SCIENCE OLYMPIAD™

Exploring the World of Science

Division B Rules Manual

Division B (Gr. 6-9)

WELCOME TO THE 2022 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 $60, paid as part of the state membership). There is no exception to this requirement, regardless of what teams from the same school are called (Varsity, JV, Alternate Team, Extra Team, Team Two, Team B). No school, region or state Science Olympiad organization is allowed to alter or amend these national membership requirements. Please see the Science Olympiad Copyrights and Use Statement outlining use of Science Olympiad Rules and procedures at sanctioned tournaments.

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

SCIENCE OLYMPIAD
DIVISION B RULES MANUAL

Table of Contents

- Please read the General Rules - 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, Clarifications/Rules Changes, FAQs, New Store Items, news, tips, resources, and other valuable information.

TOURNAMENT FORMATS

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

While the COVID-19 situation still changes daily, Science Olympiad has developed a series of models for tournaments which will allow State Chapters to start the season with enough options and flexibility to provide registered Science Olympiad teams with a safe and positive experience, no matter how students are learning or how local situations evolve. These models are the result of thoughtful conversations that spanned the entire Science Olympiad community. We would like to thank everyone for their candor, thoughtfulness, and creativity. In the end, we feel we were able to create options that acknowledge that circumstances vary across the US while maintaining the spirit and goals of the organization.

In-Person, Single-Location Tournaments - The Gold Standard

The expectation for the 2022 season is that if health conditions in your region/state allow for traditional in-person, single-location tournaments, your State Chapter will provide that experience for teams, qualifying them all the way through to our 2022 Science Olympiad National Tournament in partnership with the California Institute of Technology on May 14, 2022. In order to achieve this expectation, our State Chapters are ready to provide accommodations due to local public health regulations. Additionally, participants will be asked to sign a COVID-19 release.

Satellite SO

This is a new model that accounts for situations where students are physically attending school, but large public gatherings in a single location are prohibited. A Satellite SO Tournament will take place over the course of a few days after school with each team competing from their own school. This format requires that Tournaments use tech tools that schools and teachers have been using these last few months like Zoom, Google Classroom, Google Meet, Microsoft Teams and Facebook Live that have opened up new ways to communicate, learn and gather for events. This model presents shortfalls when compared to a traditional tournament, especially with regard to the scope of hands-on activity, but it capitalizes on the amount of time Science Olympiad teams are encouraged to spend in months-long preparation for competition – building, breaking, studying, making binders, taking quizzes, and prepping log books. Teams will need to accept these limitations willingly, understand the academic honor code will be in full force, and that they will need to abide by a safety agreement provided by Science Olympiad, Inc.

Mini SO

This model accounts for situations where students are unable to physically attend school and are distance learning from their homes by allowing some events to be run at home. Since students will be at home without faculty supervision, no hands-on events will be allowed to run. A chart showing acceptable events can be found online at soinc.org. As with Satellite SO, this model presents shortfalls when compared to a traditional tournament, especially with regard to the scope of hands-on activity. Teams will need to accept these limitations willingly and understand the academic honor code will be in full force. This model can be delivered through a variety of tech platforms, via email, or even postal mail if needed.

EVENT TYPE DESCRIPTIONS

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

A Science Olympiad tournament typically consists of 23 different events, and those 23 events can be classified into one of four event types. This information is being provided so that Science Olympiad participants can more easily 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 might 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 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, and/or computer test.

Core Knowledge Events can be run regardless of the tournament format that has been chosen by the State Chapter and 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 cancellation of Lab Events. To the greatest extent possible, Tournament Directors will work to ensure Lab Events are conducted, though that may mean hands-on activities are omitted and participants will work with previously collected data. 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 combines elements from two or more of the above event types. The most common combination mixes elements of a Core Knowledge Event with elements of a Build 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 altered or not to be run at a tournament, the Tournament Director will notify all teams in advance of the given tournament.

GENERAL RULES

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

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

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

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

COVID-19 PANDEMIC RULES MODIFICATIONS

The COVID-19 pandemic requires that some general modifications be made to the Event Rules listed in this manual in order to permit Science Olympiad competitions to continue in a way that reflects best public health, disease prevention, and personal safety practices. The modifications listed here will be in effect for all Science Olympiad competitions, regardless of level (e.g., Invitational, Regional, State, National), or type (e.g., In-Person, Satellite SO, mini SO). As the pandemic is evolves, these modifications may be amended or rescinded according to local conditions. If changes are made, the Tournament Director for the affected tournament will make an announcement to all participating teams as soon as possible.

1. If not already allowed, each individual participant can have a personal set of reference materials (e.g., binders, single sheets of paper), calculator, or other academic resource as specified in the specific event rule for use during the competition to facilitate social distancing, isolation, and to prevent resource sharing. Personal sets of resource materials must meet all the criteria established in the specific event rule. This does not apply to Recommended Lab Equipment for Division B or Division C Chemistry Events or tool kits for Build Events.
2. Given local conditions, participants may not be able to be in the same location as their partner during competition. Tournaments will allow designated partners to compete from separate locations and competing teams will only need one device for Build or Hybrid with Build Events.
3. At the discretion of the Tournament Director, portions of Hybrid Events containing hands-on activities as well as Build and Lab Events may be dropped from the tournament or be conducted as trial events.
4. At the discretion of the Tournament Director and Event Supervisors, completion time may be used as a tiebreaker for Core Knowledge and other events where a written or online test is used.

ANATOMY & PHYSIOLOGY

1. **DESCRIPTION:** Participants will be assessed on their understanding of the anatomy and physiology for the human **Nervous, Sense Organs, and Endocrine** systems.

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

2. **EVENT PARAMETERS:** Each team 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 along with two stand-alone non-programmable, non-graphing calculators.

3. **THE COMPETITION:** This Event may be administered as a written test or as series of lab-practical stations which can include but are not limited to experiments, scientific apparatus, models, illustrations, specimens, data collection and analysis, and problems for students to solve. Content topics will include:

   a. **Nervous System:**
      i. The Brain - major regions and their functions
      ii. Identification of simple encephalographic wave forms and why they occur
      iii. Neural Impulses - cellular anatomy and physiology of neurons and supporting cells, synapses and neurotransmitters, action potential generation and propagation, ionic basis of the cellular membrane potential, types of neural synapses
      iv. Central Nervous System - organization of the spinal cord, brainstem and cranial nerves, purpose/functions of sleep
      v. Peripheral Nervous System – neural ganglia, action and physiology of sensory and motor neurons, action and physiology of sympathetic and parasympathetic neurons, understand differences in and purposes of parasympathetic, sympathetic, somatic, and sensory systems, reflex arcs and proprioception, nerve structure
      vi. Disorders: Epilepsy, Alzheimer's Disease, Multiple Sclerosis, Parkinson's Disease, Cerebral Palsy, Shingles (herpes zoster), Stroke, Amyotrophic Lateral Sclerosis (ALS)
      vii. Effects of the drugs: alcohol, caffeine, nicotine, and marijuana on the nervous system
      viii. **National Tournament Only:**
         (1) **The Brain - anatomy and physiology of brain function including function and role of specific nuclei clusters and tracts, theories of dreaming, neural impulses - retrograde signaling, purpose and principles of MRIs and EEGs**
         (2) **Treatments and/or prevention (e.g.; drugs, surgery) for all conditions listed above**

   b. **Sense Organs:**
      i. Types of sensory receptors, General Senses vs. Special Senses
      ii. Mechanisms for the General Senses of touch, pressure, pain, temperature, itch, and proprioception
      iii. Sense Organs – regions of each of the Special Sense Organs and their functions
      iv. Physiology of sight, hearing, balance, smell, and taste
      v. Disorders: myopia, hyperopia, presbyopia, nyctalopia, astigmatism, conjunctivitis, color blindness, otitis media, types of deafness, Anosmia/dysosmia, dysgeusia
      vi. National Tournament Only:
         (1) Neural pathways for vision, depth perception, and hearing
         (2) Additional Disorders: Diabetic Retinopathy, Macular Degeneration, Glaucoma, Otosclerosis, Presbycusis, Meniere's Disease, Pink Eye (conjunctivitis) plus treatments and/or prevention of all conditions listed above

   c. **Endocrine System:**
      i. The three classes of hormones – steroids, peptides, and amines
      ii. Mechanisms of hormone action – nuclear vs. cytoplasmic
      iii. Endocrine related problems – hypersecretion, hyposecretion
      iv. Hormone producing glands, their hormones and the function of each
      v. Disorders: diabetes mellitus, hypoglycemia, Graves' disease, Hashimoto's disease, goiter, cretinism
      vi. National Tournament Only:
         (1) Endocrine cycles and negative feedback
         (2) Autonomic nervous system control of endocrine function
         (3) Additional Disorders: Cushing's Syndrome, Addison's Disease, and Myxedema, acromegaly
         (4) Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)

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

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

This event is sponsored by Hikma Pharmaceuticals

BIO PROCESS LAB

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

1. **DESCRIPTION:** This event is a lab-oriented competition involving the fundamental science processes of a middle school life science/biology lab program.

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

2. **EVENT PARAMETERS:**

   Each team 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 along with two stand-alone non-programmable, non-graphing calculators.

3. **THE COMPETITION:**

   This event will consist of a series of lab stations. Each station will require the use of process skills to answer questions and/or perform a required task such as formulating and/or evaluating hypotheses and procedures, using scientific instruments to collect data, making observations, presenting and/or interpreting data, or making inferences and conclusions.

4. **SAMPLE STATIONS:**

   a. Formulating and/or evaluating hypotheses and procedures
   b. Making predictions
   c. Making observations and collecting data by measuring length, volume, temperature, pH, and mass using a variety of traditional and electronic tools (e.g., rulers, calipers, pipettes, graduated cylinders, balances, thermometers, and electronic probes)
   d. Using compound microscopes and stereomicroscopes as measurement and identification tools
   e. Interpreting data in the forma of tables, charts, graphs, food labels, food webs, flow charts, pedigrees, karyotypes, etc.
   f. Making simple calculations such as area, density, percentages, averages (mean, median, mode)
   g. Determining genetic ratios and probabilities
   h. Using or formulating a taxonomic/dichotomous key
   i. Using indicators
   j. Making inferences and conclusions based upon data and observations

5. **SCORING:**

   a. **High score wins.**
   b. **Points will be awarded for correct answers and/or proper technique.**
   c. **Selected questions will be used to break ties.**

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

BRIDGE

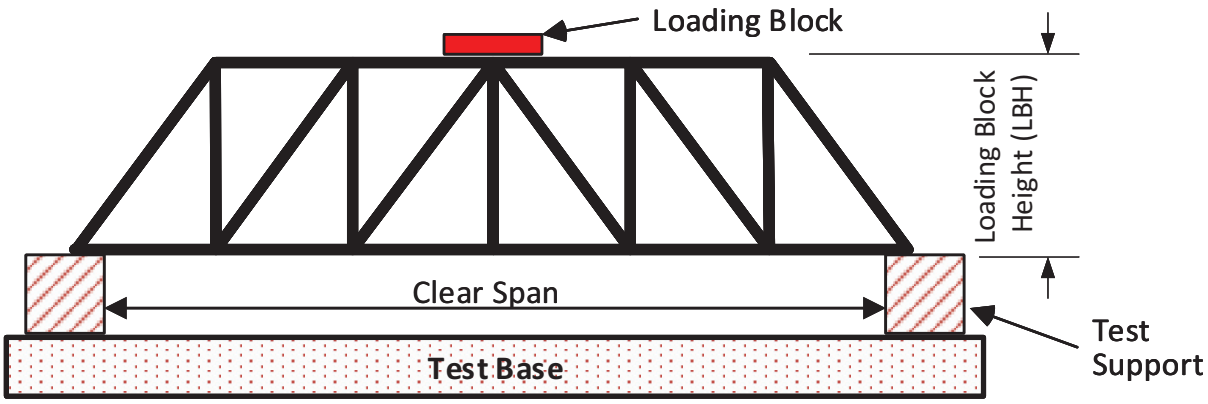
See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

1. **DESCRIPTION:** Teams will design and build a Bridge (Structure) meeting requirements specified in these rules to achieve the highest structural efficiency.

   A TEAM OF UP TO: 2 **IMPOUND:** No **EYE PROTECTION:** B **EVENT TIME:** 6 minutes

2. **EVENT PARAMETERS:**
   a. Each team is allowed to enter only one Structure, built prior to the competition.
   b. All participants must properly wear eye protection at all times. Participants not wearing proper eye protection will not be allowed to compete and be placed in Tier 3.
   c. Participants may NOT bring any equipment such as levels or squares.
   d. The Event Supervisor will provide the Test Apparatus (see Section 6) and tools/materials for measurement.

3. **CONSTRUCTION PARAMETERS:**
   a. The Bridge must be a single structure with no separate, loose, sliding, or detachable pieces, constructed of wood, and bonded by adhesive. No other materials are permitted.
      i. 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 members formed of sawdust, wood shavings, and adhesive. Wood may never be painted, soaked, or coated in glue, color enhanced, or have tape/preprinted/paper labels affixed. Ink barcodes or markings from the construction process may be left on the wood.
      ii. There are no limits on the cross-sectional sizes of individual pieces of wood. Wood may be laminated by the team without restriction.
      iii. 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 glues). Adhesive tapes are not allowed.
   b. The Bridge must be designed to sit on top of the Test Supports and support the Loading Block of the Loading Assembly (6.d.) at the center of the spanned opening.
   c. **Division B Dimensions:**
      i. **The Bridge must be designed to hold the Loading Block at a Loading Block Height (LBH) of at least 10 cm above the Test Supports.**
      ii. **A 7 cm high by 4 cm wide Pass Thru Block (6.c.) must be able to pass horizontally through the Bridge, under the Loading Block position, from one end of the Bridge's Test Support point to the adjacent Test Support point.**
      iii. The Clear Span will be 35 cm.
   d. **Division C Dimensions:**
      i. **The Bridge must be designed to hold the Loading Block at a Loading Block Height (LBH) of at least 15 cm above the Test Supports.**
      ii. **A 12 cm high by 7 cm wide Pass Thru Block (6.c.) must be able to pass horizontally through the Bridge, under the Load Block position, from one end of the Bridge's Test Support point to the adjacent Test Support point.**
      iii. **The Clear Span will be 45 cm.**
   e. Before loading, no portion of the Bridge may be below the plane defined by the top of the Test Supports.
   f. Participants must be able to answer questions regarding the design, construction, and operation of the structure per the Building Policy found on www.soinc.org.



4. **DESIGN LOG:**
   a. **Teams must submit a Design Log with documentation of bridges tested prior to competition. Each bridge documented must include at least:**
      i. **Materials used**
      ii. **Sketch of the design**
      iii. **Weight and other dimensions of the bridge**
      iv. **Appropriate metric units for all numerical values**
      v. **Predictions: Load held & weak points**
      vi. **Test results: Load held & breaking point(s)**
      vii. **Observations & recommended design improvements**
      viii. **A front cover labelled with the Team Name and the Team Number for the current tournament**
   b. **If a laser cutter, CNC machine or similar device was used as a tool to build the team's device, or any component thereof, the following information must also be supplied in the log.**
      i. **Information about the tool hardware, software, materials, and supplies used**
      ii. **Details of the source of any digital files (e.g.; CAD, STL, OBJ) utilized by the tool including but not limited to when and where the file was obtained, including the web address if downloaded from the internet**
      iii. **Descriptions of how the team constructed the final device from the tool created components**
   c. **All submitted logs will be returned to teams.**

5. **THE COMPETITION:**

Part I: Check-In

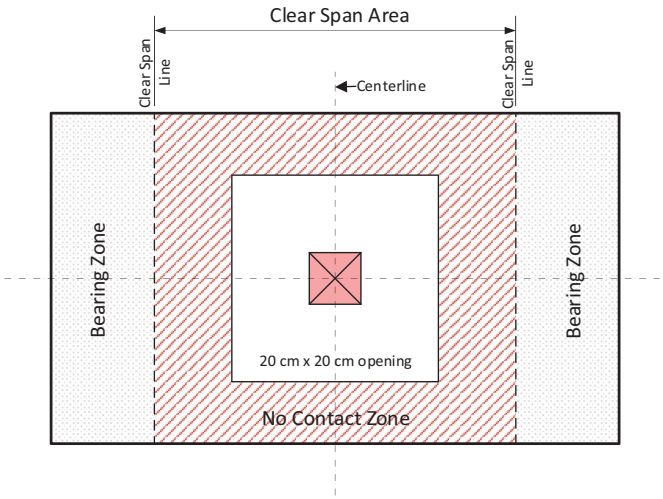
a. The team must present their Structure for inspection & measurement.
b. The team must place their Structure on the Structure Scale (6.g.) so the Event Supervisor can determine the mass, in grams to the nearest 0.01 g or best precision available.
c. The team must submit their estimated Load Supported (5.Part II.g.) to be used as a tiebreaker.
d. No alterations, substitutions, or repairs may be made to the Structure after the check-in process has started.
e. Prior to Part II: Testing, the Event Supervisor will verify that the combined mass of the Loading Assembly and sand is at least 15,100 g, but no more than 15,200 g.

Part II: Testing

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. Participants will have 6 minutes to set up and test their Structure to maximum load or failure.
c. The participants must place the Structure on the Test Supports within the Bearing Zone (6.a.iv.) of the Test Apparatus. They will then place the Loading Assembly as required to load the Structure. If necessary, participants may disassemble & reassemble the Loading Assembly. If the Loading Assembly is disassembled & reassembled it must retain the original sequence with no loose pieces and the opposing force must always be on the bottom of the Loading Block. The bucket must be mounted to allow enough clearance above the floor for the bucket to tilt or the structure to deflect.
d. The participants will be allowed to adjust the Structure until they start loading sand. Once loading of sand has begun, the Structure must not be further adjusted.
e. Prior to loading, the Event Supervisor will verify that:
   i. The Test Supports are properly placed on the Test Base
   ii. The Structure is placed properly on the Test Supports and the loading point must be within 2 cm of the center of the span.
   iii. No portion of the bridge is below the top of the Test Supports for the entire length of the Bridge.
f. Participants will load the sand into the bucket and be allowed to safely and effectively stabilize the bucket from movement caused by sand loading. Direct contact with the bucket by participants is NOT allowed. The bucket may only be stabilized by using the tips of the provided Bucket Stabilizing Sticks (6.f.). The bridge may deflect below the top of the Test Supports but may not touch the Test Base.
g. Loading stops immediately when the Structure Failure occurs, or time expires. Structure Failure is defined as the inability of the Structure to carry any additional load, if any part of the load is supported by anything other than the Structure or the Structure touches the Test Base. Incidental contact of the chain/eyebolt with the structure is not a failure.

h. Once loading stops, any parts of the Structure in the bucket will be removed. The Load Supported (mass of the Loading Assembly and the sand in the bucket) will be recorded to the nearest gram or best precision available. The minimum Load Supported is the mass of the Loading Assembly. The maximum Load Supported is 15,000 g.
i. At the Event Supervisor's discretion, more than one Test Apparatus may be used. Teams may be given a choice of which apparatus they will use.
j. The Event Supervisor will review with the team the data recorded on their scoresheet.
k. Teams who wish to file an appeal must leave their structure with the Event Supervisor.

6. **TEST APPARATUS:**
   a. The Test Base shall be a solid, level surface as follows:
      i. At least 55.0 cm long x 32.0 cm wide, stiff enough that it does not bend noticeably when loaded
      ii. Shall have a smooth, hard surface (e.g., metal, high-pressure plastic laminate)
      iii. Shall have an opening at its center approximately 20.0 cm x 20.0 cm
      iv. A Centerline and parallel Clear Span Lines shall be marked across the width of the surface of the Test Base. The Centerline shall divide the Test Base in half; Clear Span Lines to each side of the center line at 17.5 cm for Division B (35 cm span), or 22.5 cm for Division C (45 cm span) to indicate the Bearing Zones.



   b. The Test Supports shall meet the following requirements:
      i. Two identical, unfixed supports will be supplied
      ii. Must be at least 1-1/2 inches by 1-1/2 inches by 6 inches but not greater than 2 inches by 2 inches by 6 inches
      iii. Made of a material that it does not noticeably compress when loaded and have smooth, hard surfaces (e.g., hard wood, metal, high-pressure plastic laminate)
      iv. Must be able to rest flat on the Test Base
   c. **The Pass Thru Block shall be a solid light weight material (such as wood or plastic) for passing through the bridge with a minimum 50 cm dowel securely attached to the height & width face.**
      i. **Division B: Block size shall be 7 cm high by 4 cm wide by approximately 1 cm thick but not more than 2 cm thick**
      ii. **Division C: Block size shall be 12 cm high by 7 cm wide by approximately 1 cm thick but not more than 2 cm thick**
   d. 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 8 mm drilled in the center of the 5 cm x 5 cm faces for a ¼" threaded eyebolt
      ii. ¼ inch threaded eyebolt (1-inch nominal eye outside diameter), minimum 2 ¼ inch length to a maximum 4 ½ inch length, 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. The loading block cannot sit on top of the wing nut or be loose.
      iii. A chain and S-hook that are suspended from the eyebolt on the Loading Block

iv. An approximately 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 1.5 kg

e. Sand: sand or other clean, dry free-flowing material.
f. Two (2) Bucket Stabilizing Sticks each made from a piece of ½" dowel approximately 18 inches long with a spring-type door stop screwed into one end. Refer to example on www.soinc.org.
g. **Structure Scale: Scale shall have minimum resolution of 0.1 grams; recommended resolution is 0.01 grams.**
h. **Sand Scale & Load Verification: Scale shall have minimum resolution of 10 grams; recommended resolution is 1 gram.**

7. **SCORING:**

a. High score wins. Score = Load Score (g)/Mass of Structure (g).
b. The Load Score= Load Supported (5.Part II.h)+ Bonus (7.c).
c. Structures that have a Load Supported of 15,000 g will earn a Bonus of 5,000 g.
d. Structures will be placed in three tiers as follows:
   i. Tier 1: Holding any load and meeting all construction parameters and competition requirements
   ii. Tier 2: Holding any load with any violations of the construction parameters and/or competition requirements and/or not submitting a Design Log
   iii. Tier 3: Unable to be loaded for any reason (e.g., cannot accommodate or hold Loading Assembly, failure to wear eye protection) and will be ranked by lowest mass
e. Ties are broken as follows:
   i. Estimated Load Supported closest to, without exceeding, the actual Load Supported
   ii. Lowest Structure mass
f. Example score calculations:
   i. Structure 1: mass= 10.12 g, Load Supported= 12,134 g; Score= 1,199
   ii. Structure 2: mass= 12.32 g, Load Supported= 15,000 g + 5,000 g (Bonus) = 20,000 g; Score= 1,623

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

This event is sponsored by SkyCiv

CODEBUSTERS

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

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

2. **EVENT PARAMETERS:**
   a. Teams must bring writing utensils and may bring up to three (3) stand-alone non-graphing, non-programmable, non-scientific 4-function or 5-function calculators.
   b. No resource materials, except those provided by the Event Supervisor, may be used.
   c. The Event Supervisor will provide scratch paper for each team to use. **In remote tournament formats, teams may provide their own scratch paper, which should be blank paper free of any additional markings, symbols, or notes.**
3. **THE COMPETITION:**
   a. **This event consists of participants using cryptanalysis techniques and advanced ciphers to decrypt and encrypt messages 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 codes types that may be used at Division B & C Regional Tournaments are as follows:**
      i. the Caesar Cipher, also called a shift cipher
      ii. **Monoalphabetic substitution using K1, K2, or random alphabets as defined by the American Cryptogram Association (ACA)**
         (1) Aristocrats with a hint - messages with spaces included
         (2) Aristocrats - messages with spaces included, but without a hint
         (3) Aristocrats - messages with spaces and hints, but including spelling/grammar errors
         (4) Aristocrats - messages with spaces and including spelling/grammar errors but no hints
         (5) Patristocrats with a hint - messages with spaces removed, and with a hint
         (6) Patristocrats - messages with spaces removed, but without a hint
      iii. the Affine Cipher - encrypting plaintext or decrypting ciphertext given the a and b values
      iv. the Vigenère Cipher- Encrypting plaintext or decrypting ciphertext given a key
      v. 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)
      vi. Xenocrypt - no more than one cryptogram can be in Spanish
      vii. the Pollux and Morbit Ciphers - decrypting Morse code ciphertext encoded as digits and spaces given the mapping of at least 6 of the digits
   f. **Division B Only - The following code type may also be used at Regional Tournaments:**
      i. **The Atbash Cipher (In English, not Hebrew)**
   g. **Division C Only - The following code types may also be used at Regional Tournaments:**
      i. **For Mono-alphabetic substitution ciphers, a K3 alphabet as defined by the ACA may also be used**
      ii. **For aristocrats, patristocrats and xenocrypts encoded using a K1, K2 or K3 alphabet, the answer requested can be the keyword or key phrase used to construct the alphabet instead of the deciphered text**
      iii. **The Hill Cipher - Encrypting plaintext or decrypting ciphertext given a 2x2 decryption matrix**
      iv. **The Porta Cipher - Encrypting plaintext or decrypting ciphertext given a key**
      v. **The Rail Fence cipher - Decrypting transposed text given the number of rails and an unknown offset**
   h. The code types that may be used on the exam at State and National competitions are as follows:
      i. All Invitational and Regional code types
      ii. Xenocrypt - at the state and national levels, at least **one cryptogram** will be in Spanish
      iii. Cryptanalysis of the Vigenère cipher with a "crib" of at least 5 plaintext characters
      iv. Cryptanalysis of the Affine Cipher with a "crib" of at least 2 plaintext characters
      v. Cryptanalysis of The Pollux and Morbit Ciphers with a "crib" of at least 4 plaintext characters
      vi. **Cryptanalysis of the Porta Cipher with a "crib" of at least 4 plaintext characters**

vii. **Cryptanalysis of The Rail Fence Cipher with a "crib" of at least 5 plaintext characters and a range for the rails**

i. **Division C Only - The following code types may also be used at State and National Tournaments.**
   i. **The Hill Cipher - Encrypting plaintext or decrypting ciphertext with a 2x2 encryption matrix or 3x3 decryption matrix provided**
   ii. **Xenocrypt - at the State and National levels, at least two cryptograms will be in Spanish**
   iii. **Cryptanalysis of the Rail Fence Cipher with a "crib" or at least 5 plaintext characters and a range for the rails and offset**

j. For aristocrats, patristocrats, and xenocrypts, no letter can ever decrypt to itself.

k. No more than 2 cipher questions will be an encryption on the exam.

l. The exam packet will include a resource sheet with the Morse Code Table, English/Spanish letter frequencies, Vigenère table, Baconian mapping and modulus inverse tables as needed for the questions on the exam.

m. 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.ii.(1) or 3.e.ii.(2)
   ii. A team member should signal when his or her team has broken the cryptogram
   iii. Before the exam begins, the Event Supervisor will announce the nature of the signal that must be used (e.g., shouting "bingo", 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 has elapsed. After 10 minutes, the timed question can still be answered but the timing bonus is zero

n. **Up to three questions which are not aristocrats, patristocrats or xenocrypts will be marked on the exam as special bonus questions.**

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

a. The high score wins. Final Score = Exam Score + Timing Bonus **+ Special Bonus**.

b. Based on the difficulty of the question, correct answers for each question will earn a clearly indicated number of points.
   i. The general point distribution by question type is:
      (1) An "easy question" = 100-150 pts
      (2) A "medium question" = 200-300 pts
      (3) A "hard question" = 350-500 pts
      (4) A "very hard question" = 550-700 pts
   ii. For questions such as cryptograms, with answers composed of letters, the final points will be determined based on the number of errors found in the decoded plaintext
      (1) Two or fewer errors will be scored as correct and result in full credit.
      (2) Each additional error results in a penalty of 100 points.
      (3) The penalty will not exceed the value of the question. For example, a 400-point question with 5 errors earns 100 points whereas the same 400-point question with 7 errors would earn 0 points, not -100 points.
   iii. **For answers involving the keyword or key phrase for a K1, K2 or K3 alphabet, the final points will be determined based on the number of errors found in the keyword or key phrase**
      (1) **Zero errors are required for full credit.**
      (2) **Each error results in a penalty of 100 points.**
      (3) **The penalty will not exceed the value of the question. For example, a 400-point question with 3 errors earns 100 points whereas the same 400-point question with 5 errors would earn 0 points, not -100 points.**

c. 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 4 x (600 - number of seconds). For example, 6 minutes = 4 x (600-360) = 960 points.

d. **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.**

e. 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 4(600-435)	=	660 points
+**Special Bonus (One=150)**	**=**	**150 points**
Final Score		**4410** points

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

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

CRAVE THE WAVE

1. **DESCRIPTION**: In this event competitors must demonstrate knowledge and process skills needed to solve problems and answer questions regarding all types of waves and wave motion.

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

2. **EVENT PARAMETERS:**
   a. **Each team may bring one three-ring binder of any size containing information in any form and from any source attached using the available rings. Sheet protectors, lamination, tabs and labels are permitted. Participants may remove information or pages for their use during any part of the event.**
   b. **Each team may also bring writing utensils, protractors, rulers and two stand-alone calculators of any type for use during any part of the event.**
3. **THE COMPETITION:**
   a. The competition must consist of both hands-on tasks and questions related to waves.
      i. 25-50% of the score must be from the practical portion (hands-on tasks)
      ii. 50-75% must be from the theoretical portion (written questions)
      iii. No single question may count for more than 10% of the score
   b. The event supervisor may provide some mathematical relationships, but the competitors are expected to demonstrate an understanding of the concepts outlined below. The competition must consist of at least one task/question from each of the following areas:
      i. **General wave characteristics (e.g.; wavelength, amplitude, frequency, period)**
      ii. **Wave types (e.g.; transverse, longitudinal, surface, torsional waves)**
      iii. **Wave phenomena for sound and light waves (e.g.; reflection, standing waves, constructive and destructive interference, refraction, effect of media, diffraction, Doppler effect)**
      iv. **Electromagnetic waves (e.g.; electromagnetic spectrum, relationship between frequency and wavelength; wave energy; standard wavelength bands, their uses and dangers; and how waves are used in communication)**
      v. **Spectroscopy (e.g.; primary colors of light – reflection, refraction, use with filters, absorption spectra and emission spectra and their use in astronomy, primary colors of pigments)**
      vi. **State and National Only - Earthquake/seismic waves (e.g.; p-waves, s-waves, Rayleigh waves, Love waves, surface waves)**
      vii. **National Only - Boundary effects (e.g.; breaking ocean waves, tsunamis)**
4. **SAMPLE STATIONS:**
   a. Regional level
      i. Label the parts of a wave, determine frequency, period or wavelength of a wave.
      ii. Determine the angle of refraction of a prism.
      iii. Measure and label the angles of incidence and **reflection** and the normal of a mirror.
      iv. Listen to a recording and determine in which direction (toward or away) a truck is moving.
      v. Given papers with colored circles and a flashlight hidden inside a black box, determine the color of the filter over the flashlight.
      vi. Using a recording of two trucks determine which one is moving faster.
   b. State level - given p-wave and s-wave diagrams determine the distance to the epicenter.
   c. National level - label and describe the action of a breaking wave.
5. **SCORING:**
   a. Points must be awarded for the accuracy and quality of the responses. High score wins.
   b. Ties must be broken using pre-selected questions.

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

CRIME BUSTERS

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. The test results along with other evidence will be used to solve a crime.

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

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

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

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

   b. The collected evidence and other data given may be used in a mock crime scene.
   c. Qualitative Analysis: Participants will identify evidence (unknowns) by performing tests such as solubility, acidity, magnetic property, color, density, and odor. Every team will have the same set of unknowns (evidence). The scenario will identify which containers hold mixtures and if the mixtures are made of two or three materials. The unknown common materials will be taken from the following lists.
      i. Solids: Anhydrous sodium acetate, yeast, vitamin C (ascorbic acid), *calcium carbonate (powdered limestone), *table salt (NaCl), *sugar (crystal), *flour, *calcium sulfate dihydrate (gypsum), *cornstarch, *baking soda, *powdered gelatin, *powdered Alka-Seltzer®, *sand (white)
      ii. Non-Powdered Metals: aluminum, iron, zinc, magnesium, copper, tin
      iii. Liquids: lemon juice, rubbing alcohol (isopropyl), household ammonia (3%), water, vinegar, hydrogen peroxide (3%)

d. Polymer Testing/Natural and Man-made Substances: Participants will demonstrate their skill in analyzing evidence from a variety of sources such as:
   i. **Hair - Identify human, dog, and cat**
   ii. **Fibers - Identify animal, vegetable, or synthetic**
   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. **Participants may be expected to measure Rfs.**
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. **SAMPLE QUESTIONS AND ACTIVITIES:**
   a. **When HCl is put with baking soda, what evidence is there of a reaction?**
   b. **Will a plastic with a density of 1.14 g/mL sink or float in a 10% salt solution (D=1.07)?**
   c. **When Alka-Seltzer reacts with water, is heat released or taken in?**

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

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

This event is sponsored by Ward's Science

DISEASE DETECTIVES

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

2. **EVENT PARAMETERS:**
   Each team 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 along with two stand-alone non-programmable, non-graphing calculators.

3. **THE COMPETITION:**
   This event has been reorganized into three parts with each part counting approximately equally towards a team's final score.

   Part I: Background & Surveillance
   a. Understand the Clinical Approach (health of individuals) and Public Health Approach (health of populations)
   b. Understand the roles of epidemiology in public health and the steps in solving health problems
   c. Understand the Natural History and Spectrum of Disease and the Chain of Infection
   d. Understand basic epidemiological and public health terms (e.g., outbreak, epidemic, pandemic, surveillance, risk, vector, etc.)
   e. Understand the role of Surveillance in identifying health problems, the 5 step Process for Surveillance and the types of surveillance

   Part II: Outbreak Investigation
   a. Analyze an actual or hypothetical outbreak
   b. Understand the Types of Epidemiological Studies – Experimental and Observational
   c. Be able to identify the Steps in an Outbreak Investigation
   d. Identify the problem using person, place, and time triad – formulate case definition
   e. Interpret epi curves, line listings, cluster maps, and subdivided tables
   f. Generate hypotheses using agent, host, environment triad
   g. Recognize various fundamental study designs and which is appropriate for this outbreak
   h. Evaluate the data by calculating and comparing simple rates and proportions as attack rate, relative risk, odds-ratio and explaining their meaning
   i. Apply the Bradford Hill Criteria for Verifying the Cause of this outbreak
   j. **Division C Only:** Recognize factors such as study design/biases, errors, confounding that influence results
   k. **Division C - Nationals Only:** Suggest types of control & prevention measures for this outbreak

   Part III: Patterns, Control, and Prevention
   a. Identify patterns, trends of epidemiologic data in charts, tables and graphs.
   b. Using given data, calculate disease risk and frequency ratio, proportion, incidence proportion (attack rate), incidence rate, prevalence and mortality rate
   c. Understand the Strategies of Disease Control
   d. Understand Strategies for Prevention-the Scope and Levels of Prevention
   e. **Division C Only:** Propose a reasonable set of prevention strategies for a public health problem once the cause has been determined
   f. **Division C - Nationals Only:** Identify the strengths and weaknesses of a set of proposed prevention strategies

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

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

This event is presented in partnership with the Centers for Disease Control (CDC) Foundation

DYNAMIC PLANET

1. **DESCRIPTION: Students will use process skills to complete tasks related to Earth's fresh waters.**.
   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes
2. **EVENT PARAMETERS:**
   a. Each team may bring one 2" or smaller three-ring binder, as measured by the interior diameter of the rings, containing information in any form and from any source. Sheet protectors, lamination, tabs, and labels are permitted. If the event features a rotation through a series of laboratory stations where the participants interact with samples, specimens, or displays; no material may be removed from the binder throughout the event.
   b. Each team may bring two stand-alone calculators of any type.
3. **THE COMPETITION:**
   a. Participants will be presented with questions which may include one or more tasks at a workstation or a timed station-to-station format.
   b. The participants will be expected to use process skills (e.g., communicating, classifying, inferring, measuring, observing, predicting, and using number relationships) to answer questions on the following topics:
      i. **Interpretation of fresh water features shown on USGS topographic maps**
      ii. **Stream drainage systems: stream order, drainage patterns, main channel, tributaries and watersheds**
      iii. **Channel types: braided, meandering, straight and calculations of sinuosity**
      iv. **Sediment: weathering, erosion, clast forms and sizes, transportation, capacity and competence, deposition**
      v. **River valley forms and processes: geology, gradient, base level, floodplain features, dynamic equilibrium, nick points, waterfalls, stream capture, deltas and fans**
      vi. **Perennial and intermittent stream flow, stream gauging and monitoring, stream flow calculations, discharge, load, floods, recurrence intervals, (Division C only: Chezy and Manning equations)**
      vii. **Groundwater: zone of aeration, zone of saturation, water table, porosity, permeability, aquifers, confining beds, Darcy's Law (Division C only) and hydraulic gradient, water table contour lines, flow lines, capillarity, recharge and discharge, saltwater intrusion, and interactions between surface and groundwater**
      viii. **Karst features: sinkholes, solution valleys, springs, disappearing streams, caves**
      ix. **Lake formation and types: faulting, rifting, volcanic action, glaciation, damming of rivers, changes over time**
      x. **Lake features: inflow and outflow, physical and chemical properties, stratification, shorelines, waves**
      xi. **Wetlands: interactions between surface and groundwater in the evolution of bogs and marshes**
      xii. **Destruction/Effects of land use changes, dams and levees: sedimentation, down-cutting, diversion of water, flooding, ecological changes**
      xiii. **Hydrologic cycle and water budgets: precipitation, runoff, evaporation**
      xiv. **Pollution: types, sources, transport**
      xv. **Critical zone hydrology: infiltration, evapotranspiration, soil moisture, permafrost, pingos**
4. **REPRESENTATIVE ACTIVITIES:**
   a. **Analyze and interpret features and actions of a stream or river appearing on a topographic map including watershed boundaries, elevation, gradient, direction of flow, drainage pattern, valley shapes, erosional landscapes, and depositional features.**
   b. **Construct a water table contour map and indicate the direction of groundwater movement.**
   c. **Analyze data on the thermal structure of a lake and determine how the stratification changes seasonally.**
   d. **Given a geologic map, cross section, or lithologic sequence, determine pattern of water flow and storage, optimal reservoir sitting.**
5. **SCORING:** Points will be awarded for the quality and accuracy of responses. High score wins. Ties will be broken by the accuracy and/or quality of answers to selected questions.

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

This event is sponsored by the National Oceanic and Atmospheric Administration (NOAA) and the North American Association for Environmental Education (NAAEE)

ELECTRIC WRIGHT STUFF

1. **DESCRIPTION:** Prior to the tournament teams design, construct, and test free flight electric-powered monoplanes to achieve maximum time aloft.

   A TEAM OF UP TO: 2 **IMPOUND:** No **EVENT TIME:** 8 minutes

2. **EVENT PARAMETERS:**
   a. Teams may bring up to 2 airplanes, any tools, and their flight log.
   b. Event Supervisors must provide all measurement tools and timing devices.
3. **CONSTRUCTION PARAMETERS:**
   a. Airplanes may be constructed from published plans, commercial kits**, competitors' designs, and/or other sources of design.** Kits must not contain any pre-glued joints or pre-covered surfaces.
   b. Any materials except Boron filaments may be used in construction of the airplane.
   c. Total mass of the airplane throughout the flight must be **9.5 g or more.**
   d. **The wing must not exceed 45.0 cm horizontally projected wingspan and must not exceed 9.0 cm chord (straight line distance from leading edge of wing to trailing edge, parallel to the fuselage). The horizontal stabilizer must not exceed 28.0 cm horizontal projected span and must not exceed 7.0 cm chord.**
   e. The propeller assembly may be built by the competitor(s) or purchased pre-assembled. Variable-pitch propellers that include mechanisms to actively change the blade diameter or angle must not be used.
   f. **A capacitor not to exceed 3.0V, 5.0F must power a DC motor. The motor must directly drive the propeller. Gearboxes are not permitted. The capacitor must be charged with no more than 3.0V sourced from up to two 1.5V alkaline cells no larger than "D" size. The capacitor label and charging battery label must be visible and must show the manufacturer ratings. The power system on the airplane may only include a propeller, motor, capacitor, switch, wires, and connectors. The charging system may only include the battery cells, a battery holder, wiring, connectors, and a resistor.**
   g. **The airplane(s) must be labeled so that the Event Supervisor can easily identify to which team it belongs.**
   h. Students 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. **FLIGHT LOG:**
   a. **Teams must submit a Flight Log along with their plane. The log must include the following:**
      i. **Materials used to construct the plane**
      ii. **A labeled diagram or picture that identifies and describes the parts of their plane**
      iii. **Appropriate metric units for all numerical values**
      iv. **A front cover labeled with the Team Name and the Team Number for the current tournament**
   b. **The submitted Flight Log should contain recorded data covering 6 or more parameters (3 required and at least 3 additional) for 10 or more test flights prior to the competition.**
      i. **The required parameters are:**
         (1) **Charging duration (seconds) or capacitor voltage at launch**
         (2) **Flight Time**
         (3) **Estimated or measured altitude**
      ii. **The team must choose 3 additional data parameters beyond those required (e.g.; charge remaining after landing, decalage measurements, center of gravity, etc.).**
   c. **If a 3-D printer, laser cutter, CNC machine or similar device was used as a tool to build the team's device, or any component thereof, the following information must also be supplied in the log.**
      i. **Information about the tool hardware, software, materials, and supplies used**
      ii. **Details of the source of any digital files (e.g.; CAD, STL, OBJ) utilized by the tool including but not limited to when and where the file was obtained, including the web address if downloaded from the internet**
      iii. **Descriptions of how the team constructed the final device from the tool created components**
   d. **All submitted logs will be returned to teams.**

5. **THE COMPETITION:**
   a. The event must be held indoors. Tournament officials must announce the room dimensions (approximate length, width and ceiling height) in advance of the competition. Tournament officials and the Event Supervisor are urged to minimize the effects of environmental factors such as air currents. Rooms with minimal ceiling obstructions are preferred over very high ceilings.
   b. Once competitors enter the cordoned off competition area to trim, practice, or compete they must not receive outside assistance, materials, or communication. Teams violating this rule must be ranked below all other teams. Spectators must be in a separate area.
   c. At the Event Supervisor's discretion:
      i. Multiple official flights may occur simultaneously according to the Event Supervisor's direction.
      ii. Test flights may occur throughout the contest but must yield to any official flight.
      iii. No test flights will occur in the final half-hour of the event's last period, except for teams that declare a trim flight during their 8-minute flight period.
   d. A self-check inspection station may be made available to competitors for checking their airplanes prior to check-in with the Event Supervisor.
   e. Competitors must present their event materials (airplanes, motors, and logs) for inspection immediately prior to their 2 official flights. Timers must follow and observe teams as they are charging their capacitors.
   f. Teams may make up to a total of 2 official flights using 1 or 2 airplanes.
   g. After check-in teams must be given an 8-minute Flight Period, starting when their first flight (trim or official) begins. Any flight beginning within the 8-minute period will be permitted to fly to completion. Competitors may make adjustments/repairs/trim flights during their official 8-minute period. Before their launches, competitors must indicate to the Timers whether a flight is official or a trim flight. A flight is considered official if a team fails to notify Timer(s) of the flight's status. Teams must not be given extra time to recover or repair their airplanes.
   h. **All chargers will be collected at check-in and will be re-issued to the team only for their Preflight Period and 8-minute Flight Period. Time taken during the Preflight Period will impact a team's final score (see 6.b.). Timers will follow and observe teams as they are charging their capacitors. Event Supervisors will return flight logs after inspection.**
   i. **Before the preflight period, the team must demonstrate their capacitors are discharged by connecting to the motor and the propeller does not turn.**
   j. **A team's Preflight Period ends with their first flight, trim or official, which starts their 8-minute Flight Period or if 2 minutes passes after their charger has been returned, whichever comes first.**
   k. Any flight beginning within the 8-minute Flight Period will be permitted to fly to completion. Participants may make adjustments/repairs/trim flights during their official 8-minute Flight Period. Before their launches, participants must indicate to the Timers whether a flight is official or a trim flight. A flight is considered official if a team fails to notify a Timer(s) of the flight's status. Teams must not be given extra time to recover or repair their airplanes.
   l. Time Aloft for each flight starts when the airplane leaves the competitor's hand and stops when any part of the airplane touches the floor, the lifting surfaces no longer support the weight of the airplane (such as the airplane landing on a girder or basketball hoop) or the judges otherwise determine the flight to be over.
   m. Event Supervisors are strongly encouraged to utilize 3 Timers on all flights. The median flight time in seconds to the precision of the device used, recorded by the 3 Timers, is the official time aloft.
   n. Competitors must not steer the airplane during flight.
   o. In the unlikely event of a collision with another airplane, a team may elect a re-flight. The decision to re-fly may be made after the airplane lands. Timers are allowed to delay a launch to avoid a possible collision. The eight-minute period does not apply to such a flight.
   p. The Supervisor will verify with the team the data being recorded on their scoresheet.
   q. Teams filing an appeal must leave their airplane(s) and Flight Log in the event area.

6. **SCORING:**
   a. The base score is the Team's longest single flight time. Ties will be broken by the longest non-scored official flight time.

b. **A bonus of 10% of the flight time will be added to the flight time of an airplane that has the entire surface of the wing between at least 2 ribs or at least one of the wing tip fences completely marked with black marker or black tissue. If no ribs are present, the whole surface must be black.**
c. **If their first airplane flight (powered or unpowered), trim or official, is launched within 2 minutes of the return of the charger a 5% bonus will be added to the base score. After 2 minutes have passed since the return of the charger, the 8-minute Flight Period will start and no bonus will be awarded.**
d. Teams with incomplete flight logs must have 10% of their flight time deducted from each flight.
e. Teams without flight logs must have 30% of their flight time deducted from each flight.
f. Teams that violate a rule under "CONSTRUCTION" or "THE COMPETITION" that does not have a specific penalty must be ranked after all teams that do not violate those rules.

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

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

EXPERIMENTAL DESIGN

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

1. **DESCRIPTION:** This event will determine the participant's ability to design, conduct, and report the findings of an experiment entirely on-site.

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

2. **EVENT PARAMETERS:**
   a. Participants must bring goggles and writing utensils. Experiments will not require any other safety equipment.
   b. Division B teams may bring one timepiece, one linear measuring device, and one stand-alone non-programmable non-graphing calculator.
   c. Division C teams may bring one timepiece, one linear measuring device, and one stand-alone calculator of any type.
   d. The Event Supervisor will provide each team with identical sets of materials either at a distribution center or in an individual container.
   e. The Event Supervisor will supply a report packet, based on the Experimental Design Checklist, posted on the event page at soinc.org, for recording their experimental information and data.
3. **THE COMPETITION:**
   a. The teams must design, conduct, and report the findings of an experiment conducted on site that addresses the assigned question/topic area provided by the Event Supervisor. The assigned question/topic area should be the same for all teams and allow the participants to conduct experiments involving relationships between independent and dependent variables (i.e., height vs. distance).
   b. During the first 20 minutes of the event, participants will receive the assigned question/topic area, materials, and Part I of the report packet. Participants will focus on designing and conducting their experiment.
   c. After the first 20 minutes, participants will receive Part II of the report packet and will focus on analyzing their experiment and reporting findings. Participants may continue experimenting throughout the entire event.
   d. Each team must use at least two of the provided materials to design and conduct an experiment. The materials will be listed on the board or placed on a card for each team. If provided, both the card and the container will be considered part of the materials. The identity of the materials will be unknown until the start of the event.
   e. When a team finishes, all materials must be returned to the Event Supervisor including both parts of the report packet.
4. **SCORING:**
   a. High score wins. Scoring will be done using the Experimental Design Checklist found on the Science Olympiad website (soinc.org).
   b. Points will be awarded depending upon the completeness of the response. Zero points will be given for no responses as well as illegible or inappropriate responses.
   c. Ties will be broken by comparing the point totals in the scoring areas of the checklist in the following order:
      i. J. Analysis of Claim/Evidence/Reasoning
      ii. E. Procedure and Set-Up Diagrams
      iii. C. Variables
      iv. G. Data Table
      v. H. 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 0.75.
   g. Any team not collecting data by conducting an experiment on-site will have their final score multiplied by 0.25.

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

EXPERIMENTAL DESIGN CHECKLIST

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

2022 Experimental Design Division B Checklist
(Note: The maximum points available for each task are shown.)

Part I – Design and Construction of the Experiment (**57** 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 independent and dependent variables
② ① ⓪ Statement gives specific direction to the prediction(s) (e.g., a stand is taken)
② ① ⓪ A rationale is given for the hypothesis.

C. Variables (**15** pts)

a. Independent Variable (IV) (**5** pts)
② ① ⓪ Correctly identified and defined
③ ② ① ⓪ Levels of IV given

b. Dependent Variable (DV) (4 pts)
④ ③ ② ① ⓪ Correctly identified and defined

c. Controlled Variables & Constant (CV) (6 pts)
② ① ⓪ First CV correctly identified
② ① ⓪ Second CV correctly identified
② ① ⓪ Constant correctly identified

D. Materials (4 pts)

② ① ⓪ All materials are listed and quantified
② ① ⓪ No extra materials are listed

E. Procedure and Set- up Diagrams (14 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
④ ③ ② ① ⓪ Enough information is given so another could repeat procedure

F. Qualitative Observations (6 pts)

② ① ⓪ Observations about procedure provided
② ① ⓪ Observations about the results provided
② ① ⓪ Observations given throughout the course of the experiment

G. Quantitative Data - Data Table (10 pts)

② ① ⓪ All raw data is provided
② ① ⓪ A condensed data table showing only the data to be graphed provided
② ① ⓪ Tables and columns labeled properly
② ① ⓪ All data has units
② ① ⓪ Example calculations for derived variables are given

Part II – Data, Analysis and Conclusions (66 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 (14 pts)

④ ③ ② ① ⓪ Statistics of Central Tendency (i.e., best fit, median, mode, mean)
④ ③ ② ① ⓪ One example calculation is given for each statistic including units
④ ③ ② ① ⓪ Statistics of Variation (i.e., min, max, range)
② ① ⓪ Calculations are accurate

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

② ① ⓪ Statistics Claim completed logically
② ① ⓪ Statistics Evidence completed logically
② ① ⓪ Statistics 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 Data Trend Claim completed logically
② ① ⓪ Data Trend Evidence completed logically
② ① ⓪ Data Trend Reasoning completed logically

K. Possible Experimental Errors (8 pts)

④ ③ ② ① ⓪ One specific error is identified and effect on results discussed.
④ ③ ② ① ⓪ Second specific error is identified and effect on results discussed.

L. Conclusion (8 pts)

② ① ⓪ Hypothesis is re-stated
② ① ⓪ Hypothesis Claim completed logically
② ① ⓪ Hypothesis Evidence completed logically
② ① ⓪ Hypothesis Reasoning completed logically

M. Recommendations for Future Experimentation (6 pts)

② ① ⓪ Suggestions to improve the experiment are given
② ① ⓪ Suggestions for practical applications of experiment are given
② ① ⓪ Suggestions for future experiments are given

School: _____Team#_____

Point Total: _____/**123**

Deduction multiplier(s): _____
Non-clean up (0.95), Off topic (0.75), or Non-lab (0.25)

Final Score: _____

(revised 8/23/2019)

FOOD SCIENCE

1. **DESCRIPTION**: Participants will answer questions on food chemistry with **a focus on sugars**. **In addition, participants will build a hydrometer capable of measuring sugar solutions between 1-10% (mass/volume).**

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

2. **EVENT PARAMETERS:**
   a. Each participant may bring one 8.5" x 11" sheet of paper, which may be in a sheet protector sealed by tape or laminated, that may contain information on both sides in any form and from any source without any annotations or labels affixed along with writing utensils, and a stand-alone non-programmable, non-graphing calculator.
   b. Each team may bring any or all of the items listed as Recommended Lab Equipment for Division B Chemistry Events, posted on soinc.org. Teams not bringing these items will be at a disadvantage. The Supervisor will not provide them.
   c. Teams may bring only specified items. Other items not listed are prohibited. The Event Supervisors will check each team's equipment, confiscate non-allowed items, and have the right to penalize the team up to 10% if additional equipment is brought to the event.
   d. Each team must bring a participant-made **hydrometer** capable of measuring **sugar** concentrations between 1-10% (mass/volume). Any **hydrometer** calibration data must be included on the 8.5" x 11" sheet(s) of paper mentioned in 2.a.
   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 or disqualified.
   f. The Event Supervisor will provide chemicals, foodstuff, a source of water and balances/equipment/materials to do laboratory activities.

3. **THE COMPETITION:**

   Part I: Written/Lab Test

   a. The competition will consist of a written exam and/or lab activities covering the following topics:
      i. **types of sugar, sweeteners, and enzymes**
      ii. food preservation processes
      iii. **testing of foods (sugars, starches, fats, proteins)**
      iv. **how cooking changes foods chemically**
      v. citric acid cycle
      vi. **essential fats, vitamins, and proteins in foods**
      vii. **new** nutrition labeling regulations
      viii. **allergens in foods**
      ix. **Crystallization and nucleation**
      x. **leavening agents**
      xi. **cold water candy tests (both temperature and sugar concentrations-thread to burnt sugar stages)**
      xii. water activity
      xiii. density

   Part II: Hands-On Testing

   a. Participants will be expected to perform at least one of the following tests at an Invitational or Regional Tournament, at least two of the tests at the State Tournament, and all three of the tests at the National Tournament. The Event Supervisor for the tournament will decide which tests are conducted. All teams at the same tournament will perform the same test(s). The possible tests are:
      i. **Determine the sugar content in 1-2 samples using the participant-made hydrometer**.
      ii. **Determine the cold water stage of a sugar solution**.
      iii. **Determine if a solution has a reducing sugar in it or not**.
   b. Teams must build, calibrate, bring, and demonstrate a hydrometer capable of measuring **sugar water (most likely sucrose)** concentrations between 1-10% (mass/volume).
      i. 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 **350 mL of sugar water** solution.

ii. Teams will be expected to estimate the percent **sugar** 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.
iii. A detailed rubric is available on the soinc.org website.

4. **SAMPLE ACTIVITIES AND QUESTIONS:**
   a. **Use a new food label to determine the number of calories from fat in the product.**
   b. **Determine the moisture content in percentage of a food where the original and dried weight are given.**
   c. **Determine the temperature range the sugar mixture was heated to based on the cold water stage seen.**
   d. **Of the following experimental setups of fermentation with balloons indicating carbon dioxide production, which flask has fructose?**
   e. **Why does diet pop float & regular pop sink, but a pack of regular mayonnaise floats higher than light?**
   f. **What percentage is the sugar concentration in a solution that has been heated to brown liquid stage?**
5. **SCORING:**
   a. High score wins.
      i. Part I counts for 60% of a team's overall score.
      ii. In Part II, bringing a **hydrometer** counts for 10% of the team's score. If one test is done, it counts for 30% of the team's score. If two tests are done they each count for 15% of the team's score. If all three tests are done, each count for 10% of the team's score.
   b. Time may be limited at each task but will not be used as a tiebreaker or for scoring.
   c. Ties will be broken by pre-selected questions from Part I.
   d. A penalty of up to 10% may be given if the area is not cleaned up as instructed.
   e. A penalty of up to 10% may be given if a team brings prohibited lab equipment to the event.

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

GREEN GENERATION

1. **DESCRIPTION:** Students will demonstrate an understanding of general ecological principles, the history and consequences of human impact on our environment, solutions to reversing trends and sustainability concepts.

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

2. **EVENT PARAMETERS:**

   Each team 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 along with two stand-alone non-programmable, non-graphing calculators.

3. **THE COMPETITION:** This event will be composed of three sections of approximately equal point value. This may include analysis, interpretation or use of charts, graphs and sample data. Note: Green Generation is designed for a two year rotation – the first year (**2022**) will cover aquatic issues, air quality issues and climate change while the second year (**2023**) will cover terrestrial issues and population growth issues.
   a. Part 1: Review of the General Principles of Ecology
      i. General Principles of Ecology – food webs and trophic pyramids, nutrient cycling, community interactions, population dynamics, species diversity and indicator species **and invasive species** (**2022** and **2023**)
      ii. Overview of Aquatic Environments – freshwater, estuaries, marine (**2022**)
   b. Part 2: Problems resulting from human impacts on the quality of our environment
      i. Aquatic Environmental Issues – Water Pollution, Ocean Dead Zones, Water Diversion, Overfishing **and Habitat Destruction, Impacts on Excess Nutrients** (**2022**)
      ii. Air Quality Issues – Acid rain, Air Pollution, Nuclear Pollution, and **Atmospheric Deposition** (**2022**)
      iii. Climate Change – Effects on Plants, Animals, and Ecosystems, Greenhouse Effect, and Ozone Depletion (**2022**)
   c. Part 3: Solutions to reversing/reducing human impacts that harm our environment
      i. Legislation and Economic Opportunity for Solving Problems (Div. C) (**2022** and **2023**)
      ii. Sustainability Strategies – Environmental Stewardship of Aquatic Ecosystems (**2022**)
      iii. Bioremediation Strategies (**2022**)
      iv. **Pollution Prevention**
      v. **Green Infrastructure**

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

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

This event is sponsored by Corteva Agriscience

METEOROLOGY

1. **DESCRIPTION:** Participants will use scientific process skills and quantitative analysis to demonstrate an understanding of the factors that influence world climate and climate change through the interpretation of climatological data, graphs, charts and images.

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

2. **EVENT PARAMETERS:**
   a. Each team may bring two stand-alone calculators of any type & two 8.5" x 11" sheets of paper, which may be in individual sheet protectors sealed by tape or laminated, that may contain information on both sides in any form & from any source without any annotations or labels affixed.
   b. Teams will not be required to bring any additional supplies or materials for any hands-on task, demonstration or lab exercise.

3. **THE COMPETITION:**

   The questions will address the following weather and climate topics:
   a. Understanding of weather vs. climate
   b. Composition and evolution of the Earth's atmosphere:
      i. Natural and anthropogenic greenhouse gases, and their sources
      ii. Anthropogenic sulfate and black carbon aerosols, and volcanic particulates, and their impacts as climate forcing agents
      iii. The ozone layer and the evolution of the ozone hole
   c. Earth's radiative energy balance:
      i. Shortwave and longwave radiation, albedo and emissivity
      ii. Impacts of high versus low clouds on climate: shortwave and longwave cloud effects, cloud composition (ice or water) effect on climate
      iii. Definition and examples of climate feedbacks that change radiative balance: Water vapor feedback, sea ice-albedo feedback
      iv. Understanding how changes in greenhouse gases and aerosols change the radiative budget using online RRTM Earth energy budget model; available at http://climatemodels.uchicago.edu/rrtm/
   d. Oceanic and atmospheric circulation mechanisms that affect climate:
      i. Semi-permanent pressure cells, the three-cell model of atmospheric circulation, and the Walker cell
      ii. Thermohaline circulation and wind-driven oceanic currents, ocean heat transport and connections between sea surface temperature trends and local climate patterns
   e. Climatic zones and their causes:
      i. Understand the connection between climate and vegetation
      ii. Understand and be able to interpret climatographs, and trends and their significance
      iii. Effects of latitude, longitude, elevation (topography) and urbanization on climate
      iv. Heat capacity: effects of land masses, bodies of water, soil composition and soil moisture on climate
   f. Recent climate trends:
      i. Modern temperature trends through use of temperature records and datasets (e.g., berkeleyearth.org)
      ii. Influence of ENSO on climate & typical weather patterns associated with ENSO
      iii. Sea level rise and its causes
      iv. Drought and heat events
   g. Understand climate reconstructions from different methods (e.g., sediment cores, ice cores, tree rings, speleothems, others)
   h. Projected changes in climate:
      i. Climate sensitivity and how it is estimated
      ii. Representative Concentration Pathways
      iii. Understanding and interpreting climate change projections from models

4. **SAMPLE QUESTIONS/TASKS:**
   a. Predict the climate zones of a hypothetical island continent given its topography, latitude, and longitude.
   b. Examine a climatograph & determine if this might be a climate windward or leeward of a mountain range or city.

c. Interpret a diagram of the elements in the sea ice-albedo feedback, including arrows and plus/minus signs to indicate direction and type.
d. Use a time series from theberkeleyearth.org dataset to estimate temperature trend.
e. Compare historical normals from NOAA, through time (e.g., new 1991 - 2020 vs. 1981 - 2010 and prior instances of normals).
f. Examine whether or not trends are present/exist in the climatology of extreme weather events, using graphs and data.

5. **SCORING:** High score wins. Points will be awarded for the quality of responses, the quality of supporting reasoning, and use of scientific technique. Pre-identified questions will be used as tiebreakers.

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

This event is sponsored by the National Oceanic and Atmospheric Administration (NOAA) and the North American Association for Environmental Education (NAAEE)

MISSION POSSIBLE

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

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

   A TEAM OF UP TO: 2 **IMPOUND:** State & National only **EYE PROTECTION:** C

   SET-UP TIME: 30 minutes for points **MAXIMUM RUN TIME:** 3 minutes

2. **EVENT PARAMETERS:**
   a. At State and National Tournaments, teams must impound their Device along with any tools or parts that they will use during their set-up time or run. Electric outlet access will not be available.
   b. All participants must properly wear eye protection at all times. Participants without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows. Participants without eye protection will not compete.
   c. Each Device must pass a safety inspection before operation. Devices with potential hazards or safety concerns must not be permitted to run unless safety concerns are resolved to the satisfaction of the Event Supervisor, otherwise they must receive only participation points.
   d. Event Supervisors will need their own eye protection (i.e.; safety glasses), meter sticks, stopwatches, and measuring tape.
   e. Participants must be able to answer questions regarding the design, construction, and operation of the Device per the Building Policy found on www.soinc.org.

3. **CONSTRUCTION PARAMETERS:**
   a. General Requirements:
      i. During operation, the Device's outer dimensions should be no greater than 60.0 cm (L) x 60.0 cm (D) x 60.0 cm (H). Devices with a dimension greater than 1 meter will not be allowed to run.
      ii. All actions used for scoring must be visible and/or verifiable. The top and at least two vertical walls must be open or transparent for viewing all actions. Actions must be consecutive. Parallel and/or dead-end actions will not count for points. Any action in the Device not designed to contribute to the completion of the Final Action will not count for points.
      iii. **All marbles in the device must be glass spheres with a diameter between 1 - 3 cm. The marbles may be taped or tied, but not glued or altered in any other way.**
      iv. Each movable/adjustable physical object in the Device must be utilized by at most one assigned action. An object at the end of one action may initiate the next action, but must not go beyond the initiation of the second action. (The initial **marble** may start the first action, as described, but must then remain at rest **on the "base" of the device until it is struck** in the Final Action.)
      v. Sensitive components (i.e.; springs/mousetraps, dominoes) may be set/placed just before starting the Device.
      vi. **Use of electricity is prohibited anywhere in the device.**
      vii. Candles, flames, matches, hazardous liquids, lead objects (even if encased), gases, and hazardous materials (e.g., rat traps, combustible fuses, dry ice, liquid nitrogen) and unsafe handling of chemicals will not be permitted.
      viii. **If a marble is to start the next action, the actual marble (not what is holding or attached to it) must initiate the next action.**
   b. Start Action: (100 points) - **Participants must drop a marble (3.a.iii.) into the Device from a point completely above the Device. The marble must fall into the Device and initiate the next action, and come to rest on the "base" of the device and not be touching anything other than the "base". The base of the device must be a hard, flat horizontal plane that may be covered with smooth cloth or felt. There must be no grooves or channels to guide the marble(s) on the "base".**
   c. Scorable Actions: (50 points each) – Participants may have up to 12 scorable unique actions to count for points. Participants may attempt none, some, or all of these actions in any order.
      i. **Use a falling marble to operate a wheel & axle to raise another marble 10 cm that then initiates the next action.**
      ii. **Use a marble to knock over a series of 3 dominoes so the last domino moves another marble to initiate the next action.**
      iii. **Use a wedge to separate two touching marbles so that one moves 20 cm from its spot and then initiates the next action.**
      iv. **Use water to raise a marble at least 5 cm that then rolls out of the container to initiate the next action.**

v. **Use a falling marble to raise a 3rd class lever that raises another marble 5 cm that then initiates the next action.**
vi. **Use a 1st class lever to raise a cup containing at least 10 marbles 10 cm before the cup initiates the next action.**
vii. **Use a single marble to hit a chain of 5 touching marbles so that the last marble moves at least 10 cm and then initiates the next action.**
viii. **Drop 5 marbles into a cup, one at a time, so that the last marble causes a pulley system with IMA of 3 to raise an object at least 10 cm before the object initiates the next action.**
ix. **Push or pull a marble up an inclined plane with an IMA of at least 2 so that the marble is vertically raised at least 10 cm before it initiates the next action.**
x. **Launch a marble completely out of and above the device so that it reenters the device at least 20 cm away from where it left the device, then it strikes an object which initiates the next action.**
xi. **Use falling marbles to turn a paddlewheel. The wheel must make at least one full revolution before triggering the next action.**
xii. **Use an Archimedes screw to raise a marble 20 cm vertically before the marble triggers the next action.**

d. Final Action:
i. **After all other planned scorable actions have been attempted, the marble from the Start Action in 3.b. must be struck so that it rolls, unguided, at least 30 horizontal cm on the "base" of the device from its original resting position and stops on its own on the "base" and within the device. (250 points)**
ii. **If the team chooses, they can place another marble 30 cm from the first marble. This marble also must be free-standing on the "base" of the device. If the first marble strikes the second one and both stop rolling and stay within the device, then an additional 100 points will be awarded. To receive the points neither marble is allowed to touch anything other than the "base" once both have started rolling.**
iii. **If a 20 cm diameter circle is drawn with the second marble at its center and the second marble completely leaves the circle after being hit by the first marble, then another 75 points will be awarded if neither marble leaves the device.**
iv. **If all parts of 3.d.iii. are successfully completed and the first marble remains completely in the 20 cm. circle, then 50 more points will be awarded.**

e. Action Sequence List (ASL):
i. **At Regionals, an Action Sequence List (ASL) must be provided to the Event Supervisor just prior to set-up. At State Tournaments, The ASL must be submitted at impound. At the National Tournament, the ASL must be submitted to the Tournament Director in a specified method and by a specified time during the week prior to the tournament.**
ii. An ASL is a written documentation of all the actions within the Device. Its purpose is to allow the Event Supervisor to follow along the chain of events while the Device is running.
iii. Each scorable action in 3.c. may only earn points once in the ASL. Other non-scorable actions may be incorporated into the Device but must contribute to the completion of the Final Action, receive no points and be listed on the Action Sequence List (ASL).
iv. All scorable and non-scorable actions must be numbered in the Device, and correspondingly numbered in the ASL.
v. An example of an ASL can be found on www.soinc.org.

4. **<u>DESIGN LOG</u>:**

a. **Teams must submit a Design Log along with their device. The log must include the following:**
i. **Materials used to construct the device**
ii. **A labeled diagram or picture that identifies and describes the parts of the device**
iii. **Team name, team number, and appropriate metric units for all numerical values**

b. **If a 3-D printer, laser cutter, CNC machine or similar device was used as a tool to build the team's device, or any component thereof, the following information must also be supplied in the log.**
   i. **Information about the tool hardware, software, materials, and supplies used**
   ii. **Details of the source of any digital files (e.g.; CAD, STL, OBJ) utilized by the tool including but not limited to when and where the file was obtained, including the web address if downloaded from the internet**
   iii. **Descriptions of how the team constructed the final device from the tool created components**
c. **All submitted logs will be returned to teams.**

5. **THE COMPETITION:**
   a. The Target Operation Time is **45 to 75** seconds at Regionals/Invitationals, 61 to 90 seconds at State, and 91 to 120 seconds at Nationals. For State and National tournaments, **teams will be told the target time at the start of their setup.** The target time will be the same for all teams at State and Nationals.
   b. **Timing and scoring begin when a participant drops the first marble (3.b.) into the Device. Timing stops when the marble from the Start Action is struck by the device, or after 180 seconds have elapsed, whichever comes first. After the 1st marble is struck, the only points awarded after timing stops are those related to the final task.**
   c. **Participants may designate one sand timer, an action taking over 10 seconds, to be eligible for bonus points. This timer must not be one of the scorable actions.**
      i. **A 1-point bonus will be awarded for every full second the sand timer runs before the Target Operation Time. The timer may run past the Target Operation Time but will not receive points for the duration after the Target Operation Time.**
      ii. The timer must successfully initiate the next action for any bonus points to count.
      iii. For State/National tournaments, the team must demonstrate how this timer is adjusted to account for the increased length of Target Operation Time for the bonus points to count.
   d. If the Device stops, jams, or fails, the participants will be allowed to adjust it to continue operation up to three times. An adjustment may consist of multiple physical touches and is only completed once the Device runs again on its own. Obvious adjusting only to stall or impact operation time will result in disqualification.
   e. If a participant completes a scorable action or makes an adjustment that leads directly to the completion of that action, then that action will not count for points, even if it is part of the Final Action.
   f. If an action starts out of the ASL order, all actions skipped in the listed sequence, even if completed, earn zero (0) points.
   g. The Supervisor will review with teams the data recorded on the scoresheet.
   h. Teams filing an appeal must leave their Device and ASL in the event area.

6. **SCORING:**
   a. High score wins.
   b. Award 25 points for each of the following (100 points maximum):
      i. **The ASL is submitted on time as specified in 3.e.i.**
      ii. The ASL is legible and uses the format specified on www.soinc.org
      iii. The ASL is 100% accurate of intended scorable and non-scorable actions
      iv. The scorable & non-scorable actions within the Device are labeled as in the ASL
   c. Award 50 points for each of the following:
      i. Participants use no more than 30 minutes to set up their Device
      ii. The first time each unique action in 3.c. is successfully completed as described
   d. Award 100 points for completing the Start Action
   e. Award 250 points for completing the Final Action as described in 3.d.i.
   f. **Award 100 points for the first marble hitting a second marble as described in 3.d.ii.**
   g. **Award 75 points if the second marble completely leaves the 20 cm circle as described in 3.d.iii.**
   h. **Award 50 points if the first marble completely remains in the circle after knocking the second marble out of the circle**
   i. Award **2** points for each full second (rounded down) of operation up to the Target Operation Time
   j. Award 1 point per full second that a **sand** timer runs before the Target Operation Time if all conditions are met and the next action is initiated by the timer
   k. Award 0.1 point for each 0.1 cm that the Device dimensions are under 60.0 cm in each axis. The maximum score awarded for each dimension is 30 points, for a total of 90 points **(Only at in-person tournaments.)**

l. Award 75 points for a Device that has no adjustments during operation
m. Teams failing to impound their device on-time will be ranked after all teams that impounded on-time.
n. Teams receive only participation points for impounding a Device but not competing, unsafe Devices, Devices with a dimension greater than 1 meter, or Devices that are remotely timed/controlled

7. **PENALTIES:**
   a. Deduct **1** point for each full second (rounded down) that the Device operates past the Target Operation Time up to 180.0 seconds.
   b. Deduct 25 points:
      i. For each dimension of the Device that exceeds 60 cm
      ii. If the top and 2 vertical walls are not open or transparent
      iii. For each time the Device is adjusted during operation, up to 3 times. If the Device stops or fails after the third adjustment, scoring stops and the operation time will be scored as 180 seconds.
   c. Deduct 50 points if any solid or liquid leaves the measured dimensions of the Device.
   d. **Devices that use electricity within the device will not be allowed to run.**
8. **TIEBREAKERS:**

   Ties are broken as follows: a) Fewest penalty points; b) Smallest overall dimension (L+D+H) of the Device.

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

MOUSETRAP VEHICLE

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

1. **DESCRIPTION**: Teams design, build, and test one Vehicle using **one or two mousetrap(s)** as its sole means of propulsion to reach a target point as accurately as possible.

   A TEAM OF UP TO: 2 **IMPOUND:** Yes

   EYE PROTECTION: B **EVENT TIME: 10** minutes

2. **EVENT PARAMETERS:**
   a. Each team must bring and impound one Vehicle, alignment devices (if used), a Practice Log, and additional/spare parts. The vehicle must be impounded with the mousetrap in its lowest potential energy state compared to an unmodified mousetrap.
   b. Teams may bring data and a stand-alone calculator of any type and non-electric tools which do not need to be impounded.
   c. All participants must properly wear eye protection at all times. Participants without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows. Participants without eye protection will not be allowed to compete and will receive participation points.
   d. Teams must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org.

3. **CONSTRUCTION PARAMETERS:**
   a. All propulsive energy must come from **one or two snap mousetrap(s)** with a base 6.0 cm x 12.0 cm or smaller. No part of the jaw/hammer may extend more than 1.0 cm beyond the base. The mousetrap must retain all of its original parts and structural integrity. Altering the structural integrity of the mousetrap is prohibited, including welding, bending, and cutting. Items may be added to the mousetrap through methods including, but not limited to: soldering, taping, tying, gluing, and clamping. Added items cannot increase the potential energy of the unmodified mousetrap. Up to 4 holes may be drilled in the mousetrap to attach it to the Vehicle.
   b. Conversion of the mechanical energy of the mousetraps is permissible, but any energy converters must be at their lowest energy states in the ready-to-run configuration. Pre-loaded energy storage devices may be used to operate other Vehicle functions (e.g., braking system) as long as they do not provide kinetic energy to propel the Vehicle.
   c. Electronic components and electric devices are not permitted except for calculators.
   d. **A jumbo paperclip (i.e. the large ones) must be attached to the front of the Vehicle and bent so that ONE end of it is pointing down toward the Surface of the Track. The paperclip must not be cut or shortened. The end toward the track surface will be the Vehicle's Measurement Point for distance measurements. The Measurement Point must extend at least 0.5cm beyond the front of all parts of the vehicle except the drive arm and drive string. The Measurement Point must be less than 1.0 cm above the surface of the track. The event supervisor must have easy access and be able to clearly see the Measurement Point.**
   e. In the ready-to-run configuration, all wheels/treads (in their entirety) must fit in a 40.0 cm x **60.0** cm space of any height and any orientation. Axles, drive arms, and other parts of the Vehicle may extend beyond these parameters.
   f. All parts of the Vehicle must move as a whole; no anchors, tethers, tie downs, launching ramps, or other separate pieces are allowed. The only parts allowed to contact the floor during the run are wheels/treads, drive string(s), and any parts already in contact with the floor in the ready-to-run configuration. Pieces falling off during the run constitutes a construction violation.

4. **PRACTICE LOG:**
   a. The Practice Log must include 3 or more parameters (2 required and at least 1 additional) for 10 or more practice runs. The required parameters are Target Distance and Vehicle Distance from Target. Each team must choose an additional 3rd parameter beyond those required (e.g., # of axle turns for braking, alignment angle) to test. **As time is not a factor in scoring, it is not a valid third parameter.** Logs must include the Team name and number.
   b. Logs must be impounded and will be returned when the team is called to compete.
   c. **If a 3-D printer, laser cutter, CNC machine or similar device was used as a tool to build the team's device, or any component thereof, the following information must also be supplied in the log.**
      i. **Information about the tool hardware, software, materials, and supplies used**

ii. **Details of the source of any digital files (e.g.; CAD, STL, OBJ) utilized by the tool including but not limited to when and where the file was obtained, including the web address if downloaded from the internet**
iii. **Descriptions of how the team constructed the final device from the tool created components**

5. **THE COMPETITION**:
   a. Only participants and the Event Supervisors will be allowed in the impound and track areas. Once participants enter the event area to compete, they must not leave or receive outside assistance, materials, or communication.
   b. Teams have 10 minutes of Event Time to set up and start up to 3 runs. Vehicles in the ready-to-run configuration before the end of the Event Time will be allowed to complete a run.
   c. Electric tools must not be used except for the calculator in 2.b.
   d. In the ready-to-run configuration, the Vehicle's Measurement Point must be over the Start Point. The Vehicle must remain at the starting position without being touched.
   e. Teams may adjust their Vehicle (e.g., change mousetraps, distance, aiming) within their Event Time, though the Event Supervisor may re-verify that the Vehicle meets specifications prior to each run. Timing is paused during any measurements made by the Event Supervisor. Timing resumes once the participants pick up their Vehicle or begin making their own measurements. Teams may use their own **non-electronic** measuring devices to verify the Track dimensions during their Event Time.
   f. Only **non-electric/non-electronic** sighting/aiming devices are permitted. If placed on the Track, they must be removed before each run. If placed on the Vehicle, they may be removed at the team's discretion. **Use of lines existing on the floor prior to the runs (e.g. basketball floor lines, the silver divider on terrazzo floors, or lines in tile floors) as an alignment device for the vehicle is not permitted as these alignment devices cannot be removed from the Track before a run.**
   g. Teams must not roll the Vehicle on the floor of the Track on the day of the event without tournament permission. If permitted, only participants may be present.
   h. Substances applied to the Vehicle must be approved by the Event Supervisor 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.
   i. Teams must start the Vehicle using any part of an unsharpened #2 pencil with an unused eraser, supplied by the Event Supervisor, in a motion approximately perpendicular to the floor, to actuate a trigger. They may not touch the Vehicle to start it, hold it while actuating the trigger, or "push" the Vehicle to get it started. Once they start a run, the participants must not follow their Vehicle and wait until called by the Event Supervisor to retrieve their Vehicle.
   j. **The Vehicle must travel forward so that the Measurement Point clearly passes the 1 m line, reverse direction, and come to a stop with the Measurement Point at the Target Point located behind the Start Point.**
   k. If the vehicle does not move upon actuation of the trigger, it does not count as a run. The team may continue to work on their device in order to attempt 3 runs within the Event Time.
   l. A Failed Run can occur if the Vehicle starts before the Event Supervisor is ready, if its distance cannot be measured (e.g., the participants pick it up before it is measured), or if the team pushes the vehicle down the track. If a team has a Failed Run, any Construction and/or Competition violations must be recorded for that Run as well. A team having only one successful run during the 10 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.
   m. **If the vehicle does not reverse within 3 seconds after coming to a stop, the run is considered to have ended.**
   n. **Failure to reverse or failure to pass the 1 m Line is a Competition Violation.**
   o. **Once the Vehicle begins a run, the competitors must move outside the lane, not follow the Vehicle, and wait until called by the Event Supervisor to retrieve their Vehicle following measurement.**
   p. The Event Supervisor will review with the team the data and penalties recorded on their scoresheet.
   q. Teams filing an appeal must leave their Vehicle and Practice Log in the event area.

6. **THE TRACK:**
   a. The Track will be on a smooth, level, and hard surface. Refer to soinc.org for a diagram of the Track.

b. **The Event Supervisors must mark the track as follows:**
   i. **Start Point - An approximately 5.0 cm by 2.5 cm piece of tape with the Start Point marked at the center of the tape.**
   ii. **1 m Line - A line of 2.5 cm tape, in FRONT of the Start Point, approximately 70 cm long, placed perpendicular to an extended imaginary line connecting the Start Point to the Target Point. The center of the line must be on the extended imaginary line. The edge of the tape farthest from the Start Point must be 1.0 m from the Start Point.**
   iii. **Target Point - An approximately 5.0 cm by 2.5 cm piece of tape with the Target Point marked at the center of the tape placed BEHIND the Start Point.**
c. **The exact Target Distance from the Start Point to the Target Point will be between 1.00 m and 4.00 m. At Regionals the interval will be 0.5 m, for States 0.25 m, and for National 0.05 m.**
d. At the Event Supervisor's discretion, more than one Track may be used. If so, the team may choose which Track they want to use, but must use the same Track for both runs.

7. **SCORING:**
   a. Each team's Final Score is the sum of their 2 best Run Scores out of their 3 runs + any Final Score Penalties. Low score wins.
   b. **Run Time begins with the first movement of the Vehicle and ends when the Vehicle comes to a complete stop (including recoil). The Run Time is recorded in seconds to the precision of the timing device used and may be used as a tiebreaker.**
   c. The Run Score for each run = Distance Score + Run Penalties
   d. The Distance Score = 1pt./cm x Vehicle Distance. The Distance Score for a Failed Run is 2500 points.
   e. The Vehicle Distance is the point-to-point distance from the Measurement Point to the Target Point in centimeters measured to the nearest 0.1 cm.
   f. Run Penalties:
      i. Competition Violation: 1500 points added to each Run Score that has 1 or more Competition Violations.
      ii. Construction Violation: 3000 points added to each Run Score that has 1 or more Construction Violations.
   g. Final Score Penalties:
      i. Incomplete Practice Log: 250 points added to the team's Final Score.
      ii. Missing or not Impounded Practice Log: 500 points added to the team's Final Score.
      iii. Vehicle Not Impounded: 10000 points add to the team's Final Score.
   h. Two or more teams tied with 2 Failed Run scores, without Competition or Construction Violations, will remain scored as ties. Other ties are possible.
   i. Tiebreakers in order: 1. Better Vehicle Distance of the 2 scored runs; **2. Shortest Run Time of the better scored run; 3. Better Vehicle Distance of the non-scored run.**

8. **SCORING EXAMPLE:**

A Vehicle has 3 runs in the allotted time.
The 1st run has 2 Competition Violations and a Vehicle Distance of 57.8 cm.
The 2nd run has a Competition Violation and a Vehicle Distance of 143.9 cm.
The 3rd run has no Violations and a Vehicle Distance of 87.5 cm.
The team's Practice Log is incomplete.

1st run's Run Score:	57.8 pts + 1500 pts	= 1557.8 pts
2nd run's Run Score:	143.9 pts + 1500 pts	= 1643.9 pts (highest points, not counted in Final Score)
3rd run's Run Score:	87.5 pts	
Final Score	= 1st run's Run Score + 3rd run's Run Score + Incomplete Practice Log	
	= 1557.8 pts + 87.5 pts + 250 pts = 1895.3 pts	

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

ORNITHOLOGY

1. **DESCRIPTION:** Participants will be assessed on their knowledge of North American birds.
   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes
2. **EVENT PARAMETERS:**
   a. Each team may bring one 2" or smaller three-ring binder, as measured by the interior diameter of the rings, containing information in any form and from any source along with one commercially produced field guide not contained in the binder. Sheet protectors, lamination, tabs and labels are permitted in both the binder and field guide.
   b. 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 throughout the event.
   c. In addition to a binder, each team may bring one unmodified and unannotated copy of either the **2022** National Bird List or a **2022** Official State Bird List which does not have to be secured in the binder.
3. **THE COMPETITION:**
   a. The competition may be run as timed stations and/or as a timed slides/PowerPoint presentation.
   b. Specimens/pictures will be lettered or numbered at each station. The event may include preserved specimens, skeletal material, recordings of songs, and slides or pictures of specimens.
   c. For each station, Regional tournaments will have questions about 1 bird per station, State tournaments will use no more than 2 birds per station, and the National Tournament may use 3 or more birds per station.
   d. Each team will be given an answer sheet on which they will record answers to each question.
   e. No more than 50% of the competition will require giving order, family, and/or common name.
   f. Participants should be able to do basic identification to the level indicated on the Official List. States may have a modified state or regional list. See your state web site.
   g. States may have a modified state or regional list which will be posted on the state website no later than November 1st.
   h. The National competition will be based on the **2022** National Bird List.
   i. Each specimen will have one or more questions accompanying it on some aspect of its life history, distribution, anatomy and physiology, reproduction, habitat characteristics, ecology, diet, behavior, conservation and biogeography.
   j. The ecology questions may pertain to any ecological aspect of the species, including behavior, habitat, niche, symbiotic relationships, trophic level, adaptive anatomy such as bill size and shape, migration, distribution or occurrence (e.g., rare, common, special concern, endangered).
4. **SAMPLE ACTIVITIES:**
   a. Identify the order, family, and/or common name of the provided sample.
   b. What conclusion can be drawn about the habitat(s) of the given specimens?
   c. Which of these animals does not fit within this taxon?
   d. What unique anatomical feature distinguishes the animal shown in the picture?
   e. Consider the potential impact of human activities on the survival of birds.
5. **SCORING:**
   a. High score wins.
   b. Selected questions may be used as tiebreakers.

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

2022 NATIONAL BIRD LIST

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

Kingdom – ANIMALIA

Phylum – CHORDATA

Subphylum – VERTEBRATA

Class - AVES

Family Group *(Family Name)*

Common Name

ORDER: Anseriformes

Ducks, Geese, and Swans (*Anatidae*)

Black-bellied Whistling-duck

Snow Goose

Canada Goose

Trumpeter Swan ♩F

Wood Duck

Mallard ♩F

Northern Shoveler

Green-winged Teal

Canvasback

Hooded Merganser

ORDER: Galliformes

Partridges, Grouse, Turkeys, and Old World Quail (*Phasianidae*)

*Ring-necked Pheasant

Ruffed Grouse ♩F

Wild Turkey

New World Quail (*Odontophoridae*)

Northern Bobwhite ♩F

ORDER: Gaviiformes

Loons (*Gaviidae*)

Red-throated Loon

Common Loon ♩F

ORDER: Podicipediformes

Grebes (*Podicipedidae*)

Pied-billed Grebe

Red-necked Grebe

ORDER: Procellariiformes

Albatrosses (*Diomedeidae*)

Laysan Albatross

Shearwaters and Petrels (*Procellariidae*)

Northern Fulmar

ORDER: Pelecaniformes

Pelicans (*Pelecanidae*)

American White Pelican

Bitterns, Herons, and Allies (*Ardeidae*)

American Bittern ♩F

Great Blue Heron

Snowy Egret

Green Heron

Black-crowned Night-heron

Ibises and Spoonbills (*Threskiornithidae*)

Roseate Spoonbill

ORDER: Suliformes

Cormorants (*Phalacrocoracidae*)

Double-crested Cormorant

Darters (*Anhingidae*)

Anhinga

Frigatebirds (*Fregatidae*)

Magnificent Frigatebird

ORDER: Ciconiiformes

Deep-water Waders (Ciconiidae)

Wood Stork

ORDER: Falconiformes

Caracaras and Falcons (*Falconidae*)

Crested Caracara

American Kestrel

Peregrine Falcon

ORDER: Accipitriformes

Osprey (*Pandionidae*)

Osprey

Hawks, Kites, Eagles, and Allies (*Accipitridae*)

Bald Eagle ♩F

Northern Harrier

Cooper's Hawk

Red-tailed Hawk ♩F

Golden Eagle

ORDER: Cathartiformes

New World Vultures (Cathartidae)

Turkey Vulture

California Condor

ORDER: Gruiformes

Rails, Gallinules, and Coots (*Rallidae*)

Clapper Rail

Sora ♩F

Purple Gallinule

American Coot

Cranes (*Gruidae*)

Whooping Crane ♩F

ORDER: Charadriiformes

Lapwings and Plovers (*Charadriidae*)

American Golden-Plover

Killdeer ♩F

Oystercatchers (*Haematopodidae*)

American Oystercatcher

Stilts and Avocets (*Recurvirostridae*)

Black-necked Stilt

American Avocet

Sandpipers, Phalaropes, and Allies (*Scolopacidae*)

Spotted Sandpiper

Ruddy Turnstone

Dunlin

Wilson's Snipe

American Woodcock

Gulls, Terns, and Skimmers (*Laridae*)

Laughing Gull ♩F

Ring-billed Gull

Herring Gull

Least Tern

Caspian Tern

Black Tern

Black Skimmer

Auks, Murres, and Puffins *(Alcidae)*

Common Murre

Tufted Puffin

ORDER: Columbiformes

Pigeons and Doves (*Columbidae*)

Mourning Dove ♩F

Common Ground-Dove

*Rock Pigeon

ORDER: Cuculiformes

Cuckoos, Roadrunners, and Anis (*Cuculidae*)

Black-billed Cuckoo ♩F

Greater Roadrunner

1) Special Characters: ♩F indicates vocalizations that may be tested & * indicates an introduced, widespread Species
2) The taxonomic scheme is based upon the 7th edition Checklist of North American Birds, American Ornithologists' Union, and www.allaboutbirds.org Cornell University Laboratory of Ornithology.

2022 NATIONAL BIRD LIST

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

ORDER: Strigiformes
Barn Owls (*Tytonidae*)
Barn Owl
Typical Owls (*Strigidae*)
Great Horned Owl
Snowy Owl
Barred Owl
Screech Owl

ORDER: Caprimulgiformes
Nightjars and Allies (*Caprimulgidae*)
Chuck-will's-widow
Common Nighthawk

ORDER: Apodiformes
Swifts (*Apodidae*)
Chimney Swift
Hummingbirds (*Trochilidae*)
Ruby-throated Hummingbird

ORDER: Coraciiformes
Kingfishers *(Alcedinidae)*
Belted Kingfisher

ORDER: Piciformes
Woodpeckers and Allies (*Picidae*)
Red-headed Woodpecker
Yellow-bellied Sapsucker
Downy Woodpecker
Northern Flicker
Pileated Woodpecker

ORDER: Passeriformes
Tyrant Flycatchers (*Tyrannidae*)
Olive-sided Flycatcher
Eastern Phoebe
Vermilion Flycatcher
Great Crested Flycatcher
Eastern Kingbird
Scissor-tailed Flycatcher
Shrikes (*Laniidae*)
Loggerhead Shrike
Vireos (*Vireonidae*)
Warbling Vireo
Red-eyed Vireo
Jays and Crows (*Corvidae*)
Steller's Jay
Blue Jay
Black-billed Magpie
American Crow
Common Raven
Larks (*Alaudidae*)
Horned Lark
Swallows (*Hirundinidae*)
Purple Martin
Cliff Swallow
Barn Swallow
Chickadees and Titmice (*Paridae*)
Black-capped Chickadee
Tufted Titmouse
Nuthatches (*Sittidae*)
Red-breasted Nuthatch
White-breasted Nuthatch
Creepers (*Certhiidae*)
Brown Creeper
Wrens (*Troglodytidae*)
Cactus Wren
Marsh Wren
Carolina Wren
Dippers (*Cinclidae*)
American Dipper
Kinglets (*Regulidae*)
Golden-crowned Kinglet
Ruby-crowned Kinglet
Gnatcatchers (*Polioptilidae*)
Blue-gray Gnatcatcher
Thrushes (*Turdidae*)
Eastern Bluebird
Wood Thrush
American Robin
Mockingbirds and Thrashers (*Mimidae*)
Gray Catbird
Northern Mockingbird
Brown Thrasher
Waxwings (*Bombycillidae*)
Cedar Waxwing
Wood-Warblers (*Parulidae*)
Yellow Warbler
Magnolia Warbler
Yellow-rumped Warbler
Black-throated Green Warbler
Black-and-white Warbler
American Redstart
Ovenbird
Kentucky Warbler
Common Yellowthroat
New World Sparrow (Passerellidae)
Spotted Towhee
Black-chinned Sparrow
Lark Sparrow
Harris's Sparrow
White-crowned Sparrow
Chipping Sparrow
Dark-eyed Junco
Longspurs and Buntings *(Calcariidae)*
Lapland Longspur
Snow Bunting
Cardinals and Allies (*Cardinalidae*)
Northern Cardinal
Indigo Bunting
Painted Bunting
Scarlet Tanager
Blackbirds (*Icteridae*)
Bobolink
Red-winged Blackbird
Western Meadowlark
Yellow-headed Blackbird
Common Grackle
Brown-headed Cowbird
Baltimore Oriole
Fringillids and Allies (*Fringillidae*)
Red Crossbill
American Goldfinch
Evening Grosbeak
House Finch
Pine Siskin
Old World Sparrows *(Passeridae)*
*House Sparrow
Old World Starlings *(Sturnidae)*
*European Starling

1) Special Characters: indicates vocalizations that may be tested & * indicates an introduced, widespread Species
2) The taxonomic scheme is based upon the 7th edition Checklist of North American Birds, American Ornithologists' Union, and www.allaboutbirds.org Cornell University Laboratory of Ornithology.

PING PONG PARACHUTE

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 three** 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 **IMPOUND:** No **EYE PROTECTION:** B **EVENT TIME: 8 minutes**

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

3. **CONSTRUCTION PARAMETERS:**
   a. Rocket pressure vessels must be made from a single **20 oz, in measured volume,** or less plastic carbonated beverage bottle with a nozzle opening internal diameter of approximately 2.2 cm (a 1/2-inch Schedule 40 PVC pipe must fit tightly inside the nozzle opening) and a standard neck height from flange to bottle's opening of under 1.6 cm. The bottle label must be presented at check in.
   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 outside of the pressure vessel. Nothing may be added to or placed on the inside of 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 tire pump; no water. Gases other than air, explosives, liquids including water, chemical reactions, pyrotechnics, electrical devices, elastic powered flight assists, throwing devices, remote controls, and tethers are prohibited at any time.
   g. At the National Event the launcher nipple will extend into the rocket 1.173 in +/- 0.2 in (3.0 cm +/- 0.5 cm) above the top side of the shoulder of the bottle (see Figure 3).

Figure 1

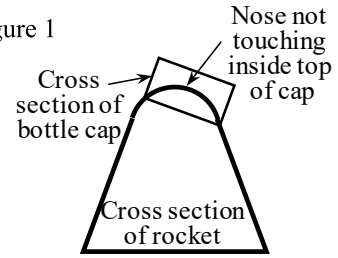


Figure 2

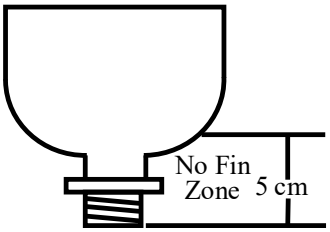
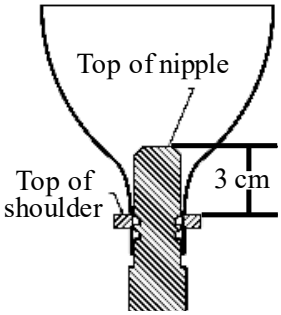


Figure 3



4. **PRACTICE LOG:**
   a. During inspection, each team must present a flight log **and graph** of recorded data for each rocket **design**. Data must include 5 or more parameters (3 required and at least 2 additional) for 15 or more test flights prior to the competition for each rocket. The required parameters are: 1) pressure (psi), 2) estimated/ recorded peak flight height (feet), 3) time aloft (seconds). The additional parameters are chosen by the team (examples include: # fins, parachute diameter, etc.).

b. **For each rocket design, the team needs to prepare a graph showing estimated/recorded peak flight height (feet) vs Pressure (psi). The graph(s) must be printed out from an electronic source. Hand drawn graphs are not allowed.**
c. **If a 3-D printer, laser cutter, CNC machine or similar device was used as a tool to build the team's device, or any component thereof, the following information must also be supplied in the log.**
   i. **Information about the tool hardware, software, materials, and supplies used**
   ii. **Details of the source of any digital files (e.g.; CAD, STL, OBJ) utilized by the tool including but not limited to when and where the file was obtained, including the web address if downloaded from the internet**
   iii. **Descriptions of how the team constructed the final device from the tool created components**
d. **Data on the graph must match the 15 or more recorded test flights for each rocket design.**
e. **Rocket designs without flight logs and graphs will be penalized a -10 second penalty for each scorable flight.**
f. **All submitted logs will be returned to teams.**

5. **THE COMPETITION:**
   a. Teams must arrive at the competition site ready to launch with proper eye protection to have their rocket(s) inspected for safety. **If the Event Supervisor has safety concerns that cannot be addressed to their satisfaction rockets will not be launched.**
   b. Teams will have **8 minutes to make a total of three launches using any combination of rocket, ping pong ball and parachute that the team presented for inspection at check in.**
   c. **When teams are called to launch, the 8 minute timer starts when the team enters the launch area. Teams that brought their own manual tire pump will connect it to the pressure vessel connection of the launcher.** 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. At no time should the pressure vessel (bottle) be pressurized beyond the lesser value of **50 psi** or the maximum pressure determined by the Event Supervisor for safe operations given ceiling height at the tournament location. 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.
   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 rocket touches the ground.
   g. If any part of a rocket or parachute payload system hits the ceiling or any part connected to the ceiling (e.g., a rafter, light, basketball hoop), then timing is stopped at the instant of contact.
   h. If a rocket fails to separate from the launcher because of a problem with the supplied launcher then the launch never occurred 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 **flight** time.
   j. Teams filing an appeal must leave their rocket(s), parachute payload system(s), and Practice Log(s) in the event area.

6. **SCORING**:
   a. **Ranking is determined by the sum of the two greatest times of flight of the 3 launches.**
   b. **Rockets and/or parachute payload systems violating 2.c, 3.a.-f will not be launched. Rockets violating rules 4.a.-b. will be penalized with a -10 second penalty for each scorable flight.** Teams unable to make any launches will receive participation points only.
   c. **Ties will be broken by the greatest time aloft of the parachute payload system from each team's un-scored 3rd launch.**

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

ROAD SCHOLAR

1. **DESCRIPTION:** Participants will answer interpretive questions that may use one or more state highway maps, USGS topographic maps, Internet-generated maps, a road atlas, or satellite/aerial images.

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

2. **EVENT PARAMETERS:**
   a. Teams may bring two stand-alone non-programmable, non-graphing calculators, protractors, rulers, other measuring devices, USGS Map Symbol Sheet, and hard copies of other information in any form and from any source along with colored marking devices consistent with the colors utilized on USGS topographic maps. The equipment and reference materials may be in a container.
   b. The event supervisor will provide all required maps and images. Participants may NOT write on the maps. If a student-generated map is included, a one mile-square PLSS section will be printed on the answer sheets. Graphing axis will be provided for profile problems. Event supervisors will check the accuracy of scales on reproduced maps or images prior to competition.
3. **THE COMPETITION:** The satellite images, highway, and quadrangle maps may be from one or more states. The event may be presented in a storyline format. Satellite/aerial photos will be in the visible light spectrum. Items marked with an asterisk (*) should be written at an introductory level for Regional Tournaments.

Topics/Concepts Assessed

a. Topographic Map
   i. Map features
   ii. Map marginal information: location/ series/scale/index/legend
   iii. Map symbols
   iv. Distances between features (English and Metric)
   v. Contours
   vi. Elevation of features and symbols
   vii. Direction of stream flow
   viii. Coordinate systems of map features with correct formats
      (1) Public Land Survey System (PLSS)
      (2) Sector Reference System
      (3) Latitude/Longitude in degrees, minutes, & seconds
      (4) Universal Transverse Mercator (UTM)
   ix. Azimuths and bearings
   x. Magnetic declination
   xi. Survey control marks (control stations and spot elevations)
   xii. Graticule tick marks / graticule intersections
   xiii. Topographic map profiles*
   xiv. Slope (feet per 100 feet)*
   xv. Stream gradient (feet per 1000 feet)*

b. Highway Map

Topographic map topics may also be present on highway maps.
   i. Map legend/tables/index
   ii. Map features/symbols
   iii. Map grid system
   iv. Distance between features
   v. City/Regional insets
   vi. Geographic coordinates in decimal degrees

c. Student-Created Map
   i. Map scales
   ii. USGS topographic map symbols and colors
   iii. Distances
   iv. Azimuths and bearings
   v. Public Land Survey System

d. Satellite Photos/Internet Maps
   i. Feature identification
   ii. Distances and scales
   iii. Photo time-of-day identification
   iv. Internet map symbols
   v. Road travel between points
   vi. **Inferences based on satellite photos**

4. **SAMPLE QUESTIONS/TASKS:**
   a. Use the map index to identify the map coordinates of Cedarville.
   b. Use the Detroit inset map to compute the distance in miles and tenths along the roads from the Museum of Art to Cobo Arena.
   c. What does it tell us if contour lines are very close together in an area?
   d. By observing shadows, estimate the time of day that this satellite image was captured.
5. **SCORING:**
   a. High score wins. Values of questions may be weighted.
   b. Ties will be broken by the accuracy and quality of answers to pre-selected questions.

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

ROCKS AND MINERALS

1. **DESCRIPTION:** Participants will demonstrate their knowledge of rocks and minerals.
   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes
2. **EVENT PARAMETERS:**
   a. **Each team may bring one 2" or smaller three-ring binder, as measured by the interior diameter of the rings, containing information in any form and from any source along with one commercially produced field guide not contained in the binder. Sheet protectors, lamination, tabs and labels are permitted in both the binder and field guide.**
   b. **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 throughout the event.**
   c. **In addition to a binder and a field guide, each team may bring one unmodified and unannotated copy of the 2022 Rocks & Minerals List and one magnifying glass which does not have to be secured in the binder. Teams are not permitted to bring samples or specimens to the event.**
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, analyzing data, etc.**
   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 2022 Rocks and Minerals List (see www.soinc.org), but other rocks or minerals may be used to illustrate key concepts. Tournament Directors may include up to five additional specimens important to their own state. If additional specimens are to be included, all teams must be notified no later than three weeks prior to the competition.**
   d. **If identification of a specimen is not possible through observation, key characteristics/properties of the specimen will be provided.**
   e. Written descriptions as to how a specimen might react were it to be tested with HCl may be provided. HCl will not be used or provided **nor will competitors be allowed to do a taste test.**
4. **REPRESENTATIVE TOPICS:** (may include, but are not limited to):
   a. **Minerals:**
      i. Identification **- specimens or images used should show observable properties. Where observable properties are insufficient to identify a specimen, other diagnostic characteristics will be provided**
      ii. Physical **Properties -** color, hardness, luster, streak, cleavage/**fracture, density/specific gravity/ heft, diaphaneity, tenacity**
      iii. **Other properties - reaction with acid, fluorescence, magnetism, smell, taste, double refraction, piezoelectricity, radioactivity**
      iv. Mineral habit **- limited to acicular (needlelike),** bladed, botryoidal**, cubic, dendritic, dodecahedral, doubly terminated, druzy, geodic,** hexagonal**, hopper, massive, micaceous, octahedral, pisolitic, prismatic, radiating, rosette, stalactitic, twinning, and tabular**
      v. Chemical composition
      vi. **Polymorphs (e.g. diamond/graphite and orthoclase/microcline)**
         (1) **Division C Only - Solid solution series (e.g. feldspar ternary diagrams)**
      vii. Classification **- mineral families based on composition. (see Rock and Mineral List)**
         (1) **Mineral groups (e.g. feldspars, garnet, tourmaline) - similarities of chemical composition and shared properties**
         (2) **Division C Only - Silicate classifications and their structures limited to the following groups: isolated tetrahedra (nesosilicates), chain silicates (inosilicates), sheet silicates (phyllosilicates) and framework silicates (tectosilicates)**
      viii. Methods of formation **(e.g. hydrothermal, crystallization from magma, evaporites, alteration under heat & pressure)**
      ix. **Minerals associated with rock-forming environments (e.g. evaporite minerals in sedimentary settings; mafic minerals in oceanic crust; minerals that form under metamorphic conditions)**
      x. Bowen's Reaction Series – **relationship between mineral crystallization and temperature in magma**
      xi. Economic importance **and uses of minerals** (e.g. ores, industrial uses, jewelry)

b. **Rocks:**
   i. Identification - **specimens or images used should show observable characteristics. Where observable characteristics are insufficient to identify a specimen, other diagnostic characteristics will be provided (e.g.; mineral composition of fine-grained igneous rocks)**
   ii. Classification - igneous, sedimentary, and metamorphic **including observable diagnostic characteristics that facilitate classification (e.g. glassy or vesicular texture in igneous; rounded grains, fossils, or layers in sedimentary; and foliation or banding in metamorphic)**
   iii. Igneous:
      (1) **Textures - including but not limited to aphanitic (fine-grained), glassy, vesicular, porphyritic, pyroclastic, phaneritic (coarse-grained), pegmatitic**
      (2) **Composition and essential minerals - felsic, intermediate, mafic, ultramafic**
      (3) **Intrusive and extrusive environments - including but not limited to batholith, dike, sill, volcanic neck, lava flow, pyroclastic flow, laccolith**
      (4) **Relationship between textures and environments of formation (e.g. intrusive/plutonic, extrusive/volcanic and relative rates of solidification.)**
   iv. Sedimentary:
      (1) **Textures - limited to clastic (detrital), chemical, and biochemical/organic**
      (2) **Composition and essential minerals**
      (3) **Grain sizes (e.g. clay, silt, sand, pebble, cobble, boulder), sorting, and shape**
      (4) **Relationship between textures and composition to environments of deposition**
      (5) **Environments of deposition - including, but not limited to alluvial fan, delta, river/ stream, swamp, floodplain, beach, shallow marine, deep marine**
      (6) **Primary sedimentary structures (e.g. plane bedding, cross-bedding, ripple marks, mud cracks, graded bedding, fossil tracks & trails) and their implications about depositional processes**
   v. Metamorphic:
      (1) **Textures - foliated and non-foliated**
      (2) **Mineral composition**
      (3) **Protoliths (parent rocks)**
      (4) **Regional and contact metamorphism**
      (5) Grade of metamorphism **and metamorphic index minerals (e.g. chlorite, epidote, garnet, staurolite, kyanite, sillimanite)**
      (6) **Division C Only - Relationship of temperature, pressure, depth to types of metamorphism and metamorphic facies (e.g. hornfels, zeolite, greenschist, amphibolite, granulite, eclogite) based on interpretation of graphs and charts**
      (7) **Division C Only - Environments of metamorphism in the context of plate tectonics - regional metamorphism and mountain building at convergent continental-continental boundary; blueschist and eclogite formation in subduction zones; greenstone/greenschist formation from basalt or gabbro at ocean crust divergent boundaries**
   vi. Rock Cycle – **emphasis on the geologic processes that form rocks (e.g. melting and solidification; uplift, erosion & deposition; burial, compaction & cementation; heat & pressure resulting in recrystallization & deformation)**
   vii. **Economic importance and uses of rocks**

5. **SAMPLE ACTIVITIES:**
   a. List the **mineral** specimens, by name and number, in order of increasing hardness.
   b. Match each metamorphic rock with the parent rock from which it may have been formed.
   c. **Based on the texture of the metamorphic rocks, list the specimens in order from lowest to highest grade of metamorphism.**
   d. **Based on the provided diagram of igneous environments, at which location would the sample have formed?**
   e. **Based on the grain size of the shale, sandstone, and conglomerate, which one formed in the lowest energy environment?**
   f. **Classify the specimens into igneous, sedimentary, or metamorphic based on observable characteristics and state one reason for each classification.**
6. **SCORING:** High score wins. Selected questions will be used to break ties.

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

2022 ROCKS AND MINERALS LIST

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

MINERALS

Borate Family
Ulexite

Carbonate Family
Aragonite
Azurite
Calcite
Dolomite
Malachite
Rhodochrosite*

Native Element Family
Copper
Diamond
Gold
Graphite
Silver
Sulfur

Halide Family
Fluorite
Halite[4]

Oxide/Hydroxide Families
Corundum
Goethite/Limonite
Hematite
Magnetite
Pyrolusite*
Rutile*
Zincite*

Phosphate Family
Apatite Group[1]
Pyromorphite*
Turquoise*
Vanadinite*

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

Sulfide Family
Bornite*
Chalcopyrite
Galena
Pyrite
Sphalerite
Stibnite*

Silicate Family
Apophyllite*
Beryl
Epidote
Kaolinite
Kyanite
Olivine
Quartz varieties:
- Aventurine
- Agate
- Amethyst
- Chalcedony
- Citrine*
- Jasper*
- Milky Quartz
- Opal
- Rock Crystal
- Rose Quartz
- Smoky Quartz*

Sodalite
Staurolite
Stilbite*
Talc
Topaz
Tourmaline Group[1]
Willemite*
Zircon*
Amphibole Group
- Actinolite*
- Hornblende
- Tremolite*

Feldspar Group
- Plagioclase feldspars
  - Albite
  - Labradorite
- Potassium feldspars
  - Amazonite
  - Orthoclase/Microcline (pink)[2]

Garnet Group[1]
- Almandine

Mica Group
- Biotite
- Lepidolite*
- Muscovite

Pyroxene Group
- Augite
- Rhodonite*
- Spodumene*

ROCKS

IGNEOUS ROCKS
Andesite
Basalt
Diorite
Gabbro
Granite
Obsidian
Pegmatite
Peridotite
Pumice
Rhyolite
Scoria
Syenite
Tuff

SEDIMENTARY ROCKS
Banded Iron
Bauxite[3]
Breccia
Chert
Conglomerate
Diatomite
Dolostone
Rock Salt (Halite)[4]
Rock Gypsum[4]
Shale
Coal varieties:
- Anthracite
- Bituminous
- Lignite

Limestone varieties:
- Chalk
- Coquina
- Fossil Limestone
- Oolitic Limestone
- Travertine

Sandstone varieties:
- Arkose
- Greywacke
- Quartz Sandstone

METAMORPHIC ROCKS
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 - Apatite, Garnet, and Tourmaline varieties should be identified at the group level, except for Almandine.

2 - This pink variety of feldspar should be identified as Potassium feldspar and not specifically as Orthoclase or Microcline.

3 - Bauxite has been reclassified as a sedimentary rock.

4 - 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.

SOLAR SYSTEM

1. **DESCRIPTION:** Students will demonstrate an understanding and knowledge of **planet formation and structure** in our solar system and how it relates to that observed in **extrasolar systems.**

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

2. **EVENT PARAMETERS:** Each team may bring two 8.5" x 11" sheets of paper that may contain information on both sides in any form and from any source. This information may be used during any part of the event.

3. **THE COMPETITION:**
   a. Participants must be knowledgeable about the different types of terrestrial **and gaseous** planets, **moons, and minor bodies** in the Solar System, their **formation, structure, and properties,** and the typical surface and **atmospheric** features of these planets as they appear on diagrams, plots, maps, or images.
   b. Participants must be knowledgeable about the **formation, structure, and properties** of various types of **terrestrial and gaseous exoplanets**, **including, but not limited to: hot Jupiters**, **mini-Neptunes, and super-Earths,** and be able to **compare and contrast them with those of the Solar System planets.**
   c. Participants must be knowledgeable about the **details of the formation, structure, and properties** of the objects listed below. If applicable, they may be asked to identify and analyze surface **and/or atmospheric** features on these objects as they appear on diagrams, plots, maps, or images.
      i. Solar System Objects: **Venus, Jupiter, Saturn, Uranus, Neptune, Io, Iapetus, Triton, Pluto, Arrokoth (2014 MU69)**
      ii. **Extrasolar Systems/Planets: HL Tauri, HR 8799, Kepler 138, K2-18b, K2-33b, TOI-561**
   d. Participants may also be tested on the following topics:
      i. Planet formation and internal and atmospheric structure and evolution of terrestrial **and gaseous** planets within **and beyond** the Solar System.
      ii. Scientific questions addressed by relevant planetary missions and observatories, including, but not limited to: **Magellan, Galileo, Juno, Cassini, Voyager 2, New Horizons, ALMA, Kepler, and TESS**.
      iii. **Qualitative understanding of orbital mechanics and gravitational interactions between objects, including, but not limited to: Kepler's Laws, planetary migration, and tidal forces.**
      iv. **Exoplanet detection and characterization techniques (limited to transits, radial velocity, and direct imaging).**
      v. **Internal, surface, and atmospheric compositions and structures for each of the objects outlined in (c).**

4. **SAMPLE PERFORMANCE TASKS:**
   a. Given a set of images of a particular feature, identify the specific name of the feature, how old that feature might be, and explain how the feature was formed.
   b. **Describe the internal structure of an object and explain how this internal structure was determined from spacecraft data.**
   c. **Given radial velocity and transit data for a hypothetical exoplanet, compare and contrast its likely physical properties and formation mechanism with a given planet from our Solar System.**

5. **SCORING:** High score wins. Each task or question will be assigned a predetermined number of points. Selected questions will be used to break ties.

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

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

SOUNDS OF MUSIC

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

1. **DESCRIPTION:** Teams must construct and tune one device prior to the tournament based on a **one**-octave 12-tone equal tempered scale and complete a written test on the physics of sound and music concepts.

   A TEAM OF UP TO: 2 **EYE PROTECTION:** None

   IMPOUND: No **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. **Each team may bring one three-ring binder of any size containing information in any form and from** any source attached using the available rings. Sheet protectors, lamination, tabs and labels are permitted. Participants may remove information or pages for their use during any part of the event.
   b. Each team may also bring writing utensils and two stand-alone calculators of any type for use during any part of the event.
   c. Teams may bring a personal tuner, which may be an app on their cell phone, for use during set up. Access to an electrical outlet is not guaranteed.
   d. If testing a stringed device, a team may bring rosin.
   e. **Prior to the competition, teams must tune their device to play the eight notes of a one-octave major scale of the team's choosing.**
   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 device may be constructed of and contain any materials except for the following: electric or electronic components, toys, professional instruments, or parts taken from or built for toy or professional instruments (e.g., bells, whistles, mouthpieces, reeds or reed blocks, audio-oscillators, tuning pegs, etc.). The only exception is that strings (professional, instrumental or otherwise) **and rosin** of any type are permitted.
   b. **The device must be able to play an ascending major scale beginning on any note between F2 and C5 (inclusive), chosen by the team. (A4 = 440 Hz).**
   c. **The device must also be able to play one additional pitch above the scale's range in order to play the four bar refrain of "Yankee Doodle". The song excerpt (attached at the end of the rules) must be played in 25 seconds and must be played within one octave.**
   d. The energy to produce the pitches must come from the participants and may not be stored. Participants may not hum or sing to cause the device to produce its pitches.
   e. Each device must fit within a 60.0 cm x 60.0 cm x 100.0 cm box when brought into the competition area and be moveable by the participants without outside assistance. Devices may become larger once set up.
   f. Devices must use the same type of sound-producing components for all portions of the competition.

4. **DESIGN LOG:**
   a. **Teams must submit a Design Log along with their instrument. The log must contain the following:**
      i. **Materials used to construct the instrument**
      ii. **A labeled diagram or picture that describes how the eight notes for the major scale are played**
      iii. **How one specific note was tuned including at least five data points for that note**
      iv. **Team name, team number, and appropriate metric units for all numerical values**
   b. **If 3-D printing, laser cutter, or a CNC machine was used to create any elements used in the instrument the following information must also be provided in the log.**
      i. **Information about the 3-D printer and material used**
      ii. **When and where the printer file was obtained, including the web address if downloaded from the internet**
      iii. **Additional information in the log as needed to describe the construction of student made components so they are not confused for professional components, such as reeds, mouthpieces, etc.**
   c. **All submitted logs will be returned to teams.**

5. **THE COMPETITION:**

   Part I: Written Test
   a. Teams will be given a minimum of 20 minutes to complete a written test consisting of multiple choice, true-false, completion, or calculation questions/problems. **Regional exams may not have more than 50% mathematical questions. State and National exams may not have more than 75% mathematical questions.**
   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. **Basic principles of acoustics including concepts from aeroacoustics, architectural acoustics, bioacoustics, electroacoustics, speech, and underwater acoustics (e.g. hearing, human ear, noise generated by air movement, turbulence, building and auditorium acoustics, animal calls, how sound affects animals, recording and reproduction of sound, natural and man-made sounds underwater). Additional topics for States and Nationals: Environmental noise, psychoacoustics (e.g. noise and vibration caused by various forms of transportation and recreational activities, relationship between sound and cognition, noise cancellation)**
   ii. **Basic conceptual ideas and basic algebraic calculations of sound wave theory (e.g. superposition, constructive and destructive interference, beats, Doppler effect, wave velocity equation, speed of sound in various media, standing waves, plane waves, reflection, refraction, diffraction, propagation). Additional topics for States and Nationals: Intermediate conceptual ideas and intermediate algebraic calculations of sound wave theory (e.g. interaction of multiple sound waves, boundary effects, echos, sonar, radar, Helmholtz resonators, impedance, sound pressure).**
   iii. **Fundamental elements of musical sound, perception, and resonance (e.g. pitch, amplitude, harmonics, overtones, open and closed pipes, strings, membranes). Additional topics for States and Nationals: Elements of musical sound, perception, and resonance (timbre, sound quality, dissonance and consonance, complex tones, harmony, combination tones).**
   iv. **The design, function, and construction of various instrument types (e.g. how it makes sound, what determines the pitch, how is volume changed). This may include string, brass, woodwind, percussion, and keyboard instruments. Additional topics for States and Nationals: knowledge of common parts of various instruments, how the parts interact and affect overall instrument performance, materials used in construction. This may include less common instruments and is not limited to those listed previously in this section.**
   v. **Notes, major scales, intervals, time signatures, tempos, and common music terms. Additional topics for States and Nationals: major and minor scales, solfege, intervals and chords, and less common music terms.**

Part II: Device Testing

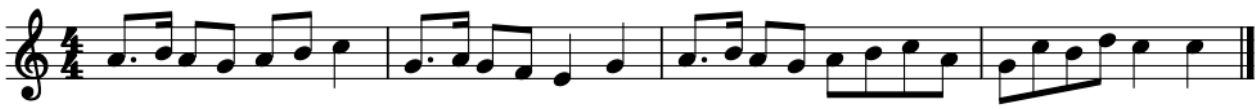
a. Device testing should take place in a room separate from the Part I written test to minimize disruption and to ensure the accuracy of the device readings.
b. Devices will be evaluated on their ability to produce accurate pitches. A recommended pitch measuring software program is available on the event page at soinc.org.
c. Teams will have two minutes to set up their device. During the two minutes, teams may use their personal tuner, including a cell phone app, to adjust the pitches on their device. One participant may continue working on the written test if not needed to play or set up the device.
d. At the end of the two minutes, the team's tuner must be put away. Failure to do so will result in a construction violation. No further alterations of the device are allowed other than those that would occur naturally while playing different pitches (such as covering different holes with fingers or moving a slide).
e. Once the device is ready, or the two-minute set-up period has expired, the participants will begin their Pitch Score Test:
   i. Participants will inform the Event Supervisor which major scale they are playing and what note they will start on. Participants must know the octave number of their starting pitch.
   ii. Participants will play one pitch at a time, holding it for a duration of 3 seconds as indicated by signals from the Event Supervisor. For devices with a quick decay time, multiple attacks on the pitch are allowed (e.g., striking a bar with a mallet or plucking a string multiple times). The pitch measurement will be the average value during the 3 seconds. Participants will wait until the Supervisor records the measured pitch frequency and indicates that they may proceed before playing the next note in the sequence.
   iii. The microphone may be moved as close as necessary to the device to register the pitch. If a pitch is so soft that it cannot register on the measurement equipment, the device scores zero for that Individual Pitch Score.
   iv. If the device is unable to play some of the required pitches, the participants must notify the Event Supervisor before playing the first note which pitches in the sequence will be skipped. Otherwise it will be assumed that the participants are playing the next note in the scale sequence. Points will be awarded per note.
f. Once the Pitch Score Test is completed the participants will conduct their Song Score Test.
   i. No alterations of the device are allowed between the Pitch and Song Score tests.
   ii. Participants will select a starting note from the range encompassed by the pitch test scale.

iii. **Participants must play the "Yankee Doodle" refrain within 25 seconds.**
iv. The Song Score test is scored based on ability to play the song within the time and the Event Supervisor's perception of the rhythmic and pitch accuracy of the song.

g. The Event Supervisor will review with the teams the Part II data recorded on their scoresheet.
h. Teams filing an appeal regarding Part II must leave their device in the competition area.

6. **SCORING:**
   a. High score wins. A complete scoring rubric is available on the Sounds of Music page on soinc.org
   b. The Final Score = TS + LS + PS + SS. **The maximum possible Final Score (FS) is 100 points**
      i. Test Score (TS) = (Part I score / Highest Part I score for all teams) x 45 points
      ii. Log Score (LS) = max of 10 points
      iii. Pitch Score (PS) = (Sum of IPS for the Device / Highest IPS Sum for all teams) x **30** points
      IPS (Individual Pitch Score for each pitch) =
         (1) C (cents) = abs (cents off the target frequency).
         (2) IPS for skipped pitches = 0
         (3) The IPS score varies by tournament level:
            a. Regionals: If $C \leq 10$, IPS = 4.5; If $C > 10$, IPS = 5 - 0.05 x C
            b. States: If $C \leq 7$, IPS = 4.5; If $C > 7$, IPS = 5 - 0.1 x C
            c. Nationals: If $C \leq 3$, IPS = 4.5; If $C > 3$, IPS = 5 - 0.2 x C
         (4) The minimum IPS score is 0 no matter the level of the tournament.
      iv. Song Score (SS) = (Device Song Score / Highest Device Song Score of all teams) x **15** points
   c. The log must track the iterations of calibrating one pitch on the device. The Log Score (LS) points will be assigned as follows (partial points may be awarded):
      i. 2 points – For a list of materials used in the device
      ii. 2 points – For including data comparing pitch accuracy to changes made to an appropriate design element (e.g., pitch vs length of tubing) in order to tune one pitch
      iii. 2 points – For including at least 5 data points in tuning the one pitch
      iv. 2 points – For proper labeling (e.g., title, team name, units, team number)
      v. 2 points – For including a labeled picture showing how to play different pitches (e.g., a fingering chart)
      vi. LS = 0 if no device is brought to the event
   d. The Device Song Score points will be assigned as follows (partial points may be awarded):
      i. **5** points – Rhythmic accuracy
      ii. **5** points – Pitch accuracy
      iii. **5** points – Was the song played within **25** seconds from the start of playing
   e. If a team violates any COMPETITION rules, their IPS values will be multiplied by 0.9 when calculating the scores.
   f. If any CONSTRUCTION violation(s) are corrected during the Part II setup period, the IPS values will be multiplied by 0.7 when calculating the scores.
   g. **Teams that are disqualified for unsafe operation, do not bring a device, or whose device does not meet construction parameters at the end of their setup time receive zero points for their PS and SS scores. Teams will be allowed to compete in Part I.**
   h. Ties will be broken using the following categories in the listed order:
      i. Best PS
      ii. Best SS
      iii. Best TS
      iv. Questions on the written test

"Yankee Doodle" excerpt:
Note that the excerpt may be transposed into an appropriate key.



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

STORM THE CASTLE

1. **DESCRIPTION:** Prior to the competition, teams will design, construct, and calibrate a single device capable of launching projectiles onto a target and collect data regarding device parameters and performance.

   A TEAM OF UP TO: 2 **EYE PROTECTION:** B **IMPOUND:** Yes **APPROX. TIME:** 10 minutes

2. **EVENT PARAMETERS:**
   a. Prior to the competition teams must collect and record launch device performance and calibration data.
   b. Each team may bring tools, supplies, writing utensils, and two stand-alone calculators of any type for use (these items need not be impounded). Each team must impound only one launch device and design log. Items must be moveable by the competitors without outside assistance.
   c. Event Supervisors will provide the projectiles, counterweights, and target.
   d. Participants must wear eye protection during device setup and operation. Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows.
   e. Participants must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org.

3. **CONSTRUCTION PARAMETERS:**
   a. When ready-to-launch, the launch device, projectiles, stabilizing weights, **counterweights,** and all other device components (except for tools / supplies) must fit in a 65.0 cm per side cube, in any orientation chosen by the team.
   b. The triggering device is not considered part of the device and activating it must not contribute significant energy to the launch. It must extend out of the launch area, allow for competitors to remain at least 75cm away from the launch area, and does not need to return to the launch area after launch. The triggering device must not pose a danger due to flying parts or excessive movement outside of launch area.
   c. The launch device must be constructed to accommodate the supervisor provided counterweights and projectiles (see Section 6 for details). Teams may not modify the counterweights or projectiles.
   d. The launch force must be entirely supplied by the gravitational potential energy from the supervisor provided falling counterweights. The device, without the counterweight and projectile, must not contribute energy to the launch. This includes any part of the device whose potential energy decreases, with the exception of items of nominal mass, such as strings and thin rods. Devices will be inspected to ensure that there are no other energy sources. At the supervisor's discretion, teams must disassemble devices after competing in order to verify this. Example violations, allowable types, and mechanisms for testing for added energy are available on soinc.org.
   e. The launch device must be designed and operated in such a way to not damage or alter the floor.
   f. Electrical components are not allowed as part of the device or triggering device.

4. **DESIGN LOG:**
   a. Teams must submit a design log showing collected device data, which should contain:
      i. One or more photos and/or diagrams of the device with labels identifying all the major components and detailing their function, along with a brief summary of how the device was built.
      ii. Any number of graphs and/or tables showing the relationship between various parameters such as arm position or counterweight mass and impact position. Graphs/tables may be computer generated or hand drawn on graph paper. Each data series counts as a separate graph. A template is available at www.soinc.org.
      iii. Example calculations showing how to use the graphs/tables to adjust the device for a target position.
   b. The team must indicate up to four graphs/tables to be scored, otherwise the first four provided are scored.
   c. All pages of the design log must be affixed together, such as via three ring binder, staples, or paperclips.
   d. Design logs will be returned to the team after they are done competing.
   e. **If a 3-D printer, laser cutter, CNC machine or similar device was used as a tool to build the team's device, or any component thereof, the following information must also be supplied in the log.**
      i. **Information about the tool hardware, software, materials, and supplies used**
      ii. **Details of the source of any digital files (e.g.; CAD, STL, OBJ) utilized by the tool including but not limited to when and where the file was obtained, including the web address if downloaded from the internet**
      iii. **Descriptions of how the team constructed the final device from the tool created components**
   f. **All submitted logs will be returned to teams.**

5. **THE COMPETITION:**
   a. Each team will have 8 minutes to set up, adjust and calibrate their device, and to launch a max of 2 shots with each counterweight. Measurement time required by the supervisor is not included in the allotted time. Devices that do not meet the construction specs will not be allowed to launch until brought into spec.
   b. When instructed by the event supervisor(s), teams must place their device at a location they select in the launch area. Competitors must not be within 75 cm of the launch area or in front of the front edge of the launch area during a launch. They may touch only the part of the triggering device that extends at least 75cm outside of the launch area.
   c. Teams may move devices within the launch area and/or adjust them in any way between and before shots.
   d. No part of the launch device may extend outside of the launch area before or after a shot. If part of the launching device extends beyond the launch area during the launching action, it must return to and remain in the launch area immediately after the launch without assistance of the competitors.
   e. Before the first launch with each counterweight, the team must notify the supervisor of the desired position of the target (only 0.5 m increments allowed).
   f. Before each launch, teams must notify the event supervisor. Any launch, even if unintended or not announced, will count as one of the four launches allowed to a team.
   g. If the team tries to trigger the device and it does not go through a launch motion, it does not count as one of the team's four launches and the team must be allowed to adjust/reset the device if time allows.
   h. After each launch the event supervisor will indicate to the team when they may approach the target to make measurements to calibrate their device.
   i. If a team hits the target, they may request the target be moved to a new location (in 0.5 m increments).
   j. Supervisors must be responsible for retrieving projectiles and returning them to the team between each launch if less than 2 projectiles of each type are initially provided to the team.
   k. The supervisor will review with the team the data recorded on their scoresheet.
   l. Teams who wish to file an appeal must leave their device and design log with the event supervisor.

6. **COMPETITION AREA:**
   a. The launch area is a rectangular area 1.0m wide by 1.0m long (parallel to the launch direction), designated by tape on the floor. Tape must also be placed 75cm away from the sides and back of the launch area. Supervisors are recommended to use hard surfaces for the floor (e.g., concrete, hardwood, plywood).
   b. **The target will be a ~5 gallon bucket, with the opening facing up.**
   c. The supervisor will set the target at a distance selected by the team so that two sides of the target are parallel with a straight line from the center of the Launch Area to the center of the target.
   d. **The 2 separate counterweights must consist of a 0.5 kg (light) and 1.5 kg (heavy) mass at the regional level. At State and National Tournaments the light mass must be between 0.5-1.5 kg and the heavy mass must be between 1.5-2.5 kg. For all levels the masses must have a standard 1" open hook bolt on top. For all levels, each counterweight with hook must fit inside a 15.0 cm cube.**
   e. **The projectile used for light mass trials will be a standard unmodified racquetball. The projectile used for heavy mass trials will be a standard unmodified tennis ball.**
   f. Target **and** counterweight must be announced only after impound is over and must be the same for all teams.

7. **SCORING:** A scoring spreadsheet is available at www.soinc.org
   a. High score wins. Final Score = Best Light LS + Best Heavy LS + CS.
   b. Launch Score (LS) = TD – 3 x AS + B. Lowest possible LS is 0
   c. Target Distance (TD) = distance, in cm, from the center of the front of the launch area to the target center.
   d. Accuracy Score (AS) = straight line distance, in cm, from the projectile initial impact location to the target
      i. Eligible impact locations include the floor, wall, support column, target, or other objects. The ceiling and objects affixed to or hanging from it are not eligible impact locations. Shots with projectiles hitting such areas will use the next eligible impact location contacted by the projectile.
      ii. If the projectile hits the target on initial impact AS = 0.

e. Bonus (B) = Hitting the target at first impact is worth 0.15 x TD points. Making contact with the inside bottom surface is worth an additional 0.15 x TD points (for a total of 0.30 x TD points).
f. Chart Score (CS) - One of the submitted graphs and/or tables, selected by the event supervisor, must be scored per items i., ii. and iii. below. Partial credit may be given. Max possible CS is 40.
   i. 6 points for including data spanning at least one variable range listed in 4.a.ii.
   ii. 6 points for including at least 10 data points in each data series
   iii. 6 points for proper labeling (e.g., title, team name, units)
   iv. 3 points for each graph or table turned in (up to 12 points total as long as they are not the same)
   v. 5 points for including a labeled device picture or diagram
   vi. 5 points for including at least 2 example calculations
g. If a team violates any THE COMPETITION rules, their LS scores will be multiplied by 0.9.
h. If any CONSTRUCTION PARAMETERS violation(s) are corrected during the allotted competition period, or if the team misses impound, their LS scores will be multiplied by 0.7.
i. Teams disqualified for unsafe operation or that do not have a device that is brought into specs during the allotted competition period will have LS scores of 0.
j. Participants will be informed before the next launch if they have received a penalty.
k. Tiebreakers: 1st: best LS; 2nd second best LS; 3rd third best LS

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

WRITE IT DO IT

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

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

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

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

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

TRIAL EVENT RULES

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 2021-2022 season, we are publishing a selection of Trial Events in the 2022 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 2022 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 2023 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.

AERIAL SCRAMBLE

1. **DESCRIPTION:** At the Tournament, teams will assemble, test, and fly up to two aircraft built on-site without using adhesives from unopened standardized model airplane kits.

   A TEAM OF UP TO: 2 **IMPOUND:** No **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. For Invitational and Regional competitions, teams must bring two unopened kits for inspection and their use. Only kits that, by design, are assembled without adhesives (i.e., Guillows Skystreak, AMA Alpha) and can be disassembled and reassembled to fly again will be accepted.
   b. At the State and National competitions, event supervisors will provide all airplane kits used in the event. Organizers will stipulate the airplane kit to be used in competition at least 2 weeks prior to the competition. Teams will choose two kits for the event from a selection of unopened standardized kits provided by the Event Supervisor. All teams must use the tournament provided standardized kit.
   c. Teams may bring up to 4 rubber motors, each not exceeding 2.0 grams.
   d. Teams may bring winders, assembly tools, fixtures (freestanding from airplanes), sandpaper, adhesive systems, thread, pins, tape, rubber O-rings for motors, clay and their logbook. All items must fit inside a single clear sided container with an approximate footprint of no more than 12" x 12".
   e. Teams must bring a first aid kit that should contain at least 3 adhesive band-aids and any other first aid equipment the team feels is necessary.
   f. Additionally, teams must bring cutting boards and wax paper to cover any and all work surfaces.
   g. The items in 2.e. and 2.f. do not need to be included in the above referenced (2.d.) tool box.
   h. Any team not using a cutting board will receive a 20% deduction on their final score.
   i. Each team is responsible for their work site. Any debris must be disposed of, and the site cleaned and inspected before official flights are attempted.
   j. Teams will be allowed to attempt two (2) official flights for scoring.

3. **CONSTRUCTION PARAMETERS:**
   a. Only those materials found as part of the two kits will be allowed in model assembly. Glue, tape, pins or clay ballast may be added by teams and are considered as parts of each model.
   b. Boron, carbon fiber, extra wood or foam plastic materials are not allowed in the construction of the aircraft.
   c. The stock rubber motor may be replaced by other rubber elastic loops.
   d. Total mass without motor must be more than 10.0 grams and cannot exceed 25.0 grams.
   e. The wingspan cannot exceed 50.0 cm.
   f. Airplanes must use the propeller provided in the kit, which may not exceed 14.0 cm in diameter.
   g. Motors may have rubber O-rings and be lubricated after check-in.
   h. Airplanes will be labeled in such a way that can be identified by the participants in reference for their logbooks.

4. **THE COMPETITION:**
   a. The event will be held indoors. Tournament officials will announce the room dimensions (approx. length, width and ceiling height) in advance of the competition. Tournament Officials and Event Supervisors are urged to minimize the effects of environmental factors such as air currents. Rooms with minimal ceiling obstructions are preferred over very high ceilings.
   b. The event will be scheduled in hour time slots with no more than 10 teams competing in a time slot. The first 30 minutes will be devoted to complete primary check-in, model assembly and trim flights. The final 20 minutes will be to accomplish the team's two official flights. These flights will occur in 2-3 team mass launches within a 4-minute scheduled window.
   c. At their scheduled time a team will enter a cordoned off competition area to begin Primary Check-In, where they:
      i. Sign-in and are scheduled, in sequence of their arrival, for an official flight time-slot, as well as receive from or have their model kits inspected by from the Event Supervisors depending upon the type of competition being held.

ii. Teams will then submit their tools and materials kit (2.d.) as well as their first aid kit (2.e.) for inspection. Teams must show officials that they have at least a minimum of 3 adhesive band-aids as part of this kit or a 10% deduction will be applied to their final score.
iii. The team members remain in the competition area until their official flights are completed. No outside assistance is allowed.
iv. Teams will assemble up to two airplanes from the two kits and proceed to test/trim fly their models.
v. The first thirty minutes of the hour include check-in, model construction and flight trimming.
vi. At the Event Supervisor's Discretion:
(1) Test Flights may occur throughout the contest but will yield to official flights.
(2) Teams ready early can proceed to make their official flights in sequence.
(3) No Test Flights may occur in the last half hour of the event.
vii. A self-check inspection station may be made available to competitors for checking their airplanes prior to the Secondary Check-In for their Official Flights.
viii. Competitors may use any kind of winder, but electricity may not be available.

d. For Secondary Check-in and their Official Flight Time-Slot, teams must present up to two airplanes, their logbook, and up to 4 motors for inspection immediately prior to their Official Flight Time-Slot. Logbooks must describe at least 4 tasks that were used in either model construction or test flying their models prior to the competition. The logbooks may contain numerical data.
e. During Secondary Check-in, Timers will collect the motors presented for inspection. Allowable motors will be returned to the team just prior to their Official Flight Time-Slot.
f. After Secondary Check-in, teams will be taken in groups of 2 or 3 to make official flights:
i. Teams may make up to two (2) official flights using 1 or 2 airplanes.
ii. Teams will be instructed to put their airplanes on the floor then asked to pick them up.
iii. All motors that meet specifications and were collected during Secondary Check-in will be returned to the teams for their official flights.
iv. When picked-up, teams will have one minute to wind airplanes.
v. Timers will follow and observe teams as they are winding their motors.
vi. In the last 10 seconds of that minute, a timer will audibly announce the countdown. At "3-2-1 Launch!" all models in the group will be launched and timed independently.
vii. When the last model lands, teams will again be instructed to pick-up their models starting a one minute countdown for the second official flight. These flights will be timed to conclusion.
viii. Time aloft for each flight starts when the model leaves the competitor's hands and stops when any part of the model touches the floor, the lifting surfaces no longer support the weight of the model (such as the airplane landing on a girder or basketball hoop) or the Event Supervisors otherwise determine the flight is over.
ix. In an unlikely event of a collision, the two teams involved will re-fly the round.
x. 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.

5. **SCORING:**

a. The final score is made by adding the two flight times together.
b. Ties will be broken by the longest single official flight time per team.
c. Teams with incomplete flight logs will have each flight time multiplied by 0.90.
d. Teams that worked without a cutting board will have each flight time multiplied by 0.80 after other penalties have been applied.
e. Teams without flight logs will have each flight time multiplied by 0.70.

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

AGRICULTURAL SCIENCE

1. **DESCRIPTION:** Participants will solve problems and answer questions about agricultural sciences using their knowledge of ecology, animal and plant biology, and environmental chemistry.

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

2. **EVENT PARAMETERS:**
   a. Each team may bring one 8.5" x 11" sheet of paper that may contain information on both sides in any form and from any source.
   b. Each team may bring two stand-alone, non-programmable, non-graphing calculators.
3. **THE COMPETITION:**
   a. **This event may be run as stations and include observations, inferences, data analysis, and calculations. This event will be composed of four parts of approximately equal point value.**
   b. **The four parts of the event are as follows:**
      i. **Part A -** Students will be tested on their knowledge of agricultural science. Year one of the rotation will focus on plants and year two of the rotation will focus on animals. This section will use multiple choice, matching, fill-in-the-blank and/or short answers in areas such as:
         (1) YEAR 1 crop rotation, nitrogen and phosphate fertilization, pest and plant pathogen management, methods of measuring plant and soil health, measuring crop yield, non-responsive fields, plant-associated microbes, ecological function of soil invertebrates, nutrient cycling in soils, agricultural runoff, water usage, effect of tilling on soil chemistry, angiosperm development and reproduction, and classical plant breeding.
         (2) YEAR 2: herd management, hormone use in animals, pest and animal pathogen management, measuring animal yield (meat and milk production), animal development and reproduction, classical animal breeding, animal welfare.
      ii. **Part B -** Prior to the tournament, teams must perform an agricultural experiment on one or more plants. Students will impound one notebook prior to the start of the tournament for grading. The notebook must contain at least three clear pictures of both team members working together with their plants. Notebooks which do not have these pictures included will not be graded.
      iii. **Part C -** Students will be required to answer exam questions on site that demonstrate their understanding of their personal experiment.
      iv. **Part D -** Students will be tested on their knowledge of experimental design. This section will use multiple choice, matching, fill-in-the-blank and/or short answers.
4. **SAMPLE QUESTIONS:**
   a. PART A: What nutrients are supplied by mycorrhizal fungi to their plant hosts? What nutrients are supplied by plants to mycorrhizae?
   b. PART A: The two specimens at this station were raised in fields with or without nitrogen fertilizer. Based on these specimens, is it likely that nitrogen fertilization improved crop yield? Why?
   c. PART C: Define experimental replicate and explain how many replicates were done in your experiment.
   d. PART D: Two sets of tomato plants are growing in a greenhouse. One set is given fertilizer. The height of the plants is measured after 1 week. What is the experimental variable?
5. **SCORING:**
   a. High score wins. Final Score = Exam score (part A, C, and D) + Notebook score (part B)
   b. If students do not impound a notebook the score for parts B and C will be zero. If students impound a notebook with an experiment that is not related to agriculture or the required pictures are missing the score for part B will be zero. All other sections will be scored as normal.
   c. Selected questions on the exam may be used as tiebreakers.
   d. Notebook score: Score will reflect the accuracy of the material provided, not whether or not the hypothesis was supported. See sample scoresheet.
      i. Hypothesis- 15% of score
      ii. Variables- 25% of score
      iii. Experimental Control- 10% of score
      iv. Methods and Materials- 10% of score
      v. Results- 15% of score
      vi. Conclusions- 25% of score

AGRICULTURAL SCIENCE NOTEBOOK
SAMPLE SCORESHEET
Total Score 50 points

1) Notebook documents an experiment related to agriculture
Yes- continue to grade
No- notebook score is zero

2) Three clear pictures of both team members working together with their plants
Yes- continue to grade
No- notebook score is zero

3) Hypothesis- 15% of score (7.5 points)			
Statement predicts a relationship or trend.	3pts	2pts	0pts
Statement gives a specific direction.	3pts	2pts	0pts
A rationale is given.	1.5 pts	1pts	0pts
4) Variables- 25% of score (12.5 points)			
Independent variable correctly identified	4pts	2pts	0pts
Dependent variable correctly identified	4pts	2pts	0pts
Controlled variables corrected identified	4.5pts	2pts	0pts
5) Experimental Control- 10% of score (5 points)			
Experimental control correctly identified	3pts	2pts	0pts
Reason given for experimental control	2pts	1pts	0pts
6) Methods and Materials- 10% of score (5 points)			
Methods listed	3pts	2pts	0pts
Materials listed separately from methods	2pts	1pts	0pts
7) Results- 15% of score (7.5 points)			
Qualitative observations are included	2pts	1pts	0pts
Quantitative data is given in a table	2pts	1pts	0pts
Quantitative data is given in a graph	2pts	1pts	0pts
Relevant statistics are given	1.5pts	1pts	0pts
8) Conclusions- 25% of score (12.5 points)			
Hypothesis evaluated according to data	4pts	2pts	0pts
Reasons to accept/reject given	4pts	2pts	0pts
Statements supported by data	4.5pts	2pts	0pts

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

This event is sponsored by Corteva Agriscience

BOTANY

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 **EYE PROTECTION:** A **EVENT TIME:** 50 minutes
2. **EVENT PARAMETERS:**
   a. Each participant may bring one 8.5" x 11" sheet of paper, which may be in 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 as well as a stand-alone, non-programmable, non-graphing calculator.
   b. Each participant must wear a lab coat and googles when dealing with specimens.
   c. Event Supervisors will provide live/preserved specimens, pictures, tables, graphs of data, microscopes, slides, and any other required equipment for the event. If used, toxic/irritating plants or specimens in liquid (e.g., Algae, protists) must be in closed, non-breakable containers.
3. **THE COMPETITION:**
   a. This event may be run as either a sit-down exam or a series of laboratory stations with questions.
   b. Participants will be expected to master the structure of plant cells, roots, stems, leaves, spore forming bodies and flowers, aspects of plant growth and differentiation, and the transport and storage of gases, water, and nutrition throughout the plant body.
   c. Participants should also have a broad knowledge of the major divisions between groups of plants (i.e., algae vs. multicellular plants, monocot vs. dicot, embryophytes vs. cryptogams, woody vs. herbaceous plants).
   d. In addition to the above listed topics, participants should know:
      i. The history of botany
      ii. Basic plant genetics and reproduction
      iii. Photosynthesis
      iv. Differences between the major taxonomic groups of plants
      v. Paleo-botany and plant evolution
      vi. The role of plants in global energy and nutrient cycles
      vii. Use of plant materials by animals and humans
      viii. Competition in the plant community
      ix. Genetically Modified Organisms (GMOs)
      x. Production of foodstuffs and plant products
      xi. Plant diseases; including nutrient deficiencies and infections
   e. For Division C Only, participants are expected to know:
      i. Principles of horticulture and aquaculture
      ii. Plant biochemistry
      iii. The roles of plants in medicine and environmental management
      iv. Importance of plant diversity
4. **SAMPLE QUESTIONS/TASKS:**
   a. What leaf structure is being shown on this microscope slide?
   b. Using the graph, identify the peak wavelength for chlorophyll absorbance.
   c. Identify three key differences between flowering plants and ferns.
   d. Which plants would be in the next wave of plant succession for the region shown?
   e. Describe the role plants play in the nitrogen cycle.
5. **SCORING:**
   a. High Score wins.
   b. Selected questions will be used to break ties.

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

This event is sponsored by Corteva Agriscience

DIGITAL STRUCTURES

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

   A TEAM OF UP TO: 2 **EVENT TIME:** 45 minutes

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

3. **CONSTRUCTION PARAMETERS:**
   a. The Bridge must be a single structure constructed by connecting members made of the material available when using the SkyCiv Science Olympiad add-on. The cross-section of individual members must be rectangular with minimum cross-sectional dimensions as specified in SkyCiv of 1.5 mm by 1.5 mm.
   b. The xz-plane ($y = 0$) will be defined as the Testing Base. All nodes of the Bridge must be on the non-negative-y side of the xz-plane prior to load testing. The Bridge must be supported using exactly four supports placed in the plane of the Test Base ($y = 0$); two must be "Horizontal Rollers in X" with x-coordinates ≥ 22.5 cm and two must be "3D Pin Supports" with x-coordinates ≤ -22.5 cm, without restrictions on z-coordinates.
   c. The Bridge must be designed to support multiple Area Loads, each in the negative y-direction over a 5.0 cm by 5.0 cm rectangular area.
      i. The number of Area Loads the Bridge must support is two for Regionals, three for State, and four for Nationals.
      ii. One Area Load must have nodes at ($x = \pm 2.5$ cm, $y = 10.0$ cm, $z = \pm 2.5$ cm) for Division B and ($x = \pm 2.5$ cm, $y = 15.0$ cm, $z = \pm 2.5$ cm) for Division C.
      iii. The other Area Load(s) will have nodes at coordinates specified by the Event Supervisor in the range (-22.5 cm $\leq x \leq 22.5$ cm, $0 \leq y \leq 10.0$ cm, $z = \pm 2.5$ cm) for Division B and (-22.5 cm $\leq x \leq 22.5$ cm, $0 \leq y \leq 15.0$ cm, $z = \pm 2.5$ cm) for Division C. The y-coordinates for all nodes in an Area Load must be the same.
   d. To simulate lateral loading, each of the four nodes of the Area Load in 3.c.ii. must have a Point Load in the positive-z direction with magnitude 5–25 N, the same magnitude for all Point Loads.

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

5. **SCORING:**
   a. High score wins. Score = Load Score (g)/Mass of Bridge (g).
   b. The Load Score = Load Supported (4.e.) + Bonus.
   c. Bridges that have a Load Supported of 15,000 g will earn a Bonus of 5,000 g.
   d. Bridges will be placed in three tiers as follows:
      i. Tier 1: Holding any load and meeting all construction parameters and competition requirements

   ii. Tier 2: Holding any load with any violations of the construction parameters and/or competition requirements
   iii. Tier 3: Unable to hold any load and will be ranked by lowest mass
e. Ties are broken as follows:
   i. Estimated Load Supported closest to, without exceeding, the actual Load Supported
   ii. Ranked by lowest Bridge mass
f. Example score calculations:
   i. Device 1: Mass = 10.12 g, Load Supported = 12,134 g; Score = 1,199
   ii. Device 2: Mass = 12.32 g, Load Supported = 15,000 g + Bonus (5,000 g) = 20,000 g;
   iii. Score = 1,623

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

This event is sponsored by SkyCiv

HOME HORTICULTURE

1. **DESCRIPTION:** Participants will use their investigative skills in the scientific study of home horticulture.
   A TEAM OF UP TO: 2 **EYE PROTECTION:** C **EVENT TIME:** 50 minutes
2. **EVENT PARAMETERS:**
   a. Each team may bring one three-ring binder of any size containing information in any form and from any source attached using the available rings. Sheet protectors, lamination, tabs and labels are permitted. Participants may remove information or pages for their use during any part of the event.
   b. Each team may bring two stand-alone calculators of any type to use during the event.
   c. Each team must bring a soil test kit complete with chemicals to test soil samples for pH, N, P, and K.
3. **THE COMPETITION:**
   a. The competition will consist of a series of task that could include hands-on activities, questions on listed topics, interpretation of data (e.g., graphs, diagrams, and tables), or observation of an established and running experiment.
   b. Teams may be asked to analyze soil samples for pH, nitrogen, phosphorus, and/or potassium.
   c. Participants are expected to have knowledge of the following topics:
      i. basic botany
      ii. plant propagation
      iii. soil health, fertilizer management, and composting
      iv. entomology of pests & pest management
      v. plant diseases,
      vi. vegetables, tree fruit, & small fruit (e.g., blueberries. brambles, currants, gooseberries, grapes, & strawberries)
      vii. lawn care & pruning ornamentals,
      viii. woody ornamentals, herbaceous plants, and native plants
      ix. weeds and invasive plants
      x. garden wildlife (e.g., butterflies, hummingbirds, bumble bees)
      xi. nuisance animals (e.g., chipmunks, cottontail rabbits, voles, raccoons, skunks, squirrels, deer, & woodchucks)
   d. English units will be used for all calculations as current horticulture literature uses English units exclusively.
4. **SAMPLE QUESTIONS/ACTIVITIES:**
   a. Use soil test kit to determine the soil pH.
   b. Calculate the amount of 10-10-10 fertilizer to use in a 100 ft^2 garden.
   c. Identify an herbaceous plant from a picture.
   d. Determine the spacing for woody plants in a garden bed given the mature size.
   e. Recall the difference between a warm season turfgrass and a cool season turfgrass.
   f. Identify an insect pest from a picture.
5. **SCORING:**
   a. Scoring will be split approximately 75% exam and 25% hands-on activities. High score wins.
   b. Time may be limited at each task but will not be used as a tiebreaker for scoring.
   c. Ties will be broken by pre-selected questions.
   d. A penalty of up to 10% may be given if the area is not cleaned up as instructed.
   e. A penalty of up to 10% may be given if a team brings prohibited equipment to the event.

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

This event is sponsored by Corteva Agriscience

SOLAR POWER

1. **DESCRIPTION:** Teams must construct a collecting device prior to the tournament that is designed to collect heat and complete a written test on alternative energy concepts.

   A TEAM OF UP TO: 2 **IMPOUND:** No **APPROX. TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. Each team may bring one three-ring binder of any size containing information in any form and from any source, attached using the available rings. Sheet protectors, lamination, tabs and labels are permitted. Participants may remove information or pages for their use during any part of the event.
   b. Each team may bring their heat collection device, an unaltered, glass or plastic, standard (height ~1.4 times the diameter) 250 mL beaker, copies of graphs and/or tables for scoring, tools, supplies, writing utensils, and two stand-alone calculators of any type for use during any part of the event.
   c. Event supervisors will supply the water, and thermometers or probes (recommended). Non-contact thermometers are allowed.
   d. 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. Devices may be constructed of and contain any materials (e.g., cardboard, aluminum foil, reflective fabric or material, glue, tape, mirrors, tiles and lenses).
   b. The device, including beaker, must fit within a 35.0 cm x 35.0 cm x 35.0 cm cube when set up for testing.
   c. Within the device, participants must be able to insert and remove a beaker that they supply (see 2.b).
   d. The device must also easily accommodate the insertion and removal of a thermometer/probe into the beaker. Parts of the device may be inside the beaker, but the device must not contact the water.
   e. Devices will be inspected to ensure that there are no energy sources (e.g., no electrical components, small 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 in order to verify the materials used in construction.
   f. All parts of the device must not be significantly different from room temperature at the start of the event.
   g. Prior to competition, teams must calibrate devices by preparing graphs/tables showing the relationship between elapsed time and water temperature. A labeled device diagram should be included.
      i. Any number of graphs and/or data tables may be submitted but the team must indicate up to four to be used for the Chart Score, otherwise the first four provided are scored.
      ii. Graphs and/or tables may be computer generated or drawn by hand on graph paper. Each data series counts as a separate graph . A template is available at www.soinc.org.
      iii. Teams are encouraged to have a duplicate set to use, as those submitted may not be returned.

4. **THE COMPETITION:**

   Part I: Written Test
   a. Teams will be given a minimum of 20 minutes to complete a written test consisting of multiple choice, true-false, completion, or calculation questions/problems.
   b. Unless otherwise requested, answers must be in metric units with appropriate significant figures.
   c. The competition must consist of at least five questions from each of the following areas:
      i. Basic information and definitions about energy, work, heat and heat transfer, temperature, temperature scales, thermal energy and insulation.
      ii. General information about renewable energy including but not limited to solar, wind, hydroelectric, tidal, ocean thermal energy conversion (OTEC), and geothermal.
      iii. General information about energy conservation practices including but not limited to recycling, reusing, and using materials with greater efficiency.
      iv. Mathematical relationships and equations used in determining heat loss and gain, specific heat, and heat transfer.

   Part II: Device Testing
   a. At the start of the competition block, teams will be given 5 minutes to set up or modify their devices and use their graphs and/or tables to calibrate them. Devices that do not meet the construction specs will not be allowed to be tested until brought into specification.

b. At each station, the event supervisor will provide an incandescent lamp with a bell-shaped reflector. The lamp will be mounted, facing down, above the testing surface (on which teams will set up their device) such that the bottom of the bulb is at least 40.0 cm from the testing surface. Multiple identical stations may be used.
c. At the start of a team's device testing period the supervisor, using their own measuring device, will dispense 100 mL of water into the team's beaker. A team may elect to install the beaker in a device prior to this, but must leave sufficient access to the beaker. Otherwise the team may then place the beaker into their device.
d. Teams will use their graphs and/or tables to predict the temperature of the water in their beaker at the end of the 10-minute heating time. After receiving water, teams will be given at least 3, but no more than 5 minutes to make their final predictions. During this time, teams may use their own thermometers to measure the starting water temperature in their beaker, but after this time must remove them.
e. The supervisor will insert a probe/digital thermometer into the water to measure and record the initial temperature to the nearest tenth of a degree. Supervisors may leave thermometers/probes in the devices for the entire heating period, but will announce if they will do so before impound. Otherwise they will insert a thermometer/probe into the beaker in the device, wait at least 20 seconds, and record the resulting temperature. Multiple thermometers/probes may be used at the supervisor's discretion
f. The light source must be turned on and a stopwatch started. At the end of 10 minutes the light will be turned off and the thermometer/probe will be read and recorded to the nearest tenth of a degree to determine the gain in temperature.
g. The supervisor will review with the team the Part II data recorded on their scoresheet.
h. Teams filing an appeal regarding Part II must leave their device in the competition area.

5. **SCORING:**
   a. High score wins.
   b. All scoring calculations are to be done in degrees Celsius.
   c. Final Score (FS) = TS + CS + HS + PS; The maximum possible FS is 100 points. A scoring spreadsheet is available at www.soinc.org.
   d. Test Score (TS) = (Part I score / Highest Part I score for all teams) x 50 points
   e. Chart Score (CS): One of the submitted graphs/tables, selected by the Event Supervisor, is scored using i., ii., and iii., described below for a maximum of 6 points. Four (4) additional CS points are available via items iv. and v. Partial credit may be given. A device must be present to receive a CS.
      i. 2 points for including data spanning at least one variable range
      ii. 2 points for including at least 10 data points
      iii. 2 points for proper labeling (e.g., title, team name, units)
      iv. 0.5 points for each distinct graph or table turned in (up to 2 points total)
      v. 2 points for including a labeled device diagram
   f. Heat Score (HS) = (HRF / Highest HRF of all teams) x 15 points; HRF (Heat Retention Factor) = (final beaker water temp / starting beaker water temp)
   g. Prediction Score (PS) = (PE / Highest PE of all teams) x 25 points; PE (Prediction Estimate) = (1-(abs (final beaker water temp - predicted final beaker water temp) / final beaker water temp)). The minimum PS possible is 0 points.
   h. If a team violates any COMPETITION rules, their HRF and PE values will be multiplied by 0.9 when calculating the scores.
   i. If any CONSTRUCTION violation(s) are corrected during the Part II testing period the HRF and PE values will be multiplied by 0.7 when calculating the scores.
   j. Teams that are disqualified for unsafe operation or do not bring a collecting device receive zero points for their HRF and PE scores. Teams will be allowed to compete in Part I.
   k. Tie Breakers: 1st — Best TS; 2nd — Best HS; 3rd — Best PS

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

This event is supported by Continental Energy Solutions

WRITE IT CAD IT

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 in a computer-aided design (CAD) software from this description.

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

2. **EVENT PARAMETERS:**
   a. Only the text-editing software used to write the description and the CAD software are allowed. Tournament officials will determine if the software will be provided by the team or the Event Supervisor. No materials or resources are allowed.
   b. Tournament officials must announce the specific CAD software used at the tournament at least 1 month in advance. At the National Tournament, Write It CAD It will be run as a Trial Event using the free version of **Onshape (onshape.com)**. Any team interested in competing in this Trial Event will need to have their own Onshape account prior to the tournament.
3. **THE COMPETITION:**
   a. One participant (the writer) from each team is shown images (e.g. screenshots) of an object from different angles. Event Supervisors must provide image/screenshots from sufficient angles for the team to reconstruct the object. The object and images are the same for all teams, and the object is built in a CAD software.
   b. The writer has twenty-five (25) minutes to type 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, underlining, italicizing, bolding, or scientific symbols that fit within the context of the written description are allowed.
   d. The writer will send their description as a TXT, DOC/DOCX or PDF file to the Event Supervisor.
   e. The Event Supervisor will send the description by the writer and a CAD file with the various pieces to the second team member who will take the description and attempt to recreate (build) the original object in twenty (20) minutes. The CAD file will have all the pieces required to recreate the original object and no additional pieces. These pieces will have been moved and rotated. All teams will receive the same CAD file.
   f. The Event Supervisor will provide instructions for how the builder should submit their completed CAD file.
   g. Each participant in this event is expected to work independently of his or her partner. There should be no sharing of information or communication between partners with the exception of files that are shared through the Event Supervisor. Any communication between partners will result in the disqualification of the team from this event.
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. Time for the construction phase will be used as a tiebreaker. This time is recorded as the duration between when the Event Supervisor sends the builder the CAD file with description and when the Event Supervisor receives the submitted CAD file from the builder.

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

This event is sponsored by Onshape

CHEMISTRY RECOMMENDED LAB EQUIP.

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

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

Item & Expected Use	Likely to be used in:			
	Crime Busters	Can't Judge a Powder	Food Science	Potions and Poisons
Box - Containing all of the kit materials	X	X	X	X
10 ml Graduated Cylinder - Measuring volumes		X	X	X
25 ml Graduated Cylinder - Measuring volumes		X	X	X
100 ml Graduated Cylinder - Measuring volumes		X	X	X
50 ml Beakers - Doing reactions, developing chromatograms	X	X	X	X
100 ml Beakers - Doing reactions, developing chromatograms		X	X	X
250 ml Beakers - Doing reactions, developing chromatograms		X	X	X
400 ml Beakers - Doing reactions, developing chromatograms	X	X	X	X
50 ml Erlenmeyer Flasks - Doing reactions		X	X	X
125 ml Erlenmeyer Flasks - Doing reactions		X	X	X
250 ml Erlenmeyer Flasks - Doing reactions		X	X	X
Test Tubes - Mix Chemicals, heat chemicals	X	X	X	X
Test Tube Brush - Clean Test Tubes	X	X	X	X
Test Tube Holder - Holds test tubes for heating	X	X	X	X
Test Tube Rack - Hold Test Tubes	X	X	X	X
Petri Dishes - Doing reactions, developing chromatograms	X	X	X	X
Spot Plates - Doing reactions in semi-micro scale, testing solubility, pH	X	X	X	X
Slides - To put hairs, crystals, or fibers on for use with a microscope	X			
Cover Slips - To prevent items from coming off slides	X			
Droppers - Add small amounts of liquids to reactions	X	X	X	X
Spatulas or spoons - Getting small amounts of solids out of containers	X	X	X	X
Stirring Rods - Stirring mixtures	X	X	X	X
Thermometer - Determining the temperature of a solution		X	X	X
Metal Tongs, Forceps, or Tweezers - Holding objects, retrieving objects from liquids	X	X	X	X
pH or Litmus paper - Test acidity or alkalinity of solution	X	X	X	X
Hand Lens - Magnification of small items for identification	X	X		
9V or less Battery Conductivity Tester - Determining ionic strength of solution		X	X	X
Paper Towels - Cleaning	X	X	X	X
Pencil - Writing, Marking Chromatogram	X	X	X	X
Ruler - Measuring lengths	X	X	X	X
Magnets – For extraction and identification of iron filings	X	X	X	X

CALCULATOR CLASS DESCRIPTIONS

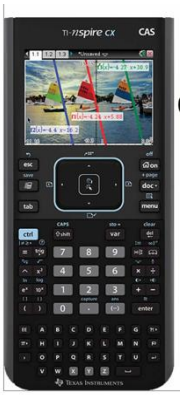
See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

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

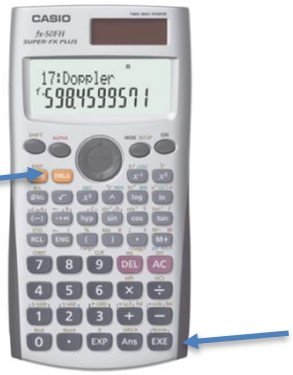
Class I - Stand-alone non-graphing, non-programmable, non-scientific 4-function or 5-function calculators
are the most basic type of calculators and often look like the one shown to the right. These calculators are limited to the four basic mathematics functions and sometimes square roots. These calculators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

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

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



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



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

CALCULATOR AND EVENTS MATRIX

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

Events	Type of Calculator Allowed				
	None	Class I	Class II	Class III	Class IV
Anatomy & Physiology		X	X		
Bio Process Lab		X	X		
Bridge	X				
Codebusters		X			
Crave the Wave		X	X	X	
Crime Busters		X	X		
Disease Detectives		X	X		
Dynamic Planet		X	X	X	
Electric Wright Stuff	X				
Experimental Design		X	X		
Food Science		X	X		
Green Generation		X	X		
Meteorology		X	X	X	
Mission Possible	X				
Mousetrap Vehicle		X	X	X	
Ornithology	X				
Ping Pong Parachute	X				
Road Scholar		X	X		
Rocks & Minerals	X				
Solar System	X				
Sounds of Music		X	X	X	
Storm the Castle		X	X	X	
Write It Do It	X				
Trial Events					
Aerial Scramble	X				
Agricultural Science		X	X		
Botany		X	X		
Digital Structures		X	X		
Home Horticulture		X	X	X	
Solar Power		X	X	X	
Write It CAD It	X				

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

MY SO

A 9-month, calendar-based set of supports to engage and keep you engaged in Science Olympiad at home, at school and afterschool.

Each themed month will contain free resources like Lesson Plans for popular Science Olympiad events you can use at home or at school; Science Olympiad STEM Sessions, webinars and interviews with leading experts in the field about careers and workforce; and the option to participate in STEM Showdowns, national-level, online Science Olympiad tests you'll take in real time to gauge your knowledge against your peers, complete with prizes and a national monthly leaderboard. **MY SO** can be used as a standalone or to support any regular Science Olympiad season.

For more information about MY SO, please visit www.soinc.org/myso

LESSON PLAN
[First Wednesday of the month]

STEM SESSION
[15th day of the month]

STEM SHOWDOWN
[Last Wednesday of the month]

2021-2022 ACADEMIC YEAR

SEPTEMBER 2021

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	**15**	16	17	18
19	20	21	22	23	24	25
26	27	28	**29**	30		

EPIDEMIOLOGY

OCTOBER 2021

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	**6**	7	8	9
10	11	12	13	14	**15**	16
17	18	19	20	21	22	23
24	25	26	**27**	28	29	30
31						

FLIGHT

NOVEMBER 2021

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	**3**	4	5	6
7	8	9	10	11	12	13
14	**15**	16	17	18	19	20
21	22	**23***	24	25	26	27
28	29	30				

ASTRONOMY

DECEMBER 2021

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	**15**	16	17	18
19	20	**21***	22	23	24	25
26	27	28	29	30	31	

ROCKS & MINERALS

JANUARY 2022

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	**5**	6	7	8
9	10	11	12	13	14	**15**
16	17	18	19	20	21	22
23	24	25	**26**	27	28	29
30	31					

ANATOMY & PHYSIOLOGY

FEBRUARY 2022

Su	Mo	Tu	We	Th	Fr	Sa
		1	**2**	3	4	5
6	7	8	9	10	11	12
13	14	**15**	16	17	18	19
20	21	22	**23**	24	25	26
27	28					

FORENSICS

MARCH 2022

Su	Mo	Tu	We	Th	Fr	Sa
		1	**2**	3	4	5
6	7	8	9	10	11	12
13	14	**15**	16	17	18	19
20	21	22	23	24	25	26
27	28	29	**30**	31		

SOLAR POWER

APRIL 2022

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	**6**	7	8	9
10	11	12	13	14	**15**	16
17	18	19	20	21	22	23
24	25	26	**27**	28	29	30

GREEN GENERATION

MAY 2022

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	**4**	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	**25**	26	27	28
29	30	31				

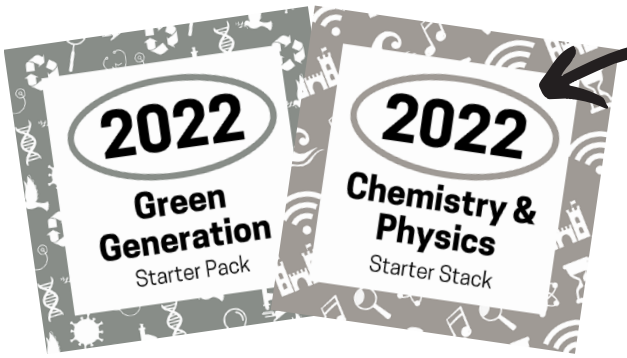
ROBOTS

* The November and December dates of the STEM Showdowns have been adjusted to avoid holidays.

Exploring the World of Science

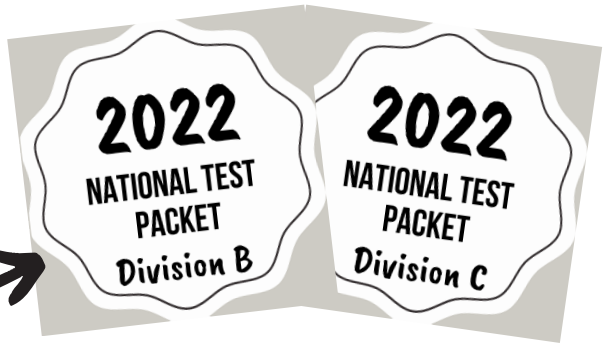
2021-2022 Science Olympiad Store Offerings

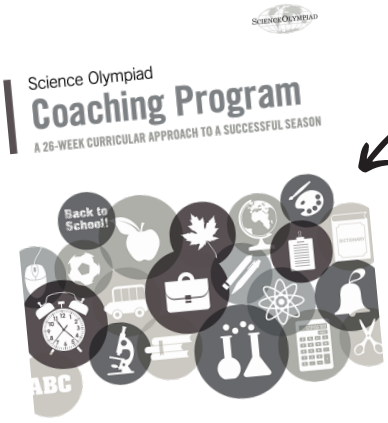
From materials to help competitors prepare for competition to additional support resources for coaches, the Science Olympiad Store has everything you need to prepare for the 2022 Science Olympiad Season!



Study materials for all core knowledge & lab events

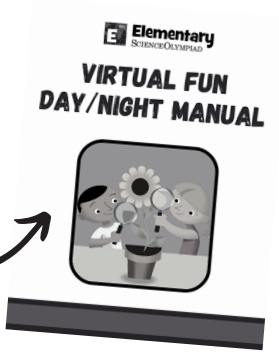
Tests to practice with from previous National Tournaments





New Coaching Program to support coaches planning their seasons

And Elementary Science Olympiad resources too!



Start shopping today! Visit store.soinc.org

Exploring the World of Science

2022 Division B
Sample In-Person Tournament Schedule

Event	7:00 – 8:00 AM	8:15 - 9:15 AM	9:30 - 10:30 AM	10:45- 11:45 AM	12:00 – 1:00 PM	1:15 - 2:15 PM	2:30 - 3:30 PM	7:30– 9:30 PM
Anatomy & Physiology		21-30	31-40	41-50	51-60	1-10	11-20	Closing Ceremony
Bio Process Lab		31-40	41-50	51-60	1-10	11-20	21-30	
Bridge		Self-Schedule						
Codebusters		11-20	21-30	31-40	41-50	51-60	1-10	
Crave the Wave		1-10	11-20	21-30	31-40	41-50	51-60	
Crime Busters		31-40	41-50	51-60	1-10	11-20	21-30	
Disease Detectives		41-50	51-60	1-10	11-20	21-30	31-40	
Dynamic Planet		21-30	31-40	41-50	51-60	1-10	11-20	
Electric Wright Stuff		Self-Schedule						
Experimental Design		31-40	41-50	51-60	1-10	11-20	21-30	
Food Science		51-60	1-10	11-20	21-30	31-40	41-50	
Green Generation		1-10	11-20	21-30	31-40	41-50	51-60	
Meteorology		11-20	21-30	31-40	41-50	51-60	1-10	
Mission Possible	Impound	Self-Schedule						
Mousetrap Vehicle	Impound	Self-Schedule						
Ornithology		11-20	21-30	31-40	41-50	51-60	1-10	
Ping Pong Parachute		Self-Schedule						
Road Scholar		41-50	51-60	1-10	11-20	21-30	31-40	
Rocks & Minerals		1-10	11-20	21-30	31-40	41-50	51-60	
Solar System		51-60	1-10	11-20	21-30	31-40	41-50	
Sounds of Music		Self-Schedule						
Storm the Castle	Impound	Self-Schedule						
Write It, Do It		41-50	51-60	1-10	11-20	21-30	31-40	

Exploring the World of Science

NATIONAL TOURNAMENT SCHEDULE

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

2022 National Tournament Schedule
Hosted by the California Institute of Technology; Pasadena, California
Saturday, May 14, 2022

Division B Tournament Day Schedule						
Events	**HST**	**AKDT**	**PDT**	**MDT**	**CDT**	**EDT**
Trial Events	*3:50 AM*	*5:50 AM*	*6:50 AM*	7:50 AM	8:50 AM	9:50 AM
				1-58	1-58	1-58
Crave the Wave, Green Generation, Rocks & Minerals	*5:00 AM*	*7:00 AM*	8:00 AM	9:00 AM	10:00 AM	11:00 AM
			1-58	1-58	1-58	1-58
Codebusters, Meteorology, Ornithology	*6:10 AM*	8:10 AM	9:10 AM	10:10 AM	11:10 AM	12:10 PM
		1-59	1-59	1-59	1-59	1-59
Anatomy & Physiology, Dynamic Planet	*7:20 AM*	9:20 AM	10:20 AM	11:20 AM	12:20 PM	1:20 PM
		1-59	1-59	1-59	1-59	1-59
Bio Process Lab, Crime Busters, Experimental Design	8:30 AM	10:30 AM	11:30 AM	12:30 PM	1:30 PM	2:30 PM
	All Teams	All Teams	All Teams	All Teams	All Teams	All Teams
Disease Detectives, Road Scholar, Write It Do It	9:40 AM	11:40 AM	12:40 PM	1:40 PM	2:40 PM	3:40 PM
	All Teams	All Teams	All Teams	All Teams	All Teams	All Teams
Food Science, Solar System, Sounds of Music (Test Only)	10:50 AM	12:50 PM	1:50 PM	2:50 PM	3:50 PM	4:50 PM
	All Teams	All Teams	All Teams	All Teams	All Teams	All Teams
Crave the Wave, Green Generation, Rocks & Minerals Trial Events	12:00 PM	2:00 PM	*3:00 PM*	*4:00 PM*	*5:00 PM*	*6:00 PM*
	Teams	Teams				
	59-60	59-60	1-58			
Codebusters, Meteorology, Ornithology	1:10 PM	*3:10 PM*	*4:10 PM*	*5:10 PM*	*6:10 PM*	*7:10 PM*
	Team 60					
Anatomy & Physiology, Dynamic Planet	2:20 PM	*4:20 PM*	*5:20 PM*	*6:20 PM*	*7:20 PM*	*8:20 PM*
	Team 60					
Times in *Italics* are for Event Supervisor reference only. No team will compete in the main Tournament (non-Trial Events) prior to 8:00 AM local time.						
Self-Scheduled Events						
Bridge Electric Wright Stuff Mission Possible Mousetrap Vehicle Ping Pong Parachute Sounds of Music (Performance) Storm the Castle	Available Event Slots start @ 8:00 AM (PDT).					

The 2022 Science Olympiad National Tournament will be a remote tournament conducted under the Satellite format. Please visit soinc.org for more details.

SOUTHERN CALIFORNIA SCIENCE OLYMPIAD

Caltech

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SCIENCE OLYMPIAD™

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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: Caltech (2022 National Tournament Partner), Arizona State University (2021 National Tournament Partner), NASA's Universe of Learning Astrophysics STEM Learning and Literacy Network, Avantor Foundation, Corteva Agriscience, Combined Federal Campaign, Double Good Foundation, Google, Lockheed Martin, NBC Universal Foundation, Ward's Science, Discovery Education 3M Young Scientist Challenge, Intel, Kinder Morgan Foundation, Centers for Disease Control and Prevention (CDC) Foundation, North American Association for Environmental Education (NAAEE), National Oceanic and Atmospheric Administration (NOAA), Texas Instruments, ThermoFisher Scientific, University of Delaware, Continental Energy Solutions, Hikma Pharmaceuticals, Investing in Communities, National Free Flight Society (NFFS), Onshape, SkyCiv and Yale Young Global Scholars. Strategic Partners: Code.org, Japan Science and Technology Agency, mHUB, Midnight Science Club, Million Women Mentors (MWM), MxD (The Digital Manufacturing Institute) and STEMConnector.

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

Science Olympiad

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