SCIENCE OLYMPIAD™

Exploring the World of Science

Division C Rules Manual

Division C (Gr. 9-12)

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 C 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.

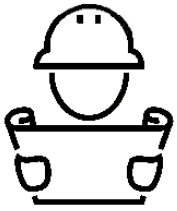
EVENT TYPE DESCRIPTIONS

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 C

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. Cellular Anatomy & Physiology
         (1) Neurons: Understand the cellular anatomy and physiology of neurons, identify and understand synapses and neurotransmitters
         (2) Glial Cells: Compare the types of glial cells and their respective functions
         (3) Electrophysiology: qualitatively understand action potential generation and propagation in myelinated and unmyelinated neurons, and qualitatively & quantitatively understand models for the ionic basis of the cellular membrane potential (i.e. Goldman-Hodgkin-Katz voltage equation)
      ii. 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.
      iii. Identification of simple encephalographic waveforms
      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
      vii. Effect of toxins on neuron function and signaling (limited to tetrodotoxin, curare, botulinum toxin, anatoxin-a, and tetanus toxin)

   State & National Level Only:
      viii. The Brain: Understand the detailed structure and function of the brainstem and cerebellum, including specific nuclei clusters and tracts.
      ix. Cranial Nerves: Understand cranial nerve pathways, classification, and clinical assessments of their functions.
      x. 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
      xi. 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:
      xii. Electrophysiology: Understand the cable theory model of the neuron and modeling the neuron as a basic RC circuit, Quantitative models of the action potential (e.g. Hodgkin-Huxley model) and spiking neuron models

xiii. 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).

xiv. 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. 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, hypersensitivity, hyposensitivity

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, central diabetes insipidus, hypoglycemia, hyperparathyroidism, hypoparathyroidism, hyperthyroidism (including Graves' disease), hypothyroidism (including Hashimoto's disease), goiter, congenital iodine deficiency syndrome, primary hyperaldosteronism, polycystic ovary syndrome

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. Understand the exposure routes and effects of endocrine disruptors (limited to DDT, BPA, and PFAS)
viii. Additional Disorders: Cushing's Syndrome, Addison's Disease, Pancreatic Neuroendocrine Tumors
ix. Endocrine cycles and negative feedback, Autonomic nervous system control of endocrine function

National Level Only

x. Explain the endocrine system's role in the stress response
xi. Additional Disorders: Congenital Adrenal Hyperplasia, Myxedema, acromegaly, and pituitary dwarfism
xii. 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.

ASTRONOMY C

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

1. **DESCRIPTION:** Teams will demonstrate an understanding of stellar evolution: From formation to destruction.

   A TEAM OF UP TO: 2

   APPROXIMATE TIME: 50 minutes

   CALCULATOR: Class IV

2. **EVENT PARAMETERS:**
   a. Each team may bring one of the following options containing information in any form from any source: a computer/tablet and a three-ring binder, two computers/tablets of any kind, or two three-ring binders.
   b. If three ring binders are used, they may be of any size and the information contained should be attached using the available rings. The information or pages may be removed during the event. Sheet protectors and laminated sheets are allowed.
   c. Each team may bring two stand-alone Class IV calculators. If the participants are using a computer or tablet, they may use the calculator app or other program on their device in place of a stand-alone calculator.
   d. Participants using computers/tablets as a resource should have all information stored so that it is available to them offline. Unauthorized generative AI tools (e.g., ChatGPT, DALL-E) are not allowed to be used to generate answers under any circumstances during the event. Teams may be asked to access a dedicated NASA image analysis website to answer some JS9 questions. If so, supervisors will provide an alternative (e.g., event supervisor-supplied computer) for teams that did not bring a laptop/tablet.
3. **THE COMPETITION:** Using information which may include Hertzsprung-Russell diagrams, spectra, light curves, motions, cosmological distance equations and relationships, stellar magnitudes and classification, multi-wavelength images (gamma-ray, X-ray, UV, optical, IR, radio), charts, graphs and JS9 imaging analysis tools, teams will compete in activities and answer questions related to:
   a. Stellar evolution including stellar classification, spectral features and chemical composition, luminosity, blackbody radiation, spectroscopy, H-R diagram transitions, cold molecular clouds & star formation regions, protostars, T Tauri Variables, red giants, Mira variables, RR Lyrae variables, Cepheid variables, white dwarfs, planetary nebulas, neutron stars, pulsars, X-Ray binaries, and Type Ia and II supernovas.
   b. Use orbital mechanics, Kepler's laws, rotation and circular motion to answer questions relating to the orbital motions of binary and multiple star systems; use parallax, spectroscopic parallax, period-luminosity relations, and the distance modulus to calculate distances to RR Lyrae, Cepheids and Type Ia supernovas, and the Stefan-Boltzmann law to answer questions relating to the content areas outlined above.
   c. Identify and answer questions relating to the content areas outlined above for the following objects: The Orion Molecular Cloud Complex, Sharpless 29 (NGC 6559), Ophion Star Family, HP Tau, Mira (Omicron Ceti), Helix Nebula (NGC 7293) Janus (ZTF J203349.8+322901.1), WDJ181058.67+311940.94, The Crab (M1), The Bone (G359.13), Cas A, Tycho's SNR
4. **SCORING:** All questions will have been assigned a predetermined number of points. The highest score wins. 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.

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

BOOMILEVER C

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 2.5 cm horizontally from either side of a perpendicular line extending from the centerline of the Testing Wall.

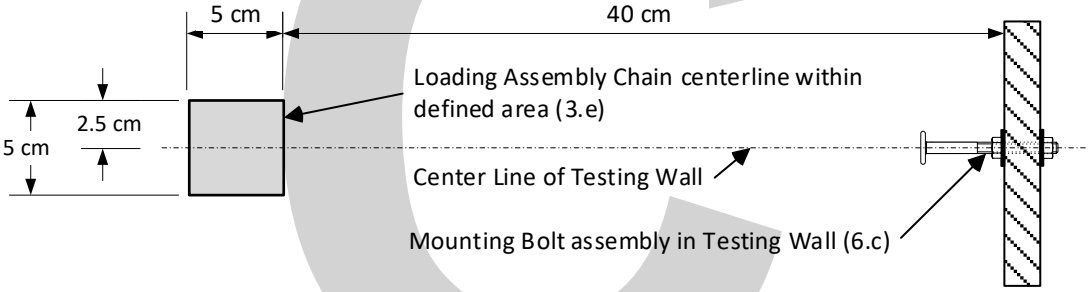


Figure 1: Top view of Test Wall (not to scale)

   f. During the Competition testing, the Boomilever may ONLY touch the Testing Wall OUTSIDE 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 10 cm and 15 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 15 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 10 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 10 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 Tiebreaker (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., and 3.f.
      (2) Conformity to requirements 3.g.i. or 3g.ii. to determine if the 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, 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.

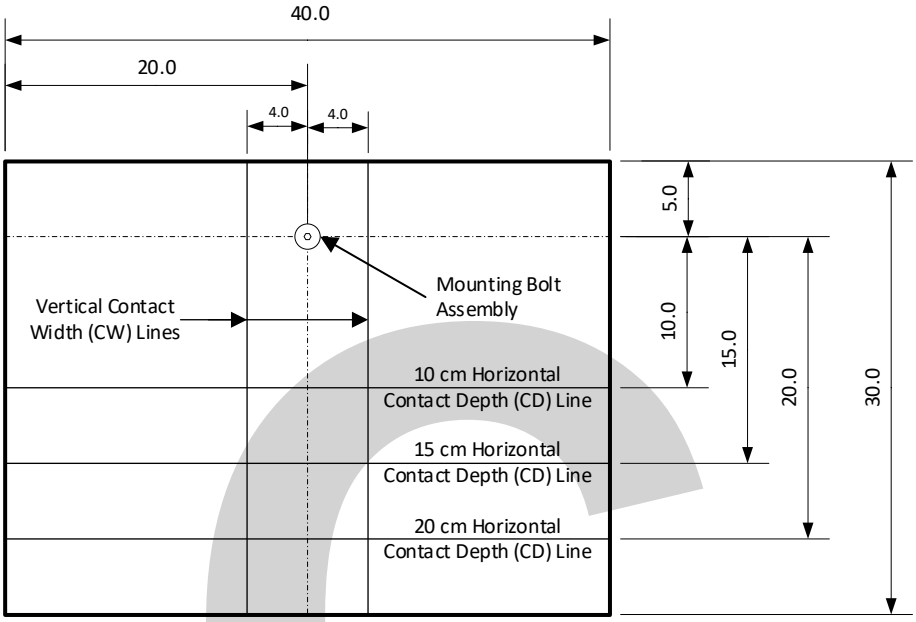


Figure 2 – Testing Wall (not to scale, dimensions in cm)

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)

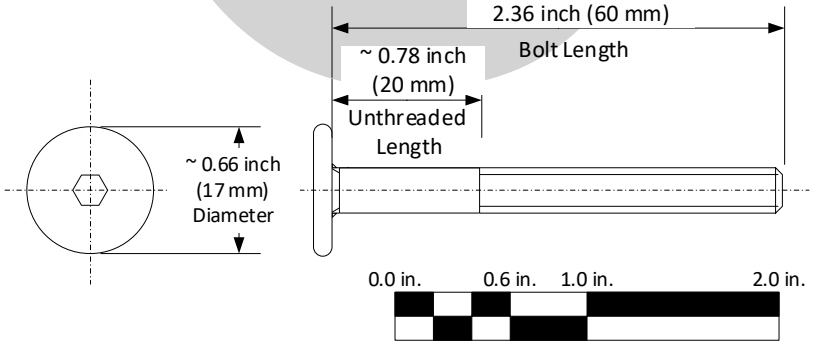


Figure 3 - Connector Bolt, ¼ -20 x 2.36 inches (60 mm) long

(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.

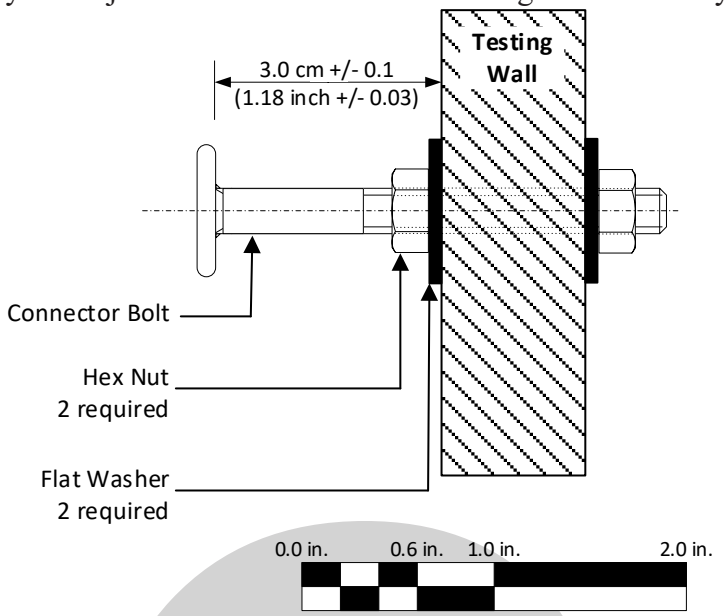


Figure 4 – Mounting Bolt Assembly in Testing Wall

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.

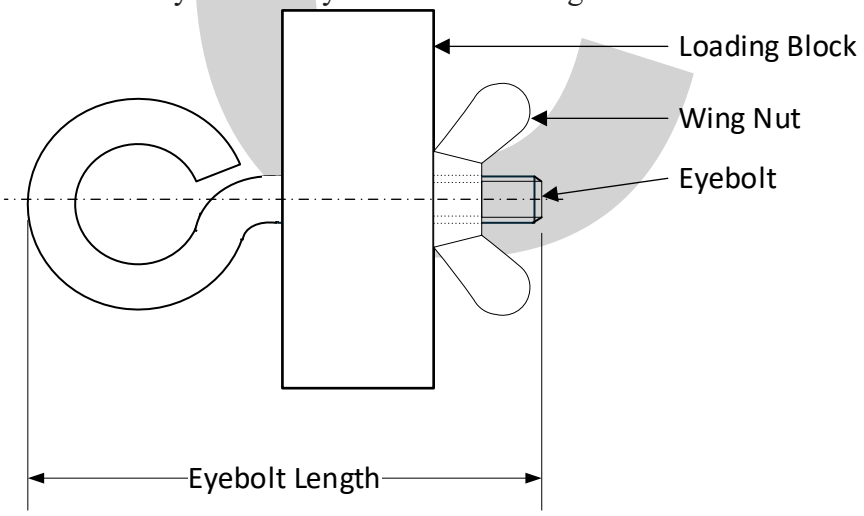


Figure 5 – Loading Block with eyebolt and wing nut (not to scale)

   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.

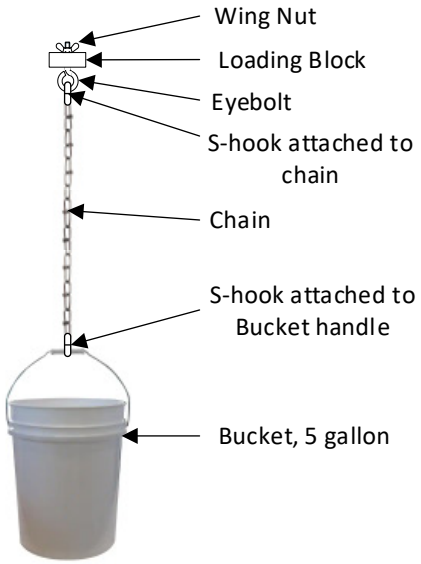


Figure 6 – Loading Assembly (not to scale)

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

BUNGEE DROP C

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

1. **DESCRIPTION:** Each team will design one elastic cord to conduct drops at a given height(s) and attempt to get a mass placed in a bottle as close as possible to, but without touching, a landing surface.

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

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

2. **EVENT PARAMETERS:**
   a. Each team must impound only one elastic cord, calibration data (if prepared), and tools. **The calibration data are the only papers or notes that the competitors may bring into the competition area and must be impounded.** Any tools used by teams to confirm heights, lengths, or mass during the time given for preparing their two drops must also be impounded. **Electric and electronic tools are allowed.**
   b. Teams may bring up to two Class II calculators, which do not need to be impounded.
   c. **After impound, the event supervisor must provide the**
      i. drop height values (for each height and bonus drop),
      ii. light and heavy mass values,
      iii. light and heavy mass lengths, and
      iv. drop instructions.
   d. **Teams 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. Teams must provide one elastic cord to be used for both drops that terminates with a **circular** closed metal ring with an inner **and outer diameter of 1.9 +/- 0.8 cm** (e.g., a key ring) that will not open.
   b. The cord may consist of more than one material (contest rubber, nylon, latex tubing, thread, sewing elastic, metal springs, etc.) and more than one strand.
   c. No physical modifications may be made to the elastic cord once it has been impounded, with the exception of marking drop locations on the cord before the drops. Physical modifications after impound constitute a construction violation.
   d. Elasticity Test: While being suspended vertically, the **bottom 0.50 m of the cord, not including the metal ring, must stretch to at least 1.00 m** when a single 500 g mass is attached to the metal ring and return to approximately its original length after the mass is removed.
   e. No "self-limiting-brake" mechanisms such as a separate, parallel, non-elastic strand that "brakes" the fall of the mass with little to no rebound are used.
4. **THE COMPETITION AREA:**
   a. Light and Heavy Mass:
      i. Supervisors will supply a light mass **and a heavy mass** that will each be composed of a 500-591 mL plastic bottle, mass inside of the bottle, and an attachment mechanism (hook, clasp, carabiner, etc.) that will connect the team's bottom cord ring to the bottle. **When hung, the masses including the attachment mechanism will have a height of at most 35.0 cm.**
      ii. The light mass and heavy mass, individually, will be the same for all drops.
      iii. The light mass will have a total mass between **100.0 g** and 300.0 g and be in increments of 25.0 g at regionals, 10.0 g at states, and 1.0 g at nationals.
      iv. The heavy mass will have a total mass between 200.0 g and 300.0 g heavier than the light mass, at increments of 1.0 g.
   b. Drop Heights:
      i. **At Regionals, there will be two total drops at one drop height, which will be between 2.00 and 5.00 meters inclusive at an interval of 25.0 cm.**
      ii. **At States, there will be four total drops - two drops at each of two different drop heights. Both drop heights will be between 2.00 and 5.00 meters inclusive at an interval of 10.0 cm.**
      iii. **At Nationals there will be four total drops - two drops at each of two different drop heights. Both drop heights will be between 5.00 and 8.00 meters inclusive at an interval of 1.0 cm.**
      iv. **The Bonus Drop will be an additional single drop, trying to drop close to a Bonus Target Drop Distance (BTDD), rather than the landing surface. The BTDD must be greater than 2.00 m and less than the drop height (regionals) or larger drop height (states/nationals).**
      v. **The drop height will be measured from the bottom most point of the clamp/attachment portion at the top of the cord to the bottom landing surface.**

c. Supervisors must provide a top anchoring system/extended platform with a release mechanism (e.g., a clamp) to attach to the top end of the elastic cord. All teams must use this anchoring system.
d. Supervisors must provide an accurate system for determining how close a team's device came to the landing surface, and whether or not it touched.

5. **THE COMPETITION:**
   a. Teams will be given a total of **3 minutes** to prepare their device in the holding area, followed immediately by **7 minutes** to complete **up to two drops at regionals and up to four drops at states and nationals as well as up to one bonus drop, if earned.**
   b. **At States/Nationals, teams will perform two drops at the lower Drop Height first, then perform two drops at the higher Drop Height, followed by the Bonus Drop if eligible, which will be completed on the higher Drop Height.**
   c. **Practice drops either in the competition area or within the vicinity of the competition area before or during competition are not allowed. Any drop, even if unintended or unannounced, will count as one of the drops allowed to the team.**
   d. **A cord that is damaged during a drop will earn a Drop Score of 0.5x the total drop height and any remaining drops will be scored as incomplete.**
   e. **The Heavy Mass Bonus.**
      i. **Teams can choose to attempt the heavy mass only on the 2nd drop for each drop height. If used, the heavy mass bonus earned will only apply to the drop(s) that used the heavy mass.**
      ii. **Teams that would like to attempt the heavy mass will attach the heavy mass (described in 5.a.) at the same closed ring as the 1st drop at each drop height, replacing the original light mass.**
   f. The Bonus Drop.
      i. Teams with a drop score within the following parameters (30.0 pts at regionals, 20.0 pts at states, 10.0 pts at nationals) must be invited to complete a single bonus drop at the BTDD. At Regionals, the Bonus Drop will be done using the same Drop Height setup. At States/Nationals, the Bonus Drop will be done on the higher of the two Drop Height setups.
      ii. The bonus drop will consist of dropping the light mass so the bottom of the mass dips within (30.0 cm at regionals, 20.0 cm at states, 10.0 cm at nationals) of the BTDD without passing the BTDD.
      iii. Teams can earn a maximum of one bonus drop and are given no additional time to complete the bonus drop.
      iv. Teams are not allowed to use the heavy mass during a bonus drop.
   g. **The supervisor will review with the team the data recorded on their scoresheet.**
   h. **Teams who wish to file an appeal must leave their device with the event supervisor.**

6. **SCORING:**
   a. **Low score wins. Final Score (FS) = HS1 + HS2 (States/Nationals only) + BD. A scoring spreadsheet is available on the event page on www.soinc.org.**
   b. **Height Score (HS) = The minimum DS for the two drops for each height.**
   c. **Drop Score (DS) = Drop Distance + Bonus. If the heavy mass is used for that drop, -20.0 points is added to the Drop Score for that drop. The heavy drop bonus can only be applied to the 2nd run for each drop height and only if the mass does not strike the landing surface for that drop.**
      i. **The Drop Distance is defined as the distance between the lowest point of the mass and the landing surface on its initial descent.**
      ii. **A drop that strikes the landing surface will have a DS of 0.5x the drop height.**
      iii. **Any drops not completed within the 7 minute test period will have a DS equal to the entire drop height.**
   d. **Bonus Drop (BD) — If the bottom of the mass is dropped within the distance of the BTDD at its lowest point on the bonus drop (described in 6.e.ii.), BD = -15.0 points. Otherwise, BD = 0.0 points.**
   e. **Devices will be placed in tiers as follows:**
      i. **Tier 1: Device meets all construction parameters for all drops.**
      ii. **Tier 2: Device still has construction parameter violation(s) during any drop.**
      iii. **Tier 3: A team with its device and/or tools not impounded or uses calibration data notes that were not impounded.**

f. **Teams that are prohibited from launching due to unsafe operation will receive Participation Points only.**
g. **Tiebreakers:**
   i. **1st: Whether a team succeeded in the bonus drop.**
   ii. **2nd: The number of drops completed using the heavy mass.**
   iii. **3rd: The team with the lowest individual drop score for any of their drops (not including bonus drop).**
   iv. **4th: Lowest non-scored drop 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.

C

CHEMISTRY LAB C

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

1. **DESCRIPTION:** Teams will complete one or more tasks and answer a series of questions involving the science processes of chemistry focused in the areas of chemical reactions/stoichiometry and **kinetics**.

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

EYE PROTECTION: C **CALCULATOR: Class III**

2. **EVENT PARAMETERS:**
   a. Each participant must bring safety equipment (e.g., goggles, lab coat, apron), a writing implement, and may bring a Class III calculator.
   b. Each participant may bring one 8.5" x 11" sheet of paper, which may be in a sheet protector sealed by tape or laminated, with information on both sides in any form and from any source.
   c. Teams should bring any or all of the items listed on the Division C 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, table of standard reduction potentials, any constants needed).
3. **THE COMPETITION:**
   a. The competition will consist of a series of tasks focused on the areas of chemical reactions/stoichiometry and kinetics. These tasks could include hands-on activities, questions on listed topics, interpretation of data (e.g., graphs, diagrams, tables), or observation of an established and running experiment. **At least 2 activities, one on each topic, are required.**
   b. Teams may be asked to collect data using a probe ware set-up demonstrated by the Supervisor(s). Following a demonstration of the sensors/probes, participants may be given data sets to interpret.
   c. Nomenclature, formula writing, & stoichiometry (mole conversions & percentage yield) are essential tools of chemistry & may be included in the event. Participants are expected to know the symbols & charges for: nitrate, carbonate, phosphate, acetate, sulfate, ammonium, bicarbonate, & hydroxide. Participants should know how to use the "ite" form of anion (one less oxygen than the "ate" form). With a periodic table, participants should be able to obtain charges for monatomic ions (e.g., Na^{+}, S^{2-}).
   d. Participants should understand the following about Chemical Reactions/Stoichiometry:
      i. classification of reaction type.
      ii. balancing reactions.
      iii. reaction prediction (including predicting products of metathesis reactions, solubility, oxidation-reduction, total ionic and net ionic equations).
   e. **Students will demonstrate an understanding of the principles of kinetics by:**
      i. **Measuring reaction rates and identify how and why reaction conditions (temperature, concentration, particle size, and catalysts) affect reaction rates.**
      ii. **At the state and national levels, teams will be asked to determine rate laws from actual experimentation or data provided, and teams should also be able to determine rate constants with correct units.**
4. **SCORING:**
   a. High score wins. Points will be divided evenly between kinetics and chemical reactions/stoichiometry.
   b. Time may be limited at each task but will not be used as a tiebreaker or for scoring.
   c. Ties will be broken by pre-selected questions.
   d. A penalty of up to 10% may be given if the area is not cleaned up as instructed.
   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.

CIRCUIT LAB C

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. Simple circuit analysis using Kirchhoff's Voltage & Current Laws
      ix. Historical perspective of the electricity and magnetism discoveries made by Ampere, Coulomb, Kirchhoff, Volta, Ohm, Tesla, & Faraday
      x. States/Nationals only:
         (1) Fundamental characteristics and operation of a light emitting diode (LED)
         (2) Basic electrical characteristics of silicon PN junctions (e.g., Diodes, PNP, NPN)
         (3) Basic operating principles and applications of Operational Amplifiers (op-amps)
   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 C

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, 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 C Regional Tournaments are as follows:
      i. Monoalphabetic substitution using Kl, K2, K3, 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 or K2 alphabet.**
      ii. For aristocrats encoded using a Kl, K2 or K3 alphabet, the answer requested can be the keyword or key phrase used to construct the alphabet instead of the deciphered text.
      iii. 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 letters.
      iv. Xenocrypt **(maximum of 2) - messages in Spanish encoded with a K1 or K2 English keyword alphabet.**
      v. Cryptanalysis of the Fractionated Morse Cipher - decrypting Morse code ciphertext encoded as letters and spaces with a "crib" of at least 4 plaintext characters.
      vi. Cryptarithms - determining mapping values to letters in base 10 (decimal) mathematical equations and decoding a word or phrase using that mapping.
      vii. The Porta Cipher - Decrypting ciphertext given a key.
      viii. 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.
      ix. The Nihilist Cipher - Decrypting ciphertext given the keys.
      x. The Hill Cipher - Decrypting ciphertext given the 2x2 encryption matrix.
      xi. 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 two cryptograms **and no more than three** will be in Spanish**, encoded using a K1 or K2 English keyword alphabet.**
      iii. Cryptanalysis of the Porta Cipher with a "crib" of at least 3 plaintext characters.
      iv. The Hill Cipher - Decrypting ciphertext with a 3x3 decryption matrix provided.
      v. Cryptanalysis of the Nihilist Cipher with a "crib" that is no shorter than **double than the length of** the keyword used.
      vi. Cryptanalysis of the Complete Columnar Transposition Cipher - Decrypting ciphertext encoded in 11 columns or less given a "crib" which is no shorter than three less than the number of columns

used.

vii. 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.vii.).**

j. For Cryptanalysis problems providing a "crib" (3.e.iii., 3.e.v., 3.f.iii., 3.f.v., 3.f.vii.) with the exception of the Complete Columnar Cipher (3.e.viii., 3.f.vi.), 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 involving the keyword or key phrase for a K1, K2 or K3 alphabet (3.e.ii) the final points will be determined based on the number of errors found in the **keyword or key phrase. For the Cryptarithm (3.e.vi), 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 = 2 x (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.

DESIGNER GENES C

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, evolutionary, 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 listed below 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. Describe inheritance patterns which violate these laws (i.e. linkage, incomplete and codominance, complementation).
         (2) Use provided information to construct Punnett Squares of mono-, di- and trihybrid 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, autosomal vs sex-linked traits) and construct pedigrees based on data from a case study.
         (5) Understand epistasis and its implications in predicting genetic outcomes.
         (6) State and Nationals only: Map two (State) or three (National) genes on a chromosome based on recombination frequency data.
      ii. Mitosis and Meiosis
         (1) Understand, compare, and contrast the major stages and key structures in mitosis and meiosis.
         (2) Describe the effects of nondisjunction and use data from karyotypes to detect chromosomal abnormalities.
         (3) State and Nationals Only: Understand somatic recombination in the context of immune cell V(D)J recombination and immunoglobulin class switching.
      iii. Population & Evolutionary Genetics
         (1) Understand the assumptions and calculations that underlie the Hardy-Weinberg equilibrium and the consequences of violating these assumptions. Be able to make these calculations given data.
         (2) Understand and explain the relationships between changing allele frequencies and genetic drift, founder effects, and bottlenecks, migration, and relative fitness.
         (3) Explain how additive alleles generate continuous variation and estimate the number of genes contributing to a trait.
         (4) Understand the role gene duplication plays in the evolution of the genome and new genes. Be able to identify homologs, orthologs, and paralogs.
         (5) Understand how a phylogenetic tree shows evolutionary histories and interpret phylogenies of nuclear, organellar, and extrachromosomal elements. Describe the basic steps of constructing a phylogenetic tree beginning with sequence data input.
         (6) State and Nationals only: Understand how heritability is used to explore phenotypic variation in a population. Calculate broad-sense heritability, narrow-sense heritability, and realized heritability.
      iv. 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), rules in the context of DNA structure and base pairing.

(2) Understand the stages of DNA replication, from assembly of the pre-replication complex to termination, understand in detail the processes that happen at the replication fork.
(3) Understand how DNA polymerases achieve fidelity of replication, and the mechanisms behind DNA proofreading.
(4) Identify and understand the organization of DNA structure, such as plasmids, chromatin complexes, euchromatin and heterochromatin, and chromosomes.
(5) Understanding the processes in which DNA gets damaged and the mechanisms for DNA repair.
(6) 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).

v. **Prokaryotic** gene expression and regulation
(1) Be able to explain the Central Dogma of Molecular Biology and reverse transcription.
(2) Transcription: Understand and explain initiation, elongation, and termination stages of transcription, the mechanism of RNA polymerase.
(3) Understand the role and general locations of cis- and trans-regulatory elements (i.e. promoters, enhancers, silencers, riboswitches, transcription factors) in the context of a gene and the lac and trp operons.
(4) Translation: Understand and explain the initiation, elongation and termination stages of translation, the mechanism of the ribosome, the role mRNA and tRNA play in translation, and how translation is regulated.
(5) State and Nationals only: Understand protein secretion systems in the context of the Sec and Tat systems.

vi. 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) 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.
(3) Next-gen (Illumina) vs. third-gen (Nanopore) sequencing: Describe the major platforms used for Next-Gen (Illumina) sequencing. Compare and contrast these methods in terms of how they are performed, data produced, and questions the data addresses.
(4) Molecular cloning: Describe the major steps in cloning a gene of interest to be expressed in a specific organism. Understand the utility of plasmids, restriction enzymes, PCR, Gibson assembly, and blue-white screens in the context of molecular cloning.
(5) Knockout/knockdowns: Understand how knockout, knockdown, and complementation experiments are used to determine gene function. Compare and contrast knockdowns and knockouts and explain why one may be used over the other. State and Nationals only: Describe techniques used to generate knockdown/knockouts (i.e. RNAi, homologous recombination, CRISPR and TALENs).
(6) State and Nationals only: Describe the basic procedure, applications, and limitations of the following techniques: ChIP-seq, Hi-C, RNA-Seq.

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.

DISEASE DETECTIVES C

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.

(9) Recognize factors such as study design/biases, errors, and confounding that influence results. Be able to propose appropriate control or comparison groups and data collection methods, and recognize limitations. Be able to interpret and use confidence intervals for measures of association. Competitors need not be able to calculate these confidence intervals since this is most often done through computer programs. Understand and use methods such as stratification and adjusted rates. Know the experimental and observational methods used to calculate vaccine effectiveness and efficacy and be able to use them.

(10) Understand the concept of herd immunity. Be able to calculate and interpret herd immunity threshold, basic and effective reproductive numbers.

(11) Nationals Only: Suggest types of control & prevention measures for outbreaks and other public health problems.

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.

(5) Propose a reasonable set of prevention strategies for public health problems within the scenarios provided, once the cause has been determined by your analyses.

(6) Nationals Only: Identify the strengths and weaknesses of a set of proposed prevention strategies and analyze pre-and post-intervention data, to determine effectiveness of presented strategies.

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)

DYNAMIC PLANET C - 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)

i. Oceanic tools used for research (e.g. water samples, sediment cores, seawater velocity trackers, sonar and acoustic sensing, CTD devices)
j. Pressure-gradient force, geostrophic balance, Rossby waves, Kelvin waves

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)

C

ELECTRIC VEHICLE C

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

1. **DESCRIPTION:** Teams design, build, and test one vehicle that uses electrical energy as its sole means of propulsion to travel in a set amount of time and stop close to a Target Point.

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

   IMPOUND: Yes

2. **EVENT PARAMETERS:**
   a. Vehicle will be designed and built by the team prior to the competition.
   b. Impound: Team must impound before the first time slot.
   c. Event Time: Teams will each have 8 minutes to adjust, repair, and run their Vehicle.
   d. Track: The Event Supervisor will provide and set up the Track as listed in the Track section.
3. **CONSTRUCTION PARAMETERS:**
   a. Electrical Energy used by the Vehicle for any purpose must come from a maximum of eight (8) AA batteries.
      i. No battery containing lithium or lead acid is permitted. Teams using these batteries will not be permitted to run and will receive only participation points.
      ii. **Energy storage methods which allow teams to exceed the instantaneous energy available from the batteries are not allowed. An example would be large capacitors or a spring.**
      iii. Electronic sighting, alignment, or aiming devices may have their own separate power source. **Lasers are prohibited.**
      iv. All sources of energy must be in easily accessible locations for inspection by the ES.
   b. Propulsion Energy: must be electric and come from the batteries.
   c. Components may be purchased or made by the team members. Electronic components are allowed.
      i. If a microprocessor is used, **students may communicate with their device over WiFi, Bluetooth, or USB.**
   d. Vehicle Length: The distance from the front of the front wheel(s) to the back of the back wheel(s) must not exceed 70.0 cm.
   e. Vehicle Width: The Vehicle width must not exceed 35.0 cm at any point.
   f. Measurement Point: The Vehicle must have a Measurement Point (MP) for distance measurements at the front of the Vehicle.
   g. Remote Control: The Vehicle must not be remotely controlled or tethered.
   h. Vehicle Parts: All parts of the Vehicle must move as a whole: no anchors, tethers, tie downs, launching ramps, or other separate pieces are allowed. The only parts allowed to contact the floor during the run are wheels/treads, and any parts already in contact with the floor in the ready-to-run configuration. Pieces falling off during the run constitutes a Construction Violation.
   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 Vehicle, batteries, spare parts, alignment device (if used), and any papers (if used).
      ii. Batteries must be stored separately from Vehicle and presented to ES for inspection if asked. Teams will be allowed to correct if an issue is found.
      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 **and Target Time** will be announced and posted. The Target Distance **and Target Time** 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 and measurement by the ES. Participants will be notified at this point if any construction violations are found.
         (1) **A construction violation will be awarded to all runs if more than one Vehicle was impounded.**

(2) 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. Participants may not use an AC outlet power during their time slot.

vi. Unauthorized, generative AI tools (e.g., ChatGPT, DALL-E) are not allowed to be used to generate answers/code under any circumstances during the event.

d. **Event Time**

i. The Event Time ends after 2 runs or the time limit has been reached. Teams may adjust their Vehicle (e.g., repair, wiring, 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. Sighting, aligning, measurement, and guiding devices, if used, must be placed and used within the defined Track area. **Device(s) cannot be secured to the track.** 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 Vehicle. All items not part of the Vehicle must be moved **and placed** behind the Start Point prior to starting a run. Sighting, aligning, and guiding devices may use electricity. **Lasers are prohibited.**

iii. Teams may use their own tools to verify the Track dimensions during their Event Time.

iv. 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.

v. **Teams may access the Internet to program their Device. Any actions not required for programming will cause a team to be awarded a competition violation. Internet access may not be available at all competitions.**

vi. 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.**

vii. **Individual Run Testing**
(1) Participants must place the Vehicle's MP 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 to earn the Can Bonus by navigating between the two cans located on the Bonus Line. All cans are positioned as outlined in the Track section. There is no penalty if teams choose to run without the cans.**
(a) **Outer can is placed by the ES.**
(b) **Inner can is placed by the competitors.**
(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 violations.
(a) **The ES will only notify the participants of competition 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) **ES will measure the Inside Can Distance.**
(6) Participants will use a #2 unsharpened pencil to start the Vehicle using a vertical motion. Only the pencil may contact the Vehicle when triggered.
(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.
(7) **Once the run starts and until the Vehicle is retrieved, competitors may not use, view, or access their programming tool(s).**
(8) ES will review the run to determine if the run was Successful or a Failed Run.
(9) Run Time and Vehicle Distance will be measured and recorded for Successful runs.
(10) **To earn the Can Bonus, all parts of the Vehicle must travel between the two cans. If the Inside Can Distance has changed, then the Can Bonus cannot be awarded.**
(11) Competitors following their Vehicle down the track before being called to retrieve their vehicle, will receive a Competition Violation.

(12) All violations will be recorded. The ES must notify the participants of any violations at the end of each run.
(13) Timing resumes once the participants pick up their device or begin working toward the next run.

viii. The Event Supervisor will review with teams their data recorded at the end of their Event Time.
ix. Teams filing an appeal must leave their Vehicle and other impounded material in the event area.

5. **SCORING:**
   a. Each team's Final Score is the better of the 2 Run Scores + Final Score Penalties. Low score wins.
   b. Run Score = **100 +** Distance Score + Time Score + **Bonuses** + 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 = **Absolute value of (Target Time - Run Time)**
      i. The Run Time will be recorded as 0.00 seconds for Failed Runs.
   e. **Can Bonus = -0.5 x (110 - Inside Can Distance)**
   f. **Event Time Bonus (National Only) = (Event Time Used - 480) / 30 points**
   g. 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**.
      iii. Failed Runs can also be assessed Competition and/or Construction violations.
   h. Final Score Penalties: Vehicle not Impounded: 5000 points added to the team's Final Score.
   i. Two or more teams tied with 2 Failed Run scores, without Competition or Construction Violations, will remain scored as ties. Other ties are possible.
   j. 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. Target time is 14 seconds.
      i. In the 1st run, the Vehicle stopped 67.6 cm from the Target Point with a Run Time of 12.27 seconds with no cans.
      ii. In the 2nd run, the Vehicle stopped 27.6 cm from the Target Point with a Run Time of 16.37 seconds with an Inside Can Distance of 50.0 cm

Base Score	**= 100**		**100.00**
Distance Score	= 67.6 cm x 2.0 pts/cm	=	135.20
Time Score	**= abs(14 - 12.27)**	**=**	**1.73**
Can Bonus	**= No Cans**		**0.00**
1st Run Score		**=**	**236.93**
Base Score	**= 100**		**100.00**
Distance Score	= 27.6 cm x 2.0 pts/cm	=	55.20
Time Score	**= abs(14 - 16.37)**	**=**	**2.37**
Can Bonus	**= -0.5 x (110.0 - 50.0)**		**-30.00**
2nd Run Score		**=**	**127.57**

Final Score = 2nd Run Score (Better Score) = 127.57 pts

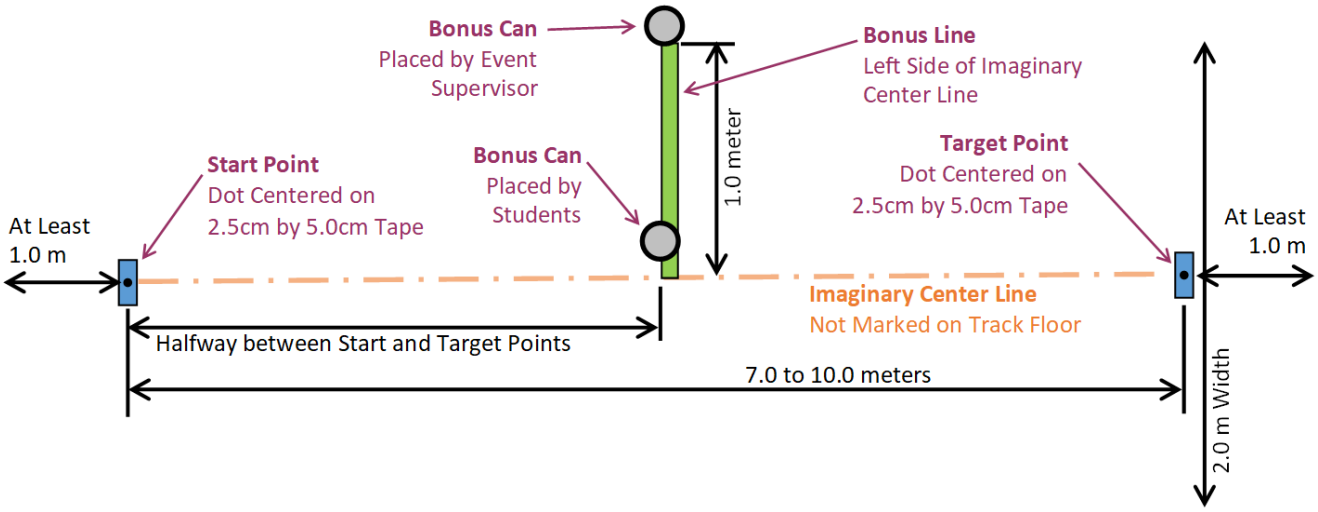
7. **THE TRACK:**
   a. In-Person tournaments: The ES will supply and set up the Track.
   b. Virtual tournaments: Team will supply the Track that fully complies with the requirements of this section. Any deviation will be scored as a competition violation for all runs.
   c. Track Definition:
      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.
(3) **Bonus Line - an approximately 2.5 cm width tape placed halfway between the Start Point and the Target Point extending perpendicular from the imaginary center line at least 1.0 meter to the left when facing the Target Point. The edge of the line closest to the Start Point defines the line.**
(4) **Imaginary Center Line is a line not placed on the Track that is from the Start Point to the Target Point.**

iii. **The two (2) Bonus Cans will be empty with a diameter of 7.0 to 8.0 cm and a height at least 10.5 cm. For example, an empty can of corn. All cans are placed upright with their center on the Bonus Line.**
(1) **Outside Can is placed by the ES with the inside edge at 100.0 cm from the track's imaginary center line.**
(2) **Inside Can is placed by the competitors with the outside edge between 0.0 and 100.0 cm from the inside edge of the Outside Can.**

iv. The Track Area will have a width of 2.0 m and extend at least 1.0 m **behind the Start Point and** beyond the Target Point. More space may be available but is not guaranteed.

v. 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. *Batteries* are commercial batteries, including rechargeables, labeled as AA batteries. Individual batteries must have a voltage between 1.2 and 1.5 volts when fully charged. The battery label must be the manufacturer's original label and easily viewable by the ES. The batteries must be individual batteries and removable from a battery pack. Batteries containing lithium or lead are prohibited.
c. *Components* can be, but not limited to, motors, gearboxes, motor controls, bodies, and chassis.
d. *Electronic components* can be, but not limited to, solid-state devices such as transistors, integrated circuits, diodes, and microprocessors.
e. *Measurement Point (MP)* must meet the following requirements:
i. The MP may be made of any material (e.g. wooden skewer, toothpick, pencil, dowel). Examples include but are not limited to: tip of a skewer/toothpick, tip of a pen, tip of a nail/paper clip/wire, corner of a wedge, the edge of a dowel.
ii. The MP must be less than or equal to 1.0 cm above the Track.
iii. The MP does not need to be the foremost part of the Vehicle, but its bottom must be easily accessible for measurements while the Vehicle is on the Track.
f. *Tools* may be electric and electronic tools. To qualify as a Tool, the item must not travel on the Track with the Vehicle and cannot be used to align or aim the Vehicle.

g. *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.
h. *Target Time* is selected by the ES and will be between 10.0 and 20.0 seconds. The interval will be 0.5 seconds for all tournaments.
i. *Vehicle Distance* is a point-to-point measurement from the Vehicle Measurement Point to the Target Point, measured to the nearest 0.1 cm.
j. *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.
k. *Complete Stop* is when the Vehicle is stationary for 3 or more seconds. The 3 seconds is not part of the Run Time.
l. *Inside Can Distance* is the distance measured along the Bonus Line between the inside edges of the two cans.
m. *Successful Run:* Any run when the Vehicle moves before the end of the Event Time and is not a Failed Run.
n. *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. The Vehicle travels the wrong direction from the Start Point.
    ii. The Vehicle starts before the Event Supervisor 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.

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.

ENGINEERING CAD C

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

1. **DESCRIPTION:** Teams will read a set of engineering drawings and collaborate to CAD parts in Onshape and then incorporate these parts with provided components to create an assembly.

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

2. **EVENT PARAMETERS:**
   a. Teams will use Onshape (onshape.com/edu) on two computers with mice to create the model.
   b. Each participant must bring a laptop capable of running Onshape for the purposes of completing the event unless specified by the Event Supervisor.
      i. Each participant may bring a wired or wireless mouse, a laptop charger, and writing utensils.
   c. No resource materials, except those provided by the Event Supervisor, may be used.
   d. Teams will be provided with a printed set of engineering drawings and a starting Onshape document with an assembly that has parts needed for creating the finished assembly. Teams will either be required to use their own Onshape accounts or use provided Onshape credentials at the discretion of the Event Supervisor.

3. **THE COMPETITION:**
   a. Teams will use Onshape to CAD parts and an assembly based on the engineering drawings which specify the geometry, materials, and units for each part.
      i. For Regionals, teams will be required to model 2 to 3 parts for use in the assembly.
      ii. For State and Nationals, teams will be required to model 4 to 6 parts for use in the assembly.
   b. Students on the team will work collaboratively on the parts and assembly.

4. **SCORING**:
   a. The high score wins.
   b. Event Score = Individual Part Scores (IPS) + Individual Assembly Score (IAS)
   c. IPS is determined by comparing the mass of named parts as specified in the engineering drawing to the correct values. A perfect match for the mass is 100 points. Answers cannot earn negative points and will be worth a minimum of 0 points. Points for each part will be calculated as:

$$IPS = 100\,(1 - |\Delta_{mass}|) \quad \text{where} \quad \Delta_{mass} = \left|\frac{mass_{student} \;\; mass_{correct}}{mass_{correct}}\right|$$

   d. IAS is determined by comparing the X, Y and Z component of the center of mass (CoM) of the named assembly as specified in the engineering drawing to the correct values. A perfect match for the center of mass is 100 points and the minimum score is 0 points. Points for each assembly will be calculated as:

$$IAS = 100\left(1 - \frac{|\Delta_{X\,CoM}|}{3} - \frac{|\Delta_{Y\,CoM}|}{3} - \frac{|\Delta_{Z\,CoM}|}{3}\right) \quad \text{where} \quad \Delta_{CoM} = \left|\frac{CoM_{student} - CoM_{correct}}{CoM_{correct}}\right|$$

   e. The tiebreaker is modeling time. The team with the lowest modeling time wins the tiebreaker. Time is measured from the moment the "Start assignment" button is pressed to the moment the "Submit" button is pressed. Work done after the last submission is not graded.

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 Onshape.

ENTOMOLOGY C

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 C

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 III

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 stand alone Class III 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 the scoring 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.

FORENSICS C

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

1. **DESCRIPTION:** Given a scenario and some possible suspects, students will perform a series of tests. These tests, along with other evidence or test results, will be used to solve a crime.

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

EYE PROTECTION: C **CALCULATOR:** Class III

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 III calculator.
   c. Each team may bring any or all of the items listed on the Division C Chemistry Events Lab Equipment List, posted on soinc.org. Teams not bringing these items may be at a disadvantage. The Supervisor will not provide them.
   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 in KI solution)
      ii. 1M HCl
      iii. 1M NaOH
      iv. Benedict's solution
      v. a hot water bath
      vi. a Bunsen burner or equivalent BTU heat source to perform flame tests
      vii. a waste container
      viii. chromatography materials (e.g., beakers, Petri dishes, etc.)
      ix. a wash bottle with distilled water
   f. The Supervisor may provide:
      i. other equipment (e.g., a microscope, probes, 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 other tests

3. **THE COMPETITION:**
   a. The competition will consist of evidence from Parts 3.b. - e. and analysis of the evidence in Part 3.f. Analysis or questions can only be on the evidence topics included in the competition. The collected evidence and other data given may be used in a mock crime scene. The amount of evidence included will be according to the following table:

Level	Part b. # of samples	Part c. # of samples	Part d. # of chromatograms	Part e. # of topics	Part f.
Regional	3-8	5-9	1 type + Mass Spectra	1-2	Required
State	6-10	6-12	1-2 types + Mass Spectra	1-3	Required
National	10-14	10-18	1-3 types + Mass Spectra	3-5	Required

   b. Qualitative Analysis: Participants may be asked to identify the following substances: sodium acetate, sodium chloride, sodium hydrogen carbonate, sodium carbonate, lithium chloride, potassium chloride, calcium nitrate, calcium sulfate, calcium carbonate, cornstarch, glucose, sucrose, magnesium sulfate, boric acid, and ammonium chloride (there will be no mixtures). All teams will have the same set of solids to identify.
   c. Polymers: Participants may be asked to identify:
      i. Plastics: PETE, HDPE, non-expanded PS, LDPE, PP, PVC, PMMA, PC – Participants will not perform any burn tests on these plastics, but the Supervisor may provide burn test results on them.

ii. Fibers: cotton, wool, silk, linen, nylon, spandex, polyester - burn tests will be permitted on the fibers.
iii. Hair: human, bat, cow, squirrel, and horse - participants will need to know hair structure including medulla, cortex, cuticle, root and hair scale classification.

d. Chromatography/Spectroscopy: Participants will be expected to separate components using paper chromatography, TLC, and/or analyze mass spectra. Participants may be expected to measure Rfs.
e. Crime Scene Physical Evidence:
i. Fingerprint Analysis: Participants will be expected to know the 8 specific fingerprint patterns (plain arch, tented arch, radial loop, ulnar loop, plain whorl, central pocket whorl, accidental whorl, and double loop whorl). Participants should also be familiar with the common fingerprint development techniques of dusting, iodine fuming, ninhydrin, and cyanoacrylate fuming. Participants should understand terminology such as bifurcation, ridges, island, enclosure, loop, eye, spur, trifurcation, delta, and double bifurcation. Participants should be able to answer questions about skin layers and how fingerprints are formed. Participants may be asked questions on the different methods of detecting fingerprints and the chemistry behind each of these methods.
ii. DNA: Participants may be asked to compare DNA chromatograms/electropherograms from materials found at the scene to those of the suspects. Participants will be expected to know how DNA is copied. See http://educationalgames.nobelprize.org/educational/chemistry/pcr/
iii. Glass analysis: Participants may be asked to use index of refraction to determine the type of a glass found broken at a crime scene. They may be asked to analyze which hole or fractures occurred before others based on a piece of glass available for examination or a picture of a piece of glass.
iv. Entomology: Participants may be asked to identify how long an animal has been dead based on the type of insects found on the body at the scene.
v. Spatters: Participants may be asked to analyze actual spatters or photographs of spatters to determine the angle and velocity with which the liquid approached the solid object bearing the spatter & the spatter origin direction.
vi. Seeds and Pollen: Participants may be asked to compare pictures of seeds/pollen found at the scene with either seeds/pollen found on the suspects or seeds/pollen from different country regions.
vii. Tracks and Soil: Participants may be asked to match tire tracks or footprints found at the scene to tires or shoes of the suspects. 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.
viii. Blood: Participants may be asked to identify the ABO blood type using artificial blood (Event Supervisor required to provide instructions on how the typing system works) or participants may be asked to identify if a blood sample, either prepared microscope slide or pictures of microscope slide, is human, avian, mammalian, or reptilian/amphibian.
ix. Bullet striations: Participants may be asked to match the striations on bullets or casings found at the crime scene and fired from a given gun.
f. Analysis of the Crime: Participants will be asked to write an analysis of the crime scene explaining not only which pieces of evidence implicate which suspect(s) 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.
g. Teams will dispose of waste as directed by the Event Supervisor.

4. **SCORING:**

a. High score wins. Time will not be used for scoring.
b. The score will be composed of the following elements (percentages given are approximate): Part 3.b. ≈ 20%, Part 3.c. ≈ 20%, Part 3.d. ≈ 15%, Part 3.e. ≈ 15%, and 3.f. ≈ 30%.
c. Ties will be broken by the highest score on the analysis of the crime scene, which includes the reasons why certain suspects have been eliminated or others remain in the pool of possible criminals.
d. A 10% penalty may be given if the area is not cleaned up as designated 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.

HELICOPTER C

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).

HOVERCRAFT C

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

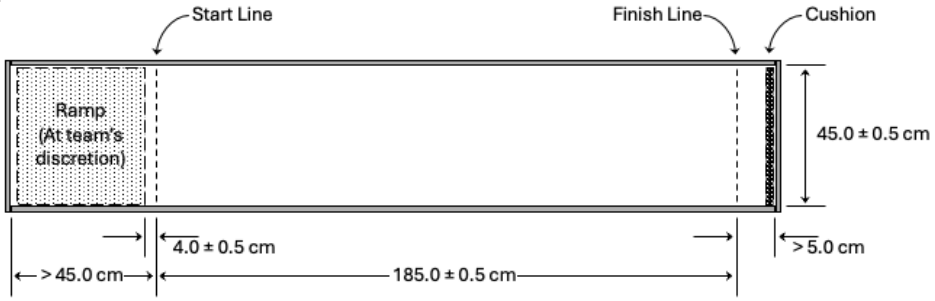
1. **DESCRIPTION:** Prior to the competition, participants will design, construct, and calibrate a self-propelled air-levitated vehicle that moves down a track.

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.

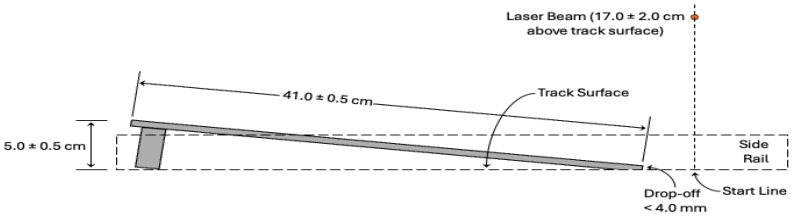
d. At the start of their testing period, each team will be given a Target Time (TT). The Target Time will be between **6.0-26.0** seconds in intervals of 2.0 seconds for Regionals, 1.0 second for States, and 0.5 seconds for Nationals. The TT will be the same for all teams.
e. Teams have a testing period 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. Multiple tracks may be used to facilitate teams competing in a timely manner.

6. **SCORING:**
a. Final Score (FS) = Best Run Score + **BS (if any)**. High score wins. A scoring **spreadsheet** is available at www.soinc.org.
b. Run Score = DS + 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 C

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 connected directly via a flexible or rigid link to a class 2 or 3 lever, each with a single "beam" of length that measures no longer than 40.0 cm. The "beam" is the bar that rests on the fulcrum and includes any attached components, except the flexible or rigid link between the two levers. 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
8.0	10.0	12.0

   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 and compound machines in static equilibrium and include questions from each of the following topics as they apply to simple/compound machines:
   i. Ideal and actual mechanical advantage
   ii. Efficiency, load, and effort
   iii. Potential and kinetic energy
   iv. Coefficient of friction
   v. Self-locking machines
   vi. Angle of repose
   vii. States/Nationals Only: Simple and compound machines that are not in equilibrium.
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. Basic 2D geometry required for resolving forces into component parts. For example, parallel & perpendicular lines, triangles (right, similar, & congruent).
   ii. Algebraic manipulations of multiple steps.
   iii. Basic trigonometry and vectors.
   iv. No questions may require the use of calculus.

Part II: Device Testing

a. The objective is to quickly determine the ratios of the unknown masses of the three test masses using their compound 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, any fixed masses, and the attachment of the link between the two levers. 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 fulcrums along the lever beams, 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.

MATERIALS SCIENCE C

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

1. **DESCRIPTION:** Teams will complete lab activities and answer a series of questions related to the materials science of nanomaterials with an emphasis on chemical, physical, optical, and mechanical properties of nanomaterials.

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

EYE PROTECTION: C **CALCULATOR: Class III**

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 III calculator.
   c. Teams should bring any or all of the items listed on the Division C 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, table of standard reduction potentials, any constants needed).

3. **THE COMPETITION:**

Part 1: Lab Activity

   a. At least one lab activity must be performed. Refer to soinc.org for a list of core competencies for chemistry events. Topics for lab activities shall be consistent with topics listed under Part 2: Written Test
   b. Lab Activities will comprise at least 15% of the total score at the Regional Level, 25% at the State Level, and 35% at the National Level.

Part 2: Written Test

   a. The written test will focus on the chemical structure, crystalline structure, characterization, performance, synthesis, processing and applications of nanomaterials.
   b. **Types and applications of nanomaterials:** Metal nanomaterial, metal-oxide nanomaterials, ceramic nanomaterials, semiconductor nanomaterials, carbon-based nanomaterials (graphene, fullerenes, nanotubes, etc); zero dimensional, one dimensional, two dimensional, and three-dimensional nanomaterials; nanofluids. Uses of the types of nanomaterials. The following nanomaterials are NOT included: polymer nanomaterials, organic nanomaterials.
   c. **Structure:** Crystalline structure, amorphous nanomaterials, interatomic bonding, intermolecular forces, size effects of nanomaterials, Grain boundaries. **State and National levels only may include:** Diffusion, crystalline defects.
   d. **Chemistry of surfaces:** Surface area/volume ratio, surface energy, surface tension, wetting angle, hydrophobicity, hydrophilicity, surfactants.
   e. **Nanomaterials synthesis and fabrication:** Top-down synthesis techniques (e.g., milling, sputtering, chemical etching, lithography, etc.) and Bottom-up synthesis techniques (e.g., sol-gel process, chemical vapor deposition, self-assembly, molecular beam epitaxy, etc.)
   f. **Characterization:** X-ray diffraction, light and electron microscopes, scanning probe microscopy, spectroscopes (e.g., UV-visible, photoluminescence, energy dispersive, mass, etc.)
   g. **Physical & Mechanical properties:** Melting temperature, density, hardness, strength, elastic modulus, calculation of stress, strain, and elastic modulus, adhesion, wear.
   h. **Optical properties:** Scattering, absorption, color, reflection, refraction, transmission. **State and National levels only may include** Luminescence, fluorescence, plasmons, quantum confinement effects on optical properties.
   i. **Thermal, Electrical, & Magnetic properties:** Thermal conductivity, Electrical conductivity, electronic band structure, surface scattering, dielectric properties, semiconductor behavior. **State and National levels only may include** Magnetic fields, saturation magnetization, types of magnetism in nanomaterials, quantum confinement effects on electrical properties.

4. **SCORING:** High score wins.
   a. Lab Activities (at least 15% at Regional, 25% at State, and 35% at National)
   b. Written Test (No more than 85% at Regional, 75% at State, and 65% at National)
   c. Ties will be broken by pre-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.

C

REMOTE SENSING C - CLIMATE CHANGE

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

1. **DESCRIPTION:** Participants will use remote sensing imagery, data, and computational process skills to complete tasks related to climate change processes in the Earth system.

   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 material 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:**
   a. The event will consist of questions and activities testing concepts related to the collection and use of remote sensing data to observe and study climate change processes and their effects on Earth systems.
   b. The test should be divided so that approximately 25% focuses on topics under 3.c., 35% focuses on topics under 3.d., 20% focuses on topics under 3.e., and 20% focuses on topics under 3.f. **Students should not be expected to know or use calculus to answer any questions.**
   c. Remote sensing instrumentation and physics.
      i. Active vs. Passive sensors
      ii. Optical and infrared imagers, radiometers, LIDAR, **space-based gravimetry**
      iii. Radar Altimetry, precipitation radar, **Doppler radar (ground, airborne, and satellite-based)**
      iv. Reflection, refraction, attenuation, transmission, and scattering of light by the atmosphere, aerosols, water, vegetation
      v. **Spectroscopy, including regions of the electromagnetic spectrum, basic types of spectra (continuous, emission, and absorption), usage in identifying composition (atmospheric gases, etc.)**
      vi. Characteristics of blackbody radiation (Wien's Law, Stefan-Boltzmann Law, Rayleigh-Jeans Law)
      vii. **Orbital properties, including Kepler's Laws, types of orbits (LEO, MEO, HEO, geosynchronous, geostationary, polar, sun-synchronous)**
      viii. **Imaging fidelity/quality, including satellite altitude or semi-major axis and angular resolution, instantaneous field of view, ground sample distance, field of view; revisit period vs. orbital period vs. framerate to cover a swath**
   d. Interpretation of images and datasets from only the listed satellites and instruments, as relevant to the topics of this event. **Appropriate context (e.g. sensors, bands, etc.) should be provided as necessary for satellite imagery.**
      i. Optical, infrared, and Doppler radar imagery of clouds, precipitation, **and extreme weather events** (MODIS **on Aqua**, CALIPSO, CloudSat, GOES, Suomi NPP, **GPM**)
      ii. Sea level rise and surface waves (**PACE**, JASON, GRACE)
      iii. Distributions and radiative effects of greenhouse gases, trace atmospheric gases, and aerosols (OCO-2, Aura, **MODIS on Aqua**, GOES, Suomi NPP, CALIPSO, **PACE**)
      iv. Atmospheric and sea surface temperatures (**MODIS on Aqua**, **ECOSTRESS**, ATMS, GOES, CrIS on Suomi NPP)
      v. Radiative energy flux (CERES on Suomi NPP, **PACE**)
   e. Climate processes.
      i. Atmospheric concentrations and distributions of greenhouse gases, trace gases, and aerosols **(CO_2, H_2O, CH_4, N_2O, SO_2, Ozone, CFCs, HFCs, NH_3, Halogenated gas), and relevant influencing factors (e.g. solar activity, volcanic activity, Earth's orbit and seasons, atmospheric and ocean circulation)**
      ii. **El Niño-Southern Oscillation and its effects on regional climate**
      iii. Carbon cycle **and Nitrogen cycle**, the impacts of natural phenomena and anthropogenic activity on these cycles, and relevance of these cycles to climate processes
      iv. **The effects of climate change on existing weather processes (e.g. clouds and rainfall, flooding, sea level rise, heat waves, atmospheric effects of wildfires)**
      v. **Ecological impacts, such as on vegetation and biome distributions**
   f. Energy balance modeling and climate change.

i. The effects of atmospheric and surface conditions (e.g. clouds, aerosols, surface albedo) on climate change, including radiative forcing and climate feedback loops
ii. Blackbody radiation (using the Stefan-Boltzmann Law) absorbed by the Earth from the Sun, and emitted from the Earth.
iii. Albedo-based reflection by surface, ice, and clouds
iv. Modeling planetary equilibrium temperature as a result of the interaction between incoming and outgoing radiation, and changes to equilibrium temperature due to atmospheric and surface conditions
v. **Changes in heating and cooling rates over time using linear, piecewise-linear, and exponential functions**

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).

ROBOT TOUR C

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

1. **DESCRIPTION:** Teams design, build, program and test one Robotic Vehicle to navigate a track to reach a target at a set amount of time as accurately and efficiently as possible.

   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 18 minutes

   IMPOUND: Yes

2. **EVENT PARAMETERS:**
   a. **Device**: One Robot designed, built, and programmed by the team prior to the competition.
   b. **Impound**: Team must impound before the first time slot.
   c. **Event Time**: Teams will have 18 minutes to set up and run their Robot.
   d. **Track**: The Event Supervisor will provide and set up the Track as listed in the Track section.
3. **CONSTRUCTION PARAMETERS:**
   a. **Electrical Energy** used by the Robot for any purpose must come from a maximum of **eight (8) AA or AAA batteries**.
      i. No battery containing lithium or lead acid is permitted. Teams using these batteries will not be permitted to run and will receive only participation points.
   b. **Components** may be purchased or made by the team members. Electronic components are allowed. Multiple microprocessors are allowed. **Lasers are prohibited**.
   c. **Robot Size**: The entire Robot in the ready-to-run configuration must fit in any orientation in a 30.0 cm by 30.0 cm space. No restriction on the Robot's height.
   d. **Dowel**: A dowel must be attached to the front of the Robot. The dowel must be approximately perpendicular to the floor, extend to within 1.0 cm of the track surface, and extend at least 10.0 cm above the floor. **The dowel does not need to be the foremost part of the robot.** The dowel must be easily accessible by the ES as the front bottom edge of the dowel will be used as the Measurement Point (MP). The dowel may not rotate, pivot, extend, or move around the Robot.
   e. **Robot Program:** The impounded program can be one or multiple source code files.
   f. **Sensors**: Teams may use sensors to provide information about the environment or the Robot's movements. Sensors must be attached and connected to the Robot. Sensors may change their orientation during a run. For example a motor may rotate a sensor.
   g. **Robot Parts:** All parts of the Robot must move as a whole; no tethers other separate pieces are allowed. **The Robot cannot change in size during the run.** Pieces cannot fall off during the run. This rule will be judged during the run and violations will be awarded as a Construction Violation.
   h. **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 Robot, batteries, spare parts and any papers (if used).
      ii. Batteries must be stored separately from Robot and presented to ES for inspection if asked.
      iii. The Robot's program source code(s) must be impounded using the following storage media but not limited to these options: USB drive, SD card, Robot's flash memory.
      iv. Laptops, tables, or other computers used for programming CANNOT be impounded.
      v. Tools do not need to be impounded.
      vi. **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 Time and the locations of the Start Point, Target Point, Obstacles, Gates Zones, and **Water Bottles** will be announced and posted. The Track Setup at a competition will be the same for all teams.
      i. The number of Gate Zones will be 4 for Regionals, 5 for States, and 6 for Nationals.
      ii. **The number of Water Bottles will be 3 for Regionals, 4 for States, and 5 for Nationals.**
      iii. The Target Time will be:
         (1) **For Invitationals & Regionals between 60 and 80 seconds.**
         (2) **For States between 55 and 75 seconds.**
         (3) **For Nationals between 50 and 65 seconds.**
         (4) **The interval will be 1.0 second for all tournaments.**

c. **Check-In**
   i. Only the participants will enter the event area. If needed, they must bring their programming tools 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 Robot for inspection & measurement by the ES. Participants will be notified at this point if any construction violations are found.
      (1) Teams may use their Setup Time and Track Time to correct any construction violations. A team's 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. Teams must follow the defined Program Restrictions during their Event Time.
   vi. At the Event Supervisor's discretion, participants may use an AC outlet power during their time slot but this may depend on the event location.
   vii. Unauthorized, generative AI tools (e.g., ChatGPT, DALL-E) are not allowed to be used to generate answers/code under any circumstances during the event.

d. **Setup Time**
   i. Teams are given a Setup Time to determine the Robot's path and make any programming changes. The Setup Time starts after the completion of the inspections and the ES verifies competitors have only opened their impounded program.
      (1) Setup Time is up to 10 minutes and takes place away from the track area.
      (2) **It is recommended that the ES provide a paper copy of the track setup to avoid too many competitors in the track area. Teams are not permitted to write on ES supplied paper.**
      (3) Teams may make physical modifications to the Robot. Batteries may be installed.
      (4) Participants may modify only their impounded program and transfer to the Robot.
      (5) Participants are not permitted to test their Robot's movements on any surface. The Robot may only be tested provided the Robot is held by the competitors away from any surface and held stationary.

e. **Track Time**
   i. Teams are given Track Time to run their Robot and make any required changes.
   ii. Teams may choose before starting their Track Time to compete without the 2x4 Obstacles for a penalty less than the Contact Penalty. All runs must be attempted with or without the 2x4 Obstacles. Teams cannot change their decision once their Track Time begins.
   iii. The Track Time ends after any of these are reached: 2 Successful Runs, **2 Failed Runs**, or time limit has been reached.
      (1) Track Time length is 8 minutes**.**
      (2) The ES will notify the participants when their Track Time starts.
      (3) If a run has started before the Track Time has elapsed, the Robot will be allowed to run to completion.
      (4) Track Time used will be recorded as a tiebreaker and will stop at the end of the team's last run.
   iv. Teams may use their own tools to measure any Track dimension or distance as part of their Track Time.
   v. **With the ES approval and before any run, Teams may adjust the 2x4 Obstacle and Water Bottle locations as part of their Track Time. This action can only fine tune the location and not re-locate the objects.**
   vi. Alignment or sighting devices are permitted and may be electric or electronic. **These devices must be used only within the Track Area and removed from the Track Area before the start of the run. Lasers are prohibited.**
   vii. Teams may clean the Track during their Track Time, but it must remain dry.
   viii. Teams cannot test their device on the floor of the Track on the day of the event. **Their next Successful Run will receive a competition violation.**
   ix. Teams may calibrate sensors during their Track Time provided the Robot does not move.
   x. **Individual Run Testing**
      (1) Participants must place the Robot's dowel above the Start Point.
      (2) The Robot may be placed in any orientation. If the Robot is starting from outside the Track, then the Robot's first movement must be to enter the Track area.

(3) The Robot must be able to remain at the starting position without being touched until triggered.
(4) Participants will notify the ES when ready to start the run. At which point the ES will pause the Track Time and review the Robot in the Ready-To-Run configuration for any violations.
  (a) **The ES will only notify the participants of any competition 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) **For each run, teams may choose to compete with or without <u>all</u> the Water Bottles on the track. There is no penalty for competing without the Water Bottles.**
(6) The Track Time will be restarted once ES is ready and the participants are notified to start the run.
(7) Participants must activate a Trigger on the Robot to start the run. Competitors must use an unsharpened #2 pencil supplied by the ES to actuate the Trigger. Only the pencil may contact the Robot while actuating the Trigger.
  (a) If the Robot fails to actuate or move when triggered, then a run has not occurred. The Robot 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 Track Time.
(8) **Once the run starts and until the Robot is retrieved, competitors may not use, view, or access their programming tool(s).**
(9) ES will record the following items during the run:
  (a) Gate Zones as entered. Only the first entrance will be recorded. See Entering Gate Zone.
  (b) **Water Bottles moved to Gate Zones. See Moving Water Bottle Restrictions.**
  (c) Any contact with a 2x4 obstacle.
  (d) If a Stalling Action has occurred.
(10) Track Time is paused at the end of run.
(11) ES will review the run to determine if the run was Successful or a Failed Run (See Definitions).
(12) Run Time and Vehicle Distance will be measured and recorded for Successful runs.
(13) Any violations will be recorded. See Run Penalties under Scoring. The ES must notify the participants of any violations at the end of each run.
(14) Track Time will resume once the participants pick up their device or begin working. Unless their Track Time has ended.

xi. The Event Supervisor will review with teams their data recorded.
xii. Teams filing an appeal must leave their Robot and other impounded material in the event area.

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

a. Low score wins. Each team's Final Score is their lowest Run Score plus any Final Score Penalties.
b. The Run Score for each run
  i. Successful Run = **200 +** Time Score + Distance Score + Bonuses + Run Penalties
  ii. Failed Run = **1000 points** + Run Penalties
c. The Time Score is determined by:
  i. Run Time less than Target Time: Time Score = **(Target Time - Run Time) x 2**
  ii. Run Time greater or equal to Target Time: Time Score = **(Run Time - Target Time)**
d. Distance Score = 2.0 pt/cm x Robot Distance.
e. Gate Bonus = -15 points for each Gate Zone entered in any order. Gates are only counted once per run.
f. **Water Bottle Bonus = -15 points for each Water Bottle moved into a Gate Zone.**
  i. **The Water Bottle must be completely within the Gate Zone border and upright.**
  ii. **If multiple Water Bottles are within the same Gate Zone, only one Water Bottle will be counted.**
  iii. **The bonus is awarded at the end of the run and not when a Bottle is moved into a Gate Zone.**
g. **Track Time Bonus (National Only) = (Track Time Used - 550) / 30 points**
  i. **Tournament Directors may choose to add this bonus with advance notice.**
h. Run Penalties:
  i. Contact Penalty: 70 points added to each Run Score **where Robot or Bottle makes** 1 or more contacts with the 2x4 Obstacles.
  ii. No 2x4 Obstacle Penalty: 50 points added to all Run Scores when a team chooses to run with the 2x4 Obstacles.

iii. Stalling Penalty: 20 points added to each Run Score with a Stalling Action.
iv. Competition Violation: 150 points added to the Run Score that has 1 or more Competition Violations.
v. Construction Violation: 300 points added to the Run Score that has 1 or more Construction Violations.
vi. Failed Runs can also be assessed Competition and/or Construction violations.

i. Bonuses and penalties are awarded independent of each other. For example, a run score can have both the Gate Zone Bonus and the 2x4 Obstacle Penalty.
j. Final Score Penalties:
   i. Robot's movements tested during Setup Time: 200 points added to the team's Final Score.
   ii. Robot or Program Not Impounded: 1500 points added to the team's Final Score.
k. Ties must be broken by this sequence:
   i. Lower Time Score on scored run
   ii. Lower Robot Distance on scored run
   iii. Higher number of Gate Zones entered on scored run
   iv. Lower Track Time used

6. **SCORING EXAMPLES:**

a. At a competition, the track has 4 Gates (A, B, C & D). Target Time is 73 seconds. A team's Robot stopped 21.7 cm from the Target Point with a Run Time of 62.53 sec. Gate Zones were entered in the following order "C", "D", and "A". Two (2) Water Bottles were moved into Gate Zones. The team had a recorded Track Time of 7 minutes and 35 seconds.

Base Score	**= 200**	**=**	**200.00**
Time Score	**= (73 - 62.53) x 2**	**=**	**20.94**
Distance Score	= 21.7cm x 2.0 pts/cm	=	43.40
Gate Bonus	= 3 Gates x -15 pts/Gate	=	-45.00
Water Bottle Bonus	**= 2 Bottles x -15 pts/Bottle**	**=**	**-30.00**
Run Score		**=**	**189.34**

7. **THE TRACK:**

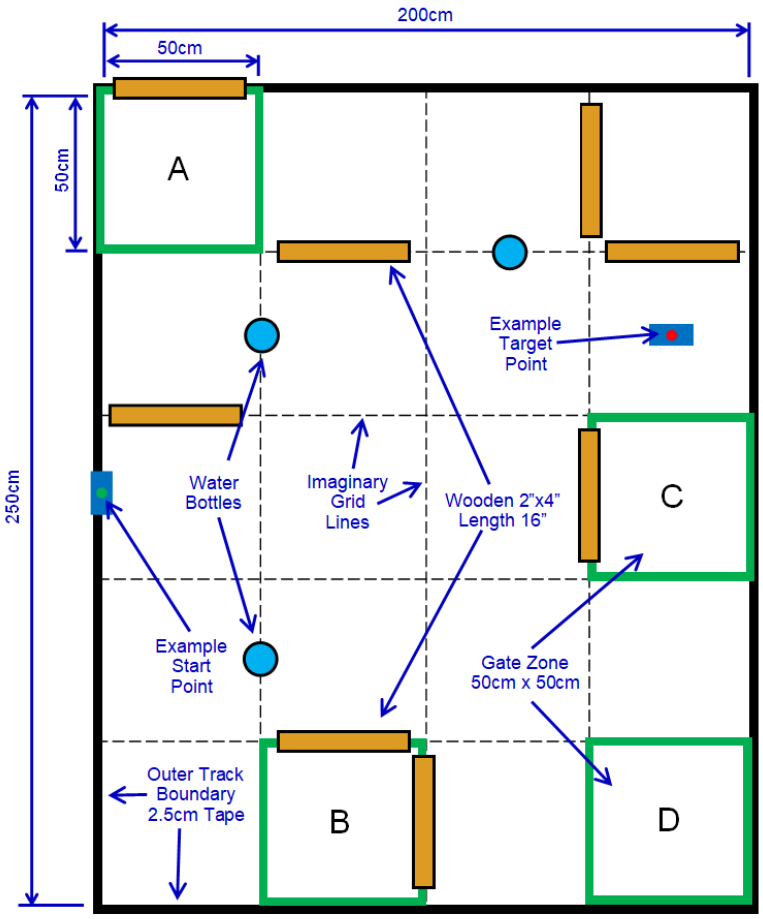
a. **In-Person tournaments**: The ES will supply and set up the Track.
b. **Virtual tournaments**: Team will supply the Track that fully complies with the requirements of this section. Any deviation will be scored as a competition violation for all runs.
c. **Track Definition**:
   i. The track area will be a 2 meter by 2.5 meter square area on a smooth, level, and hard surface.
   ii. The Outer Boundary Lines of the Track will be defined using the inside edge 2.5 cm wide tape.
   iii. The outside tape lines will be marked every 0.5 m or 50 cm for the imaginary lines within the track area. There are three (3) imaginary lines in the vertical direction and four (4) imaginary lines in the horizontal directions for a total of seven (7) lines. All imaginary lines are perpendicular to the outside tape lines. The imaginary lines will form twenty (20) square zones (approximately 50 cm x 50 cm) within the track area. It is recommended to use ¼" wide tape to mark all imaginary lines, but not required.
   iv. The Start Point will be marked on the inside edge of the outer boundary tape line. The Start Point will be centered between any imaginary line and/or a perpendicular outer boundary tape line.
   v. The Target Point will be in the center of one of the twenty (20) zones defined by the imaginary lines and outer tape lines. The Target Point will be marked on approximately 2.5 cm x 2.5 cm tape with the Target Point marked at the center of the tape.
   vi. Up to ten (10) wooden 2x4 Obstacles are placed on the tracklines. The 2x4 can be placed on any imaginary line or outside tape lines. The 2x4s are placed **approximately** centered between adjacent perpendicular track lines (outside or imaginary). The dimensions of the 2x4 obstacles are approximately 1.5 inches by 3.5 inches by 16 inches long.
   vii. Bonus Gate Zones will be marked by 2.5 cm tape lines unless the imaginary lines are marked by tape. Each Gate Zone is approximately 50 cm by 50 cm square. The tape will be placed on the inside edge of the imaginary lines and/or the outer tape line to form the Gate Zone. The ES will select the locations of the Gate Zones. Each Gate Zone will be marked with a letter (Ex: "A", "B", "C", "D", …).

viii. **Water Bottles are placed on any imaginary line and approximately centered between perpendicular imaginary lines or outside boundary tape. The ES will select the locations of the Water Bottles.**

ix. The Track Setup must contain a clear path that is free of 2x4 Obstacles to enter all Gate Zones, **for the movement of Water Bottles to a Gate Zone,** and reach the Target Point. **A clear path would allow a Robot to achieve all the event goals and bonuses while the Robot remains completely inside the track boundary.**

x. The color of the tape used to mark the track is the choice of the Event Supervisor.

xi. At the Event Supervisor's discretion, more than one track may be used. If so, the team may choose which track they use. All runs must be on the same track.



Note: Recommend using 1/4" wide tape for Imaginary Lines

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. *Batteries* are commercial batteries, including rechargeables, labeled as AA or AAA batteries. Individual batteries must have a voltage between 1.2 and 1.5 volts when fully charged. The battery label must be the manufacturer's original label and easily viewable by the ES. The batteries must be individual batteries and removable from a battery pack. Batteries containing lithium or lead are prohibited.

c. *Dowels* are defined as a wooden rod with a base dimension of approximately ¼" to ⅜". Round or square dowels are acceptable. Similar components such as pencils are allowed provided the required dimensions are met.

d. *Electronic components* can be, but not limited to, solid-state devices such as transistors, integrated circuits, diodes, and microprocessors.

e. *Tools* may be electric and electronic tools. To qualify as a Tool, the item must not travel on the Track with the Robot **and cannot be used to align or aim the Robot**.

f. *Spare Parts* are items that could travel as part of the Robot during a run. These must be impounded.

g. **Source Code File(s)** is a file(s) containing programming statements in a computer programming language that are modified by a text editor or Integrated Development Environment (IDE) tool.
h. *Programming Tool* may be, but not limited to, a laptop, tablet, or Chromebook.
i. *Program Restrictions* are defined as:
   i. **Teams may access the Internet to program their Robot. Any actions not required for programming will cause a team to be awarded a competition violation. Internet access may not be available at all competitions.**
   ii. Competitors must demonstrate to the ES that they are only modifying the impounded source code file(s) to define the Robot's motions.
   iii. The Robot's program can use libraries stored on the programming tool provided these libraries are not viewed or modified by the competitors during the event.
   iv. Testing the Robot's program on hardware other than the Robot is not permitted. Graphical software representations of the Track or the Robot's motions are not permitted. Using software algorithms to modify the impounded program is not permitted.
   v. **An algorithm to find the optimal route is not allowed. Competitors must do the work to determine the route the Robot will take.**
   vi. The Robot must remain autonomous and not be remotely controlled. The Robot cannot receive external instructions or information once a run starts.
j. *Trigger* may be, but not limited to, a pushbutton, power switch, micro switch, or a sensor.
k. *Entering Gate Zone* is when the Robot's dowel has fully entered a Gate Zone. The Robot may enter the Gate Zone forward, backwards, or sideways. Gate Zones can be entered in any order. Each Gate Zone will only be counted once.
l. *Water Bottle* **is a 16.9 oz water bottle with a diameter between 6 and 7 cm and a height between 18 and 22 cm. The bottle's weight will be between 80 to 100 grams. Metal (non-lead) BBs or similar will be used to increase the bottle's weight. Liquids cannot be used.**
m. ***Moving Water Bottle Restrictions*** **are defined as**:
   i. **The Bottle must remain in contact with the event floor at all times. No part of the Robot may extend under the Bottle.**
   ii. **The Bottle may only be pushed or pulled around the track.**
   iii. **The Robot cannot have a movable component with the intent to help relocate the Bottle. For example a gripper to grab or hold the Bottle is illegal.**
n. *Stalling Action* is a delaying movement or series of movements near the Target Point with the intent to improve only the Time Score. Possible delaying actions can include but are not limited to: repeating a single or multiple movements, moving in small circles, or other motions designed to improve the Time Score only.
   i. Near the Target Point is defined as occurring within the 50 cm by 50 cm Target Point square or any square surrounding the square with the Target Point.
   ii. Pauses between motions will not be penalized. Unless the motions between the pauses are repetitive as for example moving in a straight line with more than one pause during the straight line motion.
   iii. **Varying the speed of the Robot during a Run is allowed and is not a Stalling Action.**
   iv. An Event Supervisor may request the last run to be repeated to verify the presence of delaying movements. This repeat run will not count toward the team's Track Time or used for scoring.
o. *Robot Distance* is a point-to-point measurement from the Robot's Measurement Point to the Target Point, measured to the nearest 0.1 cm.
p. *Run Time* begins when the Robot begins to move and ends when the Robot comes to a complete stop.
   i. If the Robot does not move within 3 seconds after coming to a stop, the run is considered to have ended; the 3 seconds are not included in the Run Time. Any action occurring after that time does not count as part of the run.
   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.
q. *Successful Run:* Any run when the Robot moves before the end of the Event Time and has not met one of the Failed Run conditions.

r. *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. Competitors may ask to have the run recorded as a Failed Run. The Robot must be in motion to be declared as a Failed Run. If competitors declare a Failed Run during the 3 seconds of non-motion, the Robot must make another motion after the pause to be declared as a Failed Run. **Competitors may not collect information about where the Robot stopped.**
   ii. Does not finish within twice the Target Time.
   iii. The Robot exits the track area as determined by all Robot floor contact points being completely outside of the Track's outer perimeter lines.
   iv. A competitor picks up the Robot after the Robot stops moving and before the ES gives permission to pick up the Robot. In addition, the team's next successful run will receive a competition violation.
   v. If the time and/or distance cannot be measured for a Robot (e.g., it starts before the ES is ready, the participants pick it up before it is measured).
   vi. At the end of the Track Time, a team having less than 2 successful runs will have any remaining runs assessed as a Failed Run.

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.

ROCKS AND MINERALS C

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)
         (1) Solid solution series (e.g., feldspar ternary diagrams)
         (2) Phase diagram interpretation: temperature/pressure, temperature/ composition (limited to two component systems)
      vi. Polymorphs (e.g., **aragonite/calcite**; diamond/graphite, orthoclase/microcline; **sillimanite/ andalusite/kyanite)**
      vii. Classification - mineral families based on composition (see Rocks and Minerals List)
         (1) Mineral groups (e.g., feldspar, garnet, tourmaline) - similarities of chemical composition and shared properties
         (2) Silicate tetrahedra and their structures: isolated tetrahedra (nesosilicates), island (sorosilicates), chain (inosilicates), ring (cyclosilicates), sheet (phyllosilicates), and framework (tectosilicates)

(3) **State and National Only** – Crystal Systems – cubic, tetragonal, orthorhombic, monoclinic, triclinic, trigonal, and hexagonal; emphasis on how crystalline structures result in certain physical properties (e.g., cleavage planes, crystal shape)

viii. Methods of formation and environments (e.g., hydrothermal, chemical weathering, crystallization from magma, evaporites, chemical precipitation, alteration under heat & pressure)

ix. Minerals associated with rock-forming environments (e.g., evaporite minerals in sedimentary settings; mafic minerals in oceanic crust; minerals that form under metamorphic conditions)

x. Bowen's Reaction Series – relationship between mineral crystallization and temperature in magma

xi. 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** 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**

(7) Relationship of temperature, pressure, depth to types of metamorphism and metamorphic facies (hornfels, zeolite, greenschist, amphibolite, granulite, **blueschist, and** eclogite) based on interpretation of graphs and charts
(8) Environments of metamorphism in the context of plate tectonics - regional metamorphism and mountain building at convergent continental-continental boundary; blueschist and eclogite formation in subduction zones; greenstone/greenschist formation from basalt or gabbro at ocean crust divergent boundaries

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)
viii. **States and National Only** - Thin Sections of Rocks; using photographs taken through a microscope (photomicrographs)
(1) Identify minerals using their optical properties and features in polarized light (twinning, extinction, cleavage planes, birefringence); limited to microcline, plagioclase, calcite, augite, and garnet.
(2) Distinguish rock types and characteristics of igneous, sedimentary, metamorphic rocks by their microscopic textures limited to:
(a) Igneous - fine grained crystalline (holocrystalline), vesicular, glassy, porphyritic (e.g., basalt vs. pumice)
(b) Sedimentary – rounded, angular, well sorted vs. poorly sorted, skeletal fragments (e.g., oolites, sandstone vs. arkose)

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.

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

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

WATER QUALITY C

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.
   b. **Understand and apply the concept of indigenous knowledge or traditional ecological knowledge (TEK) to given scenarios.**
   c. **State and Nationals only:** life history strategies (e.g.; age structure, survival curves, life tables, succession, R and K strategies).

   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 and to understand their importance as indicators of water and wetland quality.
   b. In addition, teams are expected to know the general ecology, life cycles, and feeding habits of all listed organisms:

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.

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 C

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.

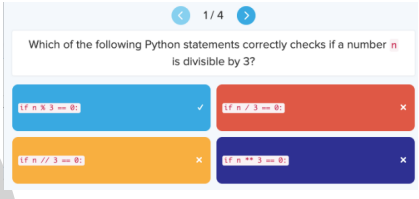
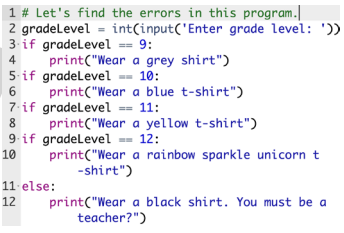
CODE CRAZE C

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 C

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

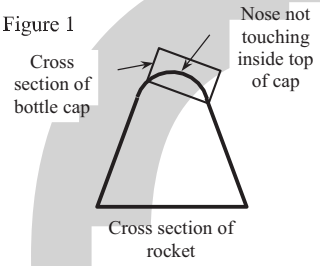


Figure 2

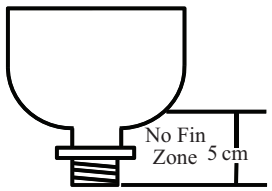
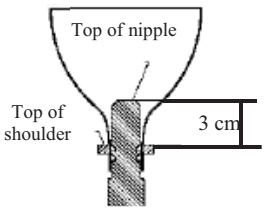


Figure 3.



   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.

PROTEIN MODELING C

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

1. **DESCRIPTION:** Participants will use computer visualization and online resources to construct a physical model of a de novo designed ideal protein structure. This year's event will focus on DI-II_10 as described in *doi: 10.1038/nature1*, paper freely available at https://pmc.ncbi.nlm.nih.gov/articles/PMC3705962/

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

   IMPOUND: Yes

2. **EVENT PARAMETERS:**
   a. Each participant must bring a writing utensil.
   b. Each participant 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.
   c. Each team will impound a pre-built model of DI-II_10
   d. Each team will bring one device (laptop, Chromebook, tablet, or phone) that can connect to WIFI with a browser that can run the JUDE Jmol program. Charging cord and wired/wireless mouse may also be used.
   e. Event Supervisors will provide written exams, WIFI information, and the website address for the molecular exploration portion of the event.

3. **THE COMPETITION:**

   Part I: The Pre-Built Model
   a. Participants will use the program JUDE (Jmol User Design Environment) to visualize residues 1 – 100 of DI-II_10 based on data found in the 2LV8 file. The atomic coordinate data file can be accessed for free from the RCSB Protein Data Bank (www.rcsb.org). A constructed model of this protein must be brought to all competitions; as the competition level increases, the scoring rubrics for the pre-built model will reflect higher expectations for model accuracy, detail, and enhancements. (See SCORING for more details.) JUDE can be accessed at learn.3dmoleculardesigns.com/digital-modeling-hub/jude_online_jmol for free.
   b. The pre-built model must be based on the protein's alpha carbon backbone display, using a scale of 2 cm per amino acid. Students may manually fold their pre-built model using Modeling Ties or comparable bendable material (Mini-Toobers, Kwik Twists, 12-gauge dimensional house wire, etc.). The backbone should primarily be gray with a diameter of 0.75 – 1.25 cm.
   c. Three-dimensional (3D) printed materials may NOT be used to build the protein backbone but may be used for functionally relevant features.
   d. Participants will use materials of their choosing to add functionally relevant features to their model (e.g., selected amino acid sidechains, DNA, or associated molecules). These additions should highlight the significance of structure to the protein's function.
   e. When an amino acid sidechain is displayed, its chemical property should be annotated on the alpha-carbon of the backbone. For example, hydrophobic sidechains are yellow, hydrophilic white, acidic red, basic blue, and cysteine green.
   f. Participants must explain their functionally relevant features using clear and concise descriptions on a printed 4.25" x 5.5" paper, in the form of a table with 3 columns, headed:
      i. What is displayed?
      ii. How is it displayed?
      iii. Why is it displayed?
   g. All models, including all functionally relevant features, must fit within a 50.0 cm x 50.0 cm x 50.0 cm space.
   h. The model must be sufficiently sturdy so that judges can remove it from any scaffolding or support, pick it up, and rotate it so that they can view it unobstructed from any angle and properly evaluate it.
   i. Teams must deliver their pre-built model and Model Description Legend for impounding. They may pick up pre-built models after the competition.

   Part II: Written Exam
   a. Teams will complete a written exam to assess their protein structure and function knowledge and their ability to explore protein structures in the molecular visualization environment, JUDE. The exam will consist of multiple-choice and short-answer questions.

b. Protein Structure topics addressed include:
   i. The principles of chemistry drive protein folding and stability.
   ii. The chemical properties of amino acid side chains and how their interactions stabilize protein structures.
   iii. The basic design principles used to create the DI-II_10 protein.
   iv. At State and National Tournaments, students will be asked questions about the current state of the field of de novo protein design.
c. Molecular Visualization topics addressed include:
   i. Ability to identify different secondary structural elements of a protein and specific amino acids found in these structures.
   ii. Chemical environment around specific amino acid sidechains that stabilize structure
d. Participants may not visit websites outside of the JUDE environment.

4. **SCORING:**
   a. High Score wins. The final score will be derived from all three parts of the competition:
   b. The pre-built model (Part I) accounts for approximately 40% of the final score.
      i. The pre-built score is based on the accuracy and scale of the secondary structures, the tertiary arrangement of these structures, and the relevant functional features added.
      ii. Features that are irrelevant or do not explain the protein's structure/function relationship will not receive credit.
      iii. The pre-built model's scoring rubric will change with each competition's level.
         (1) For Regional competitions, scoring will be based primarily on the accuracy of the 3D folded structure of the protein's alpha-carbon backbone (secondary and tertiary structures).
         (2) For State competitions, approximately 20% of the score awarded to the pre-built model will be based on functionally relevant features, such as the inclusion of key sidechains that have been added to the alpha-carbon backbone model to explain the protein's structure.
         (3) For the National competition, approximately 30% of the score awarded to the pre-built model will be based on the inclusion of key sidechains that explain the interactions between specific amino acids that stabilize the protein's structure.
   c. The written exam (Part II) accounts for approximately 60 % of the score.
   d. Ties will be broken using identified questions from the written exam (Part II).

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 3D Molecular Designs.

DIV. C CHEMISTRY LAB EQUIPMENT LIST

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

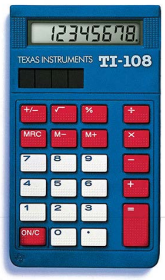
Each team may bring any or all of the items listed below for use in Division C Chemistry Events. Teams not bringing these items will be at a disadvantage as Event Supervisors will not provide the listed lab equipment. A penalty of up to 10% may be given if a team brings prohibited lab equipment to the 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 (10 - 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
Spot Plates	For semi-micro scale reactions, testing solubility, pH
Petri Dishes	Doing reactions, developing chromatograms
Slides	To put hairs, crystals, or fibers on for use with a microscope
Cover Slips	To cover & 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
Metal Tongs, Forceps, or Tweezers	Holding & retrieving objects
Stirring Rods	Stirring mixtures
Thermometer	Determining the temperature of a solution
pH paper/meter	Test acidity or alkalinity of solution
Hand Lens	Magnification of small items for identification
Flame Loop	For identification of ions in a compound
Filter Paper	Filter solids from liquids
Funnel	Hold Filter Paper
9V battery	Electrolysis
Alligator Clip Wires	Connecting meters to metals
Nail	Electrolysis
Piece of Cu metal	Electrolysis
Piece of Zn metal	Electrolysis
Multimeter	Measuring current, voltage, and resistivity
9V or less Battery Conductivity Tester	Determining ionic strength of solution
Calipers - mechanical, not digital	Measuring lengths very precisely
Paper Towels	Cleaning
Pencil	Writing, Marking Chromatogram
Ruler	Measuring lengths
Magnets	For extraction and identification of iron filings
Cobalt Blue Glass	To filter out any sodium that might contaminate flame test from hands

CALCULATOR CLASS DESCRIPTIONS

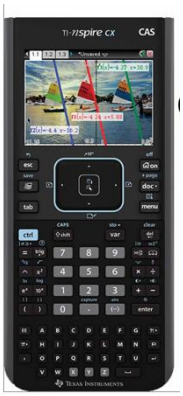
See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

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.



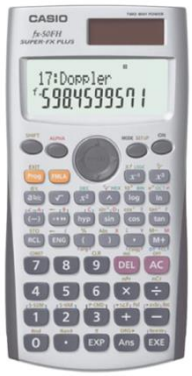
Class I - Stand-alone non-graphing, non-programmable, non-scientific 4-function or 5-function calculators are the most basic type of calculators and often look like the one shown to the right. These calculators are limited to the four basic mathematics functions and sometimes square roots. These calculators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

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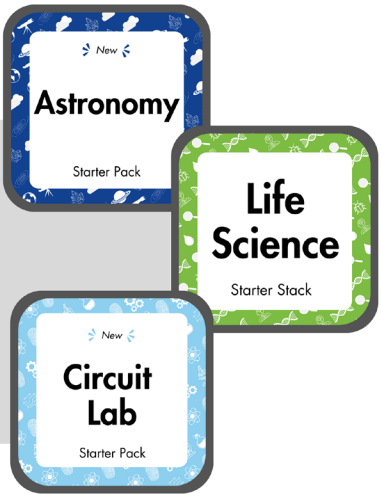
STORE OFFERINGS FOR 2026

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.

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Official Science Olympiad kits!

Kits will be available for multiple 2026 Events

- Boomilever
- Chemistry Lab Kit
- Circuit Lab
- Division C Chemistry Equipment Kit
- Electric Vehicle
- Forensics
- Helicopter
- Hovercraft
- Machines
- Photogate System
- Potions & Poisons
- Robot Tour
- Rocks & Minerals
- Water Quality: Application of Water Quality Principles
- Water Quality: Impacts of Environmental Factors

NATIONAL TOURNAMENT SCHEDULE

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

2026 National Tournament Division C 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 C		1-10	11-20	21-30	31-40	41-50	51-60	
Astronomy C		21-30	31-40	41-50	51-60	1-10	11-20	
Boomilever C		Self-Schedule						
Bungee Drop C	Impound	Self-Schedule						
Chemistry Lab C		31-40	41-50	51-60	1-10	11-20	21-30	
Circuit Lab C		41-50	51-60	1-10	11-20	21-30	31-40	
Codebusters C		11-20	21-30	31-40	41-50	51-60	1-10	
Designer Genes C		51-60	1-10	11-20	21-30	31-40	41-50	
Disease Detectives C		11-20	21-30	31-40	41-50	51-60	1-10	
Dynamic Planet C		41-50	51-60	1-10	11-20	21-30	31-40	
Electric Vehicle C	Impound							
Engineering CAD C		1-10	11-20	21-30	31-40	41-50	51-60	Closing Ceremony
Entomology C		21-30	31-40	41-50	51-60	1-10	11-20	
Experimental Design C		21-30	31-40	41-50	51-60	1-10	11-20	
Forensics C		1-10	11-20	21-30	31-40	41-50	51-60	
Helicopter C		Self-Schedule						
Hovercraft C	Impound	Self-Schedule						
Machines C		31-40	41-50	51-60	1-10	11-20	21-30	
Materials Science C		51-60	1-10	11-20	21-30	31-40	41-50	
Remote Sensing C		11-20	21-30	31-40	41-50	51-60	1-10	
Robot Tour C	Impound	Self-Schedule						
Rocks and Minerals C		51-60	1-10	11-20	21-30	31-40	41-50	
Water Quality C		41-50	51-60	1-10	11-20	21-30	31-40	

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.

See the Science Olympiad website: www.soinc.org for current information regarding Policies, Standards, Summer Workshops, Official Kits from Ward's Science and print plus digital items in the Science Olympiad Store

Science Olympiad

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