SCIENCE OLYMPIAD™

Exploring the World of Science

Division B Rules Manual

Division B (Gr. 6-9)

WELCOME TO THE 2027 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

SCIENCE OLYMPIAD
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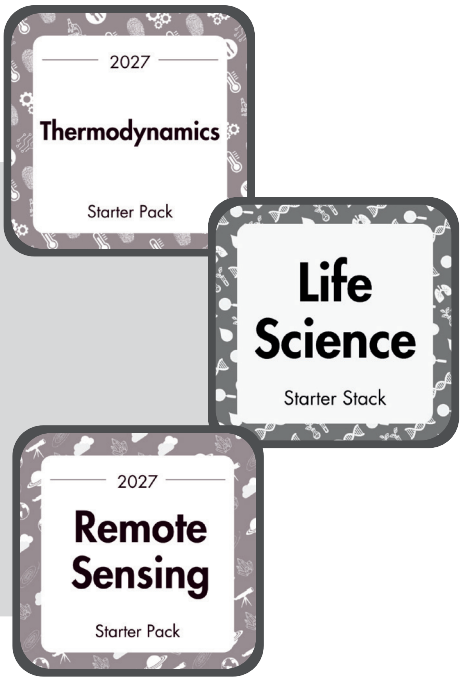
STORE OFFERINGS FOR 2027

STORE.SOINC.ORG



Starter Packs & Stacks

Use these resources to kick off your 2027 season! Starter Packs include notes and practice tests for individual events. Build your own Stacks for any of your specific events to save money.

National Test Packets

Check out the tests from the 2027 National Tournament! You can access packets that include tests, answer keys, and results from the past five National Tournaments.

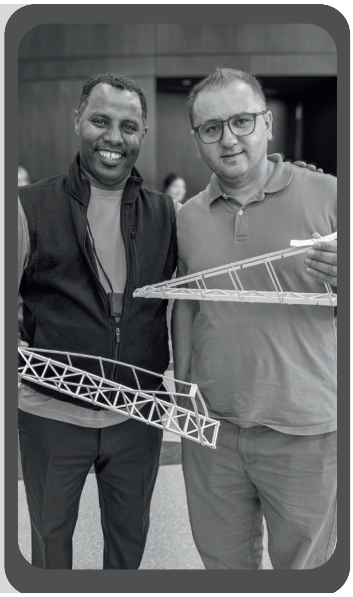
Mark Your Calendar

- **7/13/27 – 7/15/27 – Virtual Bootcamp:** Get early access to the 2028 Rules, learn directly from Science Olympiad experts, and choose live sessions based on your interests. Registration includes instructional videos, live sessions, and a hard copy draft of the 2028 Draft Rules.

Try one of the Clinics below – or do both!

- **7/19/27 – 7/20/27 – Content Clinic:** Take a deeper dive into the 2028 Core Knowledge and Lab events. Coaches will work with content experts and Event Supervisors to explore event content, resources, activities, and strategies they can bring back to their teams.
- **7/21/27 – 7/23/27 – Summer Build Clinic:** Get hands-on experience with the 2028 Build events! Coaches will work alongside expert Event Supervisors to build, test, and learn strategies for the upcoming season while collaborating with fellow coaches.

All Summer Workshop opportunities are designed for coaches and educators, not students.



SCIENCE OLYMPIAD
DIVISION B RULES MANUAL

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

GENERAL RULES, CODE OF ETHICS, AND SPIRIT OF THE PROBLEM

The goal of competition is to give one's best effort while displaying honesty, integrity, and good sportsmanship. Everyone is expected to display courtesy and respect as outlined in the Science Olympiad Pledges. Teams are expected to make an honest effort to follow the rules and the spirit of the problem (not interpret the rules so they have an unfair advantage). Failure by a participant, coach, or guest to abide by these codes, accepted safety procedures, or rules below, may result in an assessment of penalty points or, in rare cases, disqualification by the Tournament Director from the event, the tournament, or future tournaments.

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

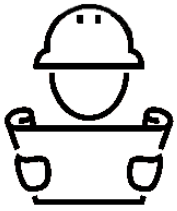
EVENT TYPE DESCRIPTIONS

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

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

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

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



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

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

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

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

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

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

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

ANATOMY & PHYSIOLOGY B

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

1. **DESCRIPTION:** Participants will be assessed on their understanding of the anatomy and physiology for the **respiratory, digestive and immune 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.
   a. RESPIRATORY SYSTEM:
      i. Anatomy and functions of the respiratory system
      ii. Mechanisms and measures of pulmonary ventilation
      iii. Patterns of breathing
      iv. Ability to read a spirogram as related to pulmonary ventilation
      v. Gas exchange and O_2 transport including oxygen dissociation curves
      vi. Effects of exercise and high altitude on the respiratory system
      vii. Understand diseases/disorders: COPD, asthma, emphysema, pneumonia, sleep apnea and cystic fibrosis

   State & National Level Only
      viii. ***Additional diseases/disorders: tuberculosis, pulmonary edema, pleurisy, small cell and non-small cell lung cancer, pulmonary fibrosis, pneumoconiosis (silicosis, coal worker lung, asbestosis)***
      ix. ***Blood chemistry and respiratory rhythm, regulation and control of the respiratory system***
      x. ***Treatments and/or preventions (drugs, surgery, etc.) for ALL diseases/disorders listed above***
   b. DIGESTIVE SYSTEM:
      i. Anatomy and functions of the digestive system
      ii. Basic anatomy of the component parts of the alimentary canal and accessory organs of digestion
      iii. Anatomy of the four layers of the wall of the alimentary canal
      iv. Comparison of the lining of the esophagus, stomach, small intestine and large intestine
      v. Compare and contrast mechanical and chemical digestion
      vi. Physiology of chemical digestion of proteins, fats and carbohydrates
      vii. Effects of exercise and obesity on the digestive system
      viii. The diseases on each level from the cell to the whole person as listed: stomach & duodenal ulcers, cancers of the digestive system, diarrhea, lactose intolerance, hepatitis, appendicitis

   State & National Level Only
      ix. ***Additional diseases: diverticular disease, GERD, peptic ulcer disease, ulcerative colitis, Crohn's Disease and celiac disease***
      x. ***The function of the liver and pancreas in the digestive system, including Kupffer cell function***
      xi. ***Treatments and/or prevention (drugs, surgery, etc.) for ALL diseases listed above***

c. IMMUNE SYSTEM:
   i. Anatomy and functions of the immune system (bone marrow, thymus, spleen, lymph nodes, skin)
   ii. Anatomy and physiology of innate immune system (eg. anatomical barriers, complement system, Toll-like receptors, inflammation, and innate immune cells)
   iii. Anatomy and physiology of adaptive immune system
   iv. Physiology of the immune response and allergic reactions
   v. Disorders: acquired and genetic immunodeficiencies (HIV/AIDS, common variable immunodeficiency, severe combined immunodeficiency), autoimmune diseases (multiple sclerosis, rheumatoid arthritis, Hashimoto thyroiditis, Graves' Disease), and type 1-4 hypersensitivities anaphylaxis, urticaria, myasthenia gravis, Arthus reaction, serum sickness, contact dermatitis)

State & National Level Only
   vi. ***Types of Organ Transplants and Prevention of Rejection (allograft and autograft)***
   vii. ***Cancer Immunotherapies (Antibody therapies, CAR-T cell therapy)***
   viii. ***Additional disorders: systemic lupus erythematosus, dermatomyositis, scleroderma, psoriasis and psoriatic arthritis***
   ix. ***Treatments and/or prevention (drugs, surgery, etc.) for ALL disorders listed above***

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

B

BOOMILEVER B

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

1. **DESCRIPTION:** Teams will build a cantilevered beam or truss structure that extends from a vertical Testing Wall and supports a load at a specified height and 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 **IMPOUND:** No

2. **EVENT PARAMETERS:**
   a. Each team may enter only one structure in the 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 construction & operation.
   d. At in person tournaments, Test Apparatus will be supplied by the Event Supervisor. Participants may not measure or adjust Test Apparatus or bring any apparatus, 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.

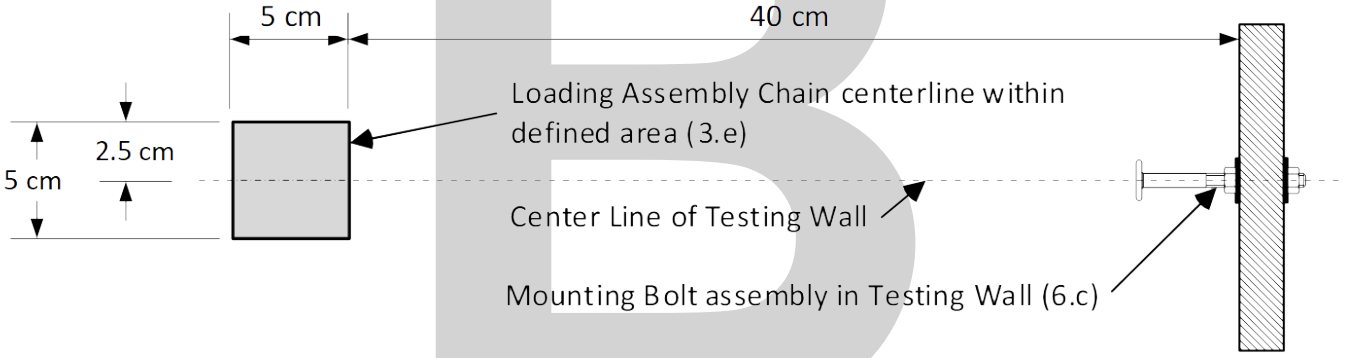


Figure 1: Top view of Testing Wall (not to scale)

   f. During the Competition testing, the Boomilever may ONLY touch the Testing Wall surface INSIDE the Vertical Contact Width Lines (6.b.iv.). Contact with the sides, top or bottom of the Testing Wall is not allowed.
   g. **Prior to loading sand, the bottom of the Loading Block must be supported ABOVE the horizontal plane extending from the centerline of the Mounting Bolt. During loading, the bottom of the loading block may go below the horizontal plane extending from the centerline of the Mounting Bolt.**
   h. **Base Option:**
      i. **During the Competition testing, the Boomilever may ONLY touch the Testing Wall ABOVE the 20 cm Horizontal Contact Depth Lines (6.b.iii.). Structures touching below the 20 cm Horizontal Contact Depth Lines shall be placed in Tier 2.**
   i. **Load Scored BONUS option scored if both of the following requirements are met in place of 3.h.:**
      i. **During the Competition testing, the Boomilever may ONLY touch the Testing Wall ABOVE the 15 cm Horizontal Contact Depth Line (6.b.iii.). Structures touching below the 15 cm Horizontal Contact Depth Lines shall be scored based on 3.h.**
      ii. **The structure must hold 15 kg. to earn the Load Scored Bonus. If the structure does not hold the 15 kg, the Boomilever will be scored using the Load Supported without the Load Scored Bonus. No construction violation will be recorded for not holding the 15 kg. Structures in Tier 2 can receive the bonus if tiered for rules other than 3.h.i.**

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 to the structure may be made once check-in begins.
      iii. Event Supervisor will verify:
         (1) Participants have proper Eye Protection
         (2) Structure meets Construction parameters
         (3) Teams have submitted their Estimated Load Supported to be used as a tie breaker
      iv. Participants will place the structure on the Structure Scale so the Event Supervisor 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 the following before loading of sand begins:
         (1) Conformity to the requirements 3.c., 3.d., 3.e., 3.f., **3.g., 3.h.**
         (2) Conformity to requirements 3.i.i. to determine if structure meets construction requirements for Load Scored Bonus.
         (3) The bucket is suspended to have clearance above the floor for testing. **(e.g. 2 inches)**
      iii. Structure may not be adjusted once loading of sand has begun.
      iv. Participants will load sand and may stabilize the Bucket from movement. Bucket may only be stabilized from movement by the tips of Bucket Stabilizing Sticks (6.e.). The Bucket may not be lifted or pushed.
      v. Loading stops immediately when the Structure fails, the load is supported by anything other than the Structure, the Structure receives any vertical support other than the Mounting Bolt, 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 team will be scored as participation only.
      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 score sheet. 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.iv.).
   b. Load Scored Bonus: meeting the Load Scored BONUS construction parameters (3.i.) 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 categories.
      i. Tier 1: meeting all construction and competition requirements.
      ii. Tier 2: NOT meeting any one or more of the construction and/or competition requirements.
      iii. Unable to be loaded, not supporting the minimum load (4.c.vii.), no eye protection, structure does not fit on test stand or for safety concerns. Scored for participation only.
   e. Tiebreakers
      i. Lowest Structure mass.
      ii. Estimated Load Supported that is the closest to actual load supported.

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. Satellite Tournaments: the team coach or designee will supply the Test Apparatus.
   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.

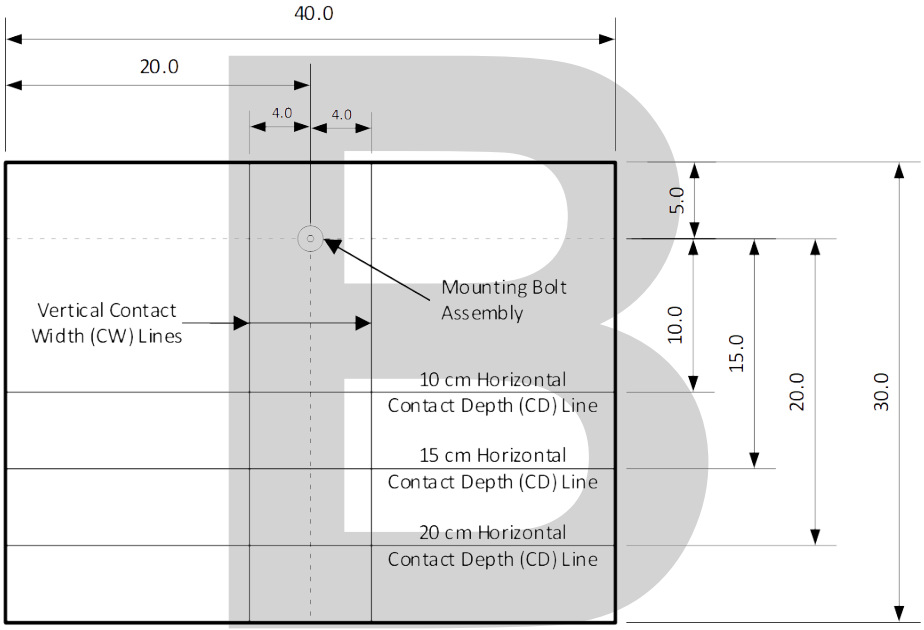


Figure 2 – Testing Wall (not to scale, dimensions in cm)

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)

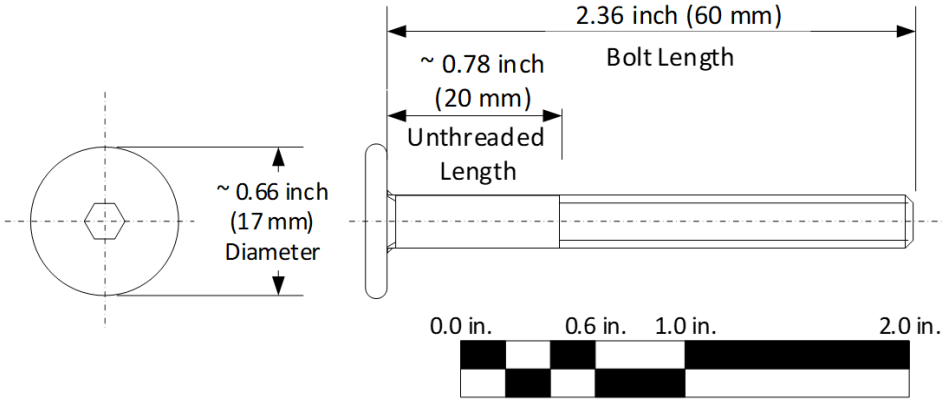


Figure 3 - Connector Bolt, ¼ -20 x 2.36 inches (60 mm) long

(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.

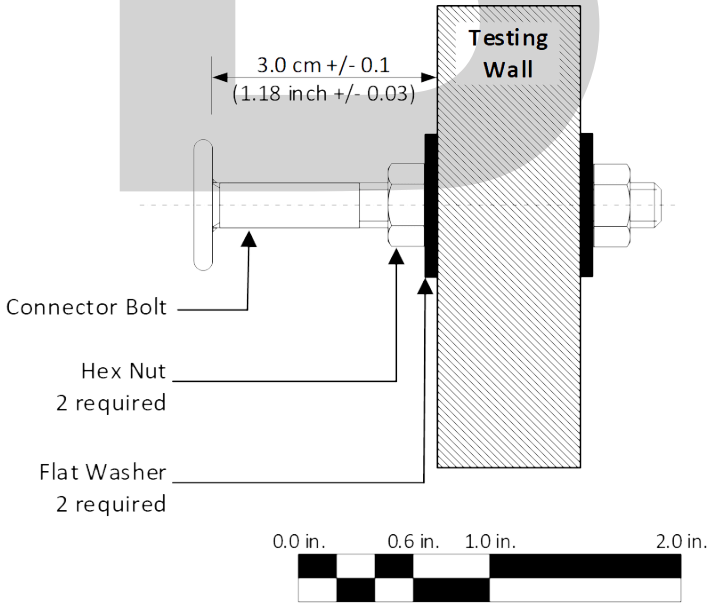


Figure 4 – Mounting Bolt Assembly in Testing Wall

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.

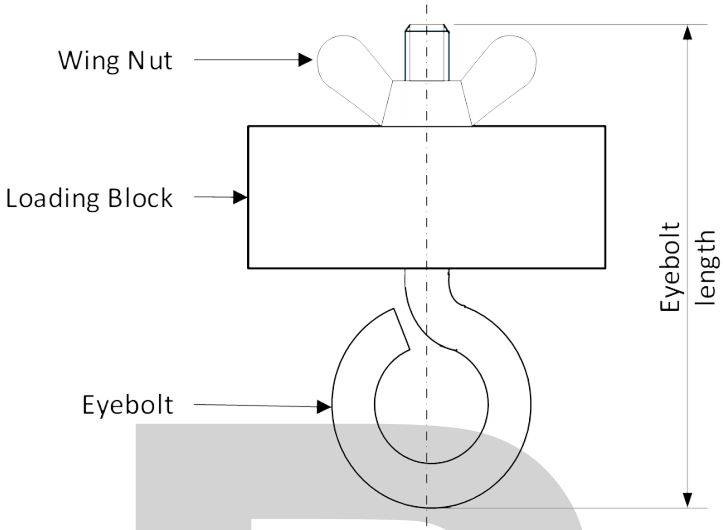


Figure 5 – Loading Block with eyebolt and wing nut (not to scale)

   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.

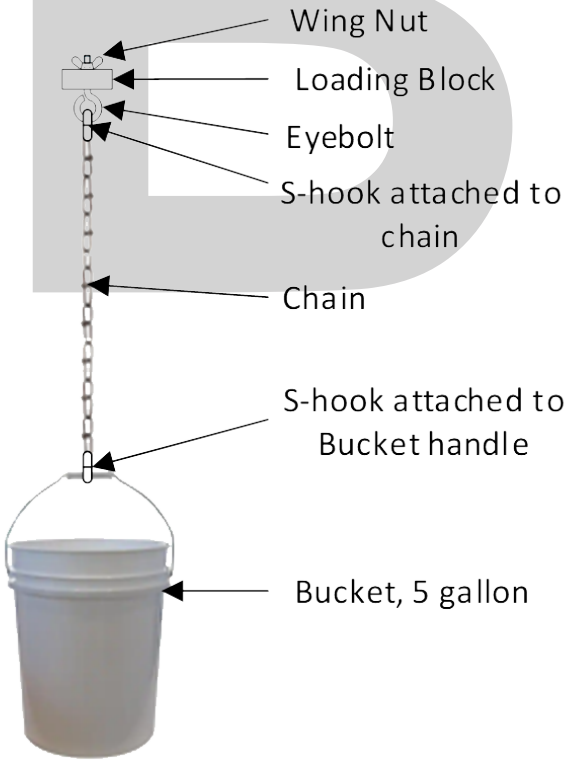


Figure 6 – Loading Assembly (not to scale)

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.

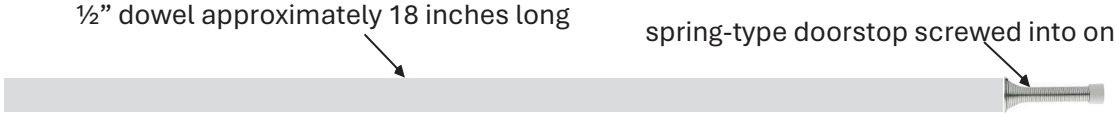


Figure 7 – Stabilizing Stick (not to scale)

f. Structure scale: A digital scale is recommended. 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: A digital scale is recommended. 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.
h. A digital countdown timer is recommended. Must be capable of being set to 6 minutes. Minimum resolution: 1 second

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 bonded together using adhesives 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 or steel shot.

This event is supported by the Cleveland-Cliffs Foundation

BOTANY B

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

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

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

3. **THE COMPETITION:**
   a. This event may be run as a paper pencil test or as a station test.
   b. Participants will be expected to understand 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

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

CIRCUIT LAB B

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

1. **DESCRIPTION:** Participants will complete **hands-on** tasks and answer questions about electricity and **electronics**.

   A TEAM OF UP TO: 2

   APPROXIMATE TIME: 50 minutes

   CALCULATOR: Class III

2. **EVENT PARAMETERS:**
   a. Each team may bring writing utensils.
   b. Each team may bring two Class III calculators for use during any part of the event.
   c. 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, **books**, 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.
   d. Event Supervisors must provide all supplies and measurement devices required for the hands-on tasks.
   e. 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 **electronics**.
   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. Historical perspective of the electricity discoveries made by Ampere, Coulomb, Kirchhoff, Volta, Ohm, **Hertz, and Boole**
      ii. Properties of electric charges/fields, sources/hazards of static electricity, and Coulomb's Law
      iii. Characteristics, sources, uses, and hazards of direct current (DC) and alternating current (AC)
      iv. Concepts, **calculations,** and units of current, voltage, resistance, power, and energy
      v. Calculations, constructions, and configurations of **DC circuits** and individual components, **including series and parallel circuits, open and short circuits, Ohm's Law,** and circuit schematics
      vi. Electrical control devices including switches, relays, fuses, ground fault circuit interrupters, and breakers
      vii. Fundamental electrical characteristics of silicon PN junctions and **uses of single-junction devices** (e.g., diodes, LEDs)
      viii. **Digital logic gates, truth tables, universal gate sets, boolean expressions, De Morgan's Law, and combinational logic circuits (e.g., multiplexers, adders)**
      ix. **States/Nationals only:** Circuit analysis using Kirchhoff's Voltage & Current Laws
   d. Topics not included in the competition are: semiconductors (beyond those listed above), AC circuit theory, frequency analysis, **capacitance**, inductance, non-linear devices **(beyond those listed above)**, 3 phase power, **Norton/Thevenin equivalents,** oscilloscopes, **sequential logic and digital clock signals.**
   e. **Questions will be limited to the following mathematical content:**
      i. **Functions, algebraic manipulations, and systems of no more than two equations**
      ii. **2D geometry required for interpreting vector directionality, including points, parallel and perpendicular lines, and angles in degrees**
      iii. **Representation of whole numbers in binary and the addition of binary numbers, not including negative numbers, floating point representations, or any arithmetic operations other than addition**
      iv. **Logical operations as boolean expressions, including De Morgan's Law and truth tables**
      v. **No questions may require the use of trigonometry, complex numbers, matrix algebra, or calculus**

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. 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.
   v. **Construct a logic circuit to mimic a given truth table.**
   vi. **Troubleshoot a faulty circuit.**
   vii. **Wire a 3-way switch using SPDT switches.**
   viii. **Create a specified equivalent resistance from given individual resistors.**
d. **Participants must not be exposed to hazardous conditions including soldering, high power circuits, and AC circuits.**

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. The hands-on portion of the competition will account for the remaining 25-50% of each team's score.
d. Preselected questions will be used as tiebreakers.

This event is supported by the Kinder Morgan Foundation

CODEBUSTERS B

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

1. **DESCRIPTION:** Participants 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

2. **EVENT PARAMETERS:**
   a. Teams must bring only writing utensils.
   b. No resource materials or other tools, except those provided by the Event Supervisor, may be used.
   c. 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.
   d. The exam packet will include a copy for each team member of a resource sheet with the Morse Code Table, English/Spanish letter frequencies, Porta Table, Atbash Table, and Baconian mappings as needed for the questions on the exam. The resource sheets may be printed double-sided.

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

j. For Cryptanalysis problems providing a "crib" (3.e.ii., 3.e.iv., 3.e.xii., 3.f.iii., 3.f.iv., 3.f.v.) with the exception of the Complete Columnar Cipher (3.e.vii.), the placement of the "crib" on the ciphertext will be clearly identified.

4. **SCORING:**

a. The high score wins.
b. Final Score = Exam Score + Timing Bonus + Special Bonus.
c. The scores for each question will be added together to determine the Exam Score.
d. 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.
e. For answers to Cryptarithm (3.e.v.) problems, the final points will be determined based on the number of errors found in the decoded word or phrase:
   i. Zero errors are required for full credit.
   ii. Each error results in a penalty of 100 points but the penalty will not exceed the value of the question. For example, a 500-point question with eight (8) errors would earn 0 points, not -300 points.
f. A Timing Bonus can be earned based on the number of seconds it takes a team to correctly decode the first question. The timing bonus is equal to 2 x (600 - number of seconds). For example, 6 minutes = 2x (600-360) = 480 points.
g. 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.
h. 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

i. 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.

CRIME BUSTERS B

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

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

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

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

2. **EVENT PARAMETERS:**
   a. Each participant may bring writing utensils.
   b. Each Participant may bring a Class II calculator.
   c. 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.
   d. Each team may bring any or all of the items listed on the Division B Chemistry Events Lab Equipment List, posted on soinc.org. Teams not bringing these items may be at a disadvantage. The Supervisor will not provide them. Items not listed are prohibited. The Event Supervisors will check each team's equipment, confiscate non-allowed items, and have the right to penalize the team up to 10% if additional equipment is brought to the event.
   e. 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, up to and including potential disqualification.
   f. The Supervisor will provide:
      i. Iodine reagent (**I_2 dissolved KI solution or 2% tincture of iodine)**
      ii. 1M HCl
      iii. Chromatography materials plus containers
      iv. Waste container(s)
      v. Wash bottle with distilled water (no more than 250 mL)
   g. The Supervisor may provide:
      i. Other equipment (e.g., microscope, probes, calculator, etc.)
      ii. Candle & matches if fibers given
      iii. Differential density solutions or other method of determining density of polymers if plastics given
      iv. Reagents to perform additional tests

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

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

   b. The collected evidence and other data given may be used in a mock crime scene.
   c. Qualitative Analysis: Participants will identify evidence (unknowns) by performing tests such as solubility, acidity, magnetic property, color, density, and odor. Every team will have the same set of unknowns (evidence). The scenario will identify which containers hold mixtures and if the mixtures are made of two or three materials. The unknown common materials will be taken from the following lists.
      i. Solids: Anhydrous sodium acetate, yeast, vitamin C (ascorbic acid), *calcium carbonate (powdered limestone), *table salt (NaCl), *sugar (crystal), *flour, *calcium sulfate dihydrate (gypsum), *cornstarch, *baking soda, *powdered gelatin, *powdered Alka-Seltzer®, *sand (white).

ii. Non-Powdered Metals: aluminum, iron, zinc, magnesium, copper, tin.
iii. Liquids: lemon juice, rubbing alcohol (isopropyl), household ammonia (3%), water, vinegar, hydrogen peroxide (3%).

d. Polymer Testing/Natural and Man-made Substances: Participants will demonstrate their skill in analyzing evidence from a variety of sources such as:
   i. Hair - the difference between human, dog, and cat; not specific kinds of hair like guard.
   ii. Fibers - the difference between animal, vegetable, and synthetic; not specific kinds of fibers like silk.
   iii. Recyclable Plastics - PETE, HDPE, non-expanded PS, LDPE, PP, PVC, PMMA. Burn tests will not be conducted but burn results may be provided.
e. Paper Chromatography: Participants will analyze evidence from paper chromatography (ink pens, juices, Kool-Aid®, etc.). The paper chromatogram(s) will be collected with the score sheet. Rfs will be performed.
f. Crime Scene Physical Evidence: Participants will also demonstrate their skill in analyzing evidence from a variety of other sources such as:
   i. Fingerprints: Participants may be asked to identify different patterns on fingerprint evidence such as the difference between whorls, loops, and arches.
   ii. DNA evidence: Participants may be asked to compare DNA chromatograms/electropherograms from materials found at the scene to those of the suspects.
   iii. Shoeprints & tire treads: Participants may be asked to compare prints and make conclusions such as direction and speed of travel. No calculations are expected to be performed.
   iv. Soil: Participants may be given the composition of soil found at the scene or on the suspects and asked to determine if this implicates any of the suspects.
   v. Spatters: Analyze spatter patterns for speed and direction of impact. No calculations are expected to be performed.
g. Analysis: Participants will be asked to write an analysis of the crime scene explaining not only which pieces of evidence implicate which suspect and why the suspect(s) was (were) chosen as the culprit(s), but also why the other suspects were not chosen. They will also answer any other crime scene analysis questions posed by the Event Supervisor.
h. Teams will dispose of waste as directed by the Event Supervisor.

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

DISEASE DETECTIVES B

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

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

   A TEAM OF UP TO: 2

   APPROXIMATE TIME: 50 minutes

   CALCULATOR: Class II

2. **EVENT PARAMETERS:**
   a. Each team may bring writing utensils.
   b. Each team may bring two Class II calculators.
   c. Each team may bring one (1) 8.5" x 11" sheet of paper that may contain information on both sides in any form and from any source. The sheet of paper may be laminated or placed in a sheet protector to increase durability. Affixed labels, as well as multiple sheets of paper (whether in a single sheet protector or not) are prohibited.
3. **THE COMPETITION:**
   a. This event addresses three topics related to disease, injury, health, and disability in populations or groups of people. Each part should count approximately equally towards a team's final score. Questions should be process-oriented and involve skills in evaluation and interpretation. Matching pathogens with specific diseases (i.e. – What causes X disease?) or knowledge of signs, symptoms or epidemiologic characteristics such as incubation or latency periods or infectious dose is not part of this event. However, it is appropriate to provide this information as background information and expect competitors to be able to use it.
   b. The topics for this event are as follows:
      i. Background & Surveillance
         (1) Understand the Clinical Approach (health of individuals) vs Public Health Approach (health of populations).
         (2) Understand the history and development of epidemiology.
         (3) Understand the roles of epidemiology in public health and the steps in solving health problems.
         (4) Understand the Natural History and Spectrum of Disease. Understand in broad terms the impact of infectious (bacterial, viral, fungal, protist 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) **State and Nationals Only: Recognize factors such as study design/biases, errors, and**

confounding that influence results.

(10) **<u>State and Nationals Only:</u> Understand the concept of herd immunity. Know the experimental and observational methods used to calculate vaccine effectiveness and efficacy and be able to use them.**

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

4. **<u>SCORING</u>:**
   a. High Score wins.
   b. Preselected questions will be used as tiebreakers.
   c. 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.
   d. 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.
   e. Points will be awarded for both quality and accuracy of answers, the quality of supporting reasoning, and the use of proper scientific methods.

In partnership with the Centers for Disease Control (CDC)

DYNAMIC PLANET B

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

1. **DESCRIPTION:** Teams will complete tasks related to the properties and processes of Earth's fresh waters.
   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 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, specimens, or displays, no material may be removed from the binder throughout the event.

3. **THE COMPETITION:** Participants will be assessed through an exam and/or timed stations on the following topics:
   a. Hydrologic cycle, water budgets, and the critical zone
      i. Components and associated fluxes of the hydrologic cycle (e.g., precipitation, evaporation, transpiration, evapotranspiration, infiltration, runoff, condensation)
      ii. Storage reservoirs, residence times, and water budgets
   b. Climatic controls on freshwater distribution
      i. Precipitation and atmospheric inputs to freshwater systems (e.g., rainfall, snowfall, seasonality, intensity, spatial patterns)
      ii. Topographic and geographic controls on precipitation and climate (e.g., orographic lift and the rain shadow effect, continentality, lake effect, elevation)
      iii. The arid–semiarid–humid spectrum and its hydrologic and geomorphic expression (e.g., perennial vs. ephemeral streams, playas, evaporite deposits)
   c. Drainage basins and stream networks
      i. Watersheds, drainage divides, and drainage basin characteristics
      ii. Stream order and networks
      iii. Drainage patterns, density, and texture
   d. Fluvial sediment processes and channel form
      i. Channel types and planform (e.g., braided, meandering, straight, anastomosing) and calculation of sinuosity
      ii. Sediment properties (e.g., grain size, shape, sorting, rounding)
      iii. Sediment transport and deposition (e.g., bed load, suspended load, dissolved load) and the controls on sediment supply, competence, and capacity
      iv. Fluvial bedforms (e.g., ripples, dunes, antidunes, bars)
   e. Fluvial geomorphology — landforms and valley processes
      i. Longitudinal profile, gradient, and base level
      ii. Dynamic equilibrium and graded streams
      iii. Erosional features (e.g., knickpoints, waterfalls, v-shaped valleys)
      iv. Erosional processes (e.g. stream capture, downcutting, abrasion, meandering, hydraulic action)
      v. Channel and floodplain landforms (e.g., point bars, cut banks, oxbow lakes, floodplains, natural levees, deltas, alluvial fans)
   f. Streamflow and floods
      i. Flow regimes (e.g., perennial, intermittent, ephemeral)
      ii. Discharge, velocity, and load (water and sediment)
      iii. Mathematical relationships describing open-channel flow
      iv. Floods, flood frequency, and recurrence intervals
   g. Groundwater and karst
      i. Subsurface zones (e.g., zone of aeration, zone of saturation, water table)
      ii. Aquifers and their properties (e.g., confined, unconfined, and artesian aquifers; porosity, permeability)
      iii. Hydraulic gradient and groundwater flow
      iv. Recharge, discharge, and capillarity
      v. Interactions between surface water and groundwater, including saltwater intrusion
      vi. Karst processes, hydrology, landforms, and features (e.g., sinkholes, solution valleys, caves, disappearing streams, springs)

h. Lakes and wetlands
   i. Lake formation and types (e.g., tectonic/rifting, volcanic, glacial, fluvial damming)
   ii. Lake water budgets — inflow and outflow
   iii. Physical and chemical properties and stratification (e.g., seasonal turnover)
   iv. Shoreline processes (e.g., waves, shoreline features)
   v. Wetland types, formation, and hydrology (e.g., bogs, marshes, swamps, fens)

i. Geologic and paleohydrologic record
   i. Sedimentary structures as indicators of water and flow conditions (e.g., ripple marks, raindrop imprints, mud cracks, cross-bedding, graded bedding)
   ii. Paleochannels and preserved fluvial and lacustrine deposits

j. Human impacts and water quality
   i. Effects of land-use change on freshwater systems (e.g., altered runoff, sedimentation, ecological change)
   ii. Engineering structures, water extraction, and their effects (e.g., dams, levees, channelization, diversion, downcutting; wells and groundwater pumping, with effects such as aquifer depletion and land subsidence)
   iii. Water pollution (e.g., types, sources, transport)

k. Measuring and monitoring freshwater
   i. Interpreting freshwater features on topographic maps
   ii. Mapping the water table from well data (e.g., contour maps, flow lines, flow direction)
   iii. Stream gauging, discharge measurement, and hydrographs (e.g., stage–discharge relationships, baseflow vs. stormflow, peak discharge, lag time)
   iv. Monitoring networks and techniques (e.g., groundwater observation wells, tracer studies, remote sensing)

4. **SCORING:**
   a. High Score wins.
   b. Points will be awarded for the quality and accuracy of answers, the quality of supporting reasoning, and the use of proper scientific methods in responses.
   c. Preselected questions will be used as tiebreakers.

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

ELASTIC LAUNCHED GLIDER B

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

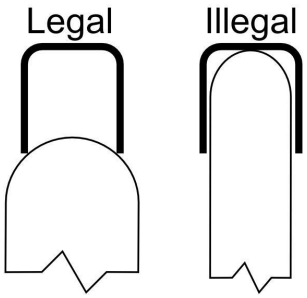
1. **DESCRIPTION:** Prior to the tournament, teams will construct, collect data on test flights, analyze and optimize free flight **Elastic Launched Gliders** to achieve maximum time aloft.

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

   EYE PROTECTION: B

2. **EVENT PARAMETERS:**
   a. Teams may bring up to 2 **Gliders, Launch Handle(s),** Flight Log(s), transportation box(es), 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.
   d. **Participants must wear Category B eye protection. Participants without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows.**

3. **CONSTRUCTION PARAMETERS:**



   a. **Gliders** 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 blunt nose of the fuselage, when inserted into a lip balm cap with inside dimensions of ~1.57 cm deep and ~1.37 cm wide must not touch the end.
   c. Any materials except Boron filaments may be used in construction of the **Glider** and boxes.
   d. The **Glider**, 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 32.0 cm x 24.0 cm x 47.0 cm, including any external protuberances on the lidless box.
   e. Total mass of the **Glider, throughout the flight,** must be more than **3.5 g and less than 10.0 g.**
   f. **Launch Handle(s), excluding elastic, must be less than 1 m long in any orientation, be supported completely by one student, and be of a safe configuration. The elastic used in the Launch Handle must be non-metallic and must be in contact with the Glider throughout the launch. Elastic must remain on the launch handle. If elastic leaves the Launch Handle, timing will end for that flight.**
   g. 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.
      ii. Tournament officials must announce the room dimensions (approximate length, width and ceiling height) in advance of the competition.
      iii. Tournament officials and the Event Supervisor are urged to minimize the effects of environmental 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 6-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 **Gliders** 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 **Gliders**. Modifications may be made prior to check-in.

d. **Check-In**
   i. At check-in, participants will present their **Gliders** in Measurement Box(es), **Launch Handle**, 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 **Glider** fits fully inside the Measurement Box while in its flight configuration. Teams may not manipulate the configuration of the Glider in order to fit into the box. The **Glider**'s overall dimensions must not change after being removed from the box. This may be verified by showing that the **Glider** slides into and out of the box without changing shape at the discretion of the Event Supervisor.
   iii. The participants will remove the **Glider** from the box to allow for the mass to be measured. The mass may be adjusted with ballast provided by the team to account for scale differences.
   iv. The **Launch Handle** will be collected and returned to the team at the start of their 10-minute Flight Period.
   v. Only participants should handle the **Gliders** or Measurement Box(es).

e. **Flight Period**
   i. The 6-minute Flight Period begins when the Event Supervisor returns the **Launch Handle** to the team.
   ii. Any flight beginning within the 6-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 **Glider.**
   vi. Teams may make up to a total of 5 official flights using 1 or 2 **Gliders.**
   vii. Time aloft for each flight starts when the **Glider** leaves the participant's hand and stops when any part of the **Glider** touches the floor, the lifting surfaces no longer support the weight of the **Glider** (such as the **Glider** 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 **Glider** during flights.
   x. Students must be on the floor to launch from their hands. Artificial aids **(other than the launch handle)** cannot be used to increase launch height.
   xi. In the unlikely event of a collision with another **Glider**, a team may elect a re-flight. The decision to re-fly may be made after the **Glider** lands. Timers are allowed to delay a launch to avoid a possible collision. The 6-minute Flight Period does not apply to such a flight.

f. **After the flight period ends, if requested by the Event Supervisor, the participants must demonstrate that each Glider still fits fully inside the Measurement Box(es) in the flight configuration. Event Supervisor may recheck the Launch Handle and the mass of the Glider.**
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 **Glider(s), Launch Handle**, 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 **4** or more parameters (3 required and at least **1** additional) with data for 10 or more test flights prior to the competition.
      i. The required parameters are:
         (1) **Estimated/recorded peak flight height after launch**
         (2) **Approximate length of elastic (relaxed)**
         (3) Flight Time
      ii. The team must choose **1** additional data parameter beyond those required (e.g. launch pitch, launch roll, elastic stretch, etc.)
   b. All numeric data must include units which may be listed with the column headers of the log.
   c. All logs will be returned to teams after inspection.

6. **SCORING:**
   a. Highest Final Score wins.
   b. A team's Final Score is the sum of their three longest Accumulated Flight Scores after multipliers are applied.
   c. Flight Score for each official flight = Flight Time x Bonuses (6.d).
   d. 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)
   e. **Example Score: For a flight time of 15.00 seconds with a complete Flight Log, the Flight Score would be: 15.00 x 1.2 = 18.00 points.**
   f. 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.
   g. Ties will be broken by the longest non-scored official Flight Score.
7. **DEFINITIONS:**
   a. *Elastic Launched Glider:* A heavier-than-air aircraft that relies on lift generated by aerodynamic forces acting on its wing(s) to remain aloft. It does not use a motor for propulsion; instead, it utilizes the release of stored elastic energy to achieve its initial launch velocity.
   b. *Wing:* A surface that creates lift by the flow of air across the surface.
   c. *Launch Handle:* A handheld device composed of a rigid handle and an elastic loop used to launch the glider. The handle and elastic are not considered part of the glider.
   d. *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.
   e. *Flight Configuration* means the **Glider** is fully assembled and ready to fly. For example, no change in chord, span, length, or total lifting area can occur after removing the **Glider** from its box and throughout the flight itself.
   f. *Trim Flight:* A test or practice flight, occurring during the flight period, that is not used for official scoring.
   g. *Steering:* Participants using something to control the direction of motion once the device is released. (e.g. Balloons, poles, rods, air, etc.)
   h. *Ballast:* A substance used to provide stability, balance, or control. (e.g. clay, tape, etc.)

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

EXPERIMENTAL DESIGN B

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

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

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

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

2. **EVENT PARAMETERS:**
   a. Participants must bring goggles and writing utensils. Experiments will not require any other safety equipment.
   b. Teams may bring one timepiece, one linear measuring device, and one Class II calculator. Teams CANNOT use any of these as part of the experiment - they must only be used for their intended function.
   c. The Event Supervisor will provide each team with identical sets of materials either at a distribution center or in an individual container.
   d. The Event Supervisor must provide the 2-part student report form posted on the event page at soinc.org for teams to record their experimental information and data. This student report form 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 student report form. Participants will focus on designing and conducting their experiment.
   c. After the first 20 minutes, participants will receive Part II of the student report form and will focus on analyzing their experiment and reporting findings. Participants may continue experimenting throughout the entire event.
   d. 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 student report form.

4. **SCORING:**
   a. High Score wins. Scoring will be done using the Experimental Design Checklist found on the Science Olympiad website (soinc.org).
   b. Points will be awarded depending upon the completeness of the response. Zero points will be given for no responses as well as illegible or inappropriate responses.
   c. Ties will be broken by comparing the point totals in these areas of the checklist in the following order:
      i. Analysis of Claim/Evidence/Reasoning
      ii. Procedure and Set-Up Diagrams
      iii. Variables
      iv. Data Table
      v. Graph
   d. Any participant not following proper safety procedures will be asked to leave the room and will be disqualified from the event.
   e. Any team not following clean-up procedures will have their final score multiplied by 0.95.
   f. 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.
   g. 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.

EXPERIMENTAL DESIGN B CHECKLIST

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

2027 Experimental Design Division B Checklist

(Note: The maximum points available for each task are shown. Consider using the electronic checklist on www.soinc.org)

Shaded cells are included only at the State/National levels.

Part I. Design and Construction of the Experiment (51 pts)

A. Statement of the Problem (2 pts)

2 1 0	Statement addresses the experiment including variables (not a yes/no question)

B. Hypothesis (6 pts)

2 1 0	Statement predicts a relationship between the IV & DV
2 1 0	Statement gives specific direction to the prediction
2 1 0	A rationale is given for the hypothesis

C. Variables (15 pts)

a. Independent (IV) and Dependent (DV) Variables

3 2 1 0	IV correctly identified and operationally defined
3 2 1 0	Levels of IV given
3 2 1 0	DV correctly identified and operationally defined

b. Controlled Variables (CV)

2 1 0	1st CV correctly identified and relevant
2 1 0	2nd CV correctly identified and relevant
2 1 0	3rd CV correctly identified and relevant

D. Materials (4 pts)

2 1 0	All materials used are listed and quantified
2 1 0	No unused or extra materials are listed

E. Procedure and Set-Up Diagrams (13 pts)

2 1 0	Procedure is presented in list form
2 1 0	Procedure is in a logical sequence
2 1 0	Steps for repeated trials are included
2 1 0	Multiple diagrams of setup are provided
2 1 0	All diagrams are appropriately labeled
3 2 1 0	Procedure detailed enough to repeat experiment accurately

F. Qualitative Observations (6 pts)

2 1 0	Observations about set-up provided
2 1 0	Observations about the procedure provided
2 1 0	Observations about the results provided

G. Quantitative Data - Data Table (5 pts)

3 2 1 0	All raw data provided with units and labels
2 1 0	Condensed data table with only the data to be graphed is provided, one sample calculation per derived variable

Part II. Data, Analysis, and Conclusions (55/67 pts)

H. Graph (12 pts)

4 3 2 1 0	Appropriate graph is provided
4 3 2 1 0	Graph properly titled and labeled
4 3 2 1 0	Appropriate scale and units included

I. Statistics (9/11 pts)

3 2 1 0	Statistics of Central Tendency used
2 1 0	One example calculation is given for each statistic with units, done on level of IV
2 1 0	Statistics of variation are included
2 1 0	One example calculation is given for each statistic with units, done on level of IV
2 1 0	Two additional accurately calculated statistics included

J. Possible Experimental Errors (6 pts)

3 2 1 0	1st specific error is identified & effect on results discussed
3 2 1 0	2nd specific error is identified & effect on results discussed

K. Analysis of Claim/Evidence/Reason (CER) (12/18 pts)

2 1 0	Data trend claim completed logically
2 1 0	Data trend evidence completed logically
2 1 0	Data trend reasoning completed logically
2 1 0	Outliers claim completed logically
2 1 0	Outliers evidence completed logically
2 1 0	Outliers reasoning completed logically
2 1 0	Variation claim completed logically
2 1 0	Variation evidence completed logically
2 1 0	Variation reasoning completed logically

L. Conclusion (8 pts)

2 1 0	Hypothesis is restated
2 1 0	Hypothesis claim completed logically
2 1 0	Hypothesis evidence completed logically
2 1 0	Hypothesis reasoning completed logically

M. Applications and Recommendations for Further Use (8/12 pts)

4 3 2 1 0	Suggestions to improve experiment with rationale provided
4 3 2 1 0	Suggestions for practical applications of experiment provided
4 3 2 1 0	Suggestions for future experiments are provided

# of 4s	# of 3s	# of 2s	# of 1s	# of 4s	# of 3s	# of 2s	# of 1s

Team Name | Team Number

Tiebreakers in Order:
K: CER
E: Procedure
C: Variables
G: Data Table
H: Graph

Multipliers:
0.95 Non Clean Up
Up to 0.75 - Off Topic
0.25 - Non Lab/Fake/Falsified Data

Total Score | Multiplier | Final Score

FOOD SCIENCE B

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

1. **DESCRIPTION:** Teams will study the science behind milk products and experiment with ingredients and other variables to produce and analyze results to produce the best dairy products below.

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

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

2. **EVENT PARAMETERS:**
   a. Each participant may bring writing utensils.
   b. Each team may bring two Class III calculators
   c. 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 annotations or labels affixed.
   d. Each team may bring any or all of the items listed on the Division B Chemistry Events Lab Equipment List, posted on soinc.org, to use during this event.
   e. In addition to the Division B Chemistry events Lab Equipment List, teams will need to bring 1 pint size plastic bag, 1 gallon size plastic bag, a 500-600 mL container with a lid, and a piece of cheesecloth approximately 30 cm square. Teams not bringing these items may be at a disadvantage. The Supervisor will not provide them.
   f. Teams 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, up to and including potential disqualification.
   g. Supervisors will provide necessary milk products (any type of milk may be provided including powdered), salts, lemon juice, vinegar, ice (if necessary), thermometers, or other reagents or equipment to complete the experimental activities. The provided quantity of milk product will be between 125 and 150 ml depending on which Lab is being used. The amounts provided shall be the same for each team.

3. **THE COMPETITION:**
   a. Notebook: Prior to the tournament, teams must perform 3 or more experiments related to each of the three Lab Tasks below. These experiments must be recorded on the Food Science Experiment Form (see on www.soinc.org) and must be placed together in the Notebook. Teams are encouraged to do more than nine experiments, but only the first 3 for each task will be graded. Each experiment will constitute one entry in the Notebook and each must have only one Independent Variable. The Notebook will be impounded prior to the start of the tournament for grading and returned to the teams at the end of the competition.
   b. At the tournament, teams will use the provided food materials to perform the tasks below. The number of tasks depends on the level of tournament: Regionals/Invitationals 1 task; State 1-2 task(s); Nationals 2-3 tasks.
      i. Ice Cream Formation: Teams will be provided the same amount of an unknown liquid milk product to prepare ice cream based on the provided materials and form the ice cream on a surface to obtain a height measurement by the Event Supervisor. Teams may use any amount of the provided ingredients. The ice cream formation must self-stand for 5 seconds before the measurement is taken. Students may hand shape the ice cream.
         (1) Combine up to 125 mL of milk, cream or half and half with up to 15 mL of sugar and add up to 1.2 mL of vanilla if desired.
         (2) Fill a 1-gallon Ziploc bag half-full with ice and add up to 90 mL of salt. Seal the bag and shake to mix the ice and salt.
         (3) In a 1 pint sized Ziploc bag place the ice cream mixture and seal the bag.
         (4) Place the smaller sealed bag in the large bag and mix and shake vigorously so that the ice cream mixture is cooled and mixed well.
         (5) After about 5-10 minutes, the ice cream can be removed from the smaller plastic bag.
      ii. Determine Curd Mass: Teams will be provided the same amount of an unknown liquid milk product to determine the mass (percentage of curd formation), which will be compared to the Event Supervisor's mass (percentage of curd formation).
         (1) Measure 120 mL of milk in the beaker and weigh the milk.

(2) The temperature of the milk should be close to room temperature.
(3) Add drops of vinegar or lemon juice to the milk and gently swirl (or stir) for 30 seconds, then allow the milk to sit for approx. 5 minutes.
(4) Drain the mixture through cheesecloth fastened over the top of a beaker collecting the curds in the cheesecloth.
(5) Let drain for 15 minutes.
(6) Determine the mass of the curds.

iii. Determine Milk Fat Mass from Cream: Teams will be provided the same amount of cream and will be asked to prepare butter to determine the Milk Fat Mass, which will be compared to the Event Supervisor's Milk Fat Mass.
(1) Transfer 150 mL of the heavy cream into a plastic 500-600 mL container and weigh the cream.
(2) The temperature of the cream should be approximately 13°C.
(3) Cap the bottle carefully and shake until a distinct separation of butter particles occurs.
(4) Drain off liquid portion and discard it.
(5) Determine the mass of the butter.

c. Test topics: Teams will take a written exam that covers only dairy food science topics such as: the role of lipids, carbohydrates and proteins typically found in dairy foods; standard labeling regulations; basic organic reactions such as esterification, fat bonding; saturated and unsaturated fats; chemical structure of sugars, starches, fats, and proteins; essential fats, vitamins, proteins; how cooking changes dairy foods chemically; allergens in dairy foods; dairy food preservation; RDA (recommended daily allowance) of essential minerals and vitamins in dairy foods and the consequences of not having them; freezing point depression; non-dairy 'milk' products; lactose free milk; health benefits of dairy foods; low fat, fat free milk; lactose intolerance; emulsification; pasteurization; organic dairy products; casein and whey proteins; probiotics.

4. **SCORING:**

a. High Score wins.
b. Final Score = Notebook Score + Lab Task(s) Score + Test Score - Penalties.
c. Notebook Score = Complete experiments receive up to 2 points each. Incomplete experiments receive fewer points (maximum 18 points).
d. Lab Tasks Score = Total of score(s) of required Lab(s)
i. Ice cream score = 0.1 pts for each mm (rounded off) of height
ii. Curd Mass and the Milk Fat Mass Scores = Team mass/Supervisor mass x 10 (e.g., Team get 2.4g Supervisor gets 2.5g = 0.96x10 = 9.6) (maximum 10 points each).
e. Test Score = Percentage correct/2 (maximum 50 points)
f. Penalties: Up to 10% of total possible score may be subtracted for failure to clean up as instructed.
g. Tie Breaker: Preselected questions on Test
h. Scoring Example: Notebook Score was 18, Ice cream height was 125mm, Curd mass score was 9.6, Test Score was 90%, No Penalties. Final Score = 18 + 12.5 + 9.6 + 90/2 = 85.1

HEREDITY B

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

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

   A TEAM OF UP TO: 2

   APPROXIMATE TIME: 50 minutes

   CALCULATOR: Class II

2. **EVENT PARAMETERS:**
   a. Each team may bring writing utensils.
   b. Each team may bring two Class II calculators.
   c. Each team may bring one (1) 8.5" x 11" sheet of paper that may contain information on both sides in any form and from any source. The sheet of paper may be laminated or placed in a sheet protector to increase durability. Affixed labels, as well as multiple sheets of paper (whether in a single sheet protector or not) are prohibited.
3. **THE COMPETITION:**
   a. 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.
   b. 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.
         (2) Use provided information to construct Punnett Squares of mono- and dihybrid crosses.
         (3) Predict genotypes and phenotypes of offspring and compute their likelihood based on Punnett Squares and experimental data using probability rules.
         (4) Evaluate pedigrees to predict modes of inheritance (i.e. dominant vs recessive traits and autosomal vs sex-linked traits) and construct pedigrees based on data from a case study.
         (5) State and Nationals only: Describe inheritance patterns which violate these laws (i.e. linkage, incomplete and codominance, complementation).
         (6) State and Nationals Only: Understand recessive epistasis and its implications in predicting phenotypic outcomes.
      ii. Mitosis and Meiosis
         (1) Understand, compare, and contrast the major stages and key structures in mitosis and meiosis
         (2) Understand the steps involved in human karyotype analysis and be able to interpret a karyotype
      iii. Molecular Biology of DNA
         (1) Be able to identify and explain the components of DNA (i.e. structure of the nucleotides and backbone), directionality of DNA (5' and 3' ends), and base pairing rules.
         (2) Understand the basic stages of DNA replication, with focus on DNA elongation and the processes that happen at the replication fork, including proofreading
         (3) Identify and understand the organization of DNA structure, such as plasmids, chromatin complexes, euchromatin and heterochromatin, and chromosomes.
         (4) 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).
         (5) State and Nationals only: Understand how UVA and UVB radiation damage DNA and the mechanism of nucleotide excision repair
      iv. Gene & Protein Relationship
         (1) Be able to explain the Central Dogma of Molecular Biology.
         (2) Transcription: Understand and explain initiation, elongation, and termination stages of transcription, the mechanism of RNA polymerase, how transcription is regulated by activators and repressors, and RNA maturation (splicing, capping, and polyadenylation).
         (3) Translation: Understand and explain the initiation, elongation and termination stages of translation, the mechanism of the ribosome, and the role mRNA and tRNA play in translation.
         (4) State and Nationals only: Understand the function and mechanism of the lac operon.

(5) **Nationals only: Understand the function and mechanism of the trp operon**

v. 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) **State and Nationals only: Explain how additive alleles generate continuous variation and estimate the number of genes contributing to a trait.**

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) State and Nationals only: Sanger sequencing: Describe how the steps and components in Sanger sequencing differ from a standard PCR reaction; Identify experimental questions which could be addressed by Sanger sequencing.

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

HOVERCRAFT B

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

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

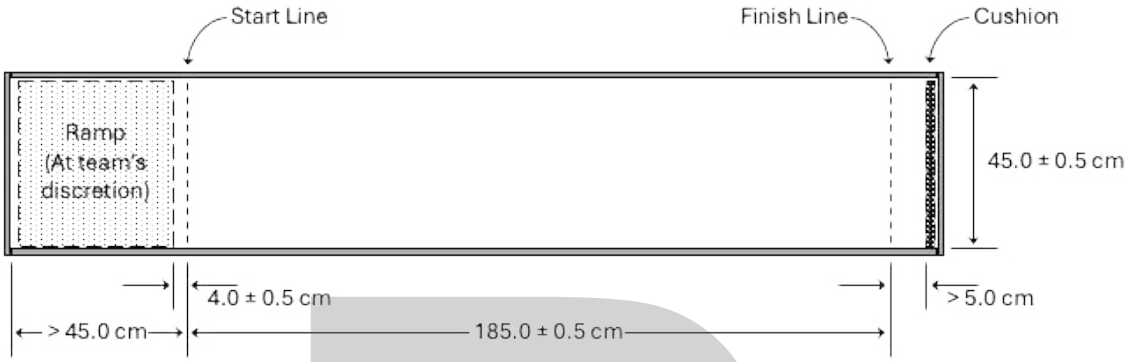
A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 10 minutes

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

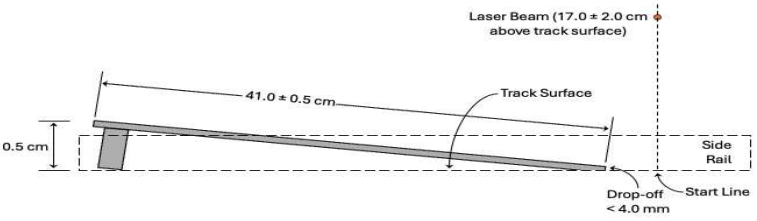
2. **EVENT PARAMETERS:**
   a. Each team must impound only one vehicle**, any spare parts,** and any papers/notes necessary for the competition time. The vehicle must be impounded with the batteries stored separately and presented to the Event Supervisor for inspection. No additional papers/notes may be brought into the competition area after impound.
   b. Teams may bring tools and two Class III calculators. These items need not be impounded. **Tools are items that do not travel with the hovercraft on its competition runs. Tools utilizing lasers are not permitted.**
   c. Participants must wear Category B 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 **ES-PROVIDED MASSES and** TRACK section**s**. Teams should not bring their own **masses,** track**,** or ramp.
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. Electrical components shall be limited to batteries, wires **(including battery holders/connectors)**, **mechanical** switches, **relays**, resistors (including potentiometers **and rheostats**), capacitors, and up to two motors (including brushless motors). Integrated circuits (other than those that are an **integrated, manufactured** part of a commercial motor) are not permitted.
      i. **Mechanical switches are switches with moving parts that connect or disconnect an electrical circuit. They may be operated manually by a person or by contact with another part of the hovercraft.**
      ii. **Components utilizing lasers are not permitted.**
   c. 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. **Contact of vehicle components with the track surface or inside edge of the track's side rails is permitted. Vehicle components cannot contact the top or outside edge of the side rails.**
   d. **All thrust and lift on the vehicle must be achieved with air pressure. Non-electric sources of energy are permitted to power other vehicle functions such as a timing system.**
   e. 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.
   f. **Safety Parameters (devices failing to meet these may not run, scored as Participation points):**
      i. All propellers/impellers, including those under the vehicle, must have shielding that prevents a 3/8" dowel from touching them.
      ii. Only commercial batteries, including rechargeables, 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. Lithium and lead batteries are prohibited. 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.
      iii. All motors must have an **accessible manually-operated mechanical** 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.
   g. 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.

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. 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.
   c. Vehicles violating any of rule 3f 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 3f, the vehicle will not run and will only receive **Participation points**.
   d. At the start of their **competition time**, each team will be given a Target Time (TT). The Target Time will be between **6**.0-**18**.0 seconds in intervals of **1.0** seconds for Regionals and 0.5 seconds for **States**/ Nationals. The TT will be the same for all teams.
   e. Teams have a **competition time** of 8 minutes to adjust and repair their vehicle and make their runs. **The team's competition time ends after two complete or two incomplete runs or the competition time limit has been reached (whichever comes first).** Practice runs are not allowed.
   f. **During their competition time, teams may dry-sweep the track, but may not wet it or apply any substance. Teams may take measurements of the track and the surface it is on, but may not request changes to the track's position or leveling.**
   g. **The vehicle may carry an ES-provided mass consisting of a combination of both loose nickels and rolls of nickels. Participants will select how much mass, if any, the vehicle carries and this amount may vary by run. Participants will not be allowed to unroll, break, or alter the packaging of the nickels nor will they be allowed to use any adhesive or tape to affix the rolls or nickels to the vehicle; any vehicle that requires such measures to carry the nickels and/or rolls will not be allowed to use masses during their competition runs.**
   h. 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. A run is complete if it is not incomplete.
   i. 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). A run **will be allowed to finish and** will be counted in the scoring as long as it is started before the 8-minute period has elapsed.
   j. If any part of the vehicle, **nickel rolls, or individual nickels** fall off during a run, the team incurs **one construction** penalty **(not one per item)** for the run. **Any nickels or rolls that fall off before the Event Supervisor tells the team to turn off the vehicle at the completion of the run do not count towards the Mass Score.**
   k. If they choose, teams may utilize an Event Supervisor-provided ramp (as described in 6.f) 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.f.v** and 7.d.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.
   l. To begin a run, the team will place their vehicle**, including the nickel load,** on the track fully behind the start line. **The team may start anywhere behind the start line. The Event Supervisor will provide and hold a wood block against the front of the vehicle to hold it in place.** The team then activates their vehicle's motor(s) **and removes their hands from the vehicle.**
   m. 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.
   n. **After removing their hands at the vehicle's start,** the team must not touch their vehicle **or interfere with its run in any manner** until the Event Supervisor states they may do so. If touched **or interfered with**, the run is counted as a complete run with a DS, TS, **and MS** of 0.
   o. 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.
   p. The Event Supervisor will review with the team the data recorded on their scoresheet.
   q. A team filing an appeal must **alert the Event Supervisor and** leave their vehicle in the **impound** area.

5. **THE ES-PROVIDED MASSES:**
   a. **The ES will provide 4 full rolls of U.S. nickels, 1 half roll of U.S. nickels, and 20 loose U.S. nickels.**
   b. **One full roll contains 40 nickels. Each roll should be unopened, wrapped in a bank paper roll wrapper, folded snugly against the nickels.**
   c. **One half roll contains 20 nickels. The one half-roll should be wrapped in a bank paper roll wrapper with the ends trimmed to minimize the excess paper, and folded snugly against the nickels.**
   d. **One full roll of U.S. nickels ≈ 200 g, each individual nickel ≈ 5 g. In combination, the ES-provided nickels can make a mass approximately between 5 g and 1 kg.**
6. **THE TRACK:**



   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. 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. **Event Supervisors may provide a track that has either a built-in base or utilize a table or the room's floor as a base. In either case, Event Supervisors should clean the base of the track (or the floor) at the start of the day and should provide as level a surface as possible. Small imperfections in the track's base surface, though, do not disqualify the track for tournament use; the point of a hovercraft is to traverse uneven terrain. Tournaments are encouraged to make available ahead of time information about the type of surface the tracks will have.**
   d. 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.
   e. A photogate timing system is 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.
   f. 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.



g. Multiple tracks may be used to facilitate teams competing in a timely manner.

7. **SCORING:**
   a. High Score wins.
   b. Final Score (FS) = Best Run Score. A scoring spreadsheet is available at www.soinc.org.
   c. Run Score = DS + TS + MS
   d. Distance Score (DS):
      i. Complete Run: Distance Score = **40**
      ii. Incomplete Run: Distance Score = **40** 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.
   e. 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 = **40** x (1 - abs(Runtime - TT)/TT)
      iii. Incomplete Run: Time Score = 0
      iv. The smallest possible Time Score is 0.
   f. **Mass Score (MS) = (4R+ .1N) x (185 - (distance from the finish line in cm)) / 185**
      i. **R = # nickel rolls. The half-roll of nickels counts as .5 of a nickel roll (i.e. if the vehicle carries 2 complete rolls and the half roll, the # of nickel rolls is 2.5)**
      ii. **N = # loose nickels**
      iii. **The Maximum Mass Score for a Complete run is 20. The Mass Score formula prorates the Mass Score for the distance traveled in incomplete runs**
      iv. **The nickel rolls and loose nickels must stay on the vehicle for the entirety of the run to be counted.**
      v. **Mass Score for a run using the ramp = 0**
   g. **Teams unable to pass the safety parameters in 3f will receive only Participation Points.**
   h. Teams without any runs will receive a Final Score of 0, with ties broken as indicated in 7.l.. Ties are possible.
   i. The DS, TS, and **MS** for each run will be multiplied by 0.7 if the team misses impound.
   j. The DS, TS, and **MS** for a run will be multiplied by 0.8 for each CONSTRUCTION violation present during that run.
   k. The DS, TS, and **MS** for a run will be multiplied by 0.9 for each COMPETITION violation present during that run.
   l. Tie Breakers: 1st – Best TS over all runs; 2nd – Fewest # construction violations **in the team's run that has the most construction violations, or, in the case of a vehicle that does not have any runs in the competition time, the number of construction violations per 4b**; 3rd – Best **MS**, 4th - 2nd Best Run Score

METEOROLOGY B - SEVERE WEATHER & STORMS

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

1. **DESCRIPTION:** Participants will use scientific process skills involving qualitative and quantitative analyses to demonstrate an understanding of the characteristics of severe weather, including the factors that contribute to, cause and influence **Severe Weather & Storms** on the Earth. The interpretation of meteorological data, graphs, maps, charts, tables and images will be emphasized.

   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 three-ring binder of any size containing information in any form and from any source attached using available rings. Sheet protectors, lamination, tabs and labels are permitted.
   d. If the event features rotation through a series of stations, no material may be removed from the binder during the event.
   e. Students are expected to have a U.S. map with the state names in their binder.

3. **THE COMPETITION:**
   a. The event may be either a written exam format, or teams may move from station to station with the length of time at each station predetermined and announced by the event supervisor. Participants may not return to stations but may change or add information to their original answers while at other stations.
   b. At least fifty percent (50%) of the questions shall be based upon interpretation of weather data displayed in maps, graphs, images, photographs, charts, and/or tables to analyze Severe Weather and Storms.
   c. Severe Weather & Storms Topics:
      i. Observation technologies: surface observation networks (i.e., Automated Surface Observing System (ASOS), high-resolution mesonets), radiosondes, buoys, Doppler radar (base and composite reflectivity, base velocity, correlation coefficient, storm relative motion and wind profiles), aircraft, satellite imagery (i.e., water vapor, visible, and infrared (IR))
      ii. Types of data used to forecast and monitor severe weather
         (1) Surface maps including interpretation of station models and decode METAR coded weather observations
         (2) Analysis of severe weather and storm data preferably from 2022 to 2027
         (3) Hodographs
         (4) Computer model predictions
         (5) Stüve diagrams: interpretation of cloud formation, wind shear, stability
         (6) States and National only - Skew-T diagrams, applying the same skills as used on Stüve diagrams
         (7) States and National Only - Lifting Condensation Level (LCL)
         (8) States and National Only - Convective Available Potential Energy (CAPE)
      iii. Factors and environmental conditions leading to severe weather:
         (1) Large-scale circulation patterns, jet streams, atmospheric stability, air masses, fronts, wind shear, atmospheric rivers, and drylines
         (2) Influence of oceans and large water bodies, including the effects of fetch, heat content, heat transport, and wakes caused by storms
         (3) Influence of physical landforms and topography on the formation and strengthening or weakening of severe storms
      iv. Clouds: identification and interpretation of cloud types, limited to those related to severe weather events
      v. Droughts and heat waves: definitions, causes and effects
      vi. Precipitation from severe storms: types and the relationship of intensity, duration, hail size, frequency of impacts of heavy precipitation, formation (collision-coalescence, Bergeron process, riming, aggregation, temperature layers, etc.)
         (1) Solid precipitation: snow, sleet, and hail as well as the importance of hail size
         (2) Liquid precipitation
            (a) types: freezing rain, freezing drizzle and rain
            (b) results: debris flows, mudslides, flooding (flash, stream, river, and urban)

(3) Impacts of Precipitation: (e.g., snow loads, structural damage (dams, buildings, roads, bridges, natural features) as well as the effects on air and ground travel)
(4) **States and National Only - Intensity-duration-frequency (IDF) curves and return periods for precipitation events**

vii. Lightning: process of electrification of clouds, charge differentiation, all types of lightning and lightning direction finders/systems
viii. Severe thunderstorms: definition, types (single, multicell, supercell and mesoscale convective complexes (MCCs)), characteristics, structure and life cycles
ix. Winds:
(1) Types and definitions: straight-line, downdrafts, downbursts, microbursts, macrobursts, gust fronts, squall lines, derechos, downslope winds and their impacts
(2) Detection by Doppler radar imagery: derecho, straight-line winds, gust fronts, and squall lines
x. Tornadoes and waterspouts: definition, life cycles, tracks, time of day and year, geographic preferences and atmospheric conditions for formation, as well as characteristics, structure
(1) Application of Fujita (F) [historically used before February 1, 2007] and Enhanced (EF) Fujita Scales [used after February 1, 2007] to tornado classification.
(2) Doppler radar:
(a) Images: reflectivity, velocity, and correlation coefficient
(b) Features: bow echo, tornadic vortex signature (TVS), hook echo and debris ball
xi. Hurricanes, typhoons and cyclones:
(1) Definition, life cycles (e.g., Invest, Depression, Tropical Storm, Hurricane, Major Hurricane), time of year and geographic preferences for formation
(2) Tracks, characteristics, formation, and structure
(3) Application of Saffir-Simpson Scale to hurricane classification
(4) Storm surge (causes, factors, effects of its height)
(5) Effects of topography, wind shear, El Niño-Southern Oscillation (ENSO) and pressure systems on track, intensification, or dissipation
(6) Identification of eye, eyewall, and spiral bands, using Doppler radar and satellite images
xii. Severe winter storms, characteristics and definitions: blizzards, nor'easters, lake effect snowstorms and ice storms
xiii. Hazards from each type of severe weather
xiv. Weather safety:
(1) NOAA/NWS watches/warnings
(2) Use of reliable sources for severe weather information and forecasts
(3) Severe weather preparedness
(4) Actions to take when faced with severe weather threats and/or impacts, such as tornadoes, hurricanes, flash floods, storm surge and lightning
xv. Severe Weather Events & Cases: Analysis and interpretation of data provided, and competitors will not be expected to memorize facts or data
(1) Historic severe events limited to:
(a) Hurricanes: Galveston (1900), Andrew (1992), Katrina (2005), Sandy (2012), Ida (2021), Ian (2022), Hilary (2023), Helene (2024), Erin (2025), and Melissa (2025)
(b) Blizzard of March 1888
(c) Dust Bowl of the 1930s
(d) Tornadoes: Xenia Ohio (1974) and the April 2011 Outbreaks
(e) Great Flood of 1993 in U.S.
(f) Storm of the Century (March 1993)
(2) Analysis of severe weather and storm data preferably from 2022 to 2027

4. **SCORING:**
a. High Score wins.
b. Points will be awarded for the accuracy of responses, the quality of supporting reasoning, and use of scientific techniques.
c. Preselected questions will be used as tiebreakers.

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

PING PONG PARACHUTE B

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

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

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

   EYE PROTECTION: B

2. **EVENT PARAMETERS:**
   a. Teams must provide up to two rockets, two unaltered standard ping pong balls, and two parachutes.
   b. Parachutes must be attached to ping pong balls with tape only. The ping pong ball attached to the parachute assembly makes up the parachute payload system.
   c. 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. **Event supervisors are encouraged to make multiple launchers available with slightly differing connection widths (21.5 mm - 22.0 mm diameters). Connection of the air pump to the launcher must be completed before timing begins for the students. Connection to the launcher must be completed before timing begins for the students. If a rocket is not maintaining pressure with one launcher, students must be allowed to change launchers (if available) while the timer is stopped.**
   d. 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 **with as much advance notice as possible.** Extreme care must be taken to protect the floor and ceiling of any inside facilities used for practice and competition. **Tournament officials are encouraged to reduce air flow (HVAC, doors opening, etc.) as much as possible.**

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 and a standard neck height from flange to bottle's opening of under 1.6 cm. The bottle label must be presented.

Figure 1

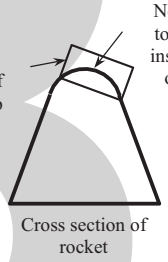
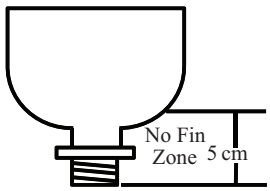


Figure 2



   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 **air pump through the launcher; water is not allowed to be used**. Gases other than air, explosives, liquids, chemical reactions, pyrotechnics, electrical devices, elastic powered flight assists, throwing devices, remote controls, and tethers are prohibited at all times.
   g. **Mylar/ultrafilm materials must not be used in any part of the parachute or rocket.**
   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. **PRACTICE LOG:**
   a. During inspection, each team must present a flight log of recorded data. Data must include five or more parameters (three required and at least two additional) for 10 or more test flights prior to the competition. The required parameters are: 1) pressure (psi), 2) estimated peak flight height (feet), 3) time aloft (seconds). The additional parameters are chosen by the team (examples include: number of fins, parachute diameter, etc.)

b. An incomplete flight log is a flight log that is missing at least one of the required or additional parameters or does not include data for at least 10 total flights.
c. **Teams must use their data to justify their pressure choice. Teams without a flight log or an incomplete flight log will not be allowed to be pressurized beyond an event-supervisor determined safe pressure that will be the same for all teams without complete practice logs and will ensure rockets will not reach the ceiling. Additionally, teams without a flight log will have their final score multiplied by 0.7 and teams with an incomplete flight log will have their final score multiplied by 0.85.**

5. **<u>THE COMPETITION</u>:**
   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 penalized with a multiplier of 0.90.**
   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) **during the ascending portion of the launch**, then timing is stopped at the instant of contact. That launch is **penalized with a multiplier of 0.25.**
   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. **<u>SCORING</u>:**
   a. High Score wins.
   b. Ranking is determined by the greatest time aloft of a parachute payload system from a single launch.
   c. Rockets and/or parachute payload systems violating 2.b. and/or 3.a.-g. will not be launched. Teams with a rocket unable to make any launches will receive participation points only.
   d. Ties will be broken by the greatest time aloft of the parachute payload system from each tied team's other launch.
   e. **Penalties will be assigned to a launch as follows:**
      i. **A 0.90 multiplier will be applied to launches where the parachute payload system does not separate from the rocket.**
      ii. **A 0.85 multiplier will be applied to launches where the team presents an incomplete practice log.**
      iii. **A 0.70 multiplier will be applied to launches where the team does not present a practice log.**
      iv. **A 0.25 multiplier will be applied to launches where any part of the rocket or parachute payload system strikes the ceiling or any part connected to the ceiling on the ascending portion of the launch.**

REMOTE SENSING B - OBSERVABLE EARTH

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

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

   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 two protractors and two rulers.
   d. Each team may bring one three-ring binder of any size containing information in any form and from any source attached using the available rings. Sheet protectors, lamination, tabs and labels are permitted. If the event features a rotation through a series of laboratory stations where the participants interact with samples, specimens, or displays; no paper may be removed from the binder throughout the event.
3. **THE COMPETITION:** Participants will be given one or more tasks presented as an exam and/or timed stations. The event will consist of questions and activities testing concepts related to the collection and use of remote sensing data to observe the Earth. Questions should emphasize conceptual understanding and interpretation (e.g., qualitative patterns/trends, proportions, and relative comparisons) rather than advanced mathematical or physical derivations. Questions will address the following topics:
   a. Remote sensing concepts (25-35% of total points) Equations should be limited to those listed below. Only equations marked with an asterisk (*) may be tested quantitatively; all others must be assessed qualitatively.
      i. Properties of light: electromagnetic spectrum, reflection, refraction, absorption, scattering, polarization, irradiance/radiance
         (1) Equations, limited to: Wien's Displacement Law ($\lambda_{max} = b/T$)*, wave equation ($c = \lambda\nu$)*, Snell's Law, inverse square law for irradiance, Stefan-Boltzmann Law
      ii. Types of sensors, limited to:
         (1) Passive: optical and thermal sensing in the ultraviolet, visible, near-infrared, shortwave infrared, and thermal infrared ranges
         (2) Active: radar backscatter, synthetic aperture radar (SAR), interferometric SAR (InSAR) at a basic interpretive level, radar altimetry, and radar-derived elevation products
            (a) Equations, limited to: Radar altimetry range*
      iii. Types of satellite orbits and their purposes, limited to: low earth, medium earth, high earth, polar/non-polar, geostationary, geosynchronous
         (1) Equations, limited to: Kepler's Third Law
      iv. Image characteristics: spatial, temporal, radiometric (limited to signal-to-noise ratio/ sensitivity), and spectral resolution
      v. Instrumentation, limited to: scanning systems, multispectral imaging systems, optical and infrared imagers, radiometers, radar altimeters, thermal infrared imagers, synthetic aperture radar (SAR) instruments, and digital elevation models
   b. Interpretation and analysis of remote sensing images and data sets (65-75% of total points), limited to the types of sensors listed in 3.a.ii., from the following satellites only: different spectral combinations from Landsat 5-9 (TM, ETM, OLI), Sentinel-1A/1B, Sentinel 2A/2B, Terra (limited to: MODIS, ASTER), Shuttle Radar Topography Mission (SRTM), ECOSTRESS, GOES. Questions will focus on the following:
      i. Fundamentals of mapping as applied to topographic maps, satellite images, aerial photographs, and other maps generated by remotely sensed data
         (1) Marginal information: location, date, scale, orientation, legend, labels, etc.
         (2) Image display and interpretation: natural color, false color, grayscale, thermal, radar, elevation, contours, classified map displays
         (3) Measurements and scaling estimates, limited to: distance between features, perimeter, area, altitude, elevation, slope/gradient

ii. Earth observation and monitoring
  (1) Physical phenomena, including but not limited to:
    (a) Absorption and scattering by aerosols and their effect on data collection
    (b) Albedo, surface temperature, reflectance, and other properties of natural and engineered materials and their uses for classifying land areas
    (c) Elevation or subsidence changes
    (d) Vegetation changes (e.g., forests, agriculture)
    (e) Geohazards: volcanoes, landslides, flooding, wildfires
    (f) Earth processes: glacial movement, fluvial processes, stream patterns
  (2) Land Cover Classification Systems
    (a) Supervised and unsupervised classification maps
    (b) National Land Cover Database (NLCD/CONUS) Land Cover Change Index
  (3) Human and environmental implications: habitat loss, land cover change, urbanization, deforestation, damage assessment and monitoring

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

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

B

ROCKS AND MINERALS B

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

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

   A TEAM OF UP TO: 2

   APPROXIMATE TIME: 50 minutes

   CALCULATOR: Class II

2. **EVENT PARAMETERS:**
   a. Each team may bring writing utensils.
   b. Each team may bring one Class II calculator.
   c. Each team may bring one magnifying glass.
   d. 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.
   e. Each team may also have one commercially produced field guide which may be tabbed and annotated.
   f. In addition to a binder and a field guide, each team may bring one copy of the 2027 National Rocks and Minerals List which does not have to be secured in the binder and may be annotated.
   g. Teams are not permitted to bring samples or specimens to the event.
   h. 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 **2027** 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 **2027** 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 should 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. **Definition of a mineral: naturally occurring inorganic solid with definite composition and crystalline structure**
      ii. Identification - specimens or images used should show observable properties. **Where observable properties are insufficient to identify a specimen, other diagnostic characteristics will be provided**
      iii. Physical Properties - color, hardness, luster, streak, cleavage/fracture, density/specific gravity/ heft, diaphaneity, and tenacity
      iv. Other properties - limited to reaction with acid, fluorescence, magnetism, smell, taste, double refraction, piezoelectricity, and radioactivity.
      v. 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
      vi. Chemical composition – chemical formulas, relationships between chemistry and properties (e.g., effect of trace elements on mineral color)
      vii. Polymorphs (e.g., aragonite/calcite; diamond/graphite, orthoclase/microcline; sillimanite/ andalusite/ kyanite)
      viii. Classification - mineral families based on composition (see **2027** National Rocks and Minerals List)
      ix. Mineral groups (e.g., feldspar, garnet, tourmaline) - similarities of chemical composition and shared properties

x. Methods of formation and environments (e.g., hydrothermal, chemical weathering, crystallization from magma, evaporites, chemical precipitation, alteration under heat & pressure)
xi. Minerals associated with rock-forming environments (e.g., evaporite minerals in sedimentary settings; mafic minerals in oceanic crust; minerals that form under metamorphic conditions)
xii. Bowen's Reaction Series – relationship between mineral crystallization and temperature in magma
xiii. Uses of minerals
(1) Ores, industry, jewelry, geochronology, medicine, manufacturing, construction, electronics, etc.
(2) Precious and semi-precious gemstone minerals on the **2027** National Rocks and Minerals List as well as the following **varieties,** limited to: emerald, aquamarine, **and** morganite **(beryl); kunzite and hiddenite (spodumene);** peridot **(olivine);** ruby, **and** sapphire **(corundum);** pearl; and amber

i. **Rock Topics**
i. **Definition of a rock: naturally occurring solid mass composed of one or more minerals or mineraloid matter; rocks can be an aggregate (mixture) of one (monomineralic) or more minerals (polymineralic); unlike minerals, rocks can be made of organic matter.**
ii. 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)
iii. 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)
iv. 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 **(plutonic)** and extrusive **(volcanic)** environments; and igneous formations limited to batholith, lava flow, and pyroclastic deposits.
(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)
v. 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), **and their relationship to water velocity in rivers and streams**; 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)
vi. 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, **peridotite for serpentinite, basalt or gabbro for amphibolite**
(5) Regional and contact metamorphism
(6) Grade (intensity) of metamorphism (low, medium, high) and index minerals (**limited to** chlorite, **muscovite, biotite,** garnet, staurolite, kyanite, and sillimanite) that indicate the degree of metamorphism

vii. 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)
viii. Economic importance and uses of rocks (e.g., building stone, ores, ornamental, agriculture, fossil fuels)

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

B

MINERALS

BORATES
- Ulexite

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

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

HALIDES
- Fluorite
- Halite[5]

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

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

SULFATES
- Barite
- Celestite/**Celestine**
- *Gypsum[5] 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] (tan/pink variety)
- *Garnet Group*
  - Almandine
  - Grossular (green variety)

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*[1]
- Wollastonite*
- Zircon*

ROCKS

IGNEOUS

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

SEDIMENTARY

- Banded Iron Formation
- Bauxite[4]
- Breccia
- Chert/Flint
- Conglomerate
- Diatomite*[1]
- Dolostone
- Rock Salt (Halite)[5]
- Rock Gypsum[5]
- Shale
- *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. **White or pink/tan Orthoclase/Microcline can be found in granite.**
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

ROLLER COASTER B

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

1. **DESCRIPTION:** Prior to the competition, teams design, build, and test a Roller Coaster track to guide a ball/sphere that uses gravitational potential energy as its means of propulsion to travel as close as possible to a Target Time.

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

   EYE PROTECTION: B **IMPOUND:** Yes

2. **EVENT PARAMETERS:**
   a. Participants must bring and impound one Roller Coaster (a track that guides a ball/sphere), at least one ball/sphere, non-electronic tools, and spare parts before the start of the competition.
   b. Participants may bring and impound additional balls/spheres, but only one will be used during a given run.
   c. 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.
   d. The Event Supervisor will provide an unsharpened #2 pencil with an unused eraser, all measurement tools for scoring purposes, and timers.
   e. If the device is deemed unsafe, it will not be allowed to run until safety concerns are resolved to the Event Supervisor's satisfaction.
   f. 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 Roller Coaster must be designed so that a single ball/sphere will travel from a Start Line to a Finish Line in as close to the given Target Time as possible.
   b. At all times during the competition the device, excluding the ball/sphere, must be no larger than 30.0 cm wide x 80.0 cm long x 60.0 cm high sitting flat.
   c. The ball/sphere must be at least 1 cm in diameter and must remain visible at all times.
   d. The ball/sphere must be held in the ready-to-run position by an unsharpened #2 pencil held only in the participant's hand. The pencil is provided by the Event Supervisor. The ball/sphere is released when the participant removes the pencil from the track.
   e. The ball/sphere must travel using only its own gravitational potential energy available at the ready-to-run position with the exception of the simple machines required for the Elevators. No added energy by use of stored potential energy is allowed (e.g., no springs, rubber bands, etc.).
   f. There must be exactly one clearly labeled Start Line and one clearly labeled Finish Line running perpendicular to the direction of ball/sphere travel on the track designated before the Target Time is released.
   g. The relative positions of the Start Line and the Finish Line must not change after impound.
   h. The device must include a mechanism that safely stops the ball/sphere after it crosses the Finish Line.
   i. Magnets, electrical, and electronic devices may not be used for any part of the Roller Coaster.
   j. Elevators: Up to 2 distinct types of clearly labeled Elevators may be included to earn points.
      i. Types of Elevators may be in any order.
         (1) Type 1: A first-class lever combined with a wheel and axle with an IMA of less than 1 must raise the ball/sphere vertically at least 10 cm.
         (2) Type 2: A second-class lever combined with a pulley with an IMA of less than 1 must raise the ball/sphere vertically at least 10 cm.
      ii. Counterweights are allowed in the operation of the elevator.
      iii. Parts of the track can be reused by the ball/sphere after being lifted vertically.
      iv. Gates/barriers may be activated/put in place as part of Elevator actions.
      v. Each type of Elevator may earn points only once.
   k. Loop: The device may contain one Loop in the track to earn a Loop Score. A Loop is defined as a continuously concave section of track which appears to self-intersect at a Point of Intersection (POI).
      i. The Loop begins and ends when the ball/sphere reaches the POI.
      ii. The track must not be fully enclosed at any point in the Loop (i.e., the ball/sphere could be easily removed by the Event Supervisor).

iii. The height of the Loop is defined as the vertical distance from the POI to the highest inside point of the Loop.
iv. The measurement from the POI to the highest inside point of the Loop must be clearly labeled for the Loop to count for points.
v. The two sections of track at the POI must touch and have a clearly labeled point that the Event Supervisor can measure from.
vi. The ball/sphere must remain in contact with the track as it traverses the Loop. When the ball/sphere is in contact with the highest point of the Loop, the ball/sphere must be completely unsupported from below.

4. **THE COMPETITION:**
   a. The Roller Coaster, ball(s)/sphere(s), tools, spare parts, and data/notes must be impounded before the start of the competition.
   b. Only the participants and Event Supervisor will be allowed in the impound and event areas during the competition. Once the participants enter the event area to compete, they must not leave the area or receive outside assistance, materials, or communications.
   c. The exact Target Time is between 30 s and 60 s (in 5 s intervals for Regional, 2 s intervals for State, and 1 s intervals for National tournaments) and will be chosen by the Event Supervisor. The Target Time will be the same for all teams at the tournament and will be revealed just before the team sets up the device.
   d. After retrieving their device from the Impound Area, teams will be given 8 minutes to set up their Roller Coaster and complete up to two scorable runs. Participants may make as many practice runs as they want during the 8 minutes.
   e. Participants may adjust their Roller Coaster (e.g., modify the track, add/remove parts of track, swap the ball/sphere, leveling) before each run. They are not allowed to change the start and finish lines.
   f. Time used by the Event Supervisor for measuring will not be included in the 8 minutes. A scorable run that begins before the end of the 8-minute time period will be allowed to run to completion.
   g. Prior to conducting a scorable run, the participants must place the Event Supervisor provided #2 pencil on the Start Line of the device. The ball/sphere must be placed completely behind the Start Line.
   h. A scorable run must be declared prior to the start of a run. Participants may not touch the device during a scorable run.
   i. Prior to each scorable run, the Event Supervisor will verify that the timekeepers and participants are ready. Three timekeepers are suggested to be used with the median time recorded as the Run Time, in seconds to the precision of the timing device used. The Event Supervisor will then count aloud "3, 2, 1, Go". On the word "Go" the participants will remove the pencil from the track such that the pencil does not exert a force on the ball/sphere.
   j. On the word "Go", the pencil is removed and timing begins. Timing ends when any of the following happens:
      i. The ball/sphere completely crosses the Finish Line.
      ii. Twice the Target Time has elapsed since the word "Go".
      iii. The ball/sphere travels outside the boundary of the device.
      iv. The ball/sphere stops moving. The ball/sphere may pause briefly, but timing stops if movement does not begin within 3 seconds.
   k. If the ball/sphere fails to cross the Finish Line on a scorable run, that run will have a Time Score of Zero (0). However, the time of the run when it stopped or left the device may be used as the final Tie Breaker (if needed) with the longer time being preferred. It will still receive scores for the Height, Elevator(s), and Loop. Only the Elevator(s) and Loop that are successful before timing stops may receive their respective points.
   l. The Roller Coaster's height will be measured at the conclusion of each scorable run.
   m. The Event Supervisor will review with teams the data recorded on their scoresheet.
   n. Teams filing appeals must leave all impounded materials with the Event Supervisor.

5. **SCORING:**
   a. High Score wins.
   b. The higher of the 2 Run Scores is used as the Final Score.

c. Run Score = Size Score + Time Score + Elevator Score + Loop Score
d. Size Score = (60 - Roller Coaster height) + (30 – Roller Coaster width) + (80 - Roller Coaster length). The Roller Coaster height/width/length is measured in 0.1 cm increments.
e. Time Score = Time Bonus - Time Penalty
   i. Time Bonus = 5 points for every full second of Run Time up to the Target Time.
   ii. Time Penalty = 5 points for every full second of Run Time past the Target Time up to the 2 x the Target Time.
f. Elevator Score = 50 points for each first successful use of each type of Elevator. Points are only awarded if the ball/sphere successfully reaches the track at the top of the Elevator, fulfills all requirements in (3.j.), and continues traveling on the track.
g. Loop Score = 3 points for each whole cm of the height of the Loop, measured vertically from the POI to the highest inner point of the Loop. Points are only awarded if the ball/sphere successfully completes the Loop and fulfills all requirements in (3.k.).
h. Tiers:
   i. Tier 1: A run with no violations
   ii. Tier 2: A run with any construction or competition violations
   iii. Tier 3: A team with a Roller Coaster or ball/sphere not impounded during the impound period
   iv. Participation points are awarded to teams who cannot start any run within the 8 minutes or have unresolved safety issues.
i. Ties are broken in this order:
   i. Highest Loop Score
   ii. Highest Size Score
   iii. Highest Time Score
   iv. The longest time the sphere ran before leaving the device or stopping

6. **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. *Gravitational Potential Energy:* stored energy an object possesses due to its position.
c. *Roller Coaster:* Track to guide a ball/sphere.
d. *Ball/Sphere:* Object that uses gravitational potential energy as its means of propulsion to travel as close as possible to a Target Time down the Roller Coaster track.
e. *Elevator:* Device used to lift the Ball/Sphere from a lower level within the Roller Coaster to a higher level in the Roller Coaster.
f. *Loop:* A Loop is defined as a continuously concave section of track which appears to self-intersect at a Point of Intersection (POI). The track for the loop may not be enclosed.
g. *Track:* A surface that the ball/sphere travels along. Materials used must not create a safety concern. If the Track is enclosed, it must be clear.

SCRAMBLER B

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

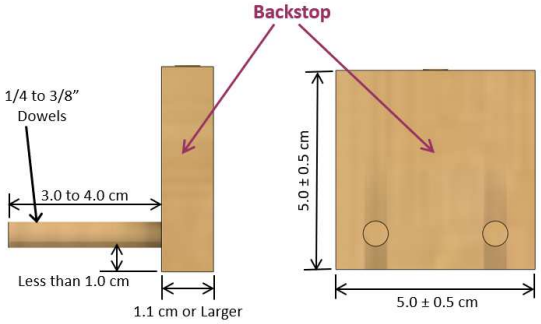
1. **DESCRIPTION:** Teams design, build, and test a mechanical device, which uses the energy from a falling mass to transport an egg along a track as quickly as possible and stop as close to the center of a Terminal Barrier (TB) without breaking the egg.

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

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

2. **EVENT PARAMETERS:**
   a. Only One Scrambler: designed, and built by the team may be entered, built prior to the competition.
   b. Impound: Team must impound before the first time slot.
   c. Eye Protection: Class B is required (See Eye Protection policy on soinc.org).
   d. Event Time: Teams will each have 8 minutes to adjust, repair, and run their Scrambler.
   e. Track: The Event Supervisor will provide and set up the Track as listed in the Track section.

3. **CONSTRUCTION PARAMETERS:**
   a. Scrambler: must consist of an egg transport (Vehicle) and an energy propulsion system (launcher and falling mass). These may be separate or combined into a single unit.
   b. Size: the entire Scrambler (Vehicle and energy propulsion system) including the egg, falling mass, and cushion to protect the floor, in the ready-to-run configuration, must completely fit within an imaginary rectangular box with 100.0 cm x 50.0 cm base with a 100.0 cm height. No part of the Scrambler can be taped or attached to the event floor.
   c. Propulsion Energy: all energy used to propel the Vehicle must come from a falling mass not to exceed 2.00 kg. The gravitational potential energy of the falling mass may be converted to other forms of energy.
      i. Additional sources of kinetic energy must be in their lowest energy state in the ready-to-run configuration.
      ii. Any part of the Scrambler whose gravitational potential energy decreases and provides energy to propel the vehicle after the Scrambler is actuated is considered to be part of the falling mass.
      iii. The falling mass cannot contact the venue floor at any time during the run. Teams must use a pad or similar protective cushion to prevent contact with or damage to the floor. The protective cushion is part of the Scrambler's size. ES can prevent teams from running or performing an action if there is a risk the floor could be damaged.
      iv. To facilitate mass measurements, the Scrambler must be impounded with the mass detached.
   d. Stopping Mechanism must be contained completely within the Vehicle and work automatically.
      i. The Vehicle must not be remotely controlled or tethered.
      ii. Pre-loaded energy storage devices may be used to operate other Scrambler functions (e.g., braking system) as long as they do not provide kinetic energy to propel the Vehicle.
   e. Egg Holder and Backstop must meet the following requirements:
      i. Backstop must be built out of one piece of solid (no holes or filled holes), rigid, flat, and unpadded wood. The flat surface must be 5.0 +/- 0.5 cm wide and 5.0 +/- 0.5 cm high. The thickness must be at least 1.1 cm. Commercially purchased wood like plywood is allowed. Balsa cannot be used.
      ii. The egg must rest on two (2) ¼" to ⅜" wooden round dowels which extend out from the flat surface of the backstop. These dowels must extend between 3.0 and 4.0 cm from the backstop. The dowels must be within 1.0 cm from the bottom of the backstop.
      iii. The bottom of the wooden dowels must be between 5.0 and 10.0 cm above the track.
      iv. The backstop must be mounted to the front of the vehicle to allow the egg to be the foremost part of the vehicle. The backstop must be mounted in a rigid method to prevent movement during an impact. **Holes can be placed on the back, sides, bottom or top of the Backstop for the purpose of attaching to the Vehicle.**



f. Pencil Start: Competitors must design the Scrambler to start by using any part of an unsharpened #2 pencil with an unused eraser, provided by the ES, to actuate a release mechanism. The pencil may be the release mechanism itself and may extend beyond the dimensions in 3.b. Actuating the release mechanism must not impart additional energy to the Vehicle.
g. Vehicle Parts: All parts of the Vehicle must move as a whole: no anchors, tethers, tie downs, or other separate pieces are allowed. The only parts allowed to contact the floor during the run are wheels/treads, drive string, drive attachment, and any parts already in contact with the floor in the ready-to-run configuration. All wheels must be in contact with the floor at launch. Pieces falling off during the run constitutes a Construction Violation.
h. Electric or Electronic components or items cannot be used (with the exception of a calculator).
i. Design Knowledge: Answer questions on design, construction, and operation of the device per the Building Policy found on www.soinc.org.
j. **Purchased Kits or Open Source Kits are allowed for this event with the following requirements:**
   i. **Teams must make at least two functional modifications to the kit during the build process. These modifications need to be documented on the Kit Modification Form available on soinc.org. The completed form must be impounded.**
   ii. **Teams violating rule 3.j.i. will receive the Non-modification Penalty to their Run Scores.**

4. **<u>THE COMPETITION</u>:**

a. Impound before first time slot.
   i. Teams must impound one Scrambler, spare parts, alignment device (if used), any papers (if used), and **Kit Modification Form (if used)**.
   ii. Launcher and a falling mass may be shared between teams from the same school.
   iii. Falling mass must be detached when impounding. Teams will be allowed to disconnect their mass if an issue is found during check-in.
   iv. Tools do not need to be impounded.
   v. Inspections will NOT take place during impound as any of the 15 member team may impound.
b. After Impound and before the first time slot, the Target Distance will be announced and posted. The Target Distance at a competition will be the same for all teams.
c. Check-In
   i. Only the participants will enter and may bring tools as defined.
   ii. Teams will be instructed by the ES when to retrieve their impounded items.
   iii. Teams will present their Vehicle for inspection & measurement by the ES. Participants will be notified at this point if any construction violations are found.
      (1) Teams may use their Event Time to correct any construction violations. A team's Event Time will be paused during re-evaluation by the ES.
   iv. Once participants start the Check-In process, they must not leave or gain any outside assistance or materials until their Event Time is completed.
   v. The ES will provide uncooked grade A large chicken eggs. Teams will select one egg at the completion of Check-In. There is no penalty if an egg breaks prior to the device being actuated before the first launch. A second egg will be provided. The second egg may be a used egg; this will be the ES's choice.
d. Event Time
   i. Participants will have their Event Time to complete up to 2 runs. The Event Time ends after 2 runs, the egg is broken or the time limit has been reached. Teams may adjust their Scrambler (e.g., repair, change distance, aiming) within their Event Time.
      (1) The time limit for the Event Time is 8 minutes.
      (2) The ES will notify the participants when their Event Time starts.
      (3) Vehicles in the ready-to-run configuration before the end of the Event Time will be allowed to complete a run.
   ii. Attaching the falling mass and egg are part of the team's Event Time.
   iii. Teams will secure the egg to the dowels on the Backstop with tape. The ES will supply the tape.
      (1) No tape can be placed on the front or rear 1.0 cm of the egg.
      (2) The egg's rounded end must be touching the Backstop and visible to the ES when attached.
      (3) The egg must be the foremost point of the Vehicle.
      (4) At the ES's discretion, the egg may be placed inside a thin transparent plastic bag.

iv. Sighting, aligning, and guiding devices, if used, must be placed and used within the defined Track area. These devices cannot be electric or electronic. If placed on the Vehicle, they may be removed at the team's discretion. Devices remaining on the Vehicle will be considered part of the Scrambler. All items not part of the Scrambler must be moved and placed behind the Start Point prior to starting a run.

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

vi. Substances applied to the Vehicle must be approved by the ES prior to use and must not damage or leave residue on the floor, Track and/or event area. Teams may clean the Track during their Event Time, but it must remain dry. **Competitors are not allowed to use tape on the event floor.**

vii. Teams must not roll or test the Vehicle on the floor of the Track on the day of the event **or prior day** without tournament permission. If permitted, only participants may be present. During competition, teams must not roll the vehicle on the floor before or after runs. Teams are allowed to roll the Vehicle into the Launcher for the sole purpose of loading the Vehicle.

viii. Individual Run Testing

(1) Participants must place the tip of the egg above the Start Point **within approximately 1 cm. Parts of the Scrambler may be beyond the Start Point. The Start Point must remain visible to the ES.**

(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. Placement of the inner can may be different for each run.**

(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 rule violations.

(a) This includes measuring the Scrambler's size.

(b) The ES will only notify the participants of any violations at the end of each run. Teams may ask question(s) before the run if there are specific violations. The ES will not answer generic questions like "Do I have a violation?"

(5) ES will measure the Inside Can Distance.

(6) Participants will use a #2 unsharpened pencil to trigger the Scrambler. Participants may only contact the pencil and not the Scrambler during the triggering action.

(a) If the Vehicle fails to actuate or move when triggered, then a run has not occurred. The Vehicle must move to be a measurable run. The participants may continue to work on their device provided they have not reached the end of their Event Time.

(7) ES will review the run to determine if the run was Successful or a Failed Run.

(8) Run Time and Vehicle Distance will be measured and recorded for Successful runs.

(9) **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.**

(10) Additional competition violations are:

(a) The egg is broken during the run. A 2nd run will not occur if broken on the 1st run.

(b) Any part of the Vehicle (besides the egg) touches the TB.

(c) The tip of the egg goes past the front of the TB.

(d) Competitors follow their Vehicle down the track before being called to retrieve their vehicle.

(11) All violations will be recorded. The ES must notify the participants of any violations at the end of each run.

(12) Timing resumes once the participants pick up their device or begin making their own measurements.

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

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

5. **SCORING:**
   a. Low Score wins.
   b. Each team's Final Score is the better of the 2 Run Scores + Final Score Penalties.
   c. Run Score = 100 + Distance Score + Time Score + Can Bonus + Run Penalties
   d. Distance Score = 2.0 pt/cm x Vehicle Distance.
      i. The Distance Score for a Failed Run is 2500 points.
   e. Time Score = Run Time
      i. The Run Time will be recorded as 0.00 seconds for Failed Runs.
   f. **Can Bonus = -0.5 x (110 – Inside Can Distance)**
   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.
         (1) A team will be awarded a construction violation if the floor is damaged by their device or actions either before or after the run.
      iii. **Non-modification Penalty: 50 points added to Run Score.**
      iv. 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.

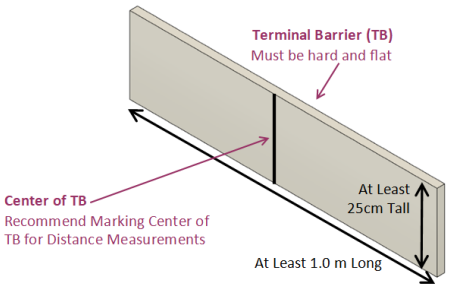
6. **SCORING EXAMPLES:**
   a. A Vehicle has 2 Successful runs during the team's Event Time.
      i. In the 1st run, the Vehicle stopped 67.6 cm from the Target Point with a Run Time of 7.27 seconds **with no cans**.
      ii. In the 2nd run, the Vehicle stopped 27.6 cm from the Target Point with a Run Time of 8.67 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	= 7.27	=	7.27
Can Bonus	**= No Cans**	**=**	**0.00**
1st Run Score		**=**	**242.47**

Base Score	= 100	=	100.00
Distance Score	= 27.6 cm x 2.0 pts/cm	=	55.20
Time Score	= 8.67	=	8.67
Can Bonus	**= -0.5 x (110.0 – 50.0)**	**=**	**-30.00**
2nd Run Score		**=**	**133.87**

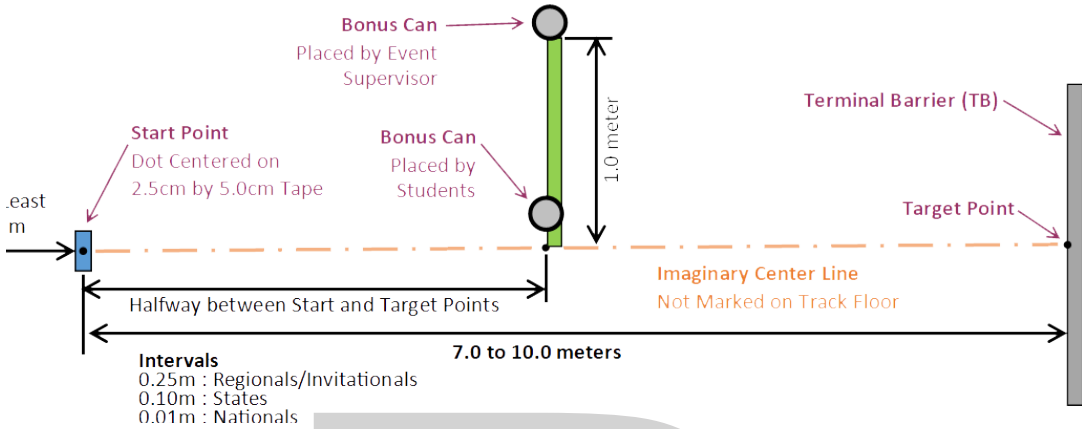
Final Score = 2nd Run Score (Better Score) = 133.87 pts

7. **THE TRACK:**
   a. In-Person tournaments: The ES will supply and set up the Track.
   b. Virtual tournaments: Team will supply the Track that fully complies with the requirements of this section. Any deviation will be scored as a competition violation for all runs.
   c. Track Definition:
      i. The Track will be on a smooth, level, and hard surface.
      ii. The Event Supervisors must mark the track as follows:
         (1) Start Point - an approximately 5 cm x 2.5 cm tape with the Start Point marked at the center of the tape.



(2) Target Point - an approximately 5 cm x 2.5 cm tape with the Target Point marked at the center of the tape. The Target Point is placed at the Target Distance from the Start Point.

(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 center of a Terminal Barrier (TB) is placed at the Target Point and must be perpendicular to the imaginary Center Line that connects the Start Point and Target Point. TB must be a hard, flat, vertical wall at least 25.0 cm tall and a minimum of 1.00 m long.

iv. **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.**

v. The Track Area will have a width of 2.0 m and extend at least 1.0 m behind the Start Point.

vi. At the ES's discretion, more than one Track may be used. If so, the team may choose which Track they use but must use the same Track for both runs.

8. **DEFINITIONS:**

a. *Event Supervisor (ES)* is responsible for ensuring the event runs correctly. The ES can assign one or more event helpers to perform various competition tasks.

b. *Tools* cannot be electric and electronic tools except for a stand-alone calculator (Class III). To qualify as a Tool, the item must not travel on the Track with the Vehicle, does not become part of the Scrambler, and cannot be used to align or aim the Vehicle.

c. *Target Distance* is selected by the ES and will be between 7.00 and 10.00 meters. At Regionals/ Invitationals the interval will be 0.25m, for States 0.10 m, and for National 0.01 m.

d. *Vehicle Distance* is a point-to-point measurement from the Vehicle Measurement Point to the Target Point, measured to the nearest 0.1 cm.

e. *Run Time* begins when the team actuates the Vehicle and ends when the Vehicle comes to a complete stop.

i. Recoil or oscillations will be included in the Run Time.

ii. The Run Time is recorded in seconds to the precision of the timing device used.

iii. Three timekeepers should be utilized with the middle time used as the official Run Time.

f. *Complete Stop* is when the Vehicle is stationary for 3 or more seconds. The 3 seconds is not part of the Run Time.

g. *Successful Run*: Any run when the Vehicle moves before the end of the Event Time and is not a Failed Run.

h. *Failed Run*: A run will be scored as a Failed Run when one of the following occurs. Construction and/or Competition Violations must still be recorded for Failed Runs.
   i. If the egg is broken on the 1st run, then the 2nd run will be a Failed Run.
   ii. The Vehicle starts before the ES is ready.
   iii. The Vehicle's distance cannot be measured (e.g., the participants pick it up before it is measured).
   iv. The team pushes the Vehicle down the track.
   v. A team having only one successful run during the 8-minute Event Time will be assessed a Failed Run for a 2nd run score. If the Vehicle does not move during the Event Time, the team will be assessed 2 Failed Runs.

i. *Broken Egg* is defined by cracking the egg enough to leave a wet spot on a paper towel.

j. *Vehicle Measurement Point* is defined as the foremost tip of the egg that is attached to the Vehicle.

This event is sponsored by International Motors.

B

SOLAR SYSTEM B

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

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

2. **EVENT PARAMETERS:**
   a. Each team may bring writing utensils.
   b. Each team may bring two 8.5" × 11" sheets of paper, which may be in a sheet protector sealed by tape or laminated, that may contain information on both sides in any form and from any source without any annotations or labels affixed.
   c. Calculators are not allowed.
3. **THE COMPETITION:** Participants will be tested on the content described below. Exams should emphasize mathematical reasoning, conceptual understanding, and interpretation of data presented in maps, graphs, images, photographs, charts, and/or tables (i.e., minimize trivia).
   a. Participants will be asked to identify and explain surface/atmospheric features, processes (e.g., cryovolcanism), and properties of the objects/systems listed below, as they relate to the content topics (3.b.). Questions should focus on Solar System objects (3.a.i) more than extrasolar systems (3.a.ii), and exams should not include detailed questions about objects/systems that are not listed.
      i. Objects in the Solar System: Venus, Mars, Ganymede, Europa, Enceladus, Titan, Makemake, 101955 Bennu, and 67P/Churyumov–Gerasimenko
      ii. Extrasolar Systems: TRAPPIST-1, Kepler-452, and LHS 1140
   b. Participants may also be tested on the following topics:
      i. Conditions relevant to habitability. Examples include: temperature, atmospheric composition and retention, presence of stable liquids (surface and subsurface), tidal heating, and chemical disequilibrium.
      ii. Geologic and chemical evidence relevant to habitability. Examples include: inferring historical evidence of liquid water from morphology, identifying surface/atmospheric composition from spectral features, and the delivery of water and organic material from small Solar System bodies.
      iii. Basic biology and chemistry relevant to habitability. Examples include: building blocks of life (e.g., proteins, nucleic acids, lipids, carbohydrates), phases/forms of water (e.g., liquid, amorphous and crystalline ice, brines, clathrates), and extremophiles (e.g., chemolithoautotrophs, tardigrades).
      iv. Exoplanet detection techniques, limited to transits, radial velocity, microlensing, and direct imaging.
      v. General engineering principles, science objectives, instrumentation, and tradeoffs underlying spacecraft and telescope design. Participants may be asked specific questions about only the following: Venus Express, DAVINCI, VERITAS, Perseverance, Mars Reconnaissance Orbiter, MAVEN, Galileo, Europa Clipper, JUICE, Cassini-Huygens, Dragonfly, OSIRIS-REx, Rosetta, Kepler, JWST, and Roman Space Telescope.
      vi. Mathematical concepts as they relate to habitability. Questions must not require a calculator and should emphasize algebraic manipulation (e.g., rearranging/deriving equations), order of magnitude estimation, dimensional analysis, sketching graphs, and proportions. Examples include:
         (1) Light, radiation, and temperature: Doppler shift, flux, inverse-square law, albedo, Stefan–Boltzmann law, Wien's displacement law, and equilibrium temperature.
         (2) Gravity, orbits, and tides: kinetic and potential energy, Newton's law of gravitation, Kepler's laws, escape velocity, and tidal forces.
         (3) Chemistry: ideal gas law, kinetics (e.g., Arrhenius equation), and chemical (dis)equilibrium.
4. **SCORING:**
   a. High Score wins.
   b. Points will be awarded for the quality and accuracy of responses.
   c. Preselected questions will be used as tiebreakers.

THERMODYNAMICS B

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

1. **DESCRIPTION:** Teams will construct a device prior to the tournament designed to collect heat and complete a written test on thermodynamic concepts.

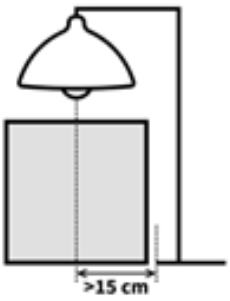
   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes

   IMPOUND: Yes **CALCULATOR:** Class III

2. **EVENT PARAMETERS:**
   a. Each team may bring writing utensils.
   b. Each Team may bring two Class III calculators for use during any part of the event.
   c. 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, books, 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.
   d. Each team may bring one pre-constructed device, spare parts, tools (defined as items aiding setup, not part of the build), and any prepared graphs or tables for use in their calculations of the device's results. Only the device and spare parts must be impounded, and all items must be at room temperature when impounded.
   e. The Event Supervisors will provide the testing materials listed in the COMPETITION AREA section. Teams should not bring these materials.

3. **CONSTRUCTION PARAMETERS:**
   a. The team's device will be designed to collect heat from an Event Supervisor-provided lamp setup to raise the temperature of room-temperature water.
   b. Devices may be constructed of and contain anything except the following materials and components:
      i. Hazardous materials, including but not limited to: asbestos, mineral wool, and fiberglass
      ii. Thermometers, probes, commercially available thermoses, coolers, or vacuum sealed devices.
      iii. A team's use of any of the hazardous materials listed in 3.b.i. means that their device will not be allowed to be set up, modified or tested. Such teams will only be allowed to participate in the written test.
   c. Within the device, participants must be able to insert and remove a 9 oz disposable plastic party cup provided by the Event Supervisor containing room-temperature water.
   d. The device, including the cup of water, must fit within a 30.0 cm x 30.0 cm x 30.0 cm cube when set up for testing.
   e. Parts of the device may be inside the cup, but no part of the device may contact the water. Nothing may be added to the water.
   f. Devices must have no energy sources (e.g., no electrical components, battery powered heaters, chemical reactions, etc.) to help warm the water. At the Event Supervisor's discretion, teams must disassemble their devices at the end of the testing period to verify the materials used in construction. A team's use of any of the materials listed in this rule will result in TS and PS scores of zero for the team.
   g. No part of the device may be significantly different from room temperature at the start of the event.
   h. Competitors must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org.

4. **COMPETITION AREA:**
   a. For each testing setup, the Event Supervisor will provide a clamp lamp with metal reflector and with a 100-125 watt heat lamp bulb. The bulb must not be tinted and may not be LED, halogen, or ceramic.
   b. The lamp will be mounted, facing down, above the Testing Surface. The Testing Surface is the surface that the team's device is placed on, like a table or countertop. Multiple identical setups may be used.
   c. The heights of the bulb and reflector above the Testing Surface must be the same for all teams. The height above the Testing Surface of the bottommost point of the bulb must be:
      i. Regionals: 40 - 50 cm height, in 5 cm increments
      ii. States: 40 - 55 cm height, in 5 cm increments
      iii. Nationals: 40 - 65 cm, in 1 cm increments



d. The Event Supervisor must mount the lamp in such a way so that the team's device can sit centered under the lamp. Any protruding parts of a lamp stand (such as the feet of the stand) must be no closer than 15 cm to the center of the bulb. See the diagram for an example.
e. The Event Supervisor will provide a source water bath, which is expected to be approximately room temperature. Event Supervisors will do their best to keep this the same for all teams.
f. The Event Supervisor will provide the thermometer for the measurement of the starting and final temperatures. The Event Supervisor thermometer may be a traditional, non-mercury thermometer or an electronic probe capable of measuring the temperature to a tenth of a degree Celsius. Multiple thermometers may be used, but, for each team, the same thermometer must be used to measure their starting and final temperatures. Non-contact thermometers are allowed. Competitors will not be allowed to use the Event Supervisor thermometers.
g. The Event Supervisor will provide one cup per team, containing 100 mL of water from the source water bath. The cup will be a disposable, clear plastic, 9 ounce party cup (approximately 3.9 - 4.0 inches tall, with a mouth of approximately 2.9-3.0 inches).

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

Part I: Written Test

a. The written test will assess the team's knowledge of thermodynamics.
b. Unless otherwise requested, answers must be in metric units with appropriate significant figures.
c. The test will consist of at least three questions from each of the following areas:
   i. Thermodynamic systems, intensive and extensive properties of a system, definition of temperature, the zeroth law of thermodynamics, temperature scales and conversions, definitions of heat-related units
   ii. Phases of matter, phase transitions, phase diagrams, latent and sensible heat, ideal gas law
   iii. Kinds of heat transfer, thermal conductivity, heat capacity, specific heat
   iv. Processes (e.g., adiabatic, isothermal, isochoric, isobaric), thermodynamic cycles, engines, efficiency, and the first and second laws of thermodynamics
   v. Historical perspective of the contributions of Kelvin, Joseph Black, Joule, Carnot, Planck, Clausius, Boltzmann, and Maxwell to the field of thermodynamics
   vi. **State/National only:** Radiant exitance, blackbody radiation, the Stefan-Boltzmann law, and the third law of thermodynamics
d. Questions on the test may use only the following mathematical content:
   i. Standard arithmetic operations, including ratios, exponents, and absolute value.
   ii. Simple algebraic manipulations, including solving one equation for one variable.
   iii. Simple geometric calculations, including computing the volume or area of common shapes.
   iv. No questions may require the use of trigonometry or calculus.

Part II: Device Testing

a. At the start of each competition block, the Event Supervisor will announce the height of the bulb above the Testing Surface, the Heating Time, room temperature, and the temperature of the source water bath. The Event Supervisor will also announce the bulb's specifications, which should include the wattage and bulb measurements. These parameters and bulb specifications must be the same for all teams, except for slight incidental variations in temperature. It is recommended that the Event Supervisor provide this information in written form. The Heating Time is:
   i. 10 minutes at Regionals,
   ii. 10 - 15 minutes at States/Nationals in 1 minute increments
b. The teams will be given 3 minutes of Device Setup Time to set up or modify their device and begin making their prediction of the water temperature at the end of the Heating Time. Teams may attempt to fix any construction violations during this time. This time is not paused for any construction re-checks. No modifications may be made to the device after the Device Setup Time finishes except for inserting/removing the cup of water.

c. The Event Supervisor, using their own measuring device and thermometer, will dispense 100 mL of water into a cup for each team and measure and record the starting temperature to the nearest tenth of a degree Celsius. The Event Supervisor will inform the team of the starting temperature of the team's water. The water may be distributed to teams at the same time or in a staggered manner. Event Supervisors will not leave a thermometer in teams' devices or measure the water temperature while the cups are in teams' devices.
d. Once a team receives their water and its Event Supervisor-measured temperature, they will have up to 1 minute of Water Setup Time to insert the cup of water into their device. Teams may not alter or manipulate the cup or the water in it beyond inserting the cup into their device.
e. At the end of the Water Setup Time, the Event Supervisor will turn on the lamp and start a timer for the Heating Time. The team may not touch their device or the lamp testing setup during the Heating Time. Teams that do so will receive a score of zero (0) for their TS and PS scores.
f. The team must finalize their prediction of the final temperature of their cup of water before the end of the Heating Time, or they will receive no Prediction Score (PS). Teams must make their prediction in degrees Celsius. Teams may also be allowed to work on the written test during the Heating Time at the discretion of the Event Supervisor.
g. At the end of the Heating Time, the Event Supervisor will turn off the lamp. The team must then completely remove the cup of water from their device and place it on the Testing Surface next to their device. The cup must be completely separated from all device components before the Event Supervisor measures the final temperature. The Supervisor will then record the final temperature to the nearest tenth of a degree Celsius. Both the team and the Supervisor should attempt to accomplish these tasks within one minute to minimize water cooling.
h. The Event Supervisor will review with the team the Part II data recorded on their scoresheet.
i. Teams filing an appeal regarding Part II must leave their device in the competition area.

6. **SCORING:**
   a. High Score wins.
   b. All scoring calculations are to be done in degrees Celsius.
   c. Final score (FS) = ES + TS + PS; The maximum possible FS is 100 points. A scoring spreadsheet is available at www.soinc.org.
   d. Exam Score (ES) = (Part I score / Highest Part I score for all teams) x 50 points
   e. Temperature Score (TS) = (TG / Highest TG of all teams) x 30 points
      i. Temperature Gain (TG) = final cup water temp - starting cup water temp
      ii. The lowest possible TG is 0 points.
      iii. A team utilizing any of the materials in rule 3.f will receive a TS of 0.
      iv. A team touching their device or the lamp testing setup during the Heating Time will receive a TS of 0.
   f. Prediction Score (PS) = (PE / Highest PE of all teams) x 20 points
      i. Prediction Estimate (PE) = 1 - abs(final cup water temp - predicted final cup water temp) / final cup water temp.
      ii. The lowest possible PE is 0 points.
      iii. A team utilizing any of the materials in rule 3.f will receive a PS of 0.
      iv. A team that does not give a final temperature prediction before the end of the Heating Time or that touches their device or the lamp testing setup during the Heating Time will receive a PS of 0.
   g. If a team violates any COMPETITION rules, their TS and PS values will be multiplied by 0.9 per violation when calculating the scores
   h. If a team has any CONSTRUCTION violations at the end of their Setup Time, their TS and PS values will be multiplied by 0.7 per violation when calculating the scores.
   i. Teams that are not allowed to compete in Part II due to unsafe operations or do not bring a device receive zero points for their TS and PS scores. Teams will be allowed to compete in Part I.
   j. Tie Breakers: 1st - Best TS; 2nd - Best ES; 3rd - preselected test questions

WATER QUALITY B

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

1. **DESCRIPTION:** Participants will be assessed on their understanding and evaluation of marine and estuary 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 Category C 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 **marine and estuary** 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: Marine and Estuary Ecology – 30% of the total score
   a. This part will use multiple choice, matching, fill-in-the-blank and/or short answers to assess participants' knowledge.
   b. Core knowledge areas may include 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, and the importance of watersheds.
   c. Additional applied topics may include: importance of estuaries, watershed resource management issues, sedimentation pollution, harmful species, recently killed coral, harmful algal blooms (HABs), emerging contaminants (e.g. medicines and chemicals like PFAS), and the five ocean garbage patches.

   Part II: Coral Reef Macroflora and Fauna Identification – 30% of the total score
   a. This part will assess participants' knowledge of coral reefs and the ecological factors that have harmful effects on reef ecosystems. It will also include the identification (common name only) of Coral Reef organisms and their importance as indicators of reef health.
   b. Participants are also expected to know the general ecology, life cycles, and feeding habits of the following organisms (note: spp. is an abbreviation for multiple species):
      i. Organisms found around the globe:
         (1) Banded coral shrimp (*Stenopus hispidus*),
         (2) Butterfly fish (*Chaetodon* spp.),
         (3) Crown of thorns starfish (*Acanthaster planci*),
         (4) Fleshy algae (**Rhodophyta, Chlorophyta, Phaephyta**),
         (5) Grouper >30 cm (Serranidae, Epinephelinae),
         (6) Hard/**Stony** corals (**Scleractinia**),
         (7) Lobsters (**Nephropidae**),
         (8) Long-spined black sea urchins (Diadematidae/Diadema spp.),
         (9) Moray eel (*Muraenidae*),
         (10) Parrotfish (>20 cm) (Scaridae),
         (11) Pencil urchins (**Eucidairis spp**.),
         (12) Sea Cucumber (Holothuroidea),
         (13) Snapper (*Lutjanidae),*
         (14) **Demosponges** (**Demospongiae**)
         (15) Sweetlips (*Haemulidae*)
         (16) Triton (***Charoniidae***/Charonia spp.).

ii. Organisms found in the Indo-Pacific region only:
   (1) Barramundi cod (*Cromileptes altivelis*),
   (2) Bumphead parrotfish (*Bolbometopon muricatum*),
   (3) Giant clams (*Tridacna* spp.),
   (4) Humphead wrasse *(Cheilinus undulatus).*
iii. Organisms found in the Atlantic region only:
   (1) Flamingo Tongue Snail *(Cyphoma gibbosum*),
   (2) Gorgonia (Octocorrallia),
   (3) Nassau grouper *(Epinephelus striatus).*

Part III: Water Monitoring and Analysis – 30% of the total score

a. Participants are expected 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 aragonite saturation and their relationships 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. **<u>SCORING</u>:**

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.Part IV.c will be 5% of the total score.
b. Preselected questions will be used as tiebreakers.

This event is sponsored in partnership with Current and the NSF Great Lakes RENEW Engine.

WRITE IT DO IT B

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

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

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

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

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 2026-2027 season, we are publishing a selection of Trial Events in the 2027 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 2027 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 2028 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.

CODE CRAZE B

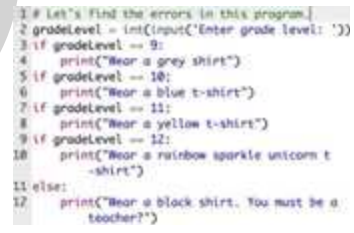
See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

1. **DESCRIPTION:** Participants will participate in quiz and coding activities designed to assess their knowledge of computer science practice module material in many areas, such as, programming concepts, AI, cryptography and programming languages (i.e., Python, Java). The annual practice module will represent the scope of material available for testing.

   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, debug and write code.
   b. Each team must bring one device capable of running Google Chrome for the purposes of competing in the event unless specified by the Event Supervisor.
   c. Each team may bring one 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. Some of the possible activity types follow.

Activity Types & Suggested Times	Activity Description	Image
Gamified Quizzes	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	Participants will be provided multiple choice questions and coding snippets. **Only the accuracy** of the response will be measured.	
Individual Debug and Coding Assessments	Participants will be provided coding challenges to debug and author. The accuracy of the result will be measured by an auto grader or event volunteer.	

4. **SCORING:**
   a. The high score wins as determined by total points.
   b. Ties will be resolved using the time rankings determined in the Gamified Quiz section.

This event is sponsored by CodeHS.

HYDRAULICS B

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

1. **DESCRIPTION:** Teams will complete a written test on density and fluid mechanics concepts and construct a hydraulic device to push objects across a surface.

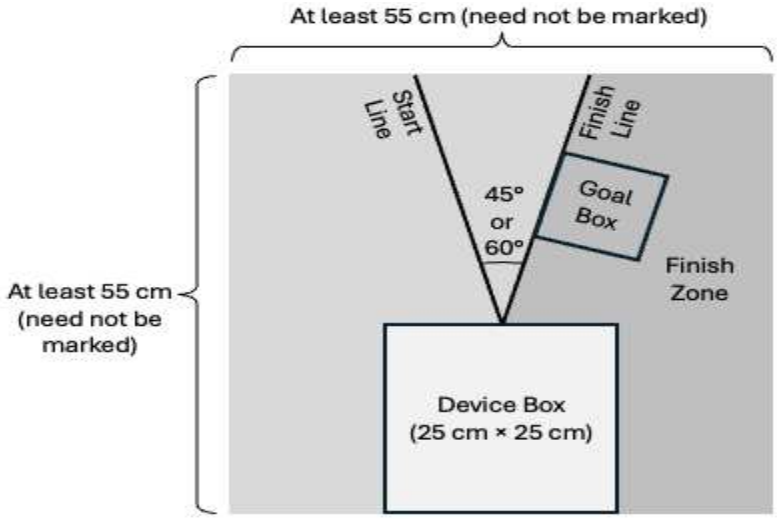
   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes

   IMPOUND: Yes **CALCULATOR:** Class III

2. **EVENT PARAMETERS:**
   a. Each team may bring writing utensils.
   b. Each team may bring two Class III calculators for use during any part of the event.
   c. Each team must impound up to one pre-constructed hydraulic device and any tools or spare parts. Teams must have all water that they need already sealed in their hydraulics in order to impound and may not impound additional water or request water from the Event Supervisor.
   d. 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, books, 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.
   e. The Event Supervisors will provide the testing materials listed in the COMPETITION AREA section. Teams should not bring these materials.

3. **CONSTRUCTION PARAMETERS:**
   a. The device must not include any energy storage devices such as batteries, springs, or rubber bands. Devices that include these items will receive a BS and TS of zero (0).
   b. The device must be operated entirely by hand-powered syringes.
      i. Hydraulic joints are operated in Control/Actuator pairs connected by tubing. Each pair has a Control Syringe, which competitors touch to push or pull on its plunger, and an Actuator Element (usually a syringe, but can be a different hydraulic element such as a balloon), which is mounted within the device to change the joint's position.
      ii. There is no limit on the number of hydraulic joints or the volume of Control Syringes/Actuator Elements.
      iii. The syringes may only contain water and/or air. The water may contain coloring.
      iv. The tubing between each Control Syringe and Actuator Element must be flexible. The Control Syringes must not be attached to the device (including to the base) except via the flexible tubing.
   c. The device must be self-supporting on a flat surface. In the ready-to-run position, the parts of the device touching the Test Surface, excluding the Control Syringes and tubing, must fit within a 25.0 cm x 25.0 cm box with no height restriction. Parts not touching the Test Surface may extend beyond this box.
   d. The device must not damage, mark, or leave residue on the Test Surface.
   e. At the Event Supervisor's discretion, the team must disassemble their device at the end of the testing period to verify the materials used in construction.
   f. Competitors must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org.

4. **COMPETITION AREA:**
   a. The Event Supervisor will provide a flat, smooth Test Surface with several boundary lines marked using 1-inch masking tape. The Test Surface must be a minimum of 55 x 55 cm and have:
      i. Device Box: A 25.0 x 25.0 cm square taped on the Test Surface. The midpoint of the front of the square must be marked.
      ii. Travel Area: A wedge-shaped area centered on the front midpoint of the Device Box. At Regionals or States, the angle of the wedge will be 45°. At Nationals, the angle of the wedge will be 60°.
      iii. Start Line: The left boundary of the Travel Area, indicated by a strip of tape at least 30.0 cm long.
      iv. Finish Line: The right boundary of the Travel Area, indicated by a strip of tape at least 30.0 cm long.
      v. Goal Box: A 10.0 x 10.0 cm square taped on the Test Surface. One side of the square is a segment of the Finish Line, extending 10.0 and 20.0 cm from the front midpoint of the Device Box. The other sides of the square are to the right of the Finish Line.
      vi. Finish Zone: The area extending to the right of the Finish Line, including the Goal Box. The Finish Zone does not include the Device Box.



b. Four 9-volt batteries will be placed upright on the Start Line with their terminals on top. They may be rotated about their vertical axis and do not have to be parallel to the Start Line. Three batteries will be designated "Movable" and one will be "Unmovable". During the Competition Time, the team will attempt to move the Movable Batteries to the Finish Zone, while not disturbing the Unmovable Battery. The Unmovable Battery must be clearly marked with tape.
   i. No part of the nearest battery may be within 3.0 cm of the Device Box, as measured along the Start Line.
   ii. No part of the furthest battery may be farther than 30.0 cm from the Device Box, as measured along the Start Line.
   iii. There must be at least 3.0 cm of open space along the Start Line between batteries.
c. Multiple identical test setups may be used to facilitate teams competing in a timely manner.

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

Part I: Written Test

a. The written test will assess the team's knowledge of density and fluid mechanics.
b. Unless otherwise requested, answers must be in metric units with appropriate significant figures.
c. The test will consist of questions from each of the following areas:
   i. Density of solids, liquids, and gases, as well as relative density, number density, and area density.
   ii. Pressure in fluids and gases, hydrostatic pressure, pressure-depth relationship, Pascal's principle.
   iii. Behavior of gases according to the gas laws: ideal gas, Boyle's, Charles', Gay-Lussac's, and Avogadro's.
   iv. Archimedes' principle, buoyancy, and stability.
   v. Hydraulic design principles and materials, mechanical advantage, common hydraulic system components, source of losses.
   vi. Concept of viscosity, Bernoulli's principle.
d. Questions on the test may use only the following mathematical content:
   i. Standard arithmetic operations, including ratios, exponents, and absolute value.
   ii. Simple algebraic manipulations, including solving one equation for one variable.
   iii. Simple geometric calculations, including computing the volume or area of common shapes.

Part II: Device Testing

a. At the start of each competition block, the Event Supervisor will reveal the Competition Area and indicate which battery is Unmovable.
   i. Teams may not swap out the part(s) of their device expected to contact the batteries after they have seen the layout of the Competition Area.
b. The team will be given 1 minute of Setup Time to set up their device in the Competition Area and fix any Construction Violations. The batteries will not be placed on the Test Surface until after the Setup Time ends. At the end of the Setup Time, the device must be in the ready-to-run position:
   i. All parts of the device touching the Test Surface, excluding the Control Syringes and tubing, are within the Device Box. (The device may touch the Test Surface outside the Device Box after the Run Time begins.)

ii. The part of the device expected to contact the batteries is approximately aligned with or extended over the Finish Line.
iii. The competitors are not touching any part of the device, including the Control Syringes.

c. The team will have up to 3 minutes of Run Time to attempt to move the Movable Batteries into the Finish Zone, while attempting not to disturb the Unmovable Battery. A Movable Battery is considered to be in the Finish Zone as long as it has crossed the Finish Line and is not touching either the Finish Line or the Device Box.
   i. Additional points will be earned if the Movable Batteries in the Finish Zone are upright.
   ii. Additional points will be earned if the Movable Battery that started the farthest from the Device Box ends in the Finish Zone.
   iii. Points will be deducted if the Unmovable Battery is no longer upright or is no longer touching the Start Line.
d. During the Run Time, competitors may touch only the Control Syringes. Competitors must not touch any other part of the device, the batteries, or the Test Surface.
e. If the device stops, jams, or fails, the participants will be allowed to adjust it as necessary to continue operation up to two times. An adjustment may consist of multiple physical touches and is only completed once the device runs again on its own. An adjustment may not result in the movement of any batteries. Each adjustment will incur a penalty. The Run Time does not stop during adjustments.
f. If the device leaks, testing will be halted immediately and the team will have no additional opportunities to score. If a team's device leaks before the Run Time, the device will not be tested.
g. The Run Time ends when either three minutes have passed, the team declares that they are finished, or the device leaks, whichever comes first.
   i. The Run Time will be recorded as 4 minutes if the device leaks or if all three Movable Batteries are not in the Finish Zone when the Run Time ends. Otherwise, the actual Run Time will be recorded.
h. The Event Supervisor will review with the team the Part II data recorded on their scoresheet.
i. Teams filing an appeal regarding Part II must leave their device in the competition area.

6. **SCORING:**
   a. High Score wins.
   b. Final score (FS) = ES + BS + TS. The maximum possible FS is 70 points. A scoring spreadsheet is available at www.soinc.org.
   c. Exam Score (ES) = (Part I score / Highest Part I score of all teams) x 40 points
   d. Battery Score (BS) = (Each Movable Battery fully in the Finish Zone x 3 points) + Goal Bonus + Upright Bonus - Unmovable Penalty - Adjustment Penalty
      i. Goal Bonus = 2 points x (Each Movable Battery entirely within the Goal Box)
      ii. Upright Bonus = 2 x (Each Movable Battery in the Finish Zone that is upright)
      iii. Unmovable Penalty = 7 points if the Unmovable Battery is displaced
      iv. Adjustment Penalty = 4 points each time the device is adjusted
      v. The lowest BS score = 0
   e. Time Score (TS) = 9 x (Lowest Run Time of all teams / Team's Run Time)
      i. Teams with a leaking device or without all three Movable Batteries in the Finish Zone receive a Time Score of 0.
   f. Teams that are not allowed to compete in Part II due to unsafe operations, do not bring a device, or violate rule 3.a. will receive zero points for their BS and TS scores. These teams will be allowed to compete in Part I.
   g. If a team has any CONSTRUCTION violations (other than rule 3a) at the end of their Setup Time, their BS and TS values will be multiplied by 0.7 per violation when calculating the scores.
   h. If a team violates any COMPETITION rules, their BS and TS values will be multiplied by 0.9 per violation when calculating the scores.
   i. If a team does not impound their device and all spare parts and tools, their BS and TS values will be multiplied by 0.5.
   j. Tie Breakers: 1st - Best TS; 2nd - Best ES; 3rd - preselected test questions.

PROTEIN BUILDERS B

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

1. **DESCRIPTION:** Participants will build a physical model of a short polypeptide at the tournament using free-form backbone material and amino acid sidechains, and will be assessed on their understanding of how amino acid properties determine protein structure and function.

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

2. **EVENT PARAMETERS:**
   a. Each team may bring writing utensils.
   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, that may contain information on both sides in any form and from any source without any affixed labels.
   c. Each team must bring one ruler or one meterstick.
   d. Event Supervisors will provide:
      i. A 1.0 m Modeling Tie that will serve as a polypeptide backbone.
      ii. Amino acid sidechain models with property-color-coding clips to attach to the Modeling Tie.
      iii. Amino acid sidechain chart that identifies each amino acid and it's chemical property.
      iv. All sequences to be modeled, any labels or flags used during judging, and all copies of the written exam.

3. **THE COMPETITION:**
   a. General format
      i. This is a hybrid event combining an on-site modeling build and a written exam, both completed during the event time.
      ii. At the start signal, each team will receive one amino acid sequence from the Event Supervisor.
      iii. Sequences will be provided as amino acid three-letter codes.
   b. Modeling build (approximately 30 minutes)
      i. Teams will have approximately 30 minutes to construct a model of the assigned sequence using only the materials described in 2.d.
      ii. Participants must:
         (1) Place amino acid sidechains along their backbone in the correct primary sequence order, approximately 5 cm apart along the backbone.
         (2) Clearly indicate the N-terminus and C-terminus on the finished model.
         (3) Fold the polypeptide model to reflect reasonable tertiary structural features based on sidechain properties and the provided structural context (e.g., clustering hydrophobic residues, placing polar/charged residues on the surface, forming disulfide bonds between cysteines when appropriate).
      iii. Event Supervisors may provide a brief written description of a target structural context (for example, soluble globular protein in aqueous solution, surface-exposed segment, or buried core) to guide folding choices.
      iv. Supervisors may require teams to label specific features on their model, such as: hydrophobic core residues, surface polar residues, an ionic interaction (salt bridge), a disulfide bond, or a putative hydrogen-bonding pattern.
      v. At the end of the modeling period, teams will place their model in a designated area for scoring and will not handle it again until released by the Event Supervisor.
   c. Written exam (approximately 20 minutes)
      i. The written exam will increase in difficulty from regionals through nationals and may involve a station format that involves observing sample model(s).
      ii. Exam content will include, but is not limited to:
         (1) Primary, secondary (alpha helices and beta sheets), and tertiary structure and how these levels are related.
         (2) Chemical properties of amino acid sidechains (hydrophobic, polar, acidic, basic, glycine, proline, cysteine) and their roles in folding and stability.

(3) Major non-covalent and covalent interactions important for protein structure: hydrogen bonds, ionic interactions, hydrophobic effect, and disulfide bonds.
(4) Simple structure–function reasoning, such as predicting how a specified amino acid substitution or environmental change (e.g., pH, polarity of environment) might alter the fold or stability of the modeled sequence.
(5) Interpretation of simple diagrams of helices, sheets, and loops appropriate for Division B.
(6) At least one question will reference a modeled sequence and ask how the protein's structure would be expected to change if a specific amino acid change were introduced; teams will answer in writing without altering the physical model.

4. **SCORING:**
   a. High Score wins.
   b. Approximately 60% of the total score will be based on the modeling build and 40% on the written exam.
   c. Modeling build: points may be awarded for:
      i. Correct sequence order and complete placement of required sidechains.
      ii. Correct identification and clear labeling of N- and C-termini.
      iii. Evidence that hydrophobic and hydrophilic residues are arranged in a chemically reasonable way for the given structural context (e.g., formation of a hydrophobic interior and polar surface in a soluble protein).
      iv. Presence and correct placement of at least one stabilizing interaction (e.g., a reasonable salt bridge, disulfide bond between cysteines, or hydrogen-bonding pattern) when requested.
      v. Overall three-dimensional compactness and plausibility of the fold.
   d. Assessment Procedure
      i. Teams will submit their completed model on a table in the orientation they want their model assessed and then will leave the assessment area
      ii. The Event Supervisor will assess the model on the table without picking it up and may view it from any angle
      iii. The Event Supervisor will photograph the model before any manipulation
      iv. Tertiary structure and sidechain interactions will be assessed first in the team's chosen orientation
      v. The backbone may then be straightened to verify amino acid order and spacing
      vi. Teams will not be penalized for disassembly during straightening if the original construction was sound
   e. Written exam: points will be assigned for correct answers, with emphasis on conceptual understanding and the ability to connect amino acid properties to protein structure and function.
      i. Preselected exam questions, especially those requiring analysis of the modeled sequence or explanation of structure–function relationships, will be used as tiebreakers.

This event is sponsored by 3D Molecular Designs and supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number R44GM154526.

DIV. B CHEMISTRY LAB EQUIPMENT LIST

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

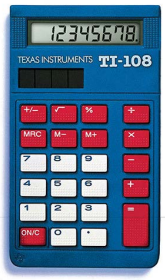
Each team may bring any or all of the items listed below for use in Division B Chemistry Events. Teams not bringing these items will be at a disadvantage as Event Supervisors will not provide the listed lab equipment. A penalty of up to 10% may be given if a team brings prohibited lab equipment to the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

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

CALCULATOR CLASS DESCRIPTIONS

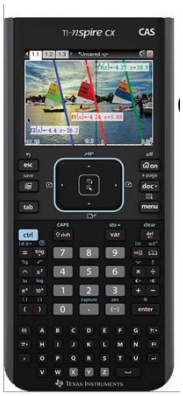
See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

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



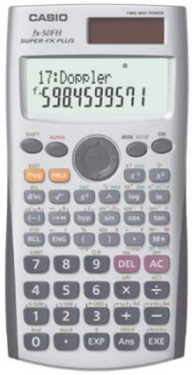
Class I - Stand-alone non-graphing, non-programmable, non-scientific 4-function or 5-function calculators are the most basic type of calculators and often look like the one shown to the right. These calculators are limited to the four basic mathematics functions and sometimes square roots. These calculators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

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

2027 National Tournament Division B Schedule
Ohio State University, Columbus, Ohio
May 14-15, 2027

Event	7:00 – 8:00 AM	8:15 - 9:15 AM	9:30 – 10:30 AM	10:45 – 11:45 AM	11:45 -12:30 BREAK	12:30 – 1:30 PM	1:45 – 2:45 PM	3:00 – 4:00 PM	7:30– 9:30 PM
Anatomy & Physiology B		11-20	21-30	31-40		41-50	51-60	1-10	
Boomilever B		Self-Schedule							
Botany B		41-50	51-60	1-10		11-20	21-30	31-40	
Circuit Lab B		31-40	41-50	51-60		1-10	11-20	21-30	
Codebusters B		1-10	11-20	21-30		31-40	41-50	51-60	
Crime Busters B		11-20	21-30	31-40		41-50	51-60	1-10	
Disease Detectives B		1-10	11-20	21-30		31-40	41-50	51-60	
Dynamic Planet B		31-40	41-50	51-60		1-10	11-20	21-30	
Elastic Launched Glider B		Self-Schedule							
Experimental Design B		51-60	1-10	11-20		21-30	31-40	41-50	
Food Science B	Impound	31-40	41-50	51-60		1-10	11-20	21-30	
Heredity B		21-30	31-40	41-50		51-60	1-10	11-20	
Hovercraft B	Impound	Self-Schedule							
Meteorology B		41-50	51-60	1-10		11-20	21-30	31-40	
Ping Pong Parachute B		Self-Schedule							
Remote Sensing B		1-10	11-20	21-30		31-40	41-50	51-60	
Rocks and Minerals B		21-30	31-40	41-50		51-60	1-10	11-20	
Roller Coaster B	Impound	Self-Schedule							
Scrambler B	Impound	Self-Schedule							
Solar System B		51-60	1-10	11-20		21-30	31-40	41-50	
Thermodynamics B	Impound	21-30	31-40	41-50		51-60	1-10	11-20	
Water Quality B		51-60	1-10	11-20		21-30	31-40	41-50	
Write It Do It B		11-20	21-30	31-40		41-50	51-60	1-10	

Closing Ceremony

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: The Ohio State University (2027 National Tournament Host), University of Southern California (2026 National Tournament Host), Science Olympiad USA Foundation, Atwell Gives Foundation, Avantor Foundation, Ward's Science, Air Force, Cleveland-Cliffs Foundation, Combined Federal Campaign, Illinois Quantum and Microelectronics Park (IQMP), P33, International Motors, Aerospace Corporation, Amcor Cares Foundation, Cambridge Centre for International Research (CCIR), Centers for Disease Control and Prevention (CDC), CodeHS, Current and the NSF Great Lakes RENEW Engine, Discovery Education 3M Young Scientists Challenge, Double Good Foundation, IEEE Geoscience and Remote Sensing Society (GRSS), InGenius Prep, Kinder Morgan Foundation, National Free Flight Society, National Oceanic and Atmospheric Administration (NOAA) and North American Association for Environmental Education (NAAEE), OnShape, Prequel, SkyCiv, TKS World, Empowerly, Investing in Communities, MDRT Foundation and Yale Young Global Scholars. Strategic Partners: American Red Cross, 3D Molecular Designs, Google, Japan Science and Technology Agency, mHUB, Midnight Science Club, MxD Digital Manufacturing Institute, NBCUniversal 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 digital items in the Science Olympiad Store.

Science Olympiad

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