11" sheet of paper, which may be in a sheet protector sealed by tape or laminated, that may contain information on both sides in any form and from any source without any affixed labels.
   b. Each participant must bring a writing implement and may bring a Class II calculator.
   c. Teams should bring any or all of the items listed on the Division B Chemistry Events Lab Equipment List, posted on soinc.org. Teams not bringing these items will be at a disadvantage, as they are not provided.
   d. Participants must wear goggles, an apron or a lab coat and have skin covered from the neck down to the wrist and toes. Gloves are optional, but if the host requires a specific type they will notify teams. Pants should be loose fitting; if the host has more specific guidelines, they will notify teams in advance of the tournament. Shoulder length or longer hair must be tied back. Participants removing safety clothing/goggles or unsafely handling materials, or equipment will be penalized or disqualified.
   e. Supervisors will provide any required reagents, additional glassware, and/or references that are needed for the tasks (e.g., Periodic Table, etc.)

3. **THE COMPETITION:** The competition will be conducted in two parts.
   a. Part 1--Exam: This part will be a multiple-choice and short answer test covering the following subject areas: Students should understand ionic and covalent bonds, and the difference between mixtures, solutions and compounds. Students may be asked to separate components of a mixture. Students will distinguish between physical and chemical changes. Students may be asked to balance a simple chemical equation. Students may be asked to identify various poisonous plants and animals, and their toxic effects. Students may be given a map and be asked to analyze the potential patterns of spread of toxic spills in the environment via water, wind or gravity. Students will understand the effects and chemistry of common household toxins. Students should understand the effect of dilution on toxicity.
      The test may include information on the following specific toxins:
      i. Household chemicals: ammonia, hydrogen peroxide, rubbing alcohol, bleach, Epsom salts, vinegar, nutritional supplements containing calcium and iron.
      ii. Toxic living organisms: poison ivy (*Toxicodendron radicans*), **giant hogweed (Heracleum mantegazzianum), Calabar bean (Physostigma venenosum), rhubarb (Rheum rhaponticum), American false hellebore (Veratrum viride), cane toad (Rhinella marina), poison dart frog (Dendrobatidae), Portuguese man o' war (Physalia physalis), lionfish (Pterois sp), fat tail scorpion (Androctonus australis)**
      iii. Environmental toxins: **copper**, lead, and mercury.
   b. Part 2--Lab: Students will be asked to perform at least one lab task themselves. Other lab exercises may be performed as a demonstration, at the discretion of the event supervisor. Lab activities will be drawn from: chromatography, mixtures of reagents, separation of a mixture, serial dilutions, determination of pH, and conductivity testing. Reagents may be mixed by students or the event supervisor with subsequent observation of changes in temperature or color, production of a gas or a precipitate, the relative rate of a chemical reaction or other parameters. Students may be asked if a particular change is a physical or chemical change.

4. **SCORING:** High Score wins. Part 1: Test questions are worth 60% of the competition. Part 2: Lab questions are worth 40% of the score. Selected questions or quality of free response answers will be used to break ties.

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

REMOTE SENSING B

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

1. **DESCRIPTION:** Participants will demonstrate an understanding of the basic principles of remote sensing and interpret imagery, data, and maps related to human interactions with land on Earth.

   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes

   CALCULATOR: Class II

2. **EVENT PARAMETERS:**
   a. Each team may bring one three-ring binder of any size containing information in any form and from any source attached using the available rings. Sheet protectors, lamination, tabs and labels are permitted. If the event features a rotation through a series of laboratory stations where the participants interact with samples, specimens, or displays; no paper may be removed from the binder throughout the event.
   b. Each team may bring two protractors, two rulers, and two Class II calculators.
3. **THE COMPETITION:** Participants will be given one or more tasks presented as an exam and/or timed stations. The event will consist of questions and activities testing concepts related to the collection and use of remote sensing data to observe and study human interactions with the Earth. Questions will address the following topics:
   a. Remote sensing concepts (25-35% of total points)
      i. Properties of light: electromagnetic spectrum, reflection, refraction, absorption, scattering, polarization, irradiance/radiance
      ii. Types of sensors, limited to: active vs. passive, UV, visible light, infrared, radar
      iii. Types of satellite orbits and their purposes, limited to: low earth, medium earth, high earth, polar/non-polar, geostationary, geosynchronous
      iv. Image characteristics: spatial, temporal, radiometric (calculations limited to signal-to-noise ratio/sensitivity), spectral
      v. Instrumentation, limited to: scanning systems, multispectral imaging systems, optical and infrared imagers, radiometers, radar altimetry
   b. Interpretation and analysis of remote sensing images and data sets (65-75% of total points), limited to the types of sensors listed in 3.a.ii., from the following satellites only: different spectral combinations from Landsat 5-9 (TM, ETM, OLI), Sentinel-1A/1B, Sentinel-2A/2B, Terra (limited to: MODIS, ASTER), Shuttle Radar Topography Mission (SRTM). Questions will focus on the following:
      i. Fundamentals of mapping as applied to topographic maps, satellite maps, aerial photographs, and other maps generated by remotely sensed data
         (1) Marginal information
         (2) Symbology and cartographic design: location, scale, legend, symbols, contours
         (3) Measurements, limited to:
            (a) Distance between features, perimeter, area
            (b) Azimuths and bearings
            (c) Latitude and longitude in degrees, minutes, seconds, and decimal degrees
            (d) Altitude and elevation
      ii. Land usage and monitoring in relation to society and human impact
         (1) Identification and classification of physical phenomena, including but not limited to
            (a) Absorption and scattering by aerosols and their effect on data collection
            (b) Refraction, albedo, surface temperature, reflectance, and other properties of natural and engineered materials and their uses for classifying land areas
            (c) Elevation or subsidence changes of buildings over time using radar altimetry
            (d) Vegetation changes (e.g., forests, agriculture) using multispectral images over time
            (e) Geohazards, limited to: volcanoes, landslides, flooding, wildfires
         (2) Land Cover Classification Systems
            (a) Supervised and Unsupervised classification maps
            (b) National Land Cover Database (NLCD/CONUS) Land Cover Change Index
            (c) Implications for habitat loss, land cover change, urbanization, deforestation, damage assessment

4. **SCORING:**
   a. High score wins.
   b. Points will be awarded for the quality and accuracy of responses.
   c. Selected questions may be used as tiebreakers.

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

This event is sponsored by the IEEE Geoscience and Remote Sensing Society (GRSS).

B

ROCKS AND MINERALS B

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

1. **DESCRIPTION: Teams will identify and classify rocks and minerals and demonstrate knowledge of how rocks and minerals help to understand geologic processes, interpretation of earth's history, the development of natural resources, and use by society.**

   A TEAM OF UP TO: 2

   APPROXIMATE TIME: 50 minutes

   CALCULATOR: Class II

2. **EVENT PARAMETERS:**
   a. Each team may bring one (1) magnifying glass and one (1) three-ring binder of any size containing information in any form and from any source attached using the available rings. Sheet protectors, lamination, tabs and labels are permitted.
   b. Each team may also have one (1) commercially produced field guide which may be tabbed and annotated.
   c. In addition to a binder and a field guide, each team may bring one (1) copy of the 2026 National Rocks and Minerals List which does not have to be secured in the binder and may be annotated.
   d. Each team may bring one (1) Class II calculator.
   e. Teams are not permitted to bring samples or specimens to the event.
   f. If the event features a rotation through a series of stations where the participants interact with samples, specimens or displays; no material may be removed from the binder, **except for the 2026 National Rocks and Minerals List.**

3. **THE COMPETITION:**
   a. Emphasis will be placed upon task-oriented activities such as identification of rocks and minerals based on observations of properties and characteristics, interpretation of graphs and charts, and analyzing data.
   b. Where possible, participants will move from station to station, with the length of time at each station predetermined and announced by the Event Supervisor. Participants may not return to stations but may change or add information to their original responses while at other stations.
   c. Identification will be limited to specimens appearing on the Official Science Olympiad **2026** National Rocks and Minerals List, but other rocks or minerals may be used to illustrate key concepts.
   d. If identification of a specimen is not possible through observation, key characteristics/properties of the specimen will be provided.
   e. Identification of rocks and minerals should be at least 30% but not more than 50% of available points.
   f. Questions/tasks will be balanced between rock and mineral topics.
   g. Written descriptions **of** how a specimen might react if tested with **hydrochloric acid** (HCl) may be given. **However**, HCl will not be used or provided. Participants will **not** be allowed to do a taste test.
   h. **Mineral Topics**
      i. Identification - specimens or images used should show observable properties. Where observable properties are insufficient to identify a specimen, other diagnostic characteristics will be provided
      ii. Physical Properties - color, hardness, luster, streak, cleavage/fracture, density/specific gravity/ heft, diaphaneity, **and** tenacity
      iii. Other properties - limited to reaction with acid, fluorescence, magnetism, smell, taste, double refraction, piezoelectricity, **and** radioactivity.
      iv. Mineral habit - limited to acicular (needlelike), bladed, botryoidal, cubic, dendritic, dodecahedral, doubly terminated, druzy, geodic, hexagonal, hopper, massive, micaceous, octahedral, pisolitic, prismatic, radiating, rosette, stalactitic, twinning, and tabular
      v. Chemical composition – chemical formulas, relationships between chemistry and properties (e.g., effect of trace elements on mineral color)
      vi. Polymorphs (e.g., **aragonite/calcite**; diamond/graphite, orthoclase/microcline; **sillimanite/ andalusite/kyanite)**
      vii. Classification - mineral families based on composition (see 2026 National Rocks and Minerals List)
      viii. Mineral groups (e.g., feldspar, garnet, tourmaline) - similarities of chemical composition and shared properties
      ix. Methods of formation and environments (e.g., hydrothermal, chemical weathering, crystallization from magma, evaporites, chemical precipitation, alteration under heat & pressure)
      x. Minerals associated with rock-forming environments (e.g., evaporite minerals in sedimentary settings; mafic minerals in oceanic crust; minerals that form under metamorphic conditions)
      xi. Bowen's Reaction Series – relationship between mineral crystallization and temperature in magma

xii. Uses of minerals
  (1) Ores, industry, jewelry, geochronology, medicine, manufacturing, construction, electronics, etc.
  (2) Precious and semi-precious gemstone **varieties from** minerals on the **2026** National Rocks and Minerals List as well as the following, limited to: emerald, aquamarine, morganite, peridot, ruby, sapphire, pearl and amber

i. Rock Topics
  i. Identification - specimens or images used should show observable characteristics. Where observable characteristics are insufficient to identify a specimen, other diagnostic characteristics will be provided (e.g., mineral composition of fine-grained igneous rocks, **reaction to acid of chalk or diatomite**)
  ii. Classification - igneous, sedimentary, and metamorphic including observable diagnostic characteristics that facilitate classification (e.g., glassy or vesicular texture in igneous; rounded grains, fossils, or layers in sedimentary; and foliation or banding in metamorphic)
  iii. Igneous Rocks:
    (1) Textures - including aphanitic (fine-grained), glassy, vesicular, porphyritic, pyroclastic, phaneritic (coarse-grained), **and** pegmatitic
    (2) Composition and essential minerals - felsic, intermediate, mafic, **and** ultramafic
    (3) Intrusive and extrusive environments a**nd formations** - limited to batholith, dike, sill, volcanic neck, lava flow, pyroclastic flow, **and** laccolith
    (4) Relationship between textures and environments of formation (e.g., intrusive/plutonic, extrusive/volcanic and relative rates of solidification.)
    (5) **Types of igneous rocks and constituent minerals at various types of plate boundaries (e.g., basalt at mid-ocean ridge; andesite/diorite at subduction zones; granite at convergent boundaries)**
  iv. Sedimentary Rocks:
    (1) Textures - limited to clastic (detrital or terrigenous), chemical (**crystalline)**, and biochemical **(organic/bioclastic)**
    (2) Composition and essential minerals
    (3) Grain sizes (e.g., clay, silt, sand, pebble, cobble, boulder), sorting, and shape **(round vs angular) and their implications for energy and conditions of environments of deposition (e.g., fine grained-low energy; coarse-grained-high energy)**
    (4) Relationship between textures and composition to environments of deposition
    (5) Environments of deposition - including, but not limited to alluvial fan, delta, river/stream (fluvial), lake (lacustrine), swamp, wind (aeolian), floodplain, beach, shallow marine/shelf, **and** deep marine
    (6) Primary sedimentary structures and their implications about depositional processes and environments (e.g., plane bedding, crossbedding, ripple marks, mud cracks, graded bedding, **and** fossil tracks & trails)
  v. Metamorphic Rocks:
    (1) Textures - foliated **(e.g., slaty cleavage, schistose, banding)** and non-foliated
    (2) Mineral composition
    (3) **Metamorphic minerals that form in existing rocks due to heat and pressure (e.g., garnet, corundum, kyanite, staurolite, epidote, andalusite, sillimanite, chlorite)**
    (4) Protoliths (parent rocks); e.g. **shale for slate, limestone for marble, sandstone for quartzite.**
    (5) Regional and contact metamorphism
    (6) Grade **(intensity)** of metamorphism **(low, medium, high**) and index minerals (e.g., chlorite, epidote, garnet, staurolite, kyanite, **and** sillimanite) **that indicate the degree of metamorphism**
  vi. Rock Cycle – emphasis on the geologic processes that form rocks (e.g., melting **&** solidification; uplift, erosion & deposition; burial, compaction & cementation; heat & pressure resulting in recrystallization & deformation)
  vii. Economic importance and uses of rocks (e.g., building stone, ores, ornamental, agriculture, fossil fuels)

4. **SCORING:**
   a. High score wins.
   b. Point values of each question or section may be specified.
   c. Preselected questions/sections will be used as tiebreakers.

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

B

MINERALS

BORATES
- Ulexite

CARBONATES
- Aragonite
- Azurite
- Calcite
- Dolomite
- Malachite
- **Magnesite*[1]**
- Rhodochrosite*
- Siderite*

NATIVE ELEMENTS
- Copper
- Diamond
- Gold
- Graphite
- Silver
- Sulfur

HALIDES
- Fluorite
- Halite[4]

OXIDE/HYDROXIDES
- Corundum
- Goethite/Limonite
- Hematite
- Magnetite
- Pyrolusite*
- Rutile*
- Zincite*

PHOSPHATES
- Turquoise*
- ***Apatite Group***
  - **Fluorapatite**
  - Pyromorphite*
  - Vanadinite*

SULFATES
- Barite
- Celestite
- *Gypsum[4] varieties:*
  - Alabaster (massive)
  - Satin Spar (fibrous)
  - Selenite (crystalline)

SULFIDES
- Bornite*[1]
- Chalcopyrite
- Galena
- Pyrite
- Sphalerite
- Stibnite*

SILICATES
- *Amphibole Group*
  - Actinolite*
  - Hornblende
  - Tremolite*
- Apophyllite*
- Beryl
- **Chrysocolla***
- **Dioptase***
- Epidote
- *Feldspar Group*
  - Plagioclase feldspars
    - Albite
    - Labradorite
  - Potassium feldspars
    - Amazonite
    - Orthoclase/Microcline[2]
- *Garnet Group*
  - Almandine
  - **Grossular (green)**

SILICATES (cont)
- Kaolinite
- Kyanite
- *Mica Group*
  - Biotite
  - Lepidolite*
  - Muscovite
- Olivine
- **Prehnite***
- *Pyroxene Group*
  - Augite
  - Rhodonite*
  - Spodumene*
- *Quartz varieties:*
  - Aventurine
  - Agate/**Chalcedony**
  - Amethyst
  - Citrine
  - Jasper*
  - Milky Quartz
  - Opal
  - Rock Crystal
  - Rose Quartz
  - Smoky Quartz*
  - **Tiger's Eye***
- Sodalite
- Staurolite
- Stilbite*
- Talc
- Topaz
- **Tourmaline[3]**
- Willemite*
- **Wollastonite***
- Zircon*

ROCKS

IGNEOUS
- Andesite
- Basalt
- Diorite
- Gabbro
- Granite
- Obsidian
- Pegmatite
- Peridotite
- Pumice
- Rhyolite
- Scoria
- Syenite*[1]
- Tuff*[1]
- **Tuff Breccia***

SEDIMENTARY
- Banded Iron Formation
- Bauxite[4]
- Breccia
- Chert/Flint
- Conglomerate
- Diatomite*[1]
- Dolostone
- Rock Salt (Halite)[5]
- Rock Gypsum[5]
- Shale
- **Siltstone*[1]**
- *Coal varieties:*
  - Anthracite
  - Bituminous
  - Lignite
- *Limestone varieties:*
  - Chalk
  - Coquina
  - Fossil Limestone
  - Oolitic Limestone
  - Travertine
- *Sandstone varieties:*
  - Arkose
  - Greywacke*
  - Quartz Sandstone

METAMORPHIC
- Amphibolite*
- Gneiss
- Marble
- Phyllite
- Quartzite
- *Schist Varieties:*
  - Garnet Schist
  - Mica Schist
  - Talc Schist (Soapstone)*
- Serpentinite*
- Slate

*Specimens marked with an asterisk (*) are for State and National Tournaments

1. **For identification purposes, information will be provided such as diagnostic properties, chemical formulas, grain size, or composition.**
2. The pink/tan variety of feldspar should be identified as **Orthoclase/Microcline** or Potassium feldspar.
3. **Although Tourmaline is the generic name for a group of related mineral species, for identification purposes, tourmaline will be accepted.**
4. Bauxite has been reclassified as a sedimentary rock.
5. Rock Salt and Rock Gypsum for identification purposes are considered the same, respectively, as the minerals Halite and Gypsum and do not need to be distinguished

SCRAMBLER B

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

1. **DESCRIPTION:** Teams design, build, and test a mechanical device, which uses the energy from a falling mass to transport an egg along a track as quickly as possible and stop as close to the center of a Terminal Barrier (TB) without breaking the egg.

A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 12 minutes

EYE PROTECTION: B **IMPOUND:** Yes **CALCULATOR:** Class III

2. **EVENT PARAMETERS:**
   a. **Only One Scrambler**: designed, and built by the team may be entered, built prior to the competition.
   b. **Impound**: Team must impound before the first time slot.
   c. **Eye Protection**: Class B is required (See Eye Protection policy on soinc.org).
   d. **Event Time**: Teams will each have 8 minutes to adjust, repair, and run their Scrambler.
   e. **Track**: The Event Supervisor will provide and set up the Track as listed in the Track section.
3. **CONSTRUCTION PARAMETERS:**
   a. **Scrambler:** must consist of an egg transport (Vehicle) and an energy propulsion system (launcher and falling mass). These may be separate or combined into a single unit.
   b. **Size:** the entire Scrambler (Vehicle and energy propulsion system) including the egg, falling mass, and cushion to protect the floor, in the ready-to-run configuration, must completely fit within an imaginary rectangular box with 100.0 cm x 50.0 cm base with a 100.0 cm height. No part of the Scrambler can be taped or attached to the event floor.
   c. **Propulsion Energy**: all energy used to propel the Vehicle must come from a falling mass not to exceed 2.00 kg. The gravitational potential energy of the falling mass may be converted to other forms of energy.
      i. Additional sources of kinetic energy must be in their lowest energy state in the ready-to-run configuration.
      ii. Any part of the Scrambler whose gravitational potential energy decreases and provides energy to propel the vehicle after the Scrambler is actuated is considered to be part of the falling mass.
      iii. The falling mass **cannot contact the venue floor at any time during the run**. Teams must use a pad or similar protective cushion to prevent contact with or damage to the floor. **The protective cushion is part of the Scrambler's size. ES can prevent teams from running or performing an action if there is a risk the floor could be damaged.**
      iv. To facilitate mass measurements, the Scrambler must be impounded with the mass detached.
   d. **Stopping Mechanism** must be contained completely within the Vehicle and work automatically.
      i. The Vehicle must not be remotely controlled or tethered.
      ii. Pre-loaded energy storage devices may be used to operate other Scrambler functions (e.g., braking system) as long as they do not provide kinetic energy to propel the Vehicle.
   e. **Egg Holder and Backstop** must meet the following requirements:
      i. Backstop must be built out of one piece of solid (no holes or filled holes), rigid, flat, and unpadded **wood**. The flat surface must be 5.0 +/- 0.5 cm wide and 5.0 +/- 0.5 cm high. The thickness must be at least 1.1 cm. **Commercially purchased wood like plywood is allowed**. **Balsa cannot be used.**
      ii. The egg must rest on two (2) ¼" to ⅜" wooden round dowels which extend out from the flat surface of the backstop. These dowels must extend between 3.0 and 4.0 cm from the backstop. The dowels must be within 1.0 cm from the bottom of the backstop.
      iii. The bottom of the wooden dowels must be between 5.0 and 10.0 cm above the track.
      iv. The backstop must be mounted to the front of the vehicle to allow the egg to be the foremost part of the vehicle. **The backstop must be mounted in a rigid method to prevent movement during an impact**.
   f. **Pencil Start**: Competitors must design the Scrambler to start by using any part of an unsharpened #2 pencil with an unused eraser, provided by the ES, to actuate a release mechanism. The pencil may be the release mechanism itself and may extend beyond the dimensions in 3.b. Actuating the release mechanism must not impart additional energy to the Vehicle.
   g. **Vehicle Parts:** All parts of the Vehicle must move as a whole: no anchors, tethers, tie downs, or other separate pieces are allowed. The only parts allowed to contact the floor during the run are wheels/treads, drive string, **drive attachment**, and any parts already in contact with the floor in the ready-to-run configuration. All wheels must be in contact with the floor at launch. Pieces falling off during the run constitutes a Construction Violation.

h. **Electric or Electronic** components or items cannot be used (with the exception of a calculator).
i. **Design Knowledge:** Answer questions on design, construction, and operation of the device per the Building Policy found on www.soinc.org.

4. **THE COMPETITION:**
   a. **Impound** before first time slot.
      i. Teams must impound one Scrambler, spare parts, alignment device (if used), and any papers (if used).
         (1) Launcher and a falling mass may be shared between teams from the same school.
      ii. Falling mass must be detached when impounding. Teams will be allowed to disconnect their mass if an issue is found during check-in.
      iii. Tools do not need to be impounded.
      iv. Inspections will NOT take place during impound as any of the 15 member team may impound.
   b. **After Impound** and before the first time slot, the Target Distance will be announced and posted. The Target Distance at a competition will be the same for all teams.
   c. **Check-In**
      i. Only the participants will enter and may bring tools as defined.
      ii. Teams will be instructed by the ES when to retrieve their impounded items.
      iii. Teams will present their Vehicle for inspection & measurement by the ES. Participants will be notified at this point if any construction violations are found.
         (1) Teams may use their Event Time to correct any construction violations. A team's Event Time will be paused during re-evaluation by the ES.
      iv. Once participants start the Check-In process, they must not leave or gain any outside assistance or materials until their Event Time is completed.
      v. The ES will provide uncooked grade A large chicken eggs. Teams will select one egg at the completion of Check-In. There is no penalty if an egg breaks prior to the device being actuated before the first launch. A second egg will be provided. The second egg may be a used egg; this will be the ES's choice.
   d. **Event Time**
      i. Participants will have their Event Time to complete up to 2 runs. The Event Time ends after 2 runs, the egg is broken or the time limit has been reached. Teams may adjust their Scrambler (e.g., repair, change distance, aiming) within their Event Time.
         (1) The time limit for the Event Time is 8 minutes.
         (2) The ES will notify the participants when their Event Time starts.
         (3) Vehicles in the ready-to-run configuration before the end of the Event Time will be allowed to complete a run.
      ii. Attaching the falling mass and egg are part of the team's Event Time.
      iii. Teams will secure the egg to the dowels on the Backstop with tape. The ES will supply the tape.
         (1) No tape can be placed on the front or rear 1.0 cm of the egg.
         (2) The egg's rounded end must be touching the Backstop and visible to the ES when attached.
         (3) The egg must be the foremost point of the Vehicle.
         (4) At the ES's discretion, the egg may be placed inside a thin transparent plastic bag.
      iv. Sighting, aligning, and guiding devices, if used, must be placed and used within the defined Track area. These devices cannot be electric or electronic. If placed on the Vehicle, they may be removed at the team's discretion. Devices remaining on the Vehicle will be considered part of the Scrambler. All items not part of the Scrambler must be moved **and placed** behind the Start Point prior to starting a run.
      v. Teams may use their own tools to verify the Track dimensions during their Event Time.
      vi. Substances applied to the Vehicle must be approved by the ES prior to use and must not damage or leave residue on the floor, Track and/or event area. Teams may clean the Track during their Event Time, but it must remain dry.
      vii. Teams must not roll or test the Vehicle on the floor of the Track on the day of the event without tournament permission. If permitted, only participants may be present. **During competition, teams must not roll the vehicle on the floor before or after runs. Teams are allowed to roll the Vehicle into the Launcher for the sole purpose of loading the Vehicle.**

viii. **Individual Run Testing**
- (1) Participants must place the tip of the egg above the Start Point.
- (2) The Vehicle must be able to remain at the starting position without being touched until triggered.
- (3) **Teams may choose per run to earn the optional Bucket Bonus by navigating around the Bucket. See Track section for Bucket position.**
- (4) Participants will notify the ES when ready to launch. At which point the ES will pause the Event Time and review the Vehicle in the Ready-To-Run configuration for any rule violations.
  - (a) This includes measuring the Scrambler's size.
  - (b) **The ES will only notify the participants of any violations at the end of each run. Teams may ask question(s) before the run if there are specific violations. The ES will not answer generic questions like "Do I have a violation?"**
- (5) Participants will use a #2 unsharpened pencil to trigger the Scrambler. Participants may only contact the pencil and not the Scrambler during the triggering action.
  - (a) If the Vehicle fails to actuate or move when triggered, then a run has not occurred. The Vehicle must move to be a measurable run. The participants may continue to work on their device provided they have not reached the end of their Event Time.
- (6) ES will review the run to determine if the run was Successful or a Failed Run.
- (7) Run Time and Vehicle Distance will be measured and recorded for Successful runs.
- (8) **To earn the Bucket Bonus, all parts of the Vehicle must travel around the Bucket. If the Bucket location has changed, then the Bucket Bonus cannot be awarded.**
- (9) Additional competition violations are:
  - (a) The egg is broken during the run. A 2nd run will not occur if broken on 1st run.
  - (b) Any part of the Vehicle (besides the egg) touches the TB.
  - (c) The tip of the egg goes past the front of the TB.
  - (d) Competitors follow their Vehicle down the track before being called to retrieve their vehicle.
- (10) All violations will be recorded. The ES must notify the participants of any violations at the end of each run.
- (11) Timing resumes once the participants pick up their device or begin making their own measurements.

ix. The Event Supervisor will review with teams their data recorded.

x. Teams filing an appeal must leave their Vehicle and other impounded material in the event area.

5. **<u>SCORING</u>:**

a. Low score wins. Each team's Final Score is the better of the 2 Run Scores + Final Score Penalties.

b. Run Score = **100 +** Distance Score + Time Score + **Bucket Bonus** + Run Penalties

c. Distance Score = 2.0 pt/cm x Vehicle Distance.
   i. The Distance Score for a Failed Run is 2500 points.

d. Time Score = Run Time
   i. The Run Time will be recorded as 0.00 seconds for Failed Runs.

e. **Bucket Bonus = -100 Points is awarded if a Vehicle navigates around the Bucket without moving the Bucket from its defined location.**

f. Run Penalties:
   i. Competition Violation: 150 points added to the Run Score **with one or more violations**.
   ii. Construction Violation: 300 points added to the Run Score **with one or more violations**.
      (1) **A team will be awarded a construction violation if the floor is damaged by their device or actions either before or after the run.**
   iii. Failed Runs can also be assessed Competition and/or Construction violations.

g. Final Score Penalties: Vehicle not Impounded: 5000 points added to the team's Final Score.

h. Two or more teams tied with 2 Failed Run scores, without Competition or Construction Violations, will remain scored as ties. Other ties are possible.

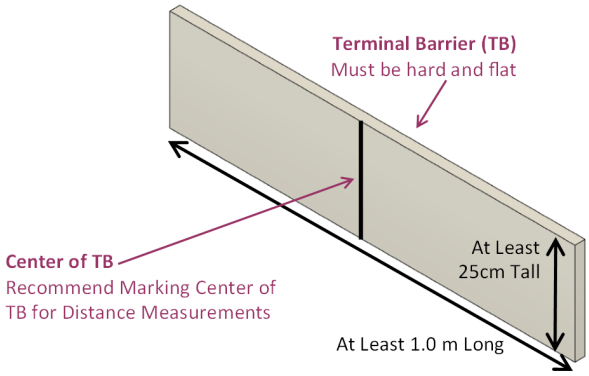
i. Tiebreakers in order: 1. Better Vehicle Distance of the scored run; 2. Lower Time Score of the scored run; 3. Better Vehicle Distance of the non-scored run; 4. Better Time Score of the non-scored run.

6. **SCORING EXAMPLES:**
   a. A Vehicle has 2 Successful runs during the team's Event Time.
      i. In the 1st run, the Vehicle stopped 67.6 cm from the Target Point with a Run Time of 7.27 s
      ii. In the 2nd run, the Vehicle stopped 27.6 cm from the Target Point with a Run Time of 8.67 s and navigated around the bucket.

Base Score	= 100		100.00
Distance Score	= 67.6 cm x 2.0 pts/cm	=	135.20
Time Score	= 7.27	=	7.27
Bucket Bonus	= No Bucket		0.00
1st Run Score		=	242.47
Base Score	= 100		100.00
Distance Score	= 27.6 cm x 2.0 pts/cm	=	55.20
Time Score	= 8.67	=	8.67
Bucket Bonus	= -100		-100.00
2nd Run Score		=	63.87

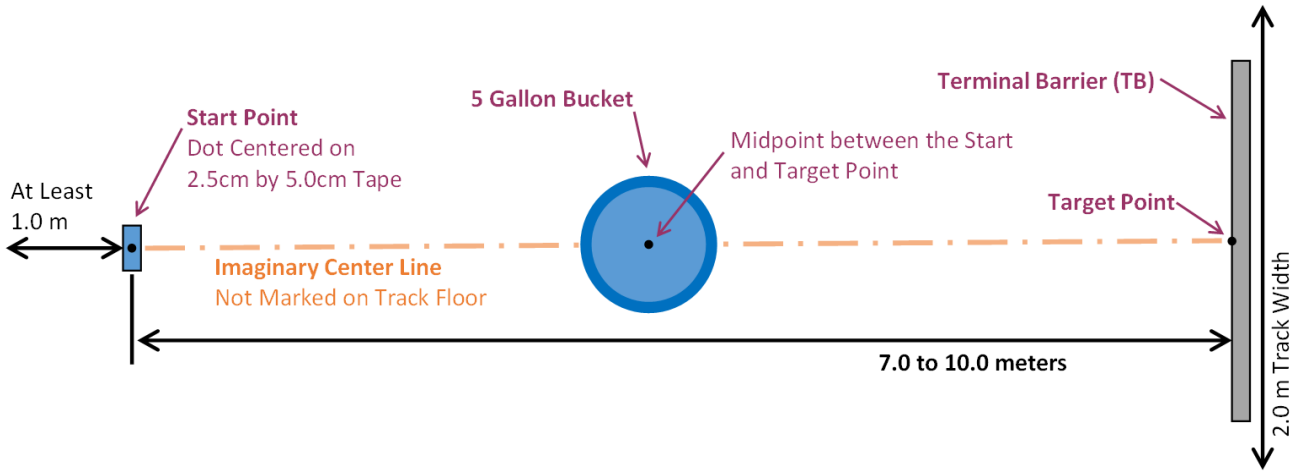
Final Score = 2nd Run Score (Better Score) = 63.87 pts

7. **THE TRACK:**
   a. In-Person tournaments: The ES will supply and set up the Track.
   b. Virtual tournaments: Team will supply the Track that fully complies with the requirements of this section. Any deviation will be scored as a competition violation for all runs.
   c. Track Definition:
      i. The Track will be on a smooth, level, and hard surface.
      ii. The Event Supervisors must mark the track as follows:
         (1) Start Point - an approximately 5 cm x 2.5 cm tape with the Start Point marked at the center of the tape.
         (2) Target Point - an approximately 5 cm x 2.5 cm tape with the Target Point marked at the center of the tape. The Target Point is placed at the Target Distance from the Start Point.
      iii. The center of a Terminal Barrier (TB) is placed at the Target Point and must be perpendicular to the imaginary Center Line that connects the Start Point and Target Point. TB must be a hard, flat, vertical wall at least 25.0 cm tall and a minimum of 1.00 m long.



      iv. **An optional empty 5-gallon bucket with a bottom diameter of 25.0 - 27.0 cm can be placed on the imaginary Center Line, at the midpoint between the Start Point and Target Point. The center of the bucket must be directly on the imaginary Center Line. The bucket should have a small hole drilled in the center of its bottom by the ES to aid in placing it in the correct position.**

v. The Track Area will have a width of **2.0 m and extend at least 1.0 m behind the Start Point.**
vi. At the ES's discretion, more than one Track may be used. If so, the team may choose which Track they use but must use the same Track for both runs.



8. **DEFINITIONS:**
   a. *Event Supervisor (ES)* is responsible for ensuring the event runs correctly. The ES can assign one or more event helpers to perform various competition tasks.
   b. *Tools* cannot be electric and electronic tools except for a stand-alone calculator (Class III). To qualify as a Tool, the item must not travel on the Track with the Vehicle, does not become part of the Scrambler, and cannot be used to align or aim the Vehicle.
   c. *Target Distance* is selected by the ES and will be between 7.00 and 10.00 meters. At Regionals/ Invitationals the interval will be 0.25m, for States 0.10 m, and for National 0.01 m.
   d. *Vehicle Distance* is a point-to-point measurement from the Vehicle Measurement Point to the Target Point, measured to the nearest 0.1 cm.
   e. *Run Time* begins when the team actuates the Vehicle and ends when the Vehicle comes to a complete stop.
      i. Recoil or oscillations will be included in the Run Time.
      ii. The Run Time is recorded in seconds to the precision of the timing device used.
      iii. Three timekeepers should be utilized with the middle time used as the official Run Time.
   f. *Complete Stop* is when the Vehicle is stationary for 3 or more seconds. The 3 seconds is not part of the Run Time.
   g. *Successful Run:* Any run when the Vehicle moves before the end of the Event Time and is not a Failed Run.
   h. *Failed Run:* A run will be scored as a Failed Run when one of the following occurs. Construction and/ or Competition Violations must still be recorded for Failed Runs.
      i. If the egg is broken on the 1st run, then the 2nd run will be a Failed Run.
      ii. The Vehicle starts before the ES is ready.
      iii. The Vehicle's distance cannot be measured (e.g., the participants pick it up before it is measured).
      iv. The team pushes the Vehicle down the track.
      v. A team having only one successful run during the 8-minute Event Time will be assessed a Failed Run for a 2nd run score. If the Vehicle does not move during the Event Time, the team will be assessed 2 Failed Runs.
   i. *Broken Egg* is defined by cracking the egg enough to leave a wet spot on a paper towel.

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

SOLAR SYSTEM B

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

1. **DESCRIPTION:** Participants will demonstrate their knowledge of **planet formation and structure within and beyond the Solar System.**

   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. Each team may bring two 8.5" x 11" sheets of paper, which may be in a sheet protector sealed by tape or laminated, that may contain information on both sides in any form and from any source without any affixed labels. Calculators are not allowed.
3. **THE COMPETITION:** Participants will be tested over the content described below. We encourage exams to emphasize mathematical reasoning, conceptual understanding, and interpretation of data from maps, graphs, images, photographs, charts, and/or tables whenever possible (i.e., minimize trivia).
   a. Participants will be asked to identify and explain surface, atmospheric, and spectroscopic features and processes (e.g., cratering, storms, etc.) associated with the following objects/systems. They will also answer questions about these objects/systems' properties and connections to the content areas defined in 3.b. Most questions about specific objects/systems should focus on objects in the Solar System (3.a.i.) rather than extrasolar systems (3.a.ii.). Furthermore, exams should not contain detailed questions about objects/systems that are not listed in 3.a.i. or 3.a.ii.
      i. *Objects in the Solar System*: Mercury, Jupiter, Saturn, Uranus, Neptune, Pluto, Ceres, Earth's Moon, Triton, 25143 Itokawa, Tempel 1, and 486958 Arrokoth
      ii. *Extrasolar Systems*: HL Tauri, 51 Pegasi, HD 209458, and Beta Pictoris
   b. Participants may also be tested on the following topics:
      i. Planet formation (e.g., core accretion, disk instability, minimum mass solar nebula, etc.) and evolution (e.g., migration, mass loss, etc.) within and beyond the Solar System.
      ii. Comparing internal/atmospheric structure, composition, etc. across planet types within and beyond the Solar System (e.g., Mercury vs. Neptune, Uranus vs. Saturn, Jupiter vs. hot Jupiters, etc.).
      iii. Properties (e.g., composition, location, etc.) of small Solar System bodies (e.g., asteroids, comets, etc.) as they relate to planet formation/structure or the early history of the Solar System.
      iv. Exoplanet detection techniques, limited to transits, radial velocity, and direct imaging.
      v. General engineering principles and science objectives underlying the design of spacecraft and telescopes. Participants may be asked specific questions about only the following: BepiColombo, Galileo, Juno, Cassini, Voyager 2, New Horizons, Dawn, Lunar Reconnaissance Orbiter, Hayabusa, Deep Impact, ALMA, Hubble, and JWST.
      vi. Mathematical concepts relevant to planet formation and structure, including, but not limited to: density, light/radiation (e.g., Stefan-Boltzmann law, Wien's displacement law, Doppler shift), and gravity/orbits (e.g., energy, force, momentum, Newton's law of gravitation, Kepler's Laws). Questions must not require a calculator and should emphasize algebraic manipulation (e.g., rearranging/deriving equations), order of magnitude estimation, and proportions.
4. **SCORING:**
   a. Points will be awarded for the quality and accuracy of responses. High score wins.
   b. Preselected questions/sections will be used as tiebreakers.

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

This event is supported by NASA's Universe of Learning Astrophysics STEM Learning and Literacy Network

WATER QUALITY B

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

1. **DESCRIPTION:** Participants will be assessed on their understanding and evaluation of freshwater aquatic environments.

   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes

   EYE PROTECTION: C **CALCULATOR:** Class II

2. **EVENT PARAMETERS:**
   a. Each team may bring writing utensils.
   b. Each team may bring two Class II calculators.
   c. Each team may bring one (1) 8.5" x 11" sheet of paper that may contain information on both sides in any form and from any source. The sheet of paper may be laminated or placed in a sheet protector to increase durability. Affixed labels, as well as multiple sheets of paper (whether in a single sheet protector or not) are prohibited.
   d. Each team may bring one student built salinometer/hydrometer for testing.
   e. Participants must wear eye protection during Salinometer Testing (3.Part IV). Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows.

3. **THE COMPETITION:** This may include analysis, interpretation or use of charts, graphs and sample data. Supervisors are expected to utilize freshwater scenarios and have students analyze and evaluate comparative macroinvertebrates and water quality data. Process skills may include equipment use, collecting and interpreting data, measuring, analyzing data, and making inferences.

   Part I: Freshwater Ecology – 30% of the total score
   a. This section will use multiple choice, matching, fill-in-the-blank and/or short answer questions in areas such as: aquatic ecology, water cycle, nutrient cycling, aquatic chemistry and its implications for life, potable water treatment, waste water treatment, aquatic food chains/webs, community interactions, population dynamics, watershed resource management issues, sedimentation pollution, and harmful species.

   Part II: Freshwater Macroinvertebrates – 30% of the total score
   a. This section will require participants to identify (common name only) immature and adult macroinvertebrates and aquatic nuisance organisms listed below.
   b. In addition, teams should understand their importance as indicators of water and wetland quality.

Class 1 – Pollution Sensitive	Class 2 – Moderately Sensitive	Class 3 – Moderately Tolerant	Class 4 – Pollution Tolerant	Class 5 – Air Breathing
Mayfly	Aquatic Sowbug	Water Mite	Air Breathing Snail	Whirligig Beetle
Caddisfly	Damselfly	Midge	Deer/Horse Fly	Water Strider
Stonefly	Dragonfly	Blackfly	Tubifex	Mosquito
Dobsonfly	Scuds	Flatworm	Blood Midge	Giant Water Bug
Gilled Snails	Crane Fly	Leeches		Back Swimmer
Water Penny				Water Boatman
Riffle Beetle				Predacious Diving Beetle
Water Scorpion				

   Aquatic Nuisance Plants: Purple Loosestrife, Eurasian Water Milfoil, and Water Hyacinth
   Aquatic Nuisance Animals: Zebra Mussel, Spiny Water Flea, Asian Tiger Mosquito, Asian Carp and Crayfish/Crawdads

   Part III: Water Monitoring and Analysis – 30% of the total score
   a. Participants should be able to understand and interpret data related to testing procedures and purposes for collecting data related to salinity, pH, phosphates, turbidity dissolved oxygen, temperature, nitrates, fecal coliform, total solids, biochemical oxygen demand and their relationship to one another.
   b. No physical laboratory tests will be performed on these topics by participants.

Part IV: Salinometer Testing – 10% of the total score

a. Teams must build, calibrate, bring and demonstrate a salinometer/hydrometer capable of measuring saltwater (most likely NaCl) concentrations between 1-10% (mass/volume). Students may build a simple electronic salinometer if they wish. No programmable devices or those that can communicate over wifi are allowed. No laptops, tablets, or other similar devices may be used in the competition.
b. There are no restrictions on size except that the team must build the device to operate within a standard 400 – 600 mL beaker filled with at least 400 mL of the saltwater solution.
c. Teams will be expected to estimate the percent salinity measured by their device to the nearest tenth of a percent. Full credit will be given ±1% at Regionals and ±0.5% at State/Nationals. Calibration solutions may or may not be provided by the Event Supervisor.

4. **SCORING:**

a. High score wins.
   i. Points will be assigned to the various questions and problems for Parts I, II and III.
   ii. Points for bringing a salinometer for testing will be 5% of the total score.
   iii. Points for making an accurate salinity measurement per 3.PartIV.c will be 5% of the total score.
b. Selected questions may be used as tiebreakers.

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

B

WRITE IT DO IT B

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

1. **DESCRIPTION:** One participant will write a description of an object and how to build it. The other participant will attempt to construct the object from this description.

   A TEAM OF: 2 **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. The participant who will be doing the writing must bring a writing utensil.
   b. No other materials or resources are allowed.
3. **THE COMPETITION:**
   a. One participant from each team is shown an object, which may be abstract but is the same for all teams, built from, but not limited to, such items as science materials, inexpensive materials (e.g., straws, push pins, Styrofoam balls, paper cups, Popsicle sticks, etc.) or commercial sets (e.g., K'nex, Tinker Toys, Lego, Lincoln Logs, etc.). This participant is not allowed to touch the object unless the Event Supervisor permits it.
   b. The participant viewing the object has twenty-five (25) minutes to write a description of the object and how to build it. There will be no advantage to finishing early.
   c. Drawings and diagrams of the model or subsections of the model are not allowed. Numerals, words and single letters that fit within the context of the written description are allowed. The participant may use abbreviations and do not have to define the abbreviation. Editing, punctuation, or scientific symbols that fit within the context of the written description are allowed.
   d. The Event Supervisor will pass the description to the second team member who will take the description and attempt to recreate (build) the original object in twenty (20) minutes.
   e. Supervisors will attempt to use different materials than the materials that were used last year.
4. **SCORING:**
   a. The team that builds the object nearest to the original and has a written description with no drawings or diagrams will be declared the winner.
   b. Each individual piece will receive points as applicable for: proper size, color, location, orientation, and/or connection.
   c. Pieces that are connected correctly beyond an incorrect connection will be counted in the score. No penalty will be assessed for parts that were not used.
   d. Students drawing a subsection of the model will be ranked in Tier 2. Drawing a picture of the model will result in disqualification.
   e. Time for the construction phase will be used as a tiebreaker.

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

TRIAL EVENT RULES EXPLANATION

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

Science Olympiad is continually in the process of researching, developing and evaluating new events. We are looking for events, activities and projects that engage students in all aspects of the scientific endeavor while presenting them with exciting and challenging problems to solve and content to master. In an effort to ensure our events meet those standards, we have established a process that moves an event from a creative concept through a series of pilots and trials, with the ultimate goal of making it into rotation as a current event.

For the 2025-2026 season, we are publishing a selection of Trial Events in the 2026 Rules Manual. The events presented here are not a comprehensive list of all the events under development. For a full list please visit: https://www.soinc.org/learn/trial-events. These particular events are being showcased here because of the topics they address, their approach to challenging Science Olympiad participants and their potential to become part of the competition in the next few seasons. Right now, they still need additional testing and trial. Besides being incorporated into this manual the rules for these events and additional resources are posted at https://www.soinc.org/learn/trial-events.

We have incorporated the rules for these Trial Events into the 2026 Rules Manual so that all teams, event supervisors, and tournaments have easy access to them. If conditions allow, we encourage State Chapters and Tournament hosts to run some of these Trial Events as they offer participants looking for an extra challenge the ability to compete against like-minded peers while contributing important information to prepare these events to become part of the competition in 2027 and beyond.

If a Tournament does choose to run one of the Trial Events published here, a Trial Event from the Trial Event page, or one of their own creation we would ask that you have both event participants and Event Supervisors complete the appropriate post-event evaluation. These evaluations can be found online at soinc.org on the Trial Event page. These brief surveys provide important information to help us fine tune events as well as make decisions about which events are worthy of being part of the Science Olympiad National Competition.

BOTANY B

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

1. **DESCRIPTION**: Participants will demonstrate their knowledge of plant life and general botany principles.
   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes
   CALCULATOR: Class II

2. **EVENT PARAMETERS:**
   a. Each team may bring writing utensils.
   b. Each team may bring two Class II calculators.
   c. Each team may bring one (1) 8.5" x 11" sheet of paper that may contain information on both sides in any form and from any source. The sheet of paper may be laminated or placed in a sheet protector to increase durability. Affixed labels, as well as multiple sheets of paper (whether in a single sheet protector or not) are prohibited.
   d. Event Supervisors will provide live/preserved specimens, pictures, tables, graphs of data, microscopes, slides, and any other required equipment for the event. If used, toxic/irritating plants or specimens in liquid (e.g., Algae, protists) must be in closed, non-breakable containers.

3. **THE COMPETITION:**
   a. This event may be run as either a sit-down exam or a series of laboratory stations with questions.
   b. Participants will be expected to master the structure of plant cells, roots, stems, leaves, spore forming bodies and flowers, aspects of plant growth and differentiation, and the transport and storage of gases, water, and nutrition throughout the plant body.
   c. Participants should also have a broad knowledge of the major divisions between groups of plants (i.e., algae vs. multicellular plants, monocot vs. dicot, embryophytes vs. cryptogams, woody vs. herbaceous plants).
   d. In addition to the above listed topics, participants should know:
      i. The history of botany
      ii. Basic plant genetics and reproduction
      iii. Photosynthesis
      iv. Differences between the major taxonomic groups of plants
      v. Paleo-botany and plant evolution
      vi. The role of plants in global energy and nutrient cycles
      vii. Use of plant materials by animals and humans
      viii. Competition in the plant community
      ix. Genetically Modified Organisms (GMOs)
      x. Production of foodstuffs and plant products
      xi. Plant diseases; including nutrient deficiencies and infections
   e. For Division C Only, participants are expected to know:
      i. Principles of horticulture and aquaculture
      ii. Plant biochemistry
      iii. The roles of plants in medicine and environmental management
      iv. Importance of plant diversity

4. **SAMPLE QUESTIONS/TASKS:**
   a. What leaf structure is being shown on this microscope slide?
   b. Using the graph, identify the peak wavelength for chlorophyll absorbance.
   c. Identify three key differences between flowering plants and ferns.
   d. Which plants would be in the next wave of plant succession for the region shown?
   e. Describe the role plants play in the nitrogen cycle.

5. **SCORING:**
   a. High Score wins.
   b. Selected questions will be used to break ties.

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

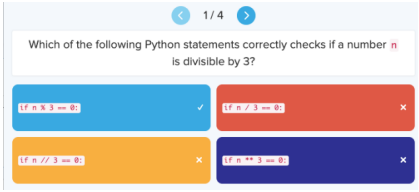
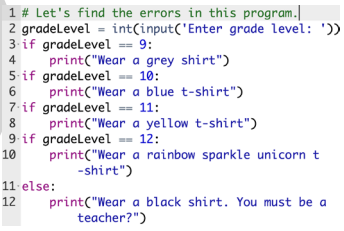
CODE CRAZE B

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

1. **DESCRIPTION:** Participants will participate in three quiz and coding activities designed to assess their knowledge of practice module material in four areas: programming concepts, AI, cryptography and Python.

   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. Participants will use CodeHS.com on a computer to take quizzes and debug code.
   b. Each participant must bring a laptop capable of running Google Chrome for the purposes of competing in the event unless specified by the Event Supervisor.
   c. Each participant may bring a wired or wireless mouse and keyboard.
   d. No resource materials, except those provided by the Event Supervisor, may be used.
   e. Unauthorized resources or copying code from sources outside of ones provided by the Event Supervisor or those from CodeHS.com will result in a disqualification.
   f. Participants will be provided a URL to access the competition site at the start of the competition.
3. **THE COMPETITION:**
   a. Teams will use CodeHS.com and the created competition module to complete multiple activity types.

Activity Types & Suggested Times	Activity Description	Image
Gamified Quizzes (15 minutes)	Participants will be provided questions in concert with other participants, and **both the accuracy and time to result** against competitors will be measured.	
Individual Quizzes (20 minutes)	Participants will be provided multiple choice questions and coding snippets. **Only the accuracy** of the response will be measured.	
Individual Coding Assessments (15 minutes)	Participants will be provided coding challenges to solve. The accuracy of the result will be measured by an auto grader or event volunteer.	

```
# Let's find the errors in this program.
gradeLevel = int(input('Enter grade level: '))
if gradeLevel == 9:
    print("Wear a grey shirt")
if gradeLevel == 10:
    print("Wear a blue t-shirt")
if gradeLevel == 11:
    print("Wear a yellow t-shirt")
if gradeLevel == 12:
    print("Wear a rainbow sparkle unicorn t
        -shirt")
else:
    print("Wear a black shirt. You must be a
        teacher?")
```

   i. For Regionals, teams will be required to show competence in 4 areas: programming concepts, AI, cryptography and Python
   ii. For State and Nationals, teams will be assessed in the same areas, and potential other topic areas (e.g., quantum, data structures)
4. **SCORING:**
   a. The high score wins with each section serving as one-third of a participant's total score.
   b. Ties will be resolved using the rankings determined in the Gamified Quiz section.

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

This event is sponsored by CodeHS.

PING PONG PARACHUTE B

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

1. **DESCRIPTION:** Prior to the tournament, teams will design, build, and bring up to two bottle rockets to the tournament to launch a ping pong ball attached to a parachute to stay aloft for the greatest amount of time.

   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 5 minutes

   EYE PROTECTION: B

2. **EVENT PARAMETERS:**
   a. Teams must provide up to two rockets, two unaltered standard ping pong balls, and two parachutes.
   b. Parachutes must be attached to ping pong balls with tape only. The ping pong ball attached to the parachute assembly makes up the parachute payload system.
   c. All participants must properly wear eye protection at all times. Participants without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows. Participants without eye protection will not compete.
   d. Event Supervisors must provide a launcher (that uses a Schrader valve), an air pump, a pressure gauge, and timing devices. Teams may bring their own manual bicycle pump with a pressure gauge to use, but it must attach to the launcher provided by the Event Supervisor.
   e. This event should be held inside with a high ceiling (greater than 20 feet recommended). Tournament directors must provide the ceiling height (in feet) to teams at least 1 month in advance. Extreme care must be taken to protect the floor and ceiling of any inside facilities used for practice and competition.

3. **CONSTRUCTION PARAMETERS:**
   a. Rocket pressure vessels must be made from a single 1-liter or less plastic carbonated beverage bottle with a nozzle opening internal diameter of approximately 2.2 cm (a 1/2-inch Schedule 40 PVC pipe must fit tightly inside the nozzle opening) and a standard neck height from flange to bottle's opening of under 1.6 cm. The bottle label must be presented.

Figure 1

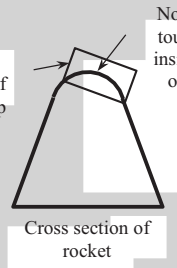


Figure 2

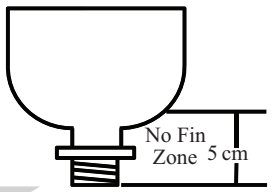
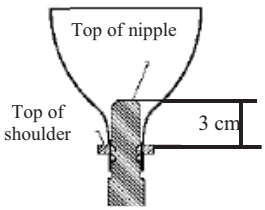


Figure 3.



   b. The structural integrity of the pressure vessel must not be altered. This includes, but is not limited to: physical, thermal or chemical damage (e.g., cutting, sanding, using hot or super glues, spray painting).
   c. The nose of the rocket must be rounded or blunt at the tip and designed such that when a standard bottle cap (~3.1 cm diameter x 1.25 cm tall) is placed on top of the nose, no portion of the nose touches the inside top of the bottle cap (see Figure 1).
   d. Only tape must be used to attach fins and other components to the pressure vessel. No glues of any type may be used on the pressure vessel. Metal of any type is prohibited anywhere on the rocket or parachute payload system.
   e. Fins and other parts added to the bottle must be 5 cm or higher above the level of the bottle's opening, to ensure rockets fit on the launcher (see Figure 2).
   f. All energy imparted to the rocket/parachute payload system must originate from air pressure provided by the Supervisor; no water. Gases other than air, explosives, liquids including water, chemical reactions, pyrotechnics, electrical devices, elastic powered flight assists, throwing devices, remote controls, and tethers are prohibited at any time.
   g. At the National Tournament the launcher nipple will extend into the rocket 1.173 in +/- 0.02 in (3 cm +/- 0.5 cm) above the top side of the shoulder of the bottle (see Figure 3).

4. **PRACTICE LOG:**
   a. During inspection, each team must present a flight log of recorded data for each rocket. Data must include 5 or more parameters (3 required and at least 2 additional) for 15 or more test flights prior to the competition for each rocket. The required parameters are: 1) pressure (psi), 2) estimated/recorded peak flight height (feet), 3) time aloft (seconds). The additional parameters are chosen by the team (examples include: # fins, parachute diameter, etc.)
   b. Teams must use their data to justify their pressure choice. Rockets without a flight log or an incomplete log will NOT be launched.

5. **THE COMPETITION:**
   a. Teams must arrive at the competition site ready to launch with proper eye protection to have their rocket(s) inspected for safety.
   b. Teams will have 5 minutes to make a total of two launches using the same rocket or two different rockets.
   c. When called to launch, teams will load their rocket onto the launcher. Once the rocket is loaded, but NOT pressurized, teams will place the parachute payload system on or in the rocket. After the payload parachute system is loaded it cannot be manipulated. Teams will then pressurize the rocket to the pressure (psi) of choice based on their practice log data. The Event Supervisor will check the gauge on the pump to ensure the rocket is pressurized to the psi chosen and justified by the team's data.
   d. The Event Supervisor will make sure 3 timers are ready and then signal a team member to make a loud announcement of, "3, 2, 1, LAUNCH!" Then a team member will proceed to launch the rocket. After launching, the team will prepare for the next launch.
   e. Timing begins when the rocket separates from the launcher and stops when the parachute payload system lands. The parachute payload system must separate from the rocket.
   f. If the parachute payload system does not separate from a rocket, timing is from when the rocket separates from the launcher to when any part of the rocket touches the ground. This launch is placed in Tier 2.
   g. If any part of a rocket or parachute payload system hits the ceiling or any part connected to the ceiling (e.g., a rafter, light, basketball hoop), then timing is stopped at the instant of contact. That launch is placed in Tier 3.
   h. If a rocket fails to separate from the launcher because of a problem with the supplied launcher then the launch never occurs and the launch can be restarted.
   i. All times for each launch MUST be recorded for breaking ties. Time aloft is recorded in hundredths of a second. The middle value is the officially recorded time.
   j. Teams filing an appeal must leave their rocket(s), parachute payload system(s), and Practice Log(s) in the event area.

6. **SCORING:**
   a. Ranking is determined by the greatest time aloft of a parachute payload system from a single launch within a tier.
   b. Rockets and/or parachute payload systems violating 2.c., 3.a.-f. and/or 4.a.-b. will NOT be launched. Teams unable to make any launches will receive participation points only.
   c. Ties will be broken by the best tier and/or greatest time aloft of the parachute payload system from each tied team's other launch.
   d. Tiers: The highest number tier will be applied when more than one is applicable:
      i. Tier 1: A launch with no violations or problems
      ii. Tier 2: A launch where the parachute payload system did not separate from the rocket
      iii. Tier 3: A launch where the rocket or any part of the parachute payload system contacted the ceiling

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

DIV. B CHEMISTRY LAB EQUIPMENT LIST

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

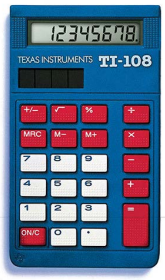
Each team may bring any or all of the items listed below for use in Division B Chemistry Events. Teams not bringing these items will be at a disadvantage as Event Supervisors will not provide the listed lab equipment. A penalty of up to 10% may be given if a team brings prohibited lab equipment to the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

Item	Expected Use
Box	Containing all of the kit materials
Graduated Cylinders (10 - 100 mL)	Measuring volumes
Beakers (50 - 500 mL)	Doing reactions, developing chromatograms
Erlenmeyer Flasks (50 - 250 mL)	Doing reactions
Test Tubes	Mix Chemicals, heat chemicals
Test Tube Brush	Clean Test Tubes
Test Tube Holder	Holds test tubes for heating
Test Tube Rack	Hold Test Tubes
Petri Dishes	Doing reactions, developing chromatograms
Spot Plates	Doing reactions in semi-micro scale, testing solubility, pH
Slides	To put hairs, crystals, or fibers on for use with a microscope
Cover Slips	To prevent items from coming off slides
Droppers	Add small amounts of liquids to reactions
Spatulas or spoons	Getting small amounts of solids out of containers
Stirring Rods	Stirring mixtures
Thermometer	Determining the temperature of a solution
Metal Tongs, Forceps, or Tweezers	Holding objects, retrieving objects from liquids
pH paper/meter	Test acidity or alkalinity of solution
Hand Lens	Magnification of small items for identification
9V or less Battery Conductivity Tester	Determining ionic strength of solution
Paper Towels	Cleaning
Pencil	Writing, Marking Chromatogram
Ruler	Measuring lengths
Magnets	For extraction and identification of iron filings

CALCULATOR CLASS DESCRIPTIONS

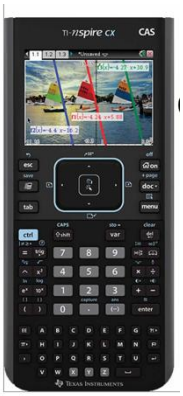
See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

The following document was prepared to offer some guidance to teams as they select calculators for use in different Science Olympiad events. **The calculator class listed in the event rules is the most complex calculator level allowed for the event. It is acceptable to use a lower calculator class in the event (e.g., Class III calculator is allowed for the event students are therefor allowed to use a class I, class II or class III calculator).** 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.



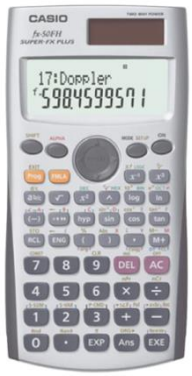
Class I - Stand-alone non-graphing, non-programmable, non-scientific 4-function or 5-function calculators are the most basic type of calculators and often look like the one shown to the right. These calculators are limited to the four basic mathematics functions and sometimes square roots. These calculators 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.



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

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.

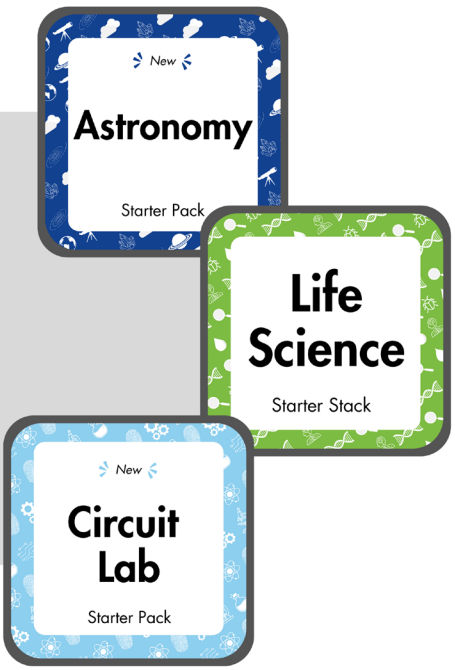
Notes:

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

Exploring the World of Science

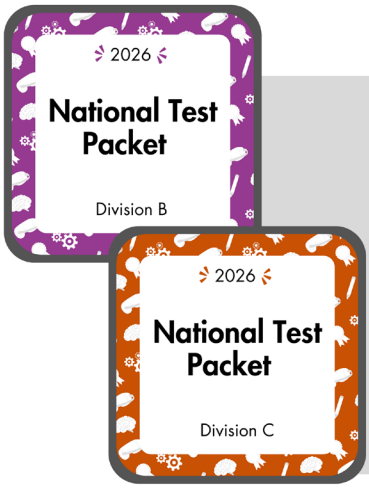
STORE OFFERINGS FOR 2026

STORE.SOINC.ORG



STARTER STACKS & PACKS

Jumpstart your 2026 season with these resources! Starter Packs come with notes and practice tests for individual events. Create your own custom Stacks for specific events, or grab a ready-to-go Starter Stack!

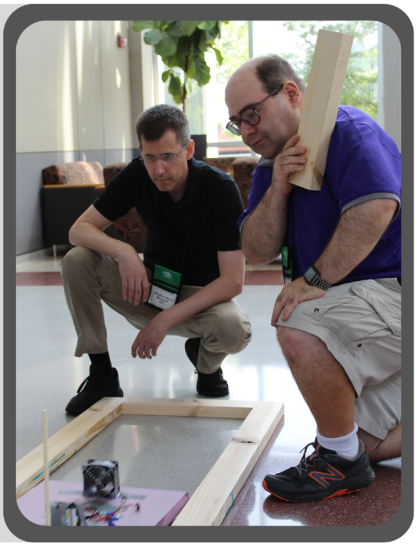


NATIONAL TEST PACKETS

Check out the tests from the 2025 National Tournament! You can access packets that include tests, answer keys, and results from the past five National Tournaments.

UPCOMING EVENTS

- **July '26** In our ***Virtual Bootcamp*** participants gain early access to the 2027 Rules, engage with experts, and choose sessions that fit their interests. Registration includes instructional videos, live sessions and a hard copy draft of the 2027 Rules.
- **July '26** The ***Summer Build Clinic*** provides a deep dive into the new events for the 2027 season. This is a great opportunity to collaborate with presenters and other coaches, as well as gain hands-on experience for the upcoming season. This event is for coaches, not students.



NATIONAL TOURNAMENT SCHEDULE

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

2026 National Tournament Division B Schedule
University of Southern California
Los Angeles, California Saturday, May 23, 2026

Event	7:00 – 8:00 AM	8:00 - 9:00 AM	9:10 – 10:10 AM	10:20 – 11:20 AM	12:00 – 1:00 PM	1:10 – 2:10 PM	2:20 – 3:20 PM	7:30– 9:30 PM
Anatomy & Physiology B		51-60	1-10	11-20	21-30	31-40	41-50	
Boomilever B		Self-Schedule						
Circuit Lab B		31-40	41-50	51-60	1-10	11-20	21-30	
Codebusters B		1-10	11-20	21-30	31-40	41-50	51-60	
Crime Busters B		51-60	1-10	11-20	21-30	31-40	41-50	
Disease Detectives B		1-10	11-20	21-30	31-40	41-50	51-60	
Dynamic Planet B		31-40	41-50	51-60	1-10	11-20	21-30	
Entomology B		11-20	21-30	31-40	41-50	51-60	1-10	
Experimental Design B		11-20	21-30	31-40	41-50	51-60	1-10	
Helicopter B		Self-Schedule						
Heredity B		41-50	51-60	1-10	11-20	21-30	31-40	
Hovercraft B	Impound	Self-Schedule						Closing Ceremony
Machines B		21-30	31-40	41-50	51-60	1-10	11-20	
Meteorology B		21-30	31-40	41-50	51-60	1-10	11-20	
Metric Mastery B		21-30	31-40	41-50	51-60	1-10	11-20	
Mission Possible B	Impound	Self-Schedule						
Potions & Poisons B		41-50	51-60	1-10	11-20	21-30	31-40	
Remote Sensing B		1-10	11-20	21-30	31-40	41-50	51-60	
Rocks and Minerals B		41-50	51-60	1-10	11-20	21-30	31-40	
Scrambler B	Impound	Self-Schedule						
Solar System B		11-20	21-30	31-40	41-50	51-60	1-10	
Water Quality B		31-40	41-50	51-60	1-10	11-20	21-30	
Write It Do It B		51-60	1-10	11-20	21-30	31-40	41-50	

SCIENCE OLYMPIAD™

Exploring the World of Science

Science Olympiad wishes to acknowledge the following business, government and education leaders for partnering with our organization. Working together, we can increase global competitiveness, improve science and technology literacy and prepare the STEM workforce of the future. Thanks to: University of Southern California (2026 National Tournament Host), University of Nebraska-Lincoln (2025 National Tournament Host), NASA's Universe of Learning Astrophysics STEM Learning and Literacy Network, Science Olympiad USA Foundation, Atwell Gives Foundation, Avantor Foundation, Ward's Science, Cleveland-Cliffs Foundation, Combined Federal Campaign, Google, Illinois Quantum & Microelectronics Park: IQMP, P33, Ramboll, Aerospace Corporation, Amcor Cares Foundation, Cambridge Centre for International Research, Centers for Disease Control and Prevention, CodeHS, Discovery Education 3M Young Scientist Challenge, Double Good Foundation, IEEE Geoscience and Remote Sensing Society (GRSS), InGenius Prep, National Free Flight Society, North American Association for Environmental Education, National Oceanic and Atmospheric Administration, Onshape, Prequel, SkyCiv, Texas Instruments, TKS World, University of Delaware, Investing in Communities, MDRT Foundation and Yale Young Global Scholars. Strategic Partners: 3D Molecular Designs, Japan Science and Technology Agency, mHUB, Midnight Science Club, MxD, NBC Universal Foundation, STEMConnector.

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