



Exploring the World of Science

Division B Rules Manual

Division B (Gr. 6-9)

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WELCOME TO THE 2023 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 KITS AND RESOURCES AVAILABLE NOW!

Please visit store.soinc.org to purchase 2023 video downloads, test packets and other event resources for Division B, Division C and Elementary Science Olympiad. Order officially licensed Science Olympiad Kits, supplies and parts for a variety of 2022 Science Olympiad events with your Fall Early Bird Savings: Save 12% on your Ward's Science Olympiad Kit order at wardsci.com/scienceolympiad with promo code SOVIP2022. Don't wait! This limited-time offer ends 12/31/22.



Science Olympiad Store: 866-312-3999
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SCIENCE OLYMPIAD

DIVISION B RULES MANUAL

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- Please read the General Rules on the next page - 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.

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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 2023 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 2023 Science Olympiad National Tournament held at Wichita State University May 19-20, 2023. 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

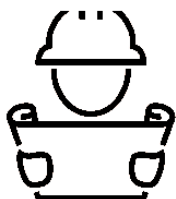
This model accounts for situations where students are unable to physically attend school and are distance learning from their homes by allowing some events to be run at home. Since students will be at home without faculty supervision, no hands-on events will be allowed to run. A chart showing acceptable 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.

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



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

Core Knowledge Events can be run regardless of the tournament format that has been chosen by the 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 in some cases participants will be working with previously collected data and hands-on activities will be omitted. The Tournament Director will make these decisions to ensure safety and fairness for all teams. If a Lab Event is altered or not to be run at a tournament, the Tournament Director will notify all teams in advance of the given tournament.



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

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

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 following modifications may be applied by the Tournament Director, if necessary, for all Science Olympiad competitions, regardless of level (e.g., Invitational, Regional, State, National), or type (e.g., In-Person, Satellite SO, mini SO). 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 social distancing is being enforced, 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. 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.



1. **DESCRIPTION:** Participants will be assessed on their understanding of the anatomy and physiology for the human **Respiratory, Digestive, and Immune** 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. **RESPIRATORY SYSTEM:**

- i. Anatomy and functions of the respiratory system
- ii. Mechanisms and measures of pulmonary ventilation
- iii. Patterns of breathing
- iv. Ability to read a spirogram as related to pulmonary ventilation
- v. Gas exchange and O₂ transport including oxygen dissociation curves
- vi. Effects of exercise and high altitude on the respiratory system
- vii. Understand disorders: COPD, asthma, emphysema, pneumonia, sleep apnea and cystic fibrosis
- viii. National Tournament Only:
 - (1) Additional diseases/disorders: tuberculosis, pulmonary edema, pleurisy, small cell and non-small cell lung cancer, pulmonary fibrosis, pneumoconiosis (e.g., silicosis, coal worker lung, asbestosis)
 - (2) Blood chemistry and respiratory rhythm, regulation and control of the respiratory system
 - (3) Treatments and/or preventions (e.g., drugs, surgery) for ALL conditions listed above

b. **DIGESTIVE SYSTEM:**

- i. Anatomy and functions of the digestive system
- ii. Basic anatomy of the component parts of the alimentary canal and accessory organs of digestion
- iii. Anatomy of the four layers of the wall of the alimentary canal
- iv. Comparison of the lining of the esophagus, stomach, small intestine and large intestine
- v. Compare and contrast mechanical and chemical digestion
- vi. Physiology of chemical digestion of proteins, fats and carbohydrates
- vii. Effects of exercise and obesity on the digestive system
- viii. The diseases on each level from the cell to the whole person as listed: stomach & duodenal ulcers, cancers of the digestive system, diarrhea, lactose intolerance, hepatitis, appendicitis
- ix. National Tournament Only:
 - (1) Additional diseases: diverticular disease, GERD, peptic ulcer disease, ulcerative colitis, Crohn's Disease and celiac disease
 - (2) The function of the liver, including Kupffer cell function, as well as the pancreas in the digestive system. The exocrine role of the pancreas may be assessed at the Regional and State levels.
 - (3) Treatments and/or prevention (e.g., drugs, surgery) for ALL conditions listed above

c. **IMMUNE SYSTEM:**

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



vi. National Tournament Only:

- (1) Types of Organ Transplants and Prevention of Rejection (allograft and autograft)
- (2) Cancer Immunotherapies (Antibody therapies, CAR-T cell therapy)
- (3) Additional disorders: systemic lupus erythematosus, dermatomyositis, scleroderma, psoriasis and psoriatic arthritis
- (4) Treatments and/or prevention (e.g., drugs, surgery) for ALL conditions listed above

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



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:**

- a. 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.
- b. **Participants must wear eye protection during this event. Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows.**

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 form 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



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

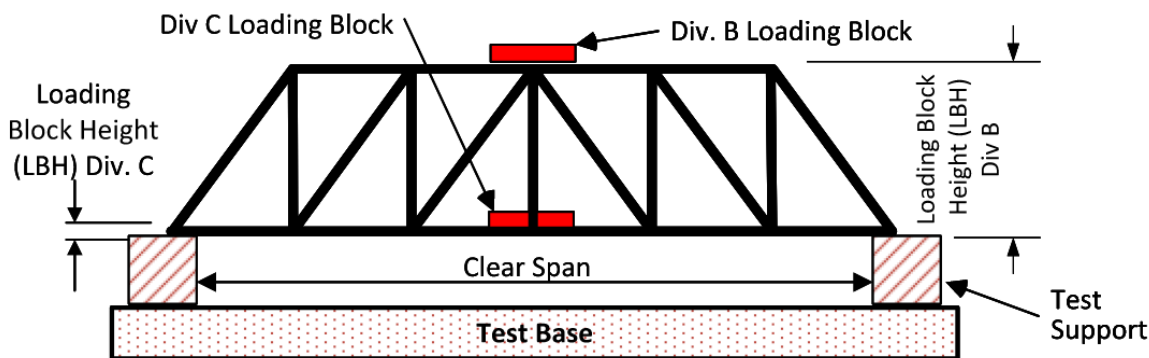
TEAM OF UP TO: 2 **EYE PROTECTION:** B **IMPOUND:** No **APPROXIMATE TIME:** 6 minutes

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. **Teams without proper eye protection will be immediately informed and given a chance to obtain eye protection if time allows.** 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. **For remote tournaments, the teams must supply all Test Apparatus that fully meet the requirements of Section 6 - any deviations from Section 6 will be a violation of construction parameters and place the team in Tier 2.**
- e. **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.**

3. **CONSTRUCTION PARAMETERS:**

- a. The Structure 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 Structure must be designed to sit on top of the Test Supports and support the Loading Assembly at the center of the spanned opening. **The Structure cannot touch the vertical sides of the Test Supports or the Test Base before or during the test.**
- c. **The Structure must be designed and built to the following dimensions and specifications for each Division:**
 - i. **Division B Dimensions and Specifications:**
 - (1) **The Structure must be designed to hold the bottom of the Loading Block at least 15 cm above the plane made by the tops of the Test Supports (6.b).**
 - (2) **The Structure must be designed to only touch the Test Supports (6.b) within the Division B Contact Zone (6.b.iv.1).**
 - (3) **Before loading, the Structure may NOT be below the plane made by the tops of the Test Supports. During the test, the Structure can deflect below the plane made by the tops of the Test Supports, but cannot touch the Test Base.**
 - (4) **The Clear Span will be 35 cm.**
 - ii. **Division C Dimensions and Specifications:**
 - (1) **The Structure must be designed to hold the bottom of the Loading Block no more than 1 cm above the plane made by the top of the Test Supports, but above the plane made by the top of the Test Base.**
 - (2) **The Structure must be designed to only touch the Test Supports (6.b) within the Division C Contact Zones (6.b.iv.2).**
 - (3) **Before loading, no part of the Structure may go below the plane made by the top of the Test Base (6.a). During the test, the Structure can deflect below the top of the Test Base, but cannot touch it.**
 - (4) **The Clear Span will be 45 cm.**



4. DESIGN LOG:

- Teams must submit a Design Log with documentation of a number of Structures tested prior to competition.
 - Regional/Invitational: 1 or more
 - State: 3 or more
 - National: 4 or more
- Documentation for each Structure in the Design Log must include:
 - Materials used
 - Sketch of the design
 - Weight and other dimensions of the Structure
 - Predictions: Load held & weak points
 - Test results: Load held & breaking point(s)
 - Observations & recommended design improvements
- If a 3-D printer, laser cutter, CNC machine or similar device was used by the team as a tool to build the team's device, or any component thereof, the following information must also be supplied in the log. Any such parts purchased as an end item or as part of a kit do NOT require this information.**
 - Information about the tool hardware, software, materials, and supplies used**
 - 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**
 - Descriptions of how the team constructed the final device from the tool created components**
- The Log must have a front cover labeled with the Team Name and the Team Number for the current tournament or be considered incomplete.**
- All numerical values should be labeled with standard units (e.g., SI or English) appropriate to the dimension being measured or be considered incomplete. SI units should be the default standard.**
- All logs will be returned to teams after inspection.

5. THE COMPETITION:

Part I: Check-In

- The team must present their Structure for inspection & measurement.
- 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.
- The team must submit their estimated Load Supported (5. Part II.g.) to be used as a tiebreaker.
- No alterations, substitutions, or repairs may be made to the Structure after the check-in process has started.
- 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

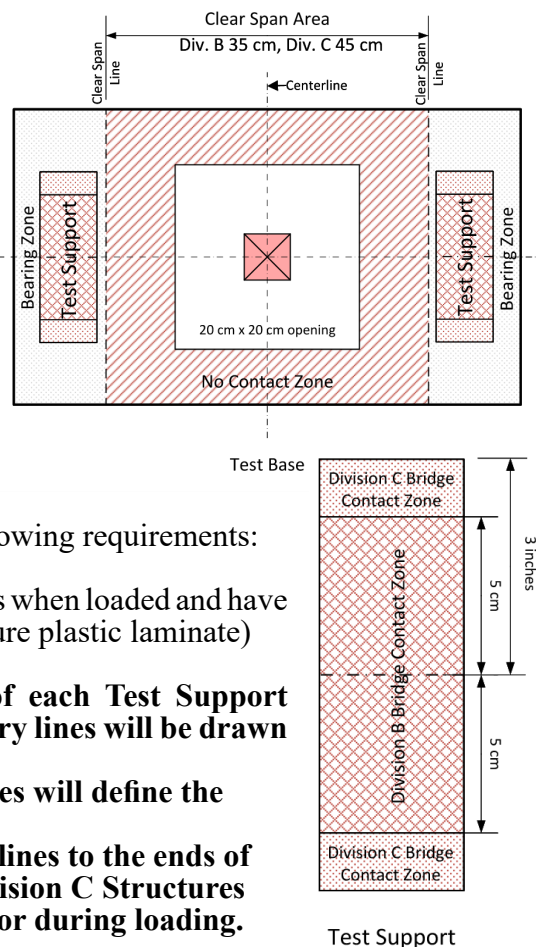
- Once participants enter the event area to compete, they must not leave or receive outside assistance, materials, or communication until they are finished competing.
- Participants will have 6 minutes to set up and test their Structure to maximum load or failure.
- The participants must place the Test Supports within the Bearing Zones (6.a.iv) of the Test Apparatus. Participants will then place their Structure within the proper Contact Zones on the Test Supports. 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 & re-

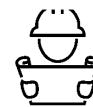


assembled, it must retain the original sequence with no loose pieces and the opposing force must always be on the bottom of the Loading Block. The bucket must be mounted to allow enough clearance above the floor for the bucket to tilt or the structure to deflect.

- 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.
 - (1) **Division B: No portion of the Structure is below the tops of the Test Supports.**
 - (2) **Division C: No portion of the Structure is below the top of the Test Base.**
 - 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.).
 - g. Loading stops immediately when 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 if 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 must 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 **and Design Log** with the Event Supervisor.
6. **TEST APPARATUS:** A list of possible questions, tasks, stations and/or examples that will help to demonstrate how the event may be run.

- 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., hard wood, 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 Centerline at 17.5 cm for Division B (35 cm span), or 22.5 cm for Division C (45 cm span) indicate the Bearing Zones.
- b. Two identical Test Supports shall be provided meeting the following requirements:
 - i. Must be 1-1/2 inches by 1-1/2 inches by 6 inches.
 - ii. Made of a material such that it does not noticeably compress when loaded and have smooth, hard surfaces (e.g., hard wood, metal, high-pressure plastic laminate)
 - iii. Must be able to rest flat and unfixed on the Test Base.
 - iv. **Must have a centerline drawn on the top surface of each Test Support perpendicular to the 6-inch sides. Additionally, boundary lines will be drawn 5 cm on both sides of the centerline.**
 - (1) **Division B: The area between the two boundary lines will define the Division B Contact Zone.**
 - (2) **Division C: The areas outside of the two boundary lines to the ends of the Test Support will define the Contact Zones. Division C Structures may not touch the Division B Contact Zone before or during loading.**





- c. The Loading Assembly will consist of:
 - i. A square Loading Block measuring 5 cm x 5 cm x approximately 2 cm high with a hole no larger than 8 mm drilled in the center of the 5 cm x 5 cm faces for a 1/4" threaded eyebolt
 - ii. 1/4 inch threaded eyebolt (1-inch nominal eye outside diameter), minimum 2 1/4 inch length to a maximum 4 1/2 inch length, and a 1/4 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
 - d. Sand: sand or other clean, dry free-flowing material.
 - e. Two (2) Bucket Stabilizing Sticks each made from a piece of 1/2" dowel approximately 18 inches long with a spring-type door stop screwed into one end. Refer to example on www.soinc.org.
 - f. Structure scale: Must be a digital scale. Scale shall have a minimum resolution of 0.1 grams; recommended resolution is 0.01 gram.
 - g. Sand scale and load verification: **Must be a digital scale.** 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)] * Design Log Penalty Multiplier.
 - 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. Design Log Penalty Multipliers:
 - i. Complete Design Log: 1.0
 - ii. Incomplete or non-compliant log: 0.9
 - iii. No Log: 0.5
 - e. 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 Test Apparatus requirements for virtual meets.
 - 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
 - f. Ties are broken as follows:
 - i. Estimated Load Supported closest to, without exceeding, the actual Load Supported
 - ii. Lowest Structure mass
 - g. Example score calculations:
 - i. Structure 1: mass= 10.12 g, Load Supported= 12,134 g; Log is complete; Score= 1,199
 - ii. Structure 2: mass= 12.32 g, Load Supported= 15,000 g + 5,000 g (Bonus) = 20,000 g; **Log is complete;** Score= 1,623
 - iii. **Structure 3: mass= 12.32 g, Load Supported= 15,000 g + 5,000 g (Bonus) = 20,000 g; No Log (0.5 multiplier); Score= 812**

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 Cleveland-Cliffs Foundation & SkyCiv



1. **DESCRIPTION:** Students will test and characterize one pure substance and then, based only on data they collect, answer a series of questions about that substance. Students will not be asked to identify the substance. The emphasis of this event is on the quality of data collected, answering questions about the substance and providing data to support their answers.

A TEAM OF UP TO: 2

EYE PROTECTION: C

APPROXIMATE TIME: 50 minutes

2. **EVENT PARAMETERS:**

- a. Each team may bring any or all of the items listed as Recommended Lab Equipment for Division B Chemistry Events, posted on soinc.org, **with the exception of pens or pencils as these will be provided by the Event Supervisor**. Teams not bringing these items will be at a disadvantage. The Supervisor will not provide them.
- b. 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.
- c. 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.
- d. The Supervisor will provide **the following items for each team:**
 - i. 1M NaOH
 - ii. 1M HCl
 - iii. 2 Different Writing Instruments
 - iv. Waste container(s)
 - v. Wash bottle with distilled water (no more than 250 mL)
- e. The Event Supervisor may provide:
 - i. Other equipment (e.g., hot plate, microscope, probes, calculator, etc.)
 - ii. If the Event Supervisor feels instructions are needed in order to use something provided, instructions will be available.

3. **THE COMPETITION:**

- a. Teams will be given a sample of one (1) per substance which may be of any color. Any general storage code chemical or household chemical such as salt, cornstarch, baking soda, Epsom salts, or Borax is permissible.
- b. The unknown sample will be provided by the Event Supervisor and be the same for all teams. In addition, the Event Supervisor will provide some equipment and test chemicals for each team to use.
- c. Teams will be expected to perform relevant tests using the materials provided to collect data about the unknown sample. The tests performed are determined by the students, not the Event Supervisor.
- d. Teams will be given approximately 25-35 minutes to do their selected tests and record data.
- e. Data is to be recorded on the provided data sheet with a pen provided by the Event Supervisor. It should be neat and organized. Any mistakes or changes should be crossed out. The data should be numbered sequentially as it is collected.
- f. At the end of the 25-35 minute data collection phase, the Event Supervisor will collect the pens provided to each team as well as all samples.
- g. The Event Supervisor will then provide teams with a different writing implement and a list of questions about the characteristics of their substance. The ability to answer these questions will depend on the quality and thoroughness of their investigations. Questions will have answers that derive from student observations. Questions will not be asked about melting point. Emphasis in scoring is placed on careful and organized observations.
- h. If the team has sufficient data and/or observations to support the answer to a question, they are to simply place the data number(s) beside the question. Place a number for all data that supports your answer to the question.



- i. Teams are never expected to actually answer a question; they just need to match the numbers of the observation(s) that would answer the question. **For example**, if the question was: “Is dissolving the substance an endothermic or exothermic process?” the participants would put the numbers of the observation of the temperature of the pure water and the temperature of the solution on dissolving as answers or if the participants had taken it a step further and already subtracted the two temperatures, the participants would put that number as the answer for more points. The participants would not ever say endothermic or exothermic.
 - j. Teams are to record observations not inferences. Inferences will score less points than observations. If in the example given in 3.i., the team had put down that the dissolving was exothermic, that would get less points than putting down the temperatures because that is an inference, not an observation.
4. **SAMPLE QUESTIONS:**
- a. Is the substance soluble in water?
 - b. If soluble in water, is the solution capable of conducting a current?
 - c. Does the substance react with an acid to produce a gas?
 - d. If soluble in water, what is the approximate pH of the solution?
 - e. If soluble in water, does the substance dissolve endothermically or exothermically?
 - f. Using a hand lens, what is the shape of the individual particles or are they too small to see?
5. **SCORING:**
- a. The team with the highest score wins. Time will not be used for scoring or breaking ties.
 - b. Each question is worth up to 5 points. The number of points awarded will depend on the quality of the data and/or observations. **Inferences can be awarded at most 3 points.**
 - c. If the team offers an answer to a question but does NOT have the supporting data and/or observations, they can receive up to a maximum of 2 points for the answer.
 - d. The tiebreaker for this event in order are the:
 - i. The total number of answers receiving 5 points
 - ii. The total number of answers receiving 4 points
 - iii. The total number of answers receiving 3 points
 - iv. The total number of answers receiving 2 points
 - e. A penalty of up to 10% may be given if the area is not cleaned up as instructed by the Event Supervisor.
 - f. 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



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

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 code types that may be used at Division B & C Regional Tournaments are as follows:
 - i. Monoalphabetic substitution using K1, K2, or random alphabets as defined by the American Cryptogram Association (ACA) **with or without a hint**
 - (1) Aristocrats - messages with spaces included **but no spelling or grammar errors**
 - (2) Aristocrats - messages with spaces **including spelling/grammar errors**
 - (3) Patristocrats - messages with spaces removed **with letters grouped in sets of 5**
 - ii. the Baconian Cipher - decrypting ciphertext encoded with the a and b values represented as one or more letters, glyphs, symbols, or character rendering variations (e.g., bold, underline, italic)
 - iii. Xenocrypt - no more than one cryptogram can be in Spanish
 - iv. the Pollux and Morbit Ciphers - decrypting Morse code ciphertext encoded as digits and spaces given the mapping of at least 5 of the digits
 - v. **Cryptanalysis of the Fractionated Morse Cipher - decrypting Morse code ciphertext encoded as letters and spaces with a “crib” of at least 4 plaintext characters.**
 - vi. **Cryptarithms – determining mapping values to letters in mathematical equations and extracting the word or words used for mapping**
 - vii. **The Porta Cipher - Encrypting plaintext or decrypting ciphertext given a key**
- f. Division B Only - The following code types may also be used at Regional Tournaments:
 - i. The Caesar Cipher, also called a shift cipher
 - ii. The Atbash Cipher (In English, not Hebrew)
 - iii. The Affine Cipher - encrypting plaintext or decrypting ciphertext given the a and b values
 - iv. **The Rail Fence Cipher – decrypting transposed text given a range for the rails and offset of 0**
- g. Division C Only - The following code types may also be used at Regional Tournaments:
 - i. For Monoalphabetic 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 Rail Fence cipher - Decrypting transposed text given the number of rails and an unknown offset
 - iv. The Hill Cipher – Encrypting plaintext or decrypting ciphertext given the corresponding 2x2 matrix
- 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. Cryptanalysis of The Pollux and Morbit Ciphers with a “crib” of at least 3 plaintext characters
 - iii. Cryptanalysis of the Porta Cipher with a “crib” of at least 3 plaintext characters
 - iv. Cryptanalysis of The Rail Fence Cipher with a “crib” of at least 4 plaintext characters given a range for the rails and offset of 0
 - v. **The Pollux and Morbit Ciphers – decrypting Morse code ciphertext encoded as digits and spaces given the mapping of only 4 of the digits**



- i. **Division B Only – The following code type may also be used at the State and National Tournaments:**
 - i. **Cryptanalysis of the Affine Cipher with a “crib” of at least 2 plaintext characters**
 - j. **Division C Only - The following code types may also be used at State and National Tournaments.**
 - i. Xenocrypt - at the State and National levels, at least two cryptograms will be in Spanish
 - ii. Cryptanalysis of the Rail Fence Cipher with a “crib” of at least 4 plaintext characters and a range for the rails and offset
 - iii. The Hill Cipher – Decrypting ciphertext with a 3x3 decryption matrix provided
 - k. For aristocrats, patristocrats, and xenocrypts, no letter can ever decrypt to itself.
 - l. No more than 2 cipher questions will be an encryption 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.i.(1)
 - ii. A team member should signal when his or her team has broken the cryptogram
 - iii. Before the exam begins, the Event Supervisor will announce the nature of the signal that must be used (e.g., shouting “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. **SCORING:**
- a. High score wins. Final Score = Exam Score + Timing Bonus + Special Bonus.
 - b. **The scores for each question will be added together to determine the exam score.**
 - c. **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 or encoded ciphertext as is appropriate to the question.**
 - i. **Two or fewer errors will be scored as correct and result in full credit.**
 - ii. **Each additional error results in a penalty of 100 points but the penalty should never exceed the value of the question. For example, a 400-point question with five (5) errors would earn a total of 100 points $[400 - 3(100)]$ whereas the same 400-point question with seven (7) errors would earn 0 points, not -100 points.**
 - d. **For answers involving the keyword or key phrases 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.**
 - i. **Zero (0) errors are required for full credit**
 - ii. **Each error results in a penalty of 100 points but the penalty should never exceed the value of the question. For example, a 500-point question with eight (8) errors would earn 0 points, not -300.**
 - e. A Timing Bonus can be earned based on the number of seconds it takes a team to correctly decode the first question. The timing bonus is equal to $2 \times (600 - \text{number of seconds})$. For example, 6 minutes = $2 \times (600 - 360) = 480$ points.
 - f. A Special Bonus can be earned by solving any of the questions marked as special bonus questions with no penalty points. The bonus will be awarded as follows: One solved = 150 points, Two solved = 400 points, All three solved = 750 points.
 - g. Scoring example: Team A earns 3600 points on the exam and solved the timed question in 435 seconds and solved one Special Bonus question.

Exam Score	=	3600 points
Timing Bonus $2(600-435)$	=	330 points
+ Special Bonus (One=150)	=	150 points
Final Score		4080 points
 - h. Tiebreakers: For teams that are tied, select questions predetermined by the Event Supervisor, will be used to break the tie using the following criteria in this order: score, degree of correctness and number attempted.

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



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 written 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)
 - iii. Wave phenomena for sound and light waves (e.g., reflection, standing waves, constructive and destructive interference, **refraction theory**, 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, primary colors of pigments, reflection, refraction, and use of filters, absorption spectra, and emission spectra in astronomy)
 - vi. Earthquake/seismic waves (e.g., p-waves, s-waves, Rayleigh waves, Love waves, surface waves)
 - vii. **State and National Only**
 - (1) **Doppler Effect Calculations**
 - (2) **Refraction Calculations**
 - viii. 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. Measure and label the angles of incidence and reflection and the normal of a mirror.
 - iii. Listen to a recording and determine in which direction (toward or away) a truck is moving.
 - iv. Given papers with colored circles and a flashlight hidden inside a black box, determine the color of the filter over the flashlight.
 - v. 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



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 R_fs.
 - 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



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:**

- a. **This event addresses three topics related to disease, injury, health, and disability in populations or groups of people.** Each part should count approximately equally towards a team's final score.

- b. **The topics for this event are as follows:**

- i. Background & Surveillance

- (1) Understand the Clinical Approach (health of individuals) and Public Health Approach (health of populations)
- (2) Understand the roles of epidemiology in public health and the steps in solving health problems
- (3) Understand the Natural History and Spectrum of Disease and the Chain of Infection
- (4) Understand basic epidemiological and public health terms (e.g., outbreak, epidemic, pandemic, surveillance, risk, vector, etc.)
- (5) Understand the role of Surveillance in identifying health problems, the 5-Step Process for Surveillance and the types of surveillance

- ii. Outbreak Investigation

- (1) Analyze an actual or hypothetical outbreak
- (2) Understand the Types of Epidemiological Studies – Experimental and Observational
- (3) Identify the Steps in an Outbreak Investigation
- (4) Identify the problem using person, place, and time triad – formulate case definition
- (5) Interpret epi curves, line listings, cluster maps, and subdivided tables
- (6) Generate hypotheses using agent, host, environment triad
- (7) Recognize various fundamental study designs and which is appropriate for this outbreak
- (8) Evaluate the data by calculating and comparing simple rates and proportions as attack rate, relative risk, odds-ratio and explaining their meaning
- (9) Apply the Bradford Hill Criteria for Verifying the Cause of this outbreak
- (10) Division C Only: Recognize factors such as study design/biases, errors, confounding that influence results
- (11) Division C - Nationals Only: Suggest types of control & prevention measures for this outbreak

- iii. Patterns, Control, and Prevention

- (1) Identify patterns, trends of epidemiologic data in charts, tables and graphs.
- (2) Using given data, calculate disease risk and frequency ratio, proportion, incidence proportion (attack rate), incidence rate, prevalence and mortality rate
- (3) Understand the Strategies of Disease Control
- (4) Understand Strategies for Prevention-the Scope and Levels of Prevention
- (5) Division C Only: Propose a reasonable set of prevention strategies for a public health problem once the cause has been determined
- (6) 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 offered through a partnership with the Centers for Disease Control (CDC) Foundation



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 three-ring binder of any size containing information in any form and from any source attached using the available rings. Sheet protectors, lamination, tabs and labels are permitted. If the event features a rotation through a series of laboratory stations where the participants interact with samples, specimens, or displays; no material may be removed from the binder throughout the event.
- b. Each team may bring two 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, & 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 & sizes, transportation, capacity & 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
 - vii. Groundwater: zone of aeration, zone of saturation, water table, porosity, permeability, aquifers, confining beds, 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 & types: faulting, rifting, volcanic action, glaciation, damming of rivers, changes over time
 - x. Lake features: inflow & outflow, physical & 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
 - xvi. Division C Only:
 - (1) Chezy and Manning equations
 - (2) Darcy's Law

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 siting.

5. **SCORING:**

- a. All questions will have been assigned a predetermined number of points.
- b. The highest score wins.
- 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

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



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. **Teams CANNOT use any of these as part of the experiment - they must only be used for their intended function.**
- c. Division C teams may bring one timepiece, one linear measuring device, and one stand-alone calculator of any type. **Teams CANNOT use any of these as part of the experiment - they must only be used for their intended function.**
- 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. **Teams failing to use at least two items will have their final score multiplied by 0.95.** The materials will be listed on the board or placed on a card for each team. If provided, both the card and the container will be considered part of the materials. The identity of the materials will be unknown until the start of the event.
- e. When a team finishes, all materials must be returned to the Event Supervisor including both parts of the report packet.

4. **SCORING:**

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

2023 Experimental Design Division B Checklist

(Note: The maximum points available for each task are shown.)

Part I – Design and Construction of the Experiment (61 pts)

A. Statement of the Problem (2 pts)

- ② ① ① Statement addresses the experiment including variables (Not a yes/no question)

B. Hypothesis (6 pts)

- ② ① ① Statement predicts a relationship between the independent and dependent variables
② ① ① Statement gives specific direction to the prediction(s) (e.g., a stand is taken)
② ① ① A rationale is given for the hypothesis.

C. Variables (15 pts)

a. Independent Variable (IV) (5 pts)

- ② ① ① Correctly identified and defined
③ ② ① Levels of IV given

b. Dependent Variable (DV) (4 pts)

- ④ ③ ② ① ① Correctly identified and defined

c. Controlled Variables (CV) (4 pts)

- ② ① ① First CV correctly identified
② ① ① Second CV correctly identified

d. Constant (2 pts)

- ② ① ① Constant correctly identified

D. Materials (4 pts)

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

E. Procedure and Set-up Diagrams (14 pts)

- ② ① ① Procedure is presented in list form
② ① ① Procedure is in a logical sequence
② ① ① Steps for repeated trials are included
② ① ① Multiple diagrams of setup are provided
② ① ① All diagrams are appropriately labeled
④ ③ ② ① ① Enough information is given so another could repeat procedure

F. Qualitative Observations (12 pts)

- ④ ③ ② ① ① Observations about procedure provided
④ ③ ② ① ① Observations about the results provided
④ ③ ② ① ① Observations given throughout the course of the experiment

G. Quantitative Data - Data Table (8 pts)

- ② ① ① All raw data is provided
② ① ① A condensed data table showing only the data to be graphed provided
② ① ① Tables and columns labeled properly
② ① ① All data has units

Part II – Data, Analysis and Conclusions (69 pts)

H. Graph (12 pts)

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

I. Statistics (14 pts)

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

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

- ② ① ① **Variation** Claim completed logically
② ① ① **Variation** Evidence completed logically
② ① ① **Variation** Reasoning completed logically
② ① ① Outliers Claim completed logically
② ① ① Outliers Evidence completed logically
② ① ① Outliers Reasoning completed logically
② ① ① Data Trend Claim completed logically
② ① ① Data Trend Evidence completed logically
② ① ① Data Trend Reasoning completed logically

K. Possible Experimental Errors (8 pts)

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

L. Conclusion (8 pts)

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

M. Recommendations for Future Experimentation (9 pts)

- ③ ② ① ① Suggestions to improve the experiment with rationale are provided
③ ② ① ① Suggestions for practical applications of experiment are given
③ ② ① ① Suggestions for future experiments are given

School: _____ Team# _____

Point Total: _____/130

Deduction multiplier(s): _____

Materials Used (0.95), Non-clean up (0.95), Off topic (0.75), or Non-lab (0.25)

(revised 06/07/2022)

Final Score: _____



1. **DESCRIPTION:** Teams will fill in a grid of terms that begin with a given letter to match given science categories.

A TEAM OF UP TO: 2

APPROXIMATE TIME: 50 minutes

2. **EVENT PARAMETERS:**

- a. Participants must bring a writing utensil.
- b. Teams are not allowed to bring any information resources or other material into the event.
- c. The Event Supervisor will provide each team an answer/scoresheet.

3. **THE COMPETITION:**

- a. Each competition will consist of 3 rounds. Each round will begin with the supervisor giving each team the same scoresheet that contains a grid which has 5 different science categories listed along the horizontal axis and 5 different letters listed along the vertical axis. The supervisor will determine the categories to be used in each round, ensuring that there is at least one valid answer for each category/letter combination. Categories and letters must not be repeated within a grid or among the three grids used in competition. No more than 1 letter from previous grids may be repeated in subsequent grids.
- b. Teams will have 6 minutes to complete each round. Teams will write a term, corresponding to the given category and beginning with the given letter, in each of the 25 boxes of the grid. At the end of 6 min. the event supervisor will stop the round. For each round all students should start and stop writing at the same time as directed by the event supervisor. Students beginning before or after the supervisor starts/stops the round will have their scoresheet not scored for that round.
- c. Students are to write their names and school on the scoresheet for each round. A scoresheet without student names and school will not be scored resulting in that scoresheet not being added to the final score.
- d. At the end of each round the supervisor will pick up all scoresheets. Then a new set of scoresheets will be distributed to students. This will be repeated for each of the 3 rounds.
- e. Names of the categories must not be used in the answer.
- f. If a correct response has more than one word, the 1st letter of the first word will be used (e.g., “D” is the 1st letter of “Doppler Effect”); Exceptions: The 1st letter of a word following the articles “the” or “a/an” will be considered the 1st letter of the term (e.g., “G” is the 1st letter for the term “The Grand Canyon”).
- g. Students may not write two or more different forms of a response within a category to get credit for two or more different answers (e.g., Category - “Human Organs”, Letters - “I”, “L” and “S”, and the student writes “small intestine”, “large intestine” and “intestine”. The student would only get credit for “small intestine” and “large intestine” because these terms are the most precise of the three responses).
- h. If the category asks for the name of a person, both the given (first) and surname (last) of a person must be written. The first letter of the surname must match the required letter (e.g., “D” – Charles Darwin; “C” – Marie Curie)
- i. Incorrect spellings of the word will be allowed if the Event Supervisor is able to determine the intended term. However, the first letter of the response must be correct (e.g., “Krust” would not be allowed for the letter “C” and “Krust” would not count for the letter “K” as the correct spelling is “crust”). All words must be found in an English based science dictionary. Abbreviations are not allowed.

4. **SCORING:**

- a. The number of points earned depends upon the number of correct terms listed in a row and in a column. Points will be awarded as follows:

One correct term in a row	= 1 pt.	One correct term in a column	= 1 pt.
Two correct terms in a row	= 4 pts.	Two correct terms in a column	= 4 pts.
Three correct terms in a row	= 9 pts.	Three correct terms in a column	= 9 pts.
Four correct terms in a row	= 16 pts.	Four correct terms in a column	= 16 pts.
Five correct terms in a row	= 25 pts.	Five correct terms in a column	= 25 pts.
- b. The round score will be determined by adding the scores from each of the rows and columns. Final score will be determined by adding all of the round scores. Highest total score wins.
- c. Tiebreakers will be determined by the following sequence: 1. Highest individual round score; 2. Second highest individual round score; 3. Third highest individual round score; 4. Total columns/rows with 5 correct; 5. Most columns/rows with 4 correct; 6. Most columns/rows with 3 correct; 7. Most columns/rows with 2 correct.

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



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

A TEAM OF UP TO: 2

IMPOUND: No

APPROXIMATE TIME: 15 minutes

2. **EVENT PARAMETERS:**

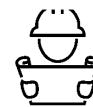
- a. Teams may bring up to 2 aircraft, each in its own team-provided box, any tools, and their Flight-Design Log. Teams may bring two different types of aircraft.
- b. Event Supervisors will provide all measurement tools and timing devices for scoring purposes.

3. **CONSTRUCTION PARAMETERS:**

- a. Aircraft may be constructed from published plans, commercial kits, competitor's designs, and/or other sources of design. Kits, if used, must not contain any pre-glued joints or pre-covered surfaces.
- b. Aircraft includes any heavier-than-air device capable of flight, including but not limited to: Airplanes of any wing configuration (e.g., monoplane, biplane, triplane, tandem wing, canard), Helicopters, Gliders, Ornithopters, and Gyrocopters. However, some aircraft have unique requirements as follows:
 - i. Helicopters must have a flat balsa wood disc, large enough to cover a dime, as the upper most part of the helicopter, the part that would touch a flat ceiling first during the flight.
 - ii. Gliders must have a hand-held launcher in its ready to use configuration that fits in the box with the glider when it is presented for inspection.
- c. Any materials except Boron filaments may be used in construction of the aircraft and boxes.
- d. The aircraft in its flight configuration and during the flight must fit into a team-provided rectangular box.
 - i. For Division B, the external dimensions of the box, with or without a lid, must be no larger than 39.0 cm x 28.5 cm x 63.0 cm.
 - ii. For Division C, the external dimensions of the box, with or without a lid, must be no larger than 33.0 cm x 27.0 cm x 43.0 cm.
- e. Boxes may be purchased or constructed by the participants.
- f. "Flight configuration" means the aircraft is fully assembled and ready to fly. For example, no change in chord, span, length, or total lifting area (as verified by returning aircraft to box after flying) can occur after removing the aircraft from its box and throughout the flight itself. Rotating components such as propellers or rotors may be rotated to allow the aircraft to fit into the box.
- g. Trimming is allowed as long as the constraints of 3.d.-e. are followed.
- h. For the aircraft to "fit" into the box, the aircraft's overall dimensions must not change after being removed from the box. This may be verified by showing that the aircraft slides into and out of the box without changing shape at the discretion of the Event Supervisor.
- i. All aircraft-lifting forces must be generated by wing(s) or rotor style flying surfaces.
- j. Total mass of the aircraft, excluding the rubber motor(s), must be 8.00 g or more.
- k. The propeller/rotor assembly/assemblies may be built by the participants or purchased pre-assembled. This may include a propeller, a shaft, a hanger, and/or a thrust bearing. Variable-pitch propellers that include mechanisms to actively change the propeller/rotor diameter or blade angle must not be used.
- l. The sole power for the aircraft must come from rubber motor(s).
 - i. Each motor used for single-motor aircraft, including any attachments such as O-rings, must mass no more than 2.00 g.
 - ii. Each set of motors for multi-motor aircraft must not exceed a combined mass of 2.00 g and must be checked in as a set. If different sets of motors are checked in, individual motors must not be interchanged between sets.
 - iii. Motor(s) will be massed separately from aircraft. Motor(s) may be lubricated before and/or after check-in.
 - iv. Up to 6 motors, or sets of motors for multi-motor aircraft, may be checked in.
- m. Participants may use any type of winder, but electricity may not be available.
- n. 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.
- o. Aircraft must be labeled so that the Event Supervisor can easily identify to which team it belongs.

4. **FLIGHT-DESIGN LOGS:**

- a. Teams must present a Flight Log of recorded data. This data must include 6 or more parameters (3 required and at least 3 additional) with units for 10 or more test flights prior to the competition.



- i. The required parameters are:
 - (1) Motor size before windup
 - (2) Number of turns on the motor or torque at launch
 - (3) Flight time
 - ii. The team must choose 3 additional data parameters beyond those required (e.g., turns remaining after landing, estimated/recorded peak flight altitude, the motor torque at landing, propeller pitch, etc.).
 - b. Teams must also present a Design Log. The log must include the following:
 - i. A list of materials used to construct the aircraft
 - ii. A labeled diagram or picture that identifies the parts of the aircraft
 - iii. 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 Design Log. Any such parts purchased as an end item or as part of a kit do not require this information.
 - (1) Information about the tool hardware, software, materials, and supplies used
 - (2) 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
 - (3) Descriptions of how the team constructed the final device from the tool-created components
 - c. Each log must have a front cover with the Team Name and the Team Number for the current tournament or be considered incomplete.
 - d. All numerical values should be labeled with standard units (e.g., SI or English) appropriate to the dimension being measured or be considered incomplete. SI units should be the default standard.
 - e. All logs will be returned to teams after inspection.
5. **THE COMPETITION:**
- a. The event will be held indoors. Tournament officials will 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.
 - b. Once participants enter the cordoned off competition area to trim, practice, or compete they must not receive outside assistance, materials, or communication. Only participants may handle aircraft until the event ends. Teams violating this rule will be ranked below all other teams. Spectators will be in a separate area.
 - c. At the Event Supervisor's discretion:
 - i. Multiple official flights may occur simultaneously.
 - 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 10-minute Flight Period.
 - d. Check-in:
 - i. Prior to check-in with the Event Supervisor, a self-check inspection station may be made available to participants for checking their box(es), aircraft, and motor(s).
 - ii. At check-in, participants will present their Flight-Design Log, motor(s), and aircraft in box(es) for inspection immediately prior to their Flight Period.
 - iii. The Event Supervisor will verify the external dimensions of the box(es). Only participants are allowed to handle the box(es).
 - iv. After verifying the box(es') dimensions, at the direction of the Event Supervisor, only participants will remove the aircraft from the box(es) and mass the aircraft.
 - v. All motor(s) will be collected, massed and returned to the team at the start of their 10-minute Flight Period.
 - e. Flight Period:
 - i. The 10-minute flight period begins when the Event Supervisor returns the motor(s) to the team.
 - ii. Any flight beginning within the 10-minute Flight Period will be permitted to fly to completion. Participants may make adjustments/repairs/trim flights during their official 10-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 the Timer(s) of the flight's status. Teams must not be given extra time to recover or repair their aircraft.
 - iii. Teams may make up to a total of 2 official flights using 1 or 2 aircraft.



- iv. Time aloft for each flight starts when the aircraft leaves the participant's hand and stops when any part of the aircraft touches the floor, the lifting surfaces no longer support the weight of the aircraft (such as the aircraft landing on a girder or basketball hoop) or the Event Supervisors otherwise determine the flight to be over.
 - v. 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.
 - vi. Participants must not steer the aircraft during flight.
 - vii. In the unlikely event of a collision with another aircraft, a team may elect a re-flight. The decision to re-fly may be made after the aircraft lands. Timers are allowed to delay a launch to avoid a possible collision. The 10-minute Flight Period does not apply to such a flight.
 - f. After all flights are completed, the participants must (if requested by the Event Supervisor) demonstrate that each aircraft still meets the dimension requirements by placing the aircraft inside the team's box(es) in the as-flown configuration. Teams may not manipulate the configuration of the aircraft in order to fit into the box except to rotate components (such as propellers/rotors) that were spinning about an axis of rotation on the aircraft during the flight. Motor(s) may be removed from the aircraft or left in place during the demonstration.
 - g. The Event Supervisor will verify with the team the data being recorded on their scoresheet.
 - h. Teams filing an appeal must leave their aircraft, box(es), motor(s) and Flight-Design Log in the event area.
6. **SCORING:**
- a. Highest Final Score wins. A team's Final Score is the larger of the team's Flight Scores. Flight Score for each official flight = Flight Time + Bonus (6.b.) - Penalties (6.c.-6.d.).
 - b. A bonus of 10% of the Flight Time will be added to the Flight Score of an aircraft that has the entire surface of the wing between at least 2 ribs or at least one of the wingtip fences or a vertical stabilizer completely marked with black marker or black tissue. If no ribs are present, the whole surface must be black. Aircraft with no wings or vertical stabilizer must have at least one black-colored lifting surface.
 - c. Teams with incomplete or missing Logs will have the following deduction from their Flight Time from each Flight Score.
 - i. An incomplete Flight Log is a 10% deduction while a missing Flight Log is a 20% deduction.
 - ii. An incomplete Design Log is a 5% deduction while a missing Design Log is a 10% deduction.
 - d. Teams that violate rule(s) under "CONSTRUCTION PARAMETERS" or "THE COMPETITION" that do not have a specific penalty will be ranked after all teams that do not violate those rules.
 - e. Ties will be broken by the longest non-scored official Flight Score.

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)



1. **DESCRIPTION:** Participants will be assessed on their knowledge of **trees found in the United States** that are on the **2023 Official Science Olympiad National Tree List**.

A TEAM OF UP TO: 2

APPROXIMATE TIME: 50 minutes

2. **EVENT PARAMETERS:**

- 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.
- Each team may also have one commercially produced field guide which may be tabbed or annotated.
- In addition to their resource binder and field guide, each team may bring one (1) copy of either the 2023 Official Science Olympiad National Tree List or a state or regional tree list if issued.

3. **THE COMPETITION:**

- All questions will be restricted to specimens on the **Official Science Olympiad National Tree List** and no more than 50% of the competition will require giving a **scientific and/or common name**.
- This event may be held either indoors, in a wooded lot, or both. Specimens (or pictures/slides if necessary) will be lettered or numbered at stations.
- Each team will be given an answer sheet on which they will record answers to each question.
- Participants should be able to do basic identification to the level indicated on the **2023 Official Science Olympiad National Tree List**.
- Leaf specimens may be live or preserved depending on availability and may be accompanied by twigs, cones, seeds, or other parts of the tree. Identification will be based on an examination of the leaf specimens (compound leaves should be intact). For each specimen, students will be asked a correlated question that pertains to the tree's structure, ecology, or economic characteristics. Structural characteristics may include leaf types, leaf shapes, leaf margins, leaf venation, leaf arrangement on the stem, twigs, bark, flowers, cones, fruits, seeds, and tree shapes.
- Ecological characteristics may include habitats, adaptations to the environment, biomes, succession, and relationships (e.g., symbiosis and competition) with animals or other plants. Economic characteristics may include beneficial or detrimental aspects of trees such as sources of food, medicine, building materials, chemicals, fuel, fiber, and trees as nuisance species.
- States may have a modified **State or Regional Tree List** which are limited to or focus on local trees. This list if created will be **posted on the state website no later than November 1st**.
- The National competition will be based on the **2023 Official Science Olympiad National Tree List** which is **based on the taxonomy of the National Audubon Society Trees of North America, 2021 Edition**. While not titled as such for our competitions, this book is considered a field guide.

4. **SAMPLE ACTIVITIES:**

- Identify **scientific name** and/or common name of the provided sample.
- What conclusion can be drawn about the habitat(s) of the given specimens?
- Which of these specimens does not fit within this **family of trees**?
- What unique feature distinguishes the specimen shown in the picture?
- Consider the potential impact of human activities on this particular tree.

5. **SCORING:**

- High score wins.
- 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

This event is sponsored by the USDA Forest Service - Conservation Education



Family: Family Name

Genus species (Common Name)

Ginkgoaceae: Ginkgo Family

Ginkgo biloba (Ginkgo)

Taxaceae: Yew Family

Taxus brevifolia (Pacific Yew)

Pinaceae: Pine Family

Abies balsamea (Balsam Fir)

Abies concolor (White Fir)

Abies grandis (Grand Fir)

Abies lasiocarpa (Subalpine Fir)

Larix laricina (Tamarack)

Larix occidentalis (Western Larch)

Picea engelmannii (Engelmann Spruce)

Picea glauca (White Spruce)

Picea mariana (Black Spruce)

Picea pungens (Blue Spruce)

Picea rubens (Red Spruce)

Picea sitchensis (Sitka Spruce)

Pinus albicaulis (Whitebark Pine)

Pinus aristata (Bristlecone Pine)

Pinus attenuate (Knobcone Pine)

Pinus banksiana (Jack Pine)

Pinus contorta (Lodgepole Pine)

Pinus echinate (Shortleaf Pine)

Pinus edulis (Colorado Pinyon Pine)

Pinus flexilis (Limber Pine)

Pinus lambertiana (Sugar Pine)

Pinus monophylla (Singleleaf Pinyon)

Pinus monticola (Western White Pine)

Pinus palustris (Longleaf Pine)

Pinus ponderosa (Ponderosa Pine)

Pinus resinosa (Red Pine)

Pinus rigida (Pitch Pine)

Pinus strobus (Eastern White Pine)

Pinus taeda (Loblolly Pine)

Pinus virginiana (Virginia Pine)

Pseudotsuga menziesii (Douglas-fir)

Tsuga canadensis (Eastern Hemlock)

Tsuga heterophylla (Western Hemlock)

Tsuga mertensiana (Mountain Hemlock)

Cupressaceae: Cypress Family

Chamaecyparis lawsoniana Port-Orford-cedar
(Oregon Cedar)

Cupressus macrocarpa (Monterey Cypress)

Juniperus osteosperma (Utah Juniper)

Juniperus scopulorum (Rocky Mountain Juniper)

Juniperus virginiana (Eastern Redcedar)

Sequoia sempervirens (Redwood)

Sequoiadendron giganteum (Giant Sequoia)

Taxodium distichum (Baldcypress)

Thuja occidentalis (Northern White-cedar)

Thuja plicata (Western Redcedar)

Palmae/Arecaceae: Palm Family

Sabal palmetto (Cabbage Palmetto)

Washingtonia filifera (California Fan Palm)

Salicaceae: Willow Family

Populus angustifolia (Narrowleaf Cottonwood)

Populus balsamifera (Balsam Poplar)

Populus deltoides (Eastern Cottonwood)

Populus fremontii (Fremont Cottonwood)

Populus grandidentata (Bigtooth/Largetooth Aspen)

Populus tremuloides (Quaking Aspen)

Populus trichocarpa (Black Cottonwood)

Salix bebbiana (Bebb Willow)

Salix nigra (Black Willow)

Salix scouleriana (Scouler Willow)

Juglandaceae: Walnut Family

Carya cordiformis (Bitternut Hickory)

Carya glabra (Pignut Hickory)

Carya illinoensis (Pecan)

Carya ovata (Shagbark Hickory)

Juglans cinerea (Butternut)

Juglans nigra (Black Walnut)

Betulaceae: Birch Family

Alnus rubra (Red Alder)

Betula alleghaniensis (Yellow Birch)

Betula lenta (Sweet Birch)

Betula occidentalis (Water Birch)

Betula papyrifera (Paper Birch)

Betula populifolia (Gray Birch)

Carpinus caroliniana (American Hornbeam)

Ostrya virginiana (American/Eastern Hophornbeam)

Fagaceae: Beech Family

Castanea dentata (American Chestnut)

Fagus grandifolia (American Beech)

Lithocarpus densiflorus (Tanoak)

Quercus agrifolia (Coast Live Oak)

Quercus alba (White Oak)

Quercus bicolor (Swamp White Oak)

Quercus chrysolepis (Canyon Live Oak)

Quercus douglasii (Blue Oak)

Quercus falcata (Southern Red Oak)

Quercus garryana (Oregon White Oak)

Quercus imbricaria (Shingle Oak)

Quercus kelloggii (California Black Oak)

Quercus macrocarpa (Bur Oak)

Quercus muehlenbergii (Chinkapin Oak)

Quercus palustris (Pin Oak)

Quercus prinus (Chestnut Oak)

Quercus rubra (Northern Red Oak)

Quercus velutina (Black Oak)

Quercus virginiana (Live Oak)

Ulmaceae: Elm Family

Celtis occidentalis (Northern Hackberry)

Ulmus americana (American Elm)

Ulmus rubra (Slippery Elm)



Moraceae: Mulberry Family

Maclura pomifera (Osage-orange)

Morus alba (White Mulberry)

Morus rubra (Red Mulberry)

Magnoliaceae: Magnolia Family

Liriodendron tulipifera (Yellow-poplar)

Magnolia grandiflora (Southern Magnolia)

Magnolia macrophylla (Bigleaf Magnolia)

Annonaceae: Custard Apple Family

Asimina triloba (Pawpaw)

Lauraceae: Laurel Family

Sassafras albidum (Sassafras)

Umbellularia californica (California-laurel)

Hamamelidaceae: Witch-Hazel Family

Hamamelis virginiana (Witch-hazel)

Liquidambar styraciflua (Sweetgum)

Platanaceae: Sycamore Family

Platanus occidentalis (Sycamore)

Platanus racemosa (California Sycamore)

Rosaceae: Rose Family

Amelanchier alnifolia (Western Serviceberry)

Cercocarpus ledifolius (Curl-leaf Mountain Mahogany)

Crataegus douglasii (Black Hawthorn)

Crataegus pruinosa (Frosted Hawthorn)

Heteromeles arbutifolia (Toyon)

Prunus americana (American Plum)

Prunus emarginata (Bitter Cherry)

Prunus pensylvanica (Pin Cherry)

Prunus serotina (Black Cherry)

Prunus virginiana (Common Chokecherry)

Sorbus americana (American Mountain-ash)

Leguminosae: Legume Family

Acacia farnesiana (Huisache/Sweet Acacia)

Cercis canadensis (Eastern Redbud)

Cercidium floridum (Blue Paloverde)

Gleditsia triacanthos (Honeylocust)

Gymnocladus dioica (Kentucky Coffeetree)

Prosopis glandulosa (Honey Mesquite)

Robinia pseudoacacia (Black Locust)

Rutaceae: Rue/Citrus Family

Zanthoxylum clava-herculis (Hercules-club/Toothache-Tree)

Simaroubaceae: Quassia Family

Ailanthus altissima (Ailanthus/Tree of Heaven)

Anacardiaceae: Cashew/Sumac Family

Rhus glabra (Smooth Sumac)

Aquifoliaceae: Holly Family

Ilex opaca (American Holly)

Ilex vomitoria (Yaupon)

Aceraceae: Maple Family

Acer negundo (Boxelder)

Acer rubrum (Red Maple)

Acer saccharinum (Silver Maple)

Acer saccharum (Sugar Maple)

Hippocastanaceae: Buckeye Family

Aesculus californica (California Buckeye)

Aesculus glabra (Ohio Buckeye)

Tiliaceae: Basswood Family

Tilia americana (American Basswood)

Cactaceae: Cactus Family

Cereus giganteus (Saguaro)¹

Myrtaceae: Myrtle Family

Eucalyptus globulus (Bluegum Eucalyptus)

Cornaceae: Dogwood Family

Cornus florida (Flowering Dogwood)

Cornus nuttallii (Pacific Dogwood)

Nyssa sylvatica (Black Tupelo/Blackgum)

Ericaceae: Heath Family

Arbutus menziesii (Pacific Madrone)

Ebenaceae: Ebony Family

Diospyros virginiana (Common Persimmon)

Oleaceae: Olive Family

Fraxinus americana (White Ash)

Fraxinus latifolia (Oregon Ash)

Fraxinus velutina (Velvet Ash)

Bignoniaceae: Bignonia Family

Catalpa bignonioides (Southern Catalpa)

Catalpa speciosa (Northern Catalpa)

Chilopsis linearis (Desert-willow)

Caprifoliaceae: Honeysuckle Family

Sambucus canadensis (American Elder/Elderberry)

Euphorbiaceae: Spurge Family

Aleurites moluccana (Candlenut/Kukui)²

Note: The 2023 Official Science Olympiad National Tree List taxonomy is based the National Audubon Society Trees of North America, 2021 Edition.

1: This organism is not listed in the National Audubon Society Trees of North America, 2021 Edition as it is a cactus but for our purposes is considered a tree.

2: This organism is not listed in the National Audubon Society Trees of North America, 2021 Edition as it is found in the Hawaiian Islands which are not addressed in the book.



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"x11" 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 from any source without any annotations or labels affixed along with two stand-alone non-programmable, non-graphing calculators.

3. **THE COMPETITION:**

- a. This event will be composed of three sections of approximately equal point value.
- b. **Questions** may include analysis, interpretation or use of charts, graphs and sample data.
- c. Green Generation is designed **to rotate the content over a two-year period with** the first year **addressing** aquatic issues, air quality, and climate change while the **second year addresses** terrestrial issues, population growth issues, and **climate change**. **The content for this year's events is as follows:**
 - i. Review of the General Principles of Ecology
 - (1) General Principles of Ecology – food webs and trophic pyramids, nutrient cycling, community interactions, population dynamics, species diversity, indicator species, and invasive species
 - (2) Overview of **Terrestrial Environments – forests, grasslands, deserts, tundra**
 - ii. Problems resulting from human impacts on the quality of our environment
 - (1) **Terrestrial Environmental Issues –Desertification, Deforestation, Soil Pollution, Waste Disposal, Mining**
 - (2) **Population Growth Issues –Habitat Destruction, Farming Practices, Fertilizers, and Pesticides**
 - (3) **Climate Change – Effects on Plants, Animals, and Ecosystems**
 - iii. Solutions to reversing/reducing human impacts that harm our environment
 - (1) Sustainability Strategies –Environmental Stewardship of **Terrestrial Ecosystems**
 - (2) Bioremediation Strategies
 - (3) **Nonrenewable, Renewable, and Alternative Energy Sources**
 - (4) **Waste Management**
 - (5) Division C Only: Legislation and Economic Opportunity for Solving Problems

4. **SCORING:**

- a. Questions will be assigned point values.
- b. High score wins.
- 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

This event is sponsored by Corteva Agriscience



1. **DESCRIPTION:** Participants will use scientific process skills as well as qualitative and quantitative analyses to demonstrate an understanding of the factors that influence **Everyday Weather**.

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. 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.
- c. Teams will not be required to bring additional supplies or materials for any hands-on task, demonstration or lab exercise.

3. **THE COMPETITION:**

- a. The event may be either in a written exam format or teams may move from station to station, with the length of time at each station predetermined and announced by the event supervisor. Participants may not return to stations, but may change or add information to their original answers while at other stations.
- b. Emphasis will be placed upon interpretation of weather data displayed in maps, graphs, images, photographs, charts, and/or tables to analyze **Everyday Weather**. The questions will address the following **Everyday Weather** topics:
 - i. The atmosphere: structure including temperature profiles of the troposphere and stratosphere, including inversions, thickness, composition and atmospheric pollutants
 - ii. Solar radiation & seasons: atmospheric influences on insolation, diurnal & seasonal temperature patterns, Earth's revolution, rotation and axial tilt
 - iii. Properties of Water: specific heat, density, sensible and latent heat along effects on weather
 - iv. Atmospheric moisture: humidity, water vapor, atmospheric rivers, virga, clouds, dew, frost & fog
 - v. Clouds: formation of high, middle, & low clouds with vertical development; limited to the following: cirrocumulus, cirrus, and cirrostratus, altocumulus, altostratus, and nimbostratus, and stratus, cumulus, stratocumulus and cumulonimbus as well as lenticular/cap, orographic and pyrocumulonimbus clouds
 - vi. Fog types and formation: advection, freezing, precipitation, radiation, steam & valley fog
 - vii. Precipitation:
 - (1) types and formation: snow, snow grains, rain, drizzle, ice pellets (sleet), hail, graupel, freezing rain, freezing drizzle
 - (2) hazards: training thunderstorms, flash and river flooding and snow and ice storms
 - viii. Atmospheric optical effects: sundogs, rainbows, halos, and mirages
 - ix. Atmospheric pressure: horizontal & vertical gradients, troughs & ridges, cyclones (lows) & anticyclones (highs) and their circulations, including Coriolis Effect & friction
 - x. Origin and characteristics of air masses: temperature, density, moisture & atmospheric stability
 - xi. Characteristics of fronts and boundaries: warm, cold, occluded (complex) and stationary fronts, dry lines
 - xii. Local winds: Chinook and Santa Ana winds, sea, lake & land breezes, valley & mountain breezes
 - xiii. Effects of topography on winds & precipitation patterns
 - xiv. Storms and other hazardous weather: cyclogenesis & cyclolysis, Alberta Clippers, panhandle hook, nor'easters, Lake Effect snowstorms, ice storms, winter storms, blizzards, thunderstorms (not severe), fire weather, heat waves, drought, dust storms, dust devils; Questions will not address the following types of severe storms: tropical storms, hurricanes, severe thunderstorms and/or tornadoes.
 - xv. Weather instrumentation & technology: thermometers, anemometers, barometers, satellite imagery (visible, infrared & water vapor), radiosondes, rawinsondes, Doppler radar, wind profilers, rain gauges, snow boards
 - xvi. Weather data: meteograms, radiosonde soundings, station models and METAR observations



- xvii. **Surface weather maps: highs, lows, fronts, dry lines, station model, isobars, isotherms, isohyets, areas of precipitation, and interpretation to understand and predict weather events**
- xviii. Upper air charts: 850, 700, 500 & 300 mb, jet streams, ridges, & troughs
- xix. **Weather forecasting:**
 - (1) weather **forecast** maps, meteograms, **isolines/isopleths**, fronts, Doppler radar images, model predictions, **radiosonde soundings**, Stüve diagrams
 - (2) National Weather Service non-severe forecast products: **Zone forecasts, Public Information Statements**
 - (3) hazard map advisories, **watches and warnings** (e.g., dense fog, flooding, high winds, associated with non-severe weather)
- xx. Temperature indices: wind chill, heat index, and heating & cooling degree days

4. **SAMPLE QUESTIONS/TASKS:**

- i. Interpret station models.
- ii. **Analyze isobars to determine areas of highest wind speeds.**
- iii. **Analyze a meteogram to determine whether a cold, warm or stationary front passed and at what time.**
- iv. **Examine a surface weather map and interpret the weather conditions at different locations.**
- v. Use upper-air charts with surface maps to predict the trajectories of high- and low-pressure systems.
- vi. Interpret local weather conditions using satellite imagery.
- vii. **Decode & interpret METAR observations.**
- viii. **Determine if and the type of precipitation that would be observed at the surface based on a radiosonde sounding.**
- ix. Given stations with temperatures and dew points, which one has the highest relative humidity?

5. **SCORING:**

- a. High score wins.
- b. Points will be awarded for the quality of responses, the quality of supporting reasoning, and use of scientific technique
- c. 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)



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 Sheets (pre- and post-2010)**, **hand lenses/magnifying glasses**, 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



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 three-ring binder of any size containing information in any form and from any source attached using the available rings. Sheet protectors, lamination, tabs and labels are permitted. If the event features a rotation through a series of laboratory stations where the participants interact with samples, specimens, or displays, no material may be removed from the binder throughout the event.
- b. 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 copy of the 2023 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, and analyzing data.
- b. Where possible, participants will move from station to station, with the length of time at each station predetermined and announced by the event supervisor. Participants may not return to stations, but may change or add information to their original responses while at other stations.
- c. Identification will be limited to specimens appearing on the Official Science Olympiad **2023** Rocks and Minerals List 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 participants be allowed to do a taste test.
- f. Participants are expected to be able to answer questions about the following Mineral topics:
 - i. Identification - specimens or images used should show observable properties. Where observable properties are insufficient to identify a specimen, other diagnostic characteristics will be provided
 - ii. Physical Properties - color, hardness, luster, streak, cleavage/fracture, density/specific gravity/ heft, diaphaneity, tenacity
 - iii. Other properties - reaction with acid, fluorescence, magnetism, smell, taste, double refraction, piezoelectricity, radioactivity, etc.
 - iv. Mineral habit - limited to acicular (needlelike), bladed, botryoidal, cubic, dendritic, dodecahedral, doubly terminated, druzy, geodic, hexagonal, hopper, massive, micaceous, octahedral, pisolitic, prismatic, radiating, rosette, stalactitic, twinning, and tabular
 - v. Chemical composition – **chemical formulas, relationships between chemistry and properties (e.g., effect of trace elements on mineral color)**
 - (1) **Division C Only - Solid solution series (e.g., feldspar ternary diagrams)**
 - (2) **Division C Only – Phase diagram interpretation: temperature/pressure, temperature/ composition (limited to two component systems)**
 - vi. Polymorphs (e.g., diamond/graphite and orthoclase/microcline)
 - 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 tetrahedra and their structures: isolated tetrahedra (nesosilicates), island (sorosilicates), chain (inosilicates), ring (cyclosilicates), sheet (phyllosilicates), and framework (tectosilicates)**
 - (3) **Division C - State/Nationals Only - Crystal Systems – cubic, tetragonal, orthorhombic, monoclinic, triclinic, trigonal, and hexagonal; emphasis on how crystalline structures result in certain physical properties (e.g., cleavage planes, crystal shape)**
 - viii. Methods of formation and environments (e.g., hydrothermal, chemical weathering, crystallization from magma, evaporites, chemical precipitation, alteration under heat & pressure)



- ix. Minerals associated with rock-forming environments (e.g., evaporite minerals in sedimentary settings; mafic minerals in oceanic crust; minerals that form under metamorphic conditions)
- x. Bowen's Reaction Series – relationship between mineral crystallization and temperature in magma
- xi. Uses of minerals (e.g., ores, **industry**, jewelry, **geochronology**)

(1) **Precious and semiprecious gemstones including minerals on the Rocks & Minerals List as well as the following varieties, limited to: emerald, aquamarine, morganite, peridot, ruby, sapphire, pearl and amber.**

g. Participants are expected to be able to answer questions about the following Rock topics:

- i. Identification - specimens or images used should show observable characteristics. Where observable characteristics are insufficient to identify a specimen, other diagnostic characteristics will be provided (e.g., mineral composition of fine-grained igneous rocks)
- ii. Classification - igneous, sedimentary, and metamorphic including observable diagnostic characteristics that facilitate classification (e.g., glassy or vesicular texture in igneous; rounded grains, fossils, or layers in sedimentary; and foliation or banding in metamorphic)
- iii. Igneous Rocks:
 - (1) Textures - including 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 Rocks:
 - (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 (**fluvial**), lake (**lacustrine**), swamp, **wind (aeolian)**, floodplain, beach, shallow marine/**shelf**, deep marine
 - (6) Primary sedimentary structures and **their implications about depositional processes and environments** (e.g., plane bedding, cross-bedding, ripple marks, mud cracks, graded bedding, fossil tracks & trails)
- v. Metamorphic Rocks:
 - (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 (**e.g., building stone, ores, ornamental, agriculture, fossil fuels**)



viii. **Division C, States and National Only - Thin Sections of Rocks; using photographs taken through a microscope (photomicrographs)**

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

4. **SAMPLE ACTIVITIES:**

- a. **Using the materials provided, determine the relative hardness of the mineral specimens.**
- b. **Identify the minerals and describe each specimen's luster.**
- c. **Determine the breakage pattern (cleavage or fracture) of the minerals.**
- d. **The color of the specimen is caused by which element?**
- e. **Based on the texture of the metamorphic rocks, list the specimens in order from lowest to highest grade of metamorphism.**
- f. **Based on the provided diagram of igneous environments, which specimen cooled at the slowest rate in a batholith?**
- g. **Based on the grain size of the shale, sandstone, and conglomerate, which one formed in the lowest energy environment?**
- h. **Classify the specimens into igneous, sedimentary, or metamorphic based on observable characteristics and state one reason for each classification.**

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



MINERALS

Borate Family

Ulexite

Carbonate Family

Aragonite
Azurite
Calcite
Dolomite
Malachite
Rhodochrosite*

Native Element Family

Copper
Diamond
Gold
Graphite
Silver
Sulfur

Halide Family

Fluorite
Halite⁴

Oxide/Hydroxide Families

Corundum
Goethite/Limonite
Hematite
Magnetite
Pyrolusite*
Rutile*
Zincite*

Phosphate Family

Apatite
Pyromorphite*
Turquoise*
Vanadinite*

Sulfate Family

Barite
Celestite*
Gypsum⁴ 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 Group¹
Willemite*
Zircon*
Amphibole Group
Actinolite*
Hornblende
Tremolite*
Feldspar Group
Plagioclase feldspars
Albite
Labradorite
Potassium feldspars
Amazonite
Orthoclase/Microcline
(pink)²
Garnet Group¹
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 Formation
Bauxite³
Breccia
Chert/Flint
Conglomerate
Diatomite
Dolostone
Rock Salt (Halite)⁴
Rock Gypsum⁴
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 - 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.



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

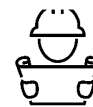
A TEAM OF UP TO: 2 **IMPOUND:** Yes **EYE PROTECTION:** B **APPROX. TIME:** 12 minutes

2. **EVENT PARAMETERS:**

- a. Participants must bring and impound one Roller Coaster (a track that guides a ball/sphere), at least one ball/sphere, non-electronic tools, spare parts, and **appropriate Logs** before the start of the competition.
- b. Participants may bring and impound additional balls/spheres, but only one will be used during a given run.
- c. Participants must properly wear eye protection at all times. Participants without proper eye protection must be immediately informed and given a chance to obtain eye protection, if time allows.
- d. The Event Supervisor will provide an unsharpened #2 pencil with an unused eraser, all measurement tools for scoring purposes, and timers.
- e. If the device is deemed unsafe, it will not be allowed to run until safety concerns are resolved to the Event Supervisor's satisfaction.
- f. Participants must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org.

3. **CONSTRUCTION PARAMETERS:**

- a. The Roller Coaster must be designed so that the ball/sphere will travel from a Start Line to a Finish Line in as close to the given Target Time as possible.
- b. At all times during the competition the device, excluding the ball/sphere, must be no larger than 30.0 cm wide x 60.0 cm long x 60.0 cm high sitting flat.
- c. The ball/sphere must be visible at all times.
- d. The ball/sphere must be held in the ready-to-run position by an unsharpened #2 pencil held only in the participant's hand. The pencil is provided by the Event Supervisor. The ball/sphere is released when the participant removes the pencil from the track.
- e. The ball/sphere must travel using only its own gravitational potential energy available at the ready-to-run position. No added energy by use of stored potential energy is allowed (e.g., no springs, rubber bands, magnets, or elevators).
- f. There must be exactly one clearly labeled Start Line and one clearly labeled Finish Line running perpendicular to the direction of ball/sphere travel on the track designated before the Target Time is released.
- g. The relative positions of the Start Line and the Finish Line must not change after impound.
- h. The device must include a mechanism that safely stops the ball/sphere after it crosses the Finish Line.
- i. Magnets, electrical, and electronic devices may not be used for any part of the Roller Coaster.
- j. Gaps: The device may contain Gap(s) in the track to earn a Gap Score. Gaps are defined as an open span without support or guidance that the ball/sphere must pass to continue its run.
 - i. Gaps must have a horizontal span of at least 5.0 cm from the end of the track that the ball/sphere leaves measured to the closest part of the track the ball/sphere lands on.
 - ii. The beginning and the end of each Gap must be clearly labeled and must have a physical edge that is at least 0.5 cm above any surface below to earn points; these physical edges will be the measurement boundaries of the Gap.
 - iii. The ball/sphere must travel completely unsupported in the air to earn points.
 - iv. There must be a minimum of 5.0 cm of unbroken track at the end of every gap.
 - v. Up to 2 distinct, clearly labeled Gaps may be included to earn points.
 - vi. Bouncing a ball/sphere off a surface does not count as part of a Gap; a Gap may not end with the ball/sphere hitting a wall.
- k. Loop: The device may contain one Loop in the track to earn a Loop Score. A Loop is defined as a continuously concave section of track which appears to self-intersect at a Point of Intersection (POI).
 - i. The Loop begins and ends when the ball/sphere reaches the POI.
 - ii. The track must not be fully enclosed (**i.e., the ball/sphere could be easily removed by the Event Supervisor**) at any point in the Loop.
 - iii. The height of the Loop is defined as the vertical distance from the POI to the highest inside point of the Loop.



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

4. DATA-DESIGN LOGS:

- a. Teams must submit a Data Log along with their device. The Data log must include the following:
 - i. The submitted Data Log must contain recorded data for 10 or more test runs covering parameters/observations prior to the competition.
 - ii. The required parameters are:
 - (1) Run time, in seconds,
 - (2) The gap and loop score(s), in centimeters, if attempted, and
 - (3) Qualitative or quantitative observations on an aspect of the device that, once modified, changes the time of the run.
- b. 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 the Start Line, Finish Line, and if included, the Gaps and Loop and how they are measured.
 - iii. 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 Design Log.

Any such parts purchased as an end item or as part of a kit do NOT require this information.

 - (1) Information about the tool hardware, software, materials, and supplies used
 - (2) 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
 - (3) Descriptions of how the team constructed the final device from the tool created components
- c. **Each log must have a front cover labeled with the Team Name and the Team Number for the current tournament or be considered incomplete.**
- d. **All numerical values should be labeled with standard units (e.g., SI or English) appropriate to the dimension being measured or be considered incomplete. SI units should be the default standard.**
- e. All logs will be returned to teams after inspection.

5. THE COMPETITION:

- a. The Roller Coaster, ball(s)/sphere(s), tools, spare parts, data/notes, and Design Log must be impounded before the start of the competition.
- b. Only the participants and Event Supervisor will be allowed in the impound and event areas during the competition. Once the participants enter the event area to compete, they must not leave the area or receive outside assistance, materials, or communications.
- c. The exact Target Time is between 30 s and 60 s (in 5 s intervals for Regional, 2 s intervals for State, and 1 s intervals for National tournaments) and will be chosen by the Event Supervisor. The Target Time will be the same for all teams at the tournament and will be revealed after the impound period.
- d. After retrieving their device from the Impound Area, teams will be given 8 minutes to set up their Roller Coaster and complete up to two scorable runs. Participants may make as many practice runs as they want during the 8 minutes.
- e. Participants may adjust their Roller Coaster (e.g., modify the track, add/remove parts of track, swap the ball/sphere, leveling) before each run.
- f. Time used by the Event Supervisor for measuring will not be included in the 8 minutes. A scorable run that begins before the end of the 8-minute time period will be allowed to run to completion.
- g. Prior to conducting a scorable run, the participants must place the Event Supervisor provided #2 pencil on the Start Line of the device. The ball/sphere must be placed completely behind the Start Line.
- h. A scorable run must be declared prior to the start of a run. Participants may not touch the device during a scorable run.



- i. Prior to each scorable run, the Event Supervisor will verify that the timekeepers and participants are ready. Three timekeepers are suggested to be used with the median time recorded as the Run Time, in seconds to the precision of the timing device used. The Event Supervisor will then count aloud “3, 2, 1, Go”. On the word “Go” the participants will remove the pencil from the track such that the pencil does not exert a force on the ball/sphere.
 - j. On the word “Go”, the pencil is removed and timing begins. Timing ends when any of the following happens:
 - i. The ball/sphere completely crosses the Finish Line.
 - ii. Twice the Target Time has elapsed since the word “Go”.
 - iii. The ball/sphere travels outside the boundary of the device.
 - iv. The ball/sphere stops moving. The ball/sphere may pause briefly, but timing stops if movement does not begin within 3 seconds.
 - k. If the ball/sphere fails to cross the Finish Line on a scorable run, that run will receive a Time Score of Zero (0), but will still receive scores for the Height, Gap(s), and Loop. Only the Gaps and Loop that are successful before timing stops may receive their respective points.
 - l. The Roller Coaster’s height will be measured at the conclusion of each scorable run.
 - m. The Event Supervisor will review with teams the data recorded on their scoresheet.
 - n. Teams filing appeals must leave all impounded materials with the Event Supervisor.
6. **SCORING:**
- a. Highest Final Score wins. The higher of the 2 Run Scores is used as the Final Score.
 - b. $\text{Run Score} = \text{Height Score} + \text{Time Score} + \text{Gap Score} + \text{Loop Score}$
 - c. $\text{Height Score} = 2 \times (60 - \text{Roller Coaster height})$. The Roller Coaster height is measured in whole cm from the highest part of the Roller Coaster to the floor or the table (if used), rounded down.
 - d. $\text{Time Score} = \text{Time Bonus} - \text{Time Penalty}$
 - i. Time Bonus = 5 points for every full second of Run Time up to the Target Time.
 - ii. Time Penalty = 5 points for every full second of Run Time past the Target Time up to the 2 x the Target Time.
 - e. Gap Score = 4 points for each whole cm measured horizontally from the end of the track the ball/sphere leaves, to the closest part of the track the ball/sphere lands on. Points are only awarded if the ball/sphere successfully reaches the track on the other side of the Gap and fulfills all requirements in (3.j.).
 - f. Loop Score = 6 points for each whole cm of the height of the Loop, measured vertically from the POI to the highest inner point of the Loop. Points are only awarded if the ball/sphere successfully completes the Loop and fulfills all requirements in (3.k.).
 - g. Teams with incomplete or missing Logs will have the following deduction from their Final Score.
 - i. **An incomplete Data Log is a 10% deduction while a missing Data Log is a 20% deduction.**
 - ii. **An incomplete Design Log is a 5% deduction while a missing Design Log is a 10% deduction.**
 - h. Tiers:
 - i. Tier 1: A run with no violations
 - ii. Tier 2: A run with any construction or competition violations
 - iii. Tier 3: A team with a Roller Coaster or ball/sphere not impounded during the impound period
 - i. Participation points are awarded to teams who cannot start any run within the 8 minutes or have unresolved safety issues.
 - j. Ties are broken in this order:
 - i. Highest Gap Score for an individual gap
 - ii. Highest Loop Score
 - iii. Highest Height Score
 - iv. Highest Time Score

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



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

A TEAM OF UP TO: 2

APPROXIMATE TIME: 50 minutes

2. **EVENT PARAMETERS:**

- a. Each team may bring 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.

3. **THE COMPETITION:**

- a. Participants will be asked to identify the following objects/systems and, if applicable, surface/atmospheric/spectroscopic features associated with these objects/systems as they appear on diagrams, plots, maps, or images. They must also be knowledgeable about the structures and properties of these objects/systems, with particular emphasis on how these objects/systems may satisfy the criteria thought to be required for originating and/or sustaining extraterrestrial life. Exams should not contain detailed questions about other objects/systems unless sufficient background information is provided.

- i. Solar System Objects: Venus, Mars, Europa, Enceladus, Titan, 101955 Bennu, & 67P/Churyumov-Gerasimenko
- ii. Extrasolar Systems: TRAPPIST-1, Kepler-186, TOI-700, and Proxima Centauri

- b. Participants may also be tested on the following topics:

- i. Techniques used to assess an object's habitability, including, but not limited to: using spectroscopy to detect specific compounds in atmospheres, analyzing images of surface features to study geologic activity, and estimating objects' surface conditions.
- ii. Engineering design principles and science objectives/discoveries associated with the following: DAVINCI+, VERITAS, Spirit/Opportunity, Phoenix, Curiosity, Perseverance/Ingenuity, Mars Reconnaissance Orbiter, MAVEN, Galileo, Europa Clipper, Cassini, Dragonfly, OSIRIS-REx, Rosetta, Spitzer, Kepler, JWST, and TESS.
- iii. Basic understanding of mathematical concepts in the context of habitability, including, but not limited to: Kepler's Laws, equilibrium temperature and energy budgets, and tidal forces. Exams should not contain any questions that require a calculator.
- iv. Exoplanet detection and characterization techniques limited to transits, radial velocity, and direct imaging.
- v. Basic biology and chemistry in the context of habitability, including, but not limited to: extremophiles, building blocks of life on Earth (e.g., proteins, nucleic acids, etc.), spectroscopy, atmospheric chemistry, and different forms of water.
- vi. General characteristics of asteroids and comets in the Solar System.

4. **SAMPLE PERFORMANCE TASKS:**

- a. Given an image of a surface feature, identify the surface feature, estimate its age, and explain how that feature is thought to have been formed.
- b. Describe how data from a magnetometer could be used to infer the presence of a subsurface ocean on an icy moon.
- c. Explain the difference between detecting *evidence of life* and detecting *areas of habitability*. Do you think that an instrument that measures chemical signatures is a better tool for detecting *evidence of life* or *areas of habitability*? Why?
- d. When the Sun becomes a red giant, its radius will become about 100 times larger, but its temperature will be halved. By what factor would we expect the equilibrium temperature of Europa to change? Assume all other variables (e.g., Europa's albedo) to stay the same.

5. **SCORING:**

- a. High score wins.
- b. Each task or question will be assigned a predetermined number of points.
- 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

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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 **all** the notes of a one-octave **chromatic scale of the team's choosing**. **Pitch scoring will be based on the tonic and 7 notes chosen by the Event Supervisor from the team's chosen chromatic scale.**
- f. **All teams will be required to play the same seven (7) additional notes relative to the tonic at a given tournament.**
- g. **Participants must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy. Per the Digital Fabrication section of that policy, teams may use 3D printers, laser cutters, CNC mills, and other similar machines as a tool to construct all or part of their device. Teams are encouraged to design customized tool files/models (e.g., CAD, STL, OBJ) from scratch and should review the complete policy on www.soinc.org for more details and examples.**

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 **chromatic** scale beginning on any note between F2 and C4 (inclusive), chosen by the team. (A4 = 440 Hz). **A CONSTRUCTION violation will not be assessed for having notes outside of the scorable range, however all notes outside of the scorable range will receive Individual Pitch Scores (IPSS, 6.b.iii.) of zero (0). Scorable notes are one octave from the starting note, making F2 to F3 the lowest scorable scale and C4 to C5 the highest scorable scale.**
- c. The energy to produce the pitches must come from the participants and may not be stored **prior to the device setup**. Participants may not hum or sing to cause the device to produce its pitches.
- d. 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 movable by the participants without outside assistance. Devices may become larger once set up.
- e. Devices must use the same sound-producing components for all portions of the competition.

4. **DESIGN LOG:**

- 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 and **how all notes for the chromatic scale are to be played**
 - iii. **The physical modifications made to tune one (1) note must be described. In addition, the pitch should be measured, in either frequency or cents off the target frequency after each modification. A minimum of five (5) measurements must be made producing at least five (5) data points for the tuning of one note.**
 - iv. A front cover labeled with the Team Name and the Team Number for the current tournament
- b. If a 3-D printer, laser cutter, CNC machine or similar device was used **by the team** as a tool to build the team's device, or any component thereof, the following information must also be supplied in the log. **Any such parts purchased as an end item or as part of a kit do NOT require this information.**



- 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 numerical values should be labeled with standard units (e.g., SI or English) appropriate to the dimension being measured. SI units should be the default standard though for this event “cents” may be used as a unit for pitch differentials.**
- d. Teams are encouraged to have a duplicate of their Design Log, as the submitted copy may not be returned.

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, electroacoustics, speech, and underwater acoustics (e.g., hearing, human ear, noise generated by air movement, turbulence, building and auditorium acoustics, recording and reproduction of sound, natural and man-made sounds underwater).
 - 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, reflection, refraction, diffraction, propagation).
 - iii. Fundamental elements of musical sound, perception, and resonance (e.g., pitch, amplitude **intensity and its measurement**, harmonics, overtones, open and closed pipes, strings, membranes).
 - 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.
 - v. Notes, major scales, **reading** intervals, time signatures, tempos, and common music terms.
 - vi. **Topics for State and National Only**
 - (1) **Basic Principles of Acoustics - Environmental noise, psychoacoustics, bioacoustics (e.g., noise and vibration caused by various forms of transportation and recreational activities, relationship between sound and cognition, noise cancellation, animal calls, how sound affects animals).**
 - (2) **Intermediate conceptual ideas and Intermediate algebraic calculations of sound wave theory - (e.g., boundary effects, echoes, sonar, Helmholtz resonators, acoustic impedance and interpreting it with respect to instruments, sound pressure, reading and interpreting sound pressure graphs).**
 - (3) **Fundamental elements of musical sound, perception, and resonance - Elements of musical sound, perception, and resonance (timbre, dissonance and consonance, complex tones, harmony, combination tones, and loudness).**
 - (4) **The design, function, and construction of various instrument types - knowledge of common parts of various instruments, how the parts of an instrument 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.**
 - (5) **Notes, major scales, calculating intervals, time signatures, tempos, and common music terms - minor scales, solfege, calculating intervals, chords and Roman numeral notation, 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. **Participants are allowed to use their own copy of the Design Log during pitch testing and song scoring to correctly interpret the required notes for pitch testing and have the music in the appropriate key for song scoring.**

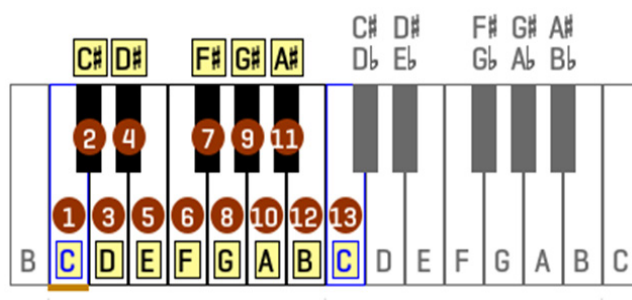


- c. Teams will have two minutes to set up their device. During the two minutes, teams may use their personal tuner, including a cell phone app, to adjust the pitches on their device. One participant may continue working on the written test if not needed to play or set up the device. **During the two (2) minutes, participants may attempt to resolve any construction violations in their device. Devices that do not meet construction parameters may still be tested if time allows and at the discretion of the Event Supervisor, but will score a zero (0) for their IPS and Song scores.**
- 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 **chromatic** scale they are playing and **must** start on **the tonic**. Participants must know the octave number of their **tonic note**.

- 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 (**built into the recommended pitch tester**). The Event Supervisor will inform the participants which seven (7) additional notes are to be tested from their chosen chromatic scale before pitch testing begins. The Event Supervisor must identify the additional seven (7) notes using the note numbers in the figure.

C chromatic scale



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 **required** sequence. Points will be awarded per note.
- f. Once the Pitch Score Test is completed the participants will conduct their Song Score Test. **The device must also be able to play the song excerpt in the time limit which will vary with the tournament level as shown at the end of these rules.**
 - 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 **their chosen chromatic scale**. **The device must be built to play all the notes and embellishments, the term used to include the five dynamics, ornaments, and other symbols, in the song excerpt or a penalty will be applied to the Song Score.**
 - iii. **The Song Score is based on the ability to play all notes and embellishments of the song within the time limit, and the Event Supervisor's perception of the rhythmic and pitch accuracy of the song. Teams that are not finished playing the song in the time limit plus the total time to reduce the Time Score to zero must be allowed to continue playing so that scoring for Rhythmic accuracy, Pitch accuracy, and Embellishments can be finished. If students stop playing before the end of the song excerpt, any remaining embellishments will be scored as zero and the Rhythmic accuracy and Pitch accuracy may be reduced since there is no way to judge them for the whole song excerpt.**
- 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:

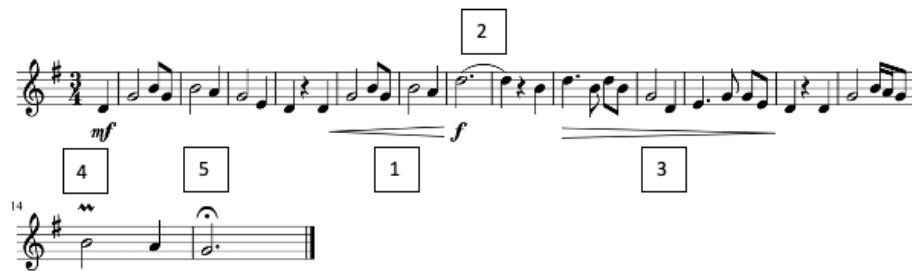
- a. High score wins. A complete scoring rubric is available on the Sounds of Music page on soinc.org
- b. The Final Score = TS + LS + PS + SS. The maximum possible Final Score (FS) is 100 points
 - i. Test Score (TS) = (Part I score / Highest Part I score for all teams) x 45 points
 - ii. Log Score (LS) = max of 10 points
 - iii. Pitch Score (PS) = (Sum of IPS for the Device/Highest IPS Sum for all teams) x **25** points
 IPS (Individual Pitch Score for each pitch) =
 - (1) C (cents) = abs (cents off the target frequency).
 - (2) IPS for skipped pitches **or pitches outside the scorable range** = 0
 - (3) The IPS score varies by tournament level:
 - a. Regionals: If $C \leq 10$, IPS = 4.5; If $C > 10$, IPS = $5 - 0.05 \times C$
 - b. States: If $C \leq 7$, IPS = 4.5; If $C > 7$, IPS = $5 - 0.1 \times C$
 - c. Nationals: If $C \leq 3$, IPS = 4.5; If $C > 3$, IPS = $5 - 0.2 \times C$
 - (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 **detailed** list of materials used in the device
 - ii. **2 points – For describing physical changes made to tune one pitch**
 - iii. 2 points – For including at least **five (5) pitch data points (using frequency or cents)** 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; **deductions will be made for missing or skipping notes**
 - iii. **5 points – Embellishments; deductions will be made for any missing embellishments**
 - (1) **1 point deduction for each missing embellishment (5 pts. max)**
 - (2) **Minimum embellishment score is zero (0)**
 - iv. 5 points – **Time; deductions will be made for exceeding specified time limits**
 - (1) **Invitational: 30 seconds; 1 pt. deduction for every 5 seconds over the time limit (5 pts. max)**
 - (2) **Regional: 25 seconds; 1 pt. deduction for every 5 seconds over the time limit (5 pts. max)**
 - (3) **State: 30 seconds; 1 pt. deduction for every 5 seconds over the time limit (5 pts. max)**
 - (4) **National: 25 seconds; 1 pt. deduction for every 3 seconds over the time limit (5 pts. max)**
 - (5) **Minimum time score is zero (0)**
- e. If a team violates any COMPETITION rules, their IPS and Song Score 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 and Song Score 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



Song Excerpts

The following song excerpts are expected to be played at the respective tournament. The embellishments for each song are numbered. The song excerpt for the National Tournament will be released on April 3, 2023. The embellishments that are included in the song excerpt for the National Tournament include a mordent, slur, turn, fermata, and a grace note. Teams should consider these embellishments when they are designing their device.

Amazing Grace (for Invitationals)



O Susanna (for Regional Tournaments)



Battle Hymn of the Republic (for State Tournaments)



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



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 UPTO: 2 **EYE PROTECTION:** B **IMPOUND:** Yes **APPROX. TIME:** 10 minutes

2. **EVENT PARAMETERS:**

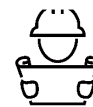
- a. Prior to the competition teams must collect and record launch device performance and calibration data.
- b. Each team may bring tools, supplies, writing utensils, and two stand-alone calculators of any type for use (these items need not be impounded). Each team must impound only one launch device 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. Per the Digital Fabrication section of that policy, teams may use 3D printers, laser cutters, CNC mills, and other similar machines as a tool to construct all or part of their device. Teams are encouraged to design customized tool files/models (e.g., CAD, STL, OBJ) from scratch and should review the complete policy on www.soinc.org for more details and examples.**

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 have a vertical dimension of no more than 70 cm. The length and width of the device may not exceed 1.0 m.**
- 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 75 cm 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 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. Any number of graphs and/or tables showing the relationship between various parameters such as arm position or counterweight mass and impact position 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. Each data series counts as a separate graph.
 - iv. 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.
 - v. **A front cover labeled with the Team Name and the Team Number for the current tournament**
- b. If a 3-D printer, laser cutter, CNC machine or similar device was used **by the team** as a tool to build the team's device, or any component thereof, the following information must also be supplied in the log. **Any such parts purchased as an end item or as part of a kit do NOT require this information.**
 - 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

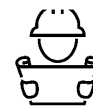


- iii. Descriptions of how the team constructed the final device from the tool created components
 - c. **All numerical values should be labelled with standard units (e.g., SI or English) appropriate to the dimension being measured. SI units should be the default standard.**
 - d. Teams are encouraged to have a duplicate of their Design Log, as the submitted copy may not be returned.
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 75 cm 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). The center of the target will be placed at the desired location.**
 - 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 1.5 m wide by 1.5 m long (parallel to the launch direction), designated by tape on the floor. Tape must also be placed 75 cm 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 Event Supervisor will set the center of the target at the distance selected by the team.**
 - d. The 2 separate counterweights must consist of a **1.0 kg (light)** and **2.0 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 1.5-3.0 kg. **For all levels the masses must have an eye bolt on top that has a minimum inside diameter of ½ inch.** For all levels, the counterweight **must not have a dimension (length, width, or height) in excess of 15.0 cm.**
 - 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. Counterweight masses must be announced only after impound is over and must be the same for all teams.
7. **SCORING:**
- 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 **closest edge of the 5 gallon bucket (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 $0.15 \times \text{TD}$ points. Making contact with the inside bottom surface is worth an additional $0.15 \times \text{TD}$ points (for a total of $0.30 \times \text{TD}$ 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. 4 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. 4 points for including a labeled device picture or diagram
 - vi. 5 points for including at least 2 example calculations
 - vii. **3 points for submitting a properly formatted Design Log containing all the required elements described in Section 4**
- 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. **If a team is unable to fix the construction violation(s), they may still be permitted to compete but be ranked behind every team that did not have a construction violation(s) or were able to fix their construction violation(s).**
- i. Teams disqualified for unsafe operation or that do not have a device will have LS scores of 0.
- j. Participants will be informed before the next launch if they have received a penalty.
- k. Tiebreakers:
 - i. 1st: best LS;
 - ii. 2nd second best LS;
 - iii. 3rd third best LS
- l. A scoring spreadsheet is available at www.soinc.org

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



1. **DESCRIPTION:** Teams must design, build, and test one Vehicle that uses non-metallic, elastic material as its sole means of propulsion to travel a distance as quickly and accurately as possible.

A TEAM OF UP TO: 2 **IMPOUND:** Yes **EYE PROTECTION:** B **APPROX. TIME:** 12 minutes

2. **EVENT PARAMETERS:**

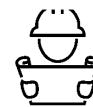
- a. Each team must bring and impound one Vehicle, alignment devices (if used), a Practice and Design Log, and additional/spare parts. The Vehicle must be impounded in its lowest potential energy state.
- b. Teams may bring a stand-alone calculator of any type and non-electronic tools which do not need 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 energy used to propel the Vehicle must be stored in non-metallic, elastic material(s). They may be left unattached until just prior to the run. Pre-loaded energy storage devices may be used to operate other Vehicle functions (e.g., braking system) as long as they do not provide energy to propel the Vehicle.
- b. Electronic components and electric devices are not permitted except for calculators.
- c. The distance from the front of the front wheel(s) to the back of the back wheel(s) must not be > 70.0 cm.
- d. The Vehicle width must not exceed 30.0 cm at any point.
- e. The Vehicle must have, attached to the front end, a $\frac{1}{4}$ " wooden dowel approximately perpendicular to the floor so as to be the foremost part of the Vehicle at all times during its run.
 - i. The dowel must extend to at least 20 cm above the Track's surface to interrupt the photogates or timing lasers, if used - see 5.d.
 - ii. The dowel must also extend to within 1.0 cm of the Track's surface so that its front bottom edge will be the Vehicle's Measurement Point for distance measurements.
- f. No part of the Vehicle including the wheels can extend beyond the front of the $\frac{1}{4}$ " dowel, other than the dowel attachment device.
- g. Participants must design the activation trigger so that its actuation is perpendicular (vertical) to the floor. The Vehicle must be able to remain at the starting position without being touched until triggered. The stopping mechanism must work automatically. The Vehicle must not be remotely controlled or tethered.
- h. 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), elastics from 3.a., 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 & DESIGN LOGS:**

- a. Teams must submit a Practice Log along with their Vehicle. The log must include the following:
 - i. Recorded data covering 4 or more parameters (3 required and at least 1 additional) for 10 or more test runs prior to the competition.
 - ii. The required parameters are Target Distance, Vehicle Distance from Target, and Time.
 - iii. The additional 4th parameter (e.g., # of axle turns for braking, alignment angle, or other adjustment to enable the Vehicle to score better) is chosen by the Team.
- b. Teams must also submit a Design Log. The log must include the following:
 - i. The materials used to construct the Vehicle
 - ii. A labeled diagram or picture that identifies and describes the parts.
 - iii. 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. **Any such parts purchased as an end item or as part of a kit do NOT require this information.**
 - (1) Information about the tool hardware, software, materials, and supplies used
 - (2) 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
 - (3) Descriptions of how the team constructed the final device from the tool created components



- c. Each log must have a front cover labeled with the Team Name and the Team Number for the current tournament or be considered incomplete.
 - d. All numerical values should be labeled with standard units (e.g., SI or English) appropriate to the dimension being measured or be considered incomplete. SI units should be the default standard.
 - e. All logs will be returned to teams after inspection.
5. **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 cm x 2.5 cm tape with the Start Point marked at the center of the tape.
 - ii. 0.25 m Timing Line - a line of 2.5 cm tape, approximately 70 cm long, to be placed perpendicular to and centered on the imaginary Center Line. The edge of the line closest to the Start Point must be 0.25 cm from the Start Point.
 - iii. 7.25 m Timing Line - a line of 2.5 cm tape, approximately 70 cm long, to be placed perpendicular to and centered on the imaginary Center Line. The edge of the line closest to the Start Point must be 7.25 m from the Start Point.
 - iv. Target Point - an approximately 5 cm x 2.5 cm tape with the Target Point marked at the center of the tape.
 - c. The exact Target Distance from the Start Point to the Target Point will be between 8.00 m and 11.00 m. At Regionals/Invitationals the interval will be 0.50 m, for States 0.20 m, and for National 0.05 m. The exact distance will be chosen by the Event Supervisor and announced after the impound period is over.
 - d. A photogate timing system is highly recommended. See www.soinc.org for information. If used, the system will be installed at the Timing Lines with the beams at a height of 17.0 ± 2.0 cm. At least one manual timer should be used as a backup. If photogates are not being used, three timekeepers should be utilized with the middle time used as the official Run Time - lasers are recommended to be placed at the Timing Lines so the timekeepers only have to watch for the flash of light as the dowel cuts through the laser beam.
 - e. 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.
6. **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 until they are finished competing and have left the event area.
 - b. Teams have 8 minutes of Event Time to set up and start up to 2 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.
 - e. Teams may adjust their Vehicle (e.g., change its elastic materials, 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.
 - f. Teams may use their own non-electronic measuring devices to verify the Track dimensions during their Event Time.
 - g. 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.
 - h. 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.
 - i. 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.
 - j. 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, teams must not follow their Vehicle and must wait until called by the Event Supervisor to retrieve their Vehicle.



- 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 2 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. Construction and/or Competition Violations must still be recorded for Failed Runs. A team having only one successful run during the 8-minute Event Time will be assessed a Failed Run for a 2nd run score. If the Vehicle does not move during the Event Time, the team will be assessed 2 Failed Runs.
 - m. If the Vehicle passes the 0.25 m Line but stops before the 7.25 m Line, it is considered a Competition Violation. The Event Supervisor records the run measurement.
 - n. If the Vehicle travels in the wrong direction or if its distance or time cannot be measured (e.g., it starts before the Event Supervisor is ready, if it moves but does not go at least 0.25 m, or the participants pick it up before it is measured), the run is a Failed Run.
 - o. The Event Supervisor will review with teams the data recorded on their scoresheet.
 - p. Teams filing an appeal must leave their Vehicle, Practice Log, and Design Log in the event area.
7. **SCORING:**
- a. Each team's Final Score is the better of the 2 Run Scores plus any Final Score Penalties. Low score wins.
 - b. Run Score = Distance Score + Time Score + Run Penalties.
 - c. Time Score = Run Time x 2
 - d. Run Time begins when the dowel of the Vehicle reaches the 0.25 m Timing Line and ends when it passes the 7.25 m Timing Line. The Run Time must be recorded in seconds to the precision of the timing device used. The Run Time will be recorded as 0.00 seconds for Failed Runs or if the Vehicle passes the 0.25 m Line but stops before the 7.25 m Line.
 - e. Distance Score: The Distance Score is the distance from the Vehicle's Measurement Point to the Target Point in centimeters measured to the nearest 0.1 cm. This is a point-to-point measurement. The Distance Score for a Failed Run is 1100 points.
 - f. Run Penalties:
 - i. Competition Violation: 150 points added to the Run Score per violation
 - ii. Construction Violation: 300 points added to the Run Score per violation
 - iii. Failed Runs can be assessed violations.
 - g. Final Score Penalties:
 - i. Incomplete Practice Log: 25 points added to the team's Final Score.
 - ii. Incomplete Design Log: 25 points added to the team's Final Score.
 - iii. Missing or not Impounded Practice Log: 150 points added to the team's Final Score.
 - iv. Missing or not Impounded Design Log: 150 points added to the team's Final Score.
 - v. Vehicle Not Impounded: 5000 points added to the team's Final Score.
 - h. Two or more teams tied with 2 Failed Run scores, without Competition or Construction Violations, will remain scored as ties. Other ties are possible.
 - i. Tiebreakers in order: 1. Better Vehicle Distance of the scored run; 2. Shortest Run Time of better scored run; 3. Better Vehicle Distance of the non-scored run.

8. **SCORING EXAMPLE:**

A Vehicle has 2 runs in the allotted time.

- In the 1st run, the Vehicle stopped 67.6 cm from the Target Point with a Run Time of 7.27 s.
- In the 2nd run, the Vehicle stopped 27.6 cm from the Target Point with a Run Time of 8.67 s.
- The team's Practice Log is incomplete.

1st run's Run Score: Time Score: 14.54 (7.27 x 2)

Distance Score: 67.6

1st Run Score: 82.14

2nd run's Run Score: Time Score: 17.34 (8.67 x 2)

Distance Score: 27.6

2nd Run Score: 44.94

Final Score = 2nd Run Score + Incomplete Practice Log Penalty = 44.94 + 25 pts = 69.94 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



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 2022-2023 season, we are publishing a selection of Trial Events in the 2023 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 2023 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 2024 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.



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



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



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:**

- 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.
- Each participant must wear a lab coat and goggles when dealing with specimens.
- 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:**

- This event may be run as either a sit-down exam or a series of laboratory stations with questions.
- 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.
- 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).
- In addition to the above listed topics, participants should know:
 - The history of botany
 - Basic plant genetics and reproduction
 - Photosynthesis
 - Differences between the major taxonomic groups of plants
 - Paleo-botany and plant evolution
 - The role of plants in global energy and nutrient cycles
 - Use of plant materials by animals and humans
 - Competition in the plant community
 - Genetically Modified Organisms (GMOs)
 - Production of foodstuffs and plant products
 - Plant diseases; including nutrient deficiencies and infections
- For Division C Only, participants are expected to know:
 - Principles of horticulture and aquaculture
 - Plant biochemistry
 - The roles of plants in medicine and environmental management
 - Importance of plant diversity

4. **SAMPLE QUESTIONS/TASKS:**

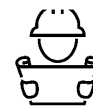
- What leaf structure is being shown on this microscope slide?
- Using the graph, identify the peak wavelength for chlorophyll absorbance.
- Identify three key differences between flowering plants and ferns.
- Which plants would be in the next wave of plant succession for the region shown?
- Describe the role plants play in the nitrogen cycle.

5. **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

This event is sponsored by Corteva Agriscience



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:**

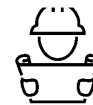
- a. The Bridge must be a single structure constructed by connecting members made of the material available when using the SkyCiv Science Olympiad add-on. The cross-section of individual members must be rectangular with minimum cross-sectional dimensions as specified in SkyCiv of 1.5 mm by 1.5 mm.
- 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



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:**

- 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.
- Each team may bring two stand-alone calculators of any type to use during the event.
- Each team must bring a soil test kit complete with chemicals to test soil samples for pH, N, P, and K.

3. **THE COMPETITION:**

- 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.
- Teams may be asked to analyze soil samples for pH, nitrogen, phosphorus, and/or potassium.
- Participants are expected to have knowledge of the following topics:
 - basic botany
 - plant propagation
 - soil health, fertilizer management, and composting
 - entomology of pests & pest management
 - plant diseases,
 - vegetables, tree fruit, & small fruit (e.g., blueberries, brambles, currants, gooseberries, grapes, & strawberries)
 - lawn care & pruning ornamentals,
 - woody ornamentals, herbaceous plants, and native plants
 - weeds and invasive plants
 - garden wildlife (e.g., butterflies, hummingbirds, bumble bees)
 - nuisance animals (e.g., chipmunks, cottontail rabbits, voles, raccoons, skunks, squirrels, deer, & woodchucks)
- English units will be used for all calculations as current horticulture literature uses English units exclusively.

4. **SAMPLE QUESTIONS/ACTIVITIES:**

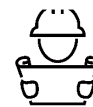
- Use soil test kit to determine the soil pH.
- Calculate the amount of 10-10-10 fertilizer to use in a 100 ft² garden.
- Identify an herbaceous plant from a picture.
- Determine the spacing for woody plants in a garden bed given the mature size.
- Recall the difference between a warm season turfgrass and a cool season turfgrass.
- Identify an insect pest from a picture.

5. **SCORING:**

- Scoring will be split approximately 75% exam and 25% hands-on activities. High score wins.
- Time may be limited at each task but will not be used as a tiebreaker for scoring.
- Ties will be broken by pre-selected questions.
- A penalty of up to 10% may be given if the area is not cleaned up as instructed.
- 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



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: approximately 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 (e.g.; 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:**

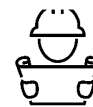
- a. During operation, the Device's outer dimensions should be no greater than 60.0 cm x 60.0 cm x **100.0 cm., in any orientation.**
- b. All actions used for scoring must be visible and/or verifiable. The top and at least two vertical walls must be open or transparent for viewing all actions. Actions must be consecutive. Parallel and/or dead-end actions will not count for points. Any action in the Device not designed to contribute to the completion of the Final Action will not count for points.
- c. Each movable/adjustable physical object in the Device must be utilized by at most one assigned action. An object at the end of one action may initiate the next action but must not go beyond the initiation of the second action.
- d. Sensitive components (e.g., springs/mousetraps, dominoes) may be set/placed just before starting the Device.
- e. Use of electricity is prohibited anywhere in the device.
- f. 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.

4. **DESIGN LOG:**

- 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. A front cover labeled with the Team Name and the Team Number for the current tournament
 - iv. All numerical values should be labeled with standard units (e.g., SI or English) appropriate to the dimension being measured. SI units should be the default standard.
- 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 Design 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 after inspection.

5. **DEVICE OPERATION:**

- a. **Start Action:** (100 points) - Participants must drop a US Quarter into the Device from a point completely above the Device. The quarter must fall into the Device and initiate the next action.



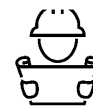
- a. **Scorable Actions:** (50 points each) – Participants may have up to the first 6 scorable unique actions (i. through vi.) to count for points at a Regional Tournament. Actions vii., viii. and ix. may be added at the State level and x., xi. and xii. may be added at the National Tournament.
- b. Just before setting up, a team will be given the scorable sequence of actions for the day. They must re-arrange their actions to match the given sequence as close as possible. **Once the first action on the given list is successfully completed, the team will receive 50 points. If the first action is not successful or attempted, then the next action on the list is eligible for points if successful. Then, 50 points will be awarded for each of the listed actions that are successfully completed in the proper sequence after the first successful listed action. Other actions may be inserted between those that could count, but the inserted actions will not be scoreable.**
- c. Each of the actions below may be attempted only once in the device. For example, if all six actions at a Regional are completed in the given sequence, then 300 points will be awarded.
 - i. Use an object to operate a wheel & axle to raise another object 10 cm. that then initiates the next action.
 - ii. Use a wedge to separate two touching marbles so that one moves 20 cm. from its spot and then initiates the next action.
 - iii. Remove a wedge that is keeping a golf ball from rolling, so that the golf ball rolls at least 20 cm. horizontally to initiate the next action.
 - iv. Push or pull an object up an inclined plane with an IMA of at least 2 so that the object is vertically raised at least 10 cm. before it initiates the next action.
 - v. Use a 3rd class lever to raise an object 10 cm. before the object initiates the next action.
 - vi. Operate a pulley system with IMA of 3 to raise an object at least 10 cm. before the object initiates the next action.

(Added for State Level for an additional 150 points)

- vii. Use a marble to knock over a series of 3 dominoes so the last domino moves another marble to initiate the next action.
- viii. Use a 2nd class lever to raise an object 10 cm. before the object initiates the next action.
- ix. 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.

(Added for National Tournament for an additional 150 points)

- x. Use water to raise a golf ball at least 5 cm. that then rolls out of the container to initiate 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 device may release a golf ball attached to the end of a string that forms a pendulum. To count, the pendulum must swing from the release point, swing, and strike a button or release mechanism that raises a Stop Sign completely above the device. The Stop Sign must be cardboard or poster board, oriented vertically, red and square or octagonal. It must be at least 15 cm. high and 15 cm. wide.
 - ii. If the entire Stop Sign is vertical and completely higher than the entire device, 250 points will be awarded. If the Stop Sign is vertical and only partially above the device, only 125 points will be awarded. If the Stop Sign is not vertical, zero points will be awarded.
 - iii. The distance the golf ball pendulum swings to the release button will add 5 points per cm. that it swings, only if it touches the release button for the sign at the end of its swing.
- e. **Two printed copies of an Action Sequence List must be given to the Event Supervisor at the time of check-in (regionals)/impound (state and national). The list must indicate the Start and the action initiated by the Quarter, the Sand Timer (if one is included), the action that releases the golf ball pendulum, the distance between the golf ball and the Stop Sign release button (in cm.), and the Stop Sign release button. The format should be the same as the one posted on the Science Olympiad website. Everything required in the ASL should also be labeled at the proper places within the device.**
- f. **Once the team is at set-up and has received the preferred sequence of scoreable actions, they must insert (write) the names of the actions they plan to attempt at the proper place in their ASL and the copy for the supervisor.**



1. THE COMPETITION:

- a. The Target Operation Time is 60 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 Quarter into the Device. Timing stops when the golf ball pendulum strikes the STOP Sign release button, or after **2 x the Target Time** in seconds have elapsed, whichever comes first.
- c. **Teams that have a time of twice the Target Time will receive no (zero) points for running time.**
- d. 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.
- e. 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.
- f. 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.
- g. Participants will not be allowed to touch the device to release the golf ball pendulum or anything after that point.
- h. The Supervisor will review with teams the data recorded on the scoresheet.
- i. Teams filing an appeal must leave their Device and ASL in the event area.

2. SCORING:

- a. High score wins.
- b. Award 50 points if participants use no more than 30 minutes to set up their Device.
- c. **Award 25 points if 2 printed copies of the ASL are presented at the proper time.**
- d. **Award 25 points if ASLs are in proper format, include all scorable actions and are accurate.**
- e. **Award 25 points if the original actions in the ASL are properly labeled in the device.**
- f. **Award 25 points if the planned preferred actions have been inserted in the ASL at set-up.**
- g. Award 50 points the first time each unique action in part 3. is successfully completed as described AND in the sequence given by the Event Supervisor.
- h. Award 100 points for completing the Start Action
- i. Award 250 points for completing the Final Action as described in 3.M or 125 points if partially completed.
- j. Award 5 points for each cm. that the golf ball pendulum swings on its way to striking the STOP sign release button. (If nothing else is touched by the pendulum and it strikes the button.)
- k. Award **2** points for each full second (rounded down) of operation up to the Target Operation Time. Devices running twice the Target Time will receive zero points for the run.
- l. 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
- m. Award 0.1 point for each 0.1 cm that the Device dimensions are under 60.0 cm for 2 dimensions and 100 cm. for the third. dimension. The maximum score awarded for each dimension is 30 points, for a total of 90 points **(Only at in-person tournaments.)**
- n. Award 75 points for a Device that has no adjustments during operation.
- o. Teams failing to impound their device on-time will be ranked after all teams that impounded on-time.
- p. 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



1. **PENALTIES:**

- a. Deduct **2** points for each full second (rounded down) that the Device operates past the Target Operation Time up to **2 x the Target Time seconds**.
- b. Deduct 10 points for incomplete Design Log
- c. Deduct 25 points for missing Design Log
- d. Deduct 25 points:
 - i. For each dimension of the Device that exceeds its limit of 60 or 100 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 **2 x the Target Time** in seconds.
- e. Deduct 50 points if any solid or liquid leaves the measured dimensions of the Device.
- f. **Devices that use electricity within the device will not be allowed to run.**

2. **TIEBREAKERS:**

Ties are broken as follows: a) Fewest penalty points; b) Smallest overall dimensions (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



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



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:**

- 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.
- 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.
- Participants may use alphabetic languages other than English with prior approval of the Event Supervisor/Tournament Director. Teams wishing to use a language other than English should contact the Tournament Director and request this accommodation at least two weeks prior to the Tournament.**

3. **THE COMPETITION:**

- 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.
- 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.
- 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.
- The writer will send their description as a TXT, DOC/DOCX or PDF file to the Event Supervisor.
- 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.
- The Event Supervisor will provide instructions for how the builder should submit their completed CAD file.
- 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:**

- 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.
- Each individual piece will receive points as applicable for: proper size, color, location, orientation, and/or connection.
- 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.
- 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

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

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

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

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



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



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

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

PROG Button



EXE Button



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



Events	Type of Calculator Allowed				
	None	Class I	Class II	Class III	Class IV
Anatomy & Physiology		X	X		
Bio Process Lab	X				
Bridge		X	X	X	
Can't Judge A Powder	X				
Codebusters		X			
Crave the Wave		X	X	X	
Crime Busters		X	X		
Disease Detectives		X	X		
Dynamic Planet		X	X	X	
Experimental Design		X	X		
Fast Facts	X				
Flight	X				
Forestry	X				
Green Generation		X	X		
Meteorology		X	X	X	
Road Scholar		X	X		
Rocks & Minerals	X				
Roller Coaster	X				
Solar System	X				
Sounds of Music		X	X	X	
Storm the Castle		X	X	X	
Wheeled Vehicle		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	
Mission Possible	X				
Solar Power		X	X	X	
Write It CAD It	X				

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 Workshop Wednesdays covering all the latest in STEM; and free STEM Quizzes that will test your knowledge and get you ready for the competitive season! **MY SO** can be used as a standalone or to support your Science Olympiad season.

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

LESSON PLAN
[First Wednesday of the month]
STEM SESSION
[Third Wednesday of the month]
STEM QUIZ
[Last Tuesday of the month]

**2022-2023
ACADEMIC YEAR**

SEPTEMBER 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	
CRAVE THE WAVE, WIFI LAB, SOUNDS OF MUSIC						

OCTOBER 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					
FORESTRY						

NOVEMBER 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			
FORENSICS & CRIME BUSTERS						

DECEMBER 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
CYBERSECURITY						

JANUARY 2023						
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 2023						
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				
ASTRONOMY & SOLAR SYSTEM						

MARCH 2023						
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	
DISEASE DETECTIVES						

APRIL 2023						
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						
AGRICULTURAL SCIENCE						

MAY 2023						
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			
WHEELED VEHICLE & SCRAMBLER						

STORE OFFERINGS FOR 2023

STORE.SOINC.ORG

STARTER STACKS & PACKS

Use these resources as a starting point for your season as you tackle the 2023 Events! Each Starter Pack contains notes & practice tests for the Event, and the Starter Stack bundles notes & practice tests for every event in the topic area.



NATIONAL TEST PACKETS

Try out the test from the National Tournament! Packets with tests, answer keys, and results from the past 5 National Tournaments are available.

COACHING PROGRAM

Coaches - this one is for you! The Coaching Program is a step-by-step guide to coaching Division B & C teams that includes a comprehensive coach's manual, 26 weeks of lesson plans (total of 52 hours of lessons), and a resource appendix with handouts and worksheets. Use this to help lay out your season and orient yourself to all things Science Olympiad!





DOUBLEGOOD POPCORN

SCIENCE OLYMPIAD'S FUNDRAISING PARTNER



Fundraise for your team by selling popcorn and earn **50%** of the profit. All product ships directly to customers! Set up your fundraiser + learn more at soinc.org/doublegood

ward's science+

Official Science Olympiad kits!

Kits will be available for the following 2023 Events

- Bridge ● Can't Judge a Powder ● Chemistry (Div. B) ●
- Chemistry (Div. C) ● Chem Lab ● Crime Busters ●
- Detector Building ● Flight ● Forensics ●
- Rocks & Minerals ● Scrambler ● Wheeled Vehicle ●



NATIONAL TOURNAMENT SCHEDULE

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

2023 National Tournament Schedule Wichita State University; Wichita, Kansas Saturday, May 20, 2023

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		51-60	1-10	11-20	21-30	31-40	41-50	Closing Ceremony	
Bio Process Lab		31-40	41-50	51-60	1-10	11-20	21-30		
Bridge		Self-Schedule							
Can’t Judge A Powder		21-30	31-40	41-50	51-60	1-10	11-20		
Codebusters		41-50	51-60	1-10	11-20	21-30	31-40		
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		
Experimental Design		1-10	11-20	21-30	31-40	41-50	51-60		
Fast Facts		21-30	31-40	41-50	51-60	1-10	11-20		
Flight		Self-Schedule							
Forestry		1-10	11-20	21-30	31-40	41-50	51-60		
Green Generation		11-20	21-30	31-40	41-50	51-60	1-10		
Meteorology		11-20	21-30	31-40	41-50	51-60	1-10		
Road Scholar		41-50	51-60	1-10	11-20	21-30	31-40		
Rocks & Minerals		31-40	41-50	51-60	1-10	11-20	21-30		
Roller Coaster	Impound	Self-Schedule							
Solar System		51-60	1-10	11-20	21-30	31-40	41-50		
Sounds of Music		51-60	1-10	11-20	21-30	31-40	41-50		
Storm the Castle	Impound	Self-Schedule							
Wheeled Vehicle	Impound	Self-Schedule							
Write It, Do It		11-20	21-30	31-40	41-50	51-60	1-10		





Exploring the World of Science

Science Olympiad wishes to acknowledge the following business, government and education leaders for partnering with our organization. Working together, we can increase global competitiveness, improve science and technology literacy and prepare the STEM workforce of the future. Thanks to: Wichita State University (2023 National Tournament Host), Caltech (2022 National Tournament Partner), NASA's Universe of Learning Astrophysics STEM Learning and Literacy Network, Avantor Foundation, Cleveland-Cliffs Foundation, Corteva Agriscience, Combined Federal Campaign, Double Good Foundation, Google, NBC Universal Foundation, Ward's Science, Amcor Cares Foundation, Centers for Disease Control and Prevention (CDC) Foundation, Discovery Education 3M Young Scientist Challenge, Intel, Kinder Morgan Foundation, North American Association for Environmental Education (NAAEE), National Oceanic and Atmospheric Administration (NOAA), National Eye Institute, Texas Instruments, ThermoFisher Scientific, University of Delaware, 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), STEMConnector and USDA Forest Service – Conservation Education.

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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