



*Exploring the World of Science*

# **Division C Rules Manual**

**Division C (Gr. 9-12)**

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## WELCOME TO THE 2022 SCIENCE OLYMPIAD!

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

**See our website for info on Membership, Policies and Terms of Use at [www.soinc.org](http://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](http://store.soinc.org) to purchase 2022 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](http://wardsci.com/scienceolympiad) with promo code SOVIP2021. Don't wait! This limited-time offer ends 12/31/21.



Science Olympiad Store: 866-312-3999  
Ward's Science: 800-962-2660





# SCIENCE OLYMPIAD

## DIVISION C RULES MANUAL

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- Please read the General Rules as they apply to all events. Note: all changes are in **bold**.
- Please visit the official Science Olympiad web site: [www.soinc.org](http://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](http://www.soinc.org) as they apply to every event.

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

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

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

## **Satellite SO**

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

## **Mini SO**

This model accounts for situations where students are unable to physically attend school and are distance learning from their homes by allowing some events to be run at home. Since students will be at home without faculty supervision, no hands-on events will be allowed to run. A chart showing acceptable events can be found online at [soinc.org](http://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.

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



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

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



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

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



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

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



**Hybrid Event:** An event which combines elements from two or more of the above event types. The most common combination mixes elements of a Core Knowledge Event with elements of a Build or Lab Event.

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



# GENERAL RULES

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://www.soinc.org) as they apply to every event.

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

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

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

## COVID-19 PANDEMIC RULES MODIFICATIONS

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

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



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

**A TEAM OF UP TO: 2**

**APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:** Each team may bring one 8.5" x 11" sheet of paper, which may be in a sheet protector sealed by tape or laminated, that may contain information on both sides in any form and from any source without any annotations or labels affixed along with two stand-alone non-programmable, non-graphing calculators.
3. **THE COMPETITION:** This Event may be administered as a written test or as series of lab-practical stations which can include but are not limited to experiments, scientific apparatus, models, illustrations, specimens, data collection and analysis, and problems for students to solve. Content topics will include:

a. **Nervous System:**

- i. The Brain - major regions and their functions
- ii. Identification of simple encephalographic wave forms and why they occur
- iii. Neural Impulses - cellular anatomy and physiology of neurons and supporting cells, synapses and neurotransmitters, action potential generation and propagation, ionic basis of the cellular membrane potential, types of neural synapses
- iv. Central Nervous System - organization of the spinal cord, brainstem and cranial nerves, purpose/functions of sleep
- v. Peripheral Nervous System – neural ganglia, action and physiology of sensory and motor neurons, action and physiology of sympathetic and parasympathetic neurons, understand differences in and purposes of parasympathetic, sympathetic, somatic, and sensory systems, reflex arcs and proprioception, nerve structure
- vi. Disorders: Epilepsy, Alzheimer's Disease, Multiple Sclerosis, Parkinson's Disease, Cerebral Palsy, Shingles (herpes zoster), Stroke, Amyotrophic Lateral Sclerosis (ALS)
- vii. Effects of the drugs: alcohol, caffeine, nicotine, and marijuana on the nervous system
- viii. **National Tournament Only:**

(1) **The Brain - anatomy and physiology of brain function including function and role of specific nuclei clusters and tracts, theories of dreaming, neural impulses - retrograde signaling, purpose and principles of MRIs and EEGs**

(2) **Treatments and/or prevention (e.g.; drugs, surgery) for all conditions listed above**

b. **Sense Organs:**

- i. Types of sensory receptors, General Senses vs. Special Senses
- ii. Mechanisms for the General Senses of touch, pressure, pain, temperature, itch, and proprioception
- iii. Sense Organs – regions of each of the Special Sense Organs and their functions
- iv. Physiology of sight, hearing, balance, smell, and taste
- v. Disorders: myopia, hyperopia, presbyopia, nyctalopia, astigmatism, conjunctivitis, color blindness, otitis media, types of deafness, Anosmia/dysosmia, dysgeusia
- vi. **National Tournament Only:**

(1) Neural pathways for vision, depth perception, and hearing

(2) Additional Disorders: Diabetic Retinopathy, Macular Degeneration, Glaucoma, Otosclerosis, Presbycusis, Meniere's Disease, Pink Eye (conjunctivitis) plus treatments and/or prevention of all conditions listed above

c. **Endocrine System:**

- i. The three classes of hormones – steroids, peptides, and amines
- ii. Mechanisms of hormone action – nuclear vs. cytoplasmic
- iii. Endocrine related problems – hypersecretion, hyposecretion
- iv. Hormone producing glands, their hormones and the function of each
- v. Disorders: diabetes mellitus, hypoglycemia, Graves' disease, Hashimoto's disease, goiter, cretinism
- vi. **National Tournament Only:**

(1) Endocrine cycles and negative feedback

(2) Autonomic nervous system control of endocrine function

(3) Additional Disorders: Cushing's Syndrome, Addison's Disease, and Myxedema, acromegaly

(4) Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)

4. **SCORING:**

- a. High score wins.
- b. Selected questions will be used to break ties.

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

**This event is sponsored by Hikma Pharmaceuticals**



1. **DESCRIPTION:** Teams will demonstrate an understanding of **Variability of Low & Mid-Mass Stars..**

**A TEAM OF UP TO: 2**

**APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**

- a. Each team may bring one of the following options containing information in any form and from any source:
  - i. two three-ring binders;
  - ii. a computer/tablet and a three-ring binder; or,
  - iii. two computers/tablets, of any kind.
- b. If three ring binders are used they may be of any size and the information contained should be attached using the available rings. The information or pages may be removed during the event. Sheet protectors and laminated sheets are allowed.
- c. Each team may bring two stand-alone calculators of any type to use during the event. If the participants are using a computer/tablet they may use the calculator app or other program on their device in place of a stand-alone calculator.
- d. Participants using computers/tablets as a resource should have all information stored so that it is available to them offline. **However, teams may be asked to access a dedicated NASA image analysis website to answer some JS9 questions. If so, supervisors will provide an alternative (e.g., proctor-supplied computer or screen shots) for teams that did not bring a laptop/tablet.**

3. **THE COMPETITION:**

Using information which may include Hertzsprung-Russell diagrams, spectra, light curves, motions, cosmological distance equations and relationships, stellar magnitudes and classification, multi-wavelength images (gamma-ray, X-ray, UV, optical, IR, radio), charts, graphs and JS9 imaging analysis software, teams will complete activities and answer questions related to:

- a. Stellar evolution including stellar classification, spectral features and chemical composition, luminosity, blackbody radiation, color index and H-R diagram transitions, **proto-stars, T Tauri variables, Herbig-Haro (HH) objects, red giants, Mira variables, RR Lyrae variables, carbon stars, white dwarfs, planetary nebulas, neutron stars, dwarf & recurrent novas, Type Ia supernovas, magnetic cataclysmic variables (MCVs).**
- b. Use **orbital mechanics, Kepler's laws, rotation and circular motion to answer questions relating to the orbital motions of binary and multiple star systems; use parallax, spectroscopic parallax, period-luminosity relations, and the distance modulus to calculate distances to RR Lyraes, and Type Ia supernovas; use hydrostatic equilibrium and the Stefan-Boltzmann law to answer questions relating to stellar structure and interiors.**
- c. Identify and answer questions relating to the content areas outlined above for the following objects:

- |                           |                            |
|---------------------------|----------------------------|
| i. <b>HOPS 383</b>        | x. <b>IC 4593</b>          |
| ii. <b>HH 24-26</b>       | xi. <b>U Antliae</b>       |
| iii. <b>V1331 Cyg</b>     | xii. <b>LP 40-365</b>      |
| iv. <b>HBC 672</b>        | xiii. <b>ASASSN-16oh</b>   |
| v. <b>Orion Nebula</b>    | xiv. <b>V Sagittae</b>     |
| vi. <b>Alpha Tauri</b>    | xv. <b>AR Scorpii</b>      |
| vii. <b>RR Lyrae</b>      | xvi. <b>SDSS 1035+0551</b> |
| viii. <b>Omicron Ceti</b> | xvii. <b>Tycho's SNR</b>   |
| ix. <b>ESO 577-24</b>     |                            |

4. **SCORING:** All questions will have been assigned a predetermined number of points. The highest score wins. Selected questions will be used to break ties.

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

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



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

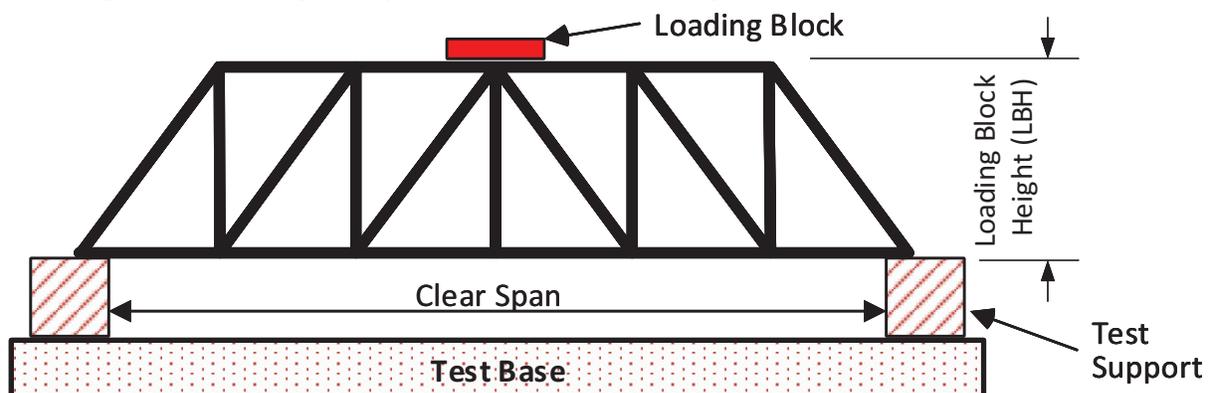
**A TEAM OF UP TO:** 2    **IMPOUND:** No    **EYE PROTECTION:** B    **EVENT TIME:** 6 minutes

2. **EVENT PARAMETERS:**

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

3. **CONSTRUCTION PARAMETERS:**

- The Bridge must be a single structure with no separate, loose, sliding, or detachable pieces, constructed of wood, and bonded by adhesive. No other materials are permitted.
  - 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.
  - There are no limits on the cross-sectional sizes of individual pieces of wood. Wood may be laminated by the team without restriction.
  - 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.
- The Bridge must be designed to sit on top of the Test Supports and support the Loading Block of the Loading Assembly (6.d.) at the center of the spanned opening.
- Division B Dimensions:**
  - The Bridge must be designed to hold the Loading Block at a Loading Block Height (LBH) of at least 10 cm above the Test Supports.
  - A 7 cm high by 4 cm wide Pass Thru Block (6.c.) must be able to pass horizontally through the Bridge, under the Loading Block position, from one end of the Bridge's Test Support point to the adjacent Test Support point.
  - The Clear Span will be 35 cm.
- Division C Dimensions:**
  - The Bridge must be designed to hold the Loading Block at a Loading Block Height (LBH) of at least 15 cm above the Test Supports.
  - A 12 cm high by 7 cm wide Pass Thru Block (6.c.) must be able to pass horizontally through the Bridge, under the Load Block position, from one end of the Bridge's Test Support point to the adjacent Test Support point.
  - The Clear Span will be 45 cm.
- Before loading, no portion of the Bridge may be below the plane defined by the top of the Test Supports.
- 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](http://www.soinc.org).





## 4. DESIGN LOG:

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

## 5. THE COMPETITION:

### Part I: Check-In

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

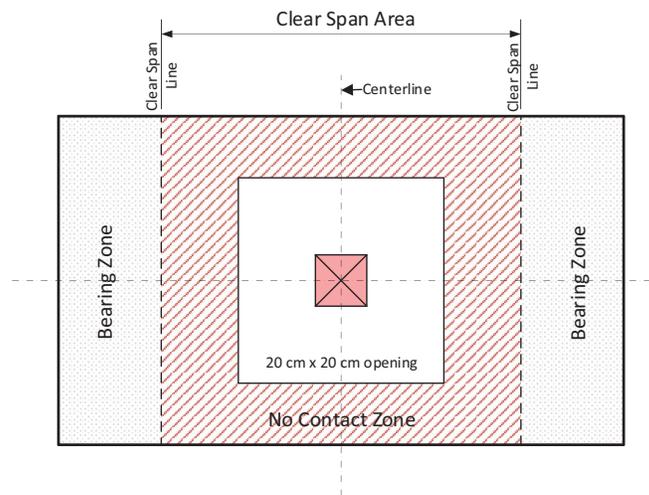
### Part II: Testing

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



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

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



indicate the Bearing Zones.

- b. The Test Supports shall meet the following requirements:
  - i. Two identical, unfixed supports will be supplied
  - ii. Must be at least 1-1/2 inches by 1-1/2 inches by 6 inches but not greater than 2 inches by 2 inches by 6 inches
  - iii. Made of a material that it does not noticeably compress when loaded and have smooth, hard surfaces (e.g., hard wood, metal, high-pressure plastic laminate)
  - iv. Must be able to rest flat on the Test Base
- c. **The Pass Thru Block shall be a solid light weight material (such as wood or plastic) for passing through the bridge with a minimum 50 cm dowel securely attached to the height & width face.**
  - i. **Division B: Block size shall be 7 cm high by 4 cm wide by approximately 1 cm thick but not more than 2 cm thick**
  - ii. **Division C: Block size shall be 12 cm high by 7 cm wide by approximately 1 cm thick but not more than 2 cm thick**
- d. The Loading Assembly will consist of:
  - i. A square Loading Block measuring 5 cm x 5 cm x approximately 2 cm high with a hole no larger than 8 mm drilled in the center of the 5 cm x 5 cm faces for a 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
  - e. Sand: sand or other clean, dry free-flowing material.
  - f. Two (2) Bucket Stabilizing Sticks each made from a piece of ½” dowel approximately 18 inches long with a spring-type door stop screwed into one end. Refer to example on [www.soinc.org](http://www.soinc.org).
  - g. **Structure Scale: Scale shall have minimum resolution of 0.1 grams; recommended resolution is 0.01 grams.**
  - h. **Sand Scale & Load Verification: Scale shall have minimum resolution of 10 grams; recommended resolution is 1 gram.**
7. **SCORING:**
- a. High score wins. Score = Load Score (g)/Mass of Structure (g).
  - b. The Load Score= Load Supported (5.Part II.h)+ Bonus (7.c).
  - c. Structures that have a Load Supported of 15,000 g will earn a Bonus of 5,000 g.
  - d. Structures will be placed in three tiers as follows:
    - i. Tier 1: Holding any load and meeting all construction parameters and competition requirements
    - ii. Tier 2: Holding any load with any violations of the construction parameters and/or competition requirements and/or not submitting a Design Log
    - iii. Tier 3: Unable to be loaded for any reason (e.g., cannot accommodate or hold Loading Assembly, failure to wear eye protection) and will be ranked by lowest mass
  - e. Ties are broken as follows:
    - i. Estimated Load Supported closest to, without exceeding, the actual Load Supported
    - ii. Lowest Structure mass
  - f. Example score calculations:
    - i. Structure 1: mass= 10.12 g, Load Supported= 12,134 g; Score= 1,199
    - ii. Structure 2: mass= 12.32 g, Load Supported= 15,000 g + 5,000 g (Bonus) = 20,000 g; Score= 1,623

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

**This event is sponsored by SkyCiv**



1. **DESCRIPTION:** This event integrates content knowledge and process skills in the areas of cell biology and cellular biochemistry.

**A TEAM OF UP TO:** 2

**EYE PROTECTION:** C

**APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**

Students will bring and wear goggles where needed. 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. The competition may be administered as a series of lab-practical stations such as demonstrations, experiments, scientific apparatus, models, illustrations, specimens, data collection and analysis, and problems for students to solve. Content topics will include:

Regional and State Tournament Topics		
Biological monomers and polymers	Cellular homeostasis (pH, osmolarity etc.)	Enzymes and inhibition
Bioenergetics, <b>metabolic networks, fermentation products and uses</b>	Cell organelles / structures and their functions <b>in eukaryotes and prokaryotes</b>	<b>Cell wall structure and diversity in all domains of life</b>
Membrane structure and function including lipid rafts, transport	Vesicle formation, fusion	Cell cycle and mitosis, role of cyclins and kinases
<b>Apoptosis and cancer</b>	<b>C3 vs. C4 vs. CAM plants</b>	<b>Cell communication, membrane receptors, and signal transduction</b>
National Tournament Topics (Regional & State topics + the following)		
Traditional fluorescence microscopy and TIRF microscopy	<b>Carcinogens, the hallmarks of cancer</b>	Cell cytoskeleton and intracellular trafficking
Induced pluripotent stem cells	Host/virus interactions	Protein folding and related diseases
<b>Cellular basis of common medicines (antibiotics, chemotherapy, insulin, etc.)</b>	Genomics and medicine/human health	Bioethics relating to above topics

- b. Process skills may include writing hypotheses, determining independent and dependent variables, controlling variables, graphing, analyzing data, interpreting results as well as using and applying technologies.
- c. Questions pertaining to the exact amount of ATP produced during cellular respiration must not be used as the amount of ATP produced varies within a cell.
4. **SAMPLE QUESTIONS:**
- a. Using models, photographs, or illustrations of structures such as organic molecules and cell organelles, identify the structure and describe its function or role in life processes.
- b. Using a light microscope, estimate cell size and determine the 3-dimensional shape of cells. Relate the size and shape of a cell to its function.



- c. **Analyze a graph showing cyclin levels and describe cell cycle effects of these cyclins.**
  - d. Contrast healthy cells to cells infected with viruses, cancerous cells using images and/or descriptions of cellular processes.
  - e. Label structures present in eukaryotic and prokaryotic cell membranes.
  - f. Identify substances such as protein, carbohydrates, lipids and vitamin C using reagent tests or data provided.
5. **SCORING:**
- a. Each correct response will be assigned a point value. The highest score wins.
  - b. Selected questions may be used as tiebreakers.

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



1. **DESCRIPTION:** Teams will complete one or more tasks and answer a series of questions involving the science processes of chemistry focused in the areas of Aqueous Solutions and **Oxidation/Reduction**.  
**A TEAM OF UP TO:** 2      **EYE PROTECTION:** C      **APPROXIMATE TIME:** 50 minutes
2. **EVENT PARAMETERS:**
  - a. Each participant must bring safety equipment (e.g., goggles, lab coat, apron), a writing implement, and may bring a stand-alone calculator of any type.
  - b. Each participant may bring one 8.5" x 11" sheet of paper, which may be in a sheet protector sealed by tape or laminated, with information on both sides in any form and from any source.
  - c. Teams should bring any or all of the items listed as Recommended Lab Equipment for Division C Chemistry Events, posted on [soinc.org](http://soinc.org). Teams not bringing these items will be at a disadvantage, as they are not provided.
  - d. Participants must wear goggles, an apron or a lab coat and have skin covered from the neck down to the wrist and toes. Gloves are optional, but if the host requires a specific type they will notify teams. Pants should be loose fitting; if the host has more specific guidelines they will notify teams in advance of the tournament. Shoulder length or longer hair must be tied back. Participants removing safety clothing/goggles or unsafely handling materials or equipment will be penalized or disqualified.
  - e. Supervisors will provide any required reagents, additional glassware, and/or references that are needed for the tasks (e.g., Periodic Table, table of standard reduction potentials, any constants needed).
3. **THE COMPETITION:**
  - a. The competition will consist of a series of tasks similar to those in first year high school courses. These tasks could include hands-on activities, questions on listed topics, interpretation of data (e.g., graphs, diagrams, tables), or observation of an established and running experiment.
  - b. Teams may be asked to collect data using a probeware set-up demonstrated by the Supervisor(s). Following a demonstration of the sensors/probes, participants may be given data sets to interpret.
  - c. **Given the data/watching a running Redox titration, students should be able to determine the endpoint of the titration and the number of moles of target ion in the titration.**
  - d. Participants should understand the following **Oxidation/Reduction** Chemistry concepts:
    - i. **Writing and balancing half reactions**
    - ii. **Oxidation numbers**
    - iii. **Balancing redox reactions in neutral, acidic, and basic solutions**
    - iv. **Calculating standard cell potentials using a table of standard reduction potentials**
    - v. **State and Nationals Only - knowledge of fuel cells, knowledge & application of the Nernst equation & common storage batteries may be included**
  - e. Participants should understand the following about Aqueous Solutions:
    - i. Principles, properties, terms, and definitions concerning aqueous solutions
    - ii. Calculate solution concentration given quantities of solute and solvent
    - iii. Calculate the amount of material needed to achieve a specific concentration
    - iv. Different measurements of concentration (e.g., molarity, molality, mass percentage, and parts per million) and how to calculate each
    - v. State and Nationals Only: conversions between concentration units
4. **SAMPLE QUESTIONS/ACTIVITIES:**
  - a. Titrations to determine percent composition, molarity, and/or molecular mass.
  - b. **Given an unbalanced Redox equation, students should be able to determine the 2 half reactions and balance the equation.**
  - c. **Given the data/watching a running Redox titration, students should be able to determine the endpoint of the titration and the number of moles of target ion in the titration.**
  - d. Use freezing point depression to determine the molar mass of a solute.
  - e. Identify and explain factors that affect solution formation.
  - f. Determine whether a solution is saturated, unsaturated, or supersaturated.
5. **SCORING:**
  - a. High score wins. Points will be divided evenly between Aqueous Solutions and **Oxidation/Reduction**.
  - b. Time may be limited at each task but will not be used as a tiebreaker or for scoring.
  - c. Ties will be broken by pre-selected questions.
  - d. A penalty of up to 10% may be given if the area is not cleaned up as instructed.
  - e. A penalty of up to 10% may be given if a team brings prohibited lab equipment to the event.

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

**This event is sponsored by Ward's Science**



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

**A TEAM OF UP TO:** 3

**APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**

- a. Teams must bring writing utensils and may bring up to three (3) stand-alone non-graphing, non-programmable, non-scientific 4-function or 5-function calculators.
- b. No resource materials, except those provided by the Event Supervisor, may be used.
- c. The Event Supervisor will provide scratch paper for each team to use. **In remote tournament formats, teams may provide their own scratch paper, which should be blank paper free of any additional markings, symbols, or notes.**

3. **THE COMPETITION:**

- a. **This event consists of participants using cryptanalysis techniques and advanced ciphers to decrypt and encrypt messages on a written or computer based exam.**
- b. Teams will begin the event simultaneously at the indication of the Event Supervisor.
- c. Teams must not open the exam packet nor write anything prior to the “start” signal, nor may they write anything after the “stop” signal.
- d. Participants are allowed to separate the pages of the test to be free to answer the questions in any order, working individually or in groups, attempting whichever of the questions seem right for them.
- e. **The codes types that may be used at Division B & C Regional Tournaments are as follows:**
  - i. the Caesar Cipher, also called a shift cipher
  - ii. **Monoalphabetic substitution using K1, K2, or random alphabets as defined by the American Cryptogram Association (ACA)**
    - (1) Aristocrats with a hint - messages with spaces included
    - (2) Aristocrats - messages with spaces included, but without a hint
    - (3) Aristocrats - messages with spaces and hints, but including spelling/grammar errors
    - (4) Aristocrats - messages with spaces and including spelling/grammar errors but no hints
    - (5) Patristocrats with a hint - messages with spaces removed, and with a hint
    - (6) Patristocrats - messages with spaces removed, but without a hint
  - iii. the Affine Cipher - encrypting plaintext or decrypting ciphertext given the a and b values
  - iv. the Vigenère Cipher- Encrypting plaintext or decrypting ciphertext given a key
  - v. the Baconian Cipher - Decrypting ciphertext encoded with the a and b values represented as one or more letters, glyphs, symbols, or character rendering variations (e.g., bold, underline, italic)
  - vi. Xenocrypt - no more than one cryptogram can be in Spanish
  - vii. the Pollux and Morbit Ciphers - decrypting Morse code ciphertext encoded as digits and spaces given the mapping of at least 6 of the digits
- f. **Division B Only - The following code type may also be used at Regional Tournaments:**
  - i. **The Atbash Cipher (In English, not Hebrew)**
- g. **Division C Only - The following code types may also be used at Regional Tournaments:**
  - i. **For Mono-alphabetic substitution ciphers, a K3 alphabet as defined by the ACA may also be used**
  - ii. **For aristocrats, patristocrats and xenocrypts encoded using a K1, K2 or K3 alphabet, the answer requested can be the keyword or key phrase used to construct the alphabet instead of the deciphered text**
  - iii. **The Hill Cipher - Encrypting plaintext or decrypting ciphertext given a 2x2 decryption matrix**
  - iv. **The Porta Cipher - Encrypting plaintext or decrypting ciphertext given a key**
  - v. **The Rail Fence cipher - Decrypting transposed text given the number of rails and an unknown offset**
- h. The code types that may be used on the exam at State and National competitions are as follows:
  - i. All Invitational and Regional code types
  - ii. Xenocrypt - at the state and national levels, at least **one cryptogram** will be in Spanish
  - iii. Cryptanalysis of the Vigenère cipher with a “crib” of at least 5 plaintext characters
  - iv. Cryptanalysis of the Affine Cipher with a “crib” of at least 2 plaintext characters
  - v. Cryptanalysis of The Pollux and Morbit Ciphers with a “crib” of at least 4 plaintext characters
  - vi. **Cryptanalysis of the Porta Cipher with a “crib” of at least 4 plaintext characters**



- vii. **Cryptanalysis of The Rail Fence Cipher with a “crib” of at least 5 plaintext characters and a range for the rails**
- i. **Division C Only - The following code types may also be used at State and National Tournaments.**
  - i. **The Hill Cipher - Encrypting plaintext or decrypting ciphertext with a 2x2 encryption matrix or 3x3 decryption matrix provided**
  - ii. **Xenocrypt - at the State and National levels, at least two cryptograms will be in Spanish**
  - iii. **Cryptanalysis of the Rail Fence Cipher with a “crib” or at least 5 plaintext characters and a range for the rails and offset**
  - j. For aristocrats, patristocrats, and xenocrypts, no letter can ever decrypt to itself.
  - k. No more than 2 cipher questions will be an encryption on the exam.
  - l. The exam packet will include a resource sheet with the Morse Code Table, English/Spanish letter frequencies, Vigenère table, Baconian mapping and modulus inverse tables as needed for the questions on the exam.
  - m. The first question of the exam will be timed.
    - i. The first question will be the decoding of an Aristocrat as defined by 3.e.ii.(1) or 3.e.ii.(2)
    - ii. A team member should signal when his or her team has broken the cryptogram
    - iii. Before the exam begins, the Event Supervisor will announce the nature of the signal that must be used (e.g., shouting “bingo”, or quietly raising hand)
    - iv. The time in seconds, to the precision of the device used, to solve the cryptogram will be recorded by the Event Supervisor or designee
    - v. If a team gets the timed question wrong, they may attempt to answer the question repeatedly without penalty. The timing bonus will be calculated from the start of the event until the question is successfully answered by the team with two or fewer errors, or until 10 minutes has elapsed. After 10 minutes, the timed question can still be answered but the timing bonus is zero
  - n. **Up to three questions which are not aristocrats, patristocrats or xenocrypts will be marked on the exam as special bonus questions.**
- 4. **SCORING:**
  - a. The high score wins. Final Score = Exam Score + Timing Bonus + **Special Bonus.**
  - b. Based on the difficulty of the question, correct answers for each question will earn a clearly indicated number of points.
    - i. The general point distribution by question type is:
      - (1) An “easy question” = 100-150 pts
      - (2) A “medium question” = 200-300 pts
      - (3) A “hard question” = 350-500 pts
      - (4) A “very hard question” = 550-700 pts
    - ii. For questions such as cryptograms, with answers composed of letters, the final points will be determined based on the number of errors found in the decoded plaintext
      - (1) Two or fewer errors will be scored as correct and result in full credit.
      - (2) Each additional error results in a penalty of 100 points.
      - (3) The penalty will not exceed the value of the question. For example, a 400-point question with 5 errors earns 100 points whereas the same 400-point question with 7 errors would earn 0 points, not -100 points.
    - iii. **For answers involving the keyword or key phrase for a K1, K2 or K3 alphabet, the final points will be determined based on the number of errors found in the keyword or key phrase**
      - (1) **Zero errors are required for full credit.**
      - (2) **Each error results in a penalty of 100 points.**
      - (3) **The penalty will not exceed the value of the question. For example, a 400-point question with 3 errors earns 100 points whereas the same 400-point question with 5 errors would earn 0 points, not -100 points.**
  - c. A Timing Bonus can be earned based on the number of seconds it takes a team to correctly decode the first question. The timing bonus is equal to  $4 \times (600 - \text{number of seconds})$ . For example, 6 minutes =  $4 \times (600 - 360) = 960$  points.



- d. A Special Bonus can be earned by solving any of the questions marked as special bonus questions with no penalty points. The bonus will be awarded as follows: One solved = 150 points, Two solved = 400 points, All three solved = 750 points.
- e. Scoring example: Team A earns 3600 points on the exam and solved the timed question in 435 seconds and solved one Special Bonus question.

Exam Score	=	3600 points
Timing Bonus $4(600-435)$	=	660 points
+ <b>Special Bonus (One=150)</b>	=	<b>150 points</b>
Final Score		<b>4410 points</b>

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

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



1. **DESCRIPTION:** Teams will build a durable Conductivity Device that will accurately measure and display both voltage and concentrations of NaCl in parts per million (ppm) from 0 to 5000 ppm of different water samples.

**A TEAM OF UP TO:** 2

**EYE PROTECTION:** None

**IMPOUND:** No

**APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**

- a. Each team may bring one participant-constructed, **conductivity**-sensing Device with a laptop or a calculator for programming/display, two calculators of any type, and 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.
- b. **Event Supervisors should supply distilled water for participants to rinse their probes between tests, and will provide standardized saltwater samples in 4 oz souffle cups with approximately 7 cm mouth with an approximate depth of 5 cm with a removable lid.**
- c. **Regional Competition will test 3 unknown concentrations. State and National Competition will test 4 different concentrations.**
- d. Teams must be able to answer questions regarding the design, construction, programming, and operation of the Device per the Building Policy found at [www.soinc.org](http://www.soinc.org).

3. **CONSTRUCTION PARAMETERS:**

- a. Devices must be built using a microcontroller or microcontroller board (e.g., TI Innovator, Raspberry Pi, Arduino, Micro:bit), a display, LED lights, and a participant-built sensor/probe. The sensor must produce a voltage which varies according to the **concentration** of the water. The Device may be connected to a laptop and/or calculator. WiFi/Internet connection is not allowed at any time during competition.
- b. **The sensor must be student constructed from fundamental electronic components such as resistors, capacitors, wire, and DIP package integrated circuits. All supporting circuits must be assembled on a breadboard. No preassembled integrated circuit PCB boards are allowed. The sensor and wires/cables, together, must be a minimum of 30.0 cm in length, and narrow enough to fit through an opening of 7.0 cm. The end must be immersible up to 5.0 cm in water.**
- c. The Device may use code libraries from any source.
- d. The Device must have a digital display that clearly shows voltage, and the salt concentration in ppm to the nearest unit value. This can be displayed on a laptop or calculator. If the team chooses to use a laptop for display purposes it CANNOT be used for the Written Test portion of the event.
- e. The Device must also be able to indicate the specific concentration zone using three separate LEDs - one red, one green, and one blue. RGB LEDs may be used but must be wired for only one color. The exact concentration range of each zone will not be revealed until teams enter to compete, and may be different for different rotations. At States / Nationals, zones may require more than one color to be displayed at the same time.
- f. Teams must not use electrical outlets at any time during the competition. If the Device is not powered by a connected laptop or calculator, then the Device must be powered by commercially available batteries. Multiple batteries may be connected in series or parallel as long as the total input voltage does not exceed 12 volts as calculated using each battery's voltage (as labeled by the manufacturer), **and the expected voltage output to the probe does not exceed 3.3 volts.**
- g. Each Device must be clearly labeled with the team name and team number.

4. **DESIGN LOG:**

- a. Teams must submit a Design Log with their Device.
- b. **This Design Log should contain the following 7 Sections:**
  - i. A top-down photograph of the Device with labels identifying all the components and detailing their functions. This section should also include a brief summary explaining how the Device was constructed.
  - ii. A data table with at least 10 trials showing the sensor voltage reading versus the corresponding in ppm using their fixed resistor(s) in the voltage divider. If multiple fixed resistors are tried, include the data and graphs of all potential resistors.



- iii. Scatter-plot graph of this data with **concentration in ppm on the Y-axis** and voltage on the X-axis.
- iv. Function graph of **the** mathematical model supported by the data overlaid on scatter-plot of the data.
- v. Equation of the above **the** mathematical model used to convert measured voltage to the corresponding **concentration in ppm** highlighted for easy identification.
- vi. **Printout of the program with its code highlighted showing this exact mathematical equation or its code implementation converting voltage to ppm.**
- vii. **On the same program printout, highlight the code that will illuminate the appropriate LED(s) according to their assigned concentration ranges.**
- c. **If a 3-D printer, laser cutter, CNC machine or similar device was used as a tool to build the team's device, or any component thereof, the following information must also be supplied in the log.**
  - i. **Information about the tool hardware, software, materials, and supplies used**
  - ii. **Details of the source of any digital files (e.g.; CAD, STL, OBJ) utilized by the tool including but not limited to when and where the file was obtained, including the web address if downloaded from the internet**
  - iii. **Descriptions of how the team constructed the final device from the tool created components**
- d. **All submitted logs will be returned to teams.**

## 5. THE COMPETITION:

### Part I: Device Testing

- a. Only participants and Event Supervisors are allowed in the competition areas. Once participants enter the event area, they must not leave or receive outside assistance, materials, or communication.
- b. **For Regional Tournaments the Event Supervisors will provide each team with three labeled samples of unknown concentrations; 4 samples will be provided at State/Nationals.**
- c. Teams may modify their code (e.g., alter the LED code to match the posted **concentration zone**) during the setup time.
- d. **At all Tournaments, teams will have 10 minutes to set up their Device and modify their code.**
- e. **After the setup/calibration time, the teams will rotate through the three different stations at Regional, and four at State/National where they will use their Device to measure the Concentration of each labeled sample. Each team will be allowed a maximum of 2 minutes for each of the 3 or 4 sample determinations. The Event Supervisor will record the voltage and the concentration in ppm to nearest whole number displayed by the Device, along with the LED color displayed at each station.**
- f. **Event Supervisors should exchange concentration samples at the end of each round to prevent contamination. Actual concentration will not be revealed until the end of the day's competition.**
- g. Teams who wish to file an appeal regarding Part I must leave their Design Log and Device in the competition area.

### Part II: Written Test

- a. Teams will be given a written test to assess their knowledge of the theories behind the event. Teams may use the entire time block to take the written test. The written test will be limited to the following topics:
  - i. **Voltage divider and the effect of different fixed resistors and the output voltage recorded.**
  - ii. **The effect of temperature, van Hoff factor, and electrolysis on the reported results.**
  - iii. **The conversion from the analog reading and voltage.**
  - iv. **The relationship between concentration units like TDS, mg of NaCl, Molarity, and ppm.**
  - v. **Theory of LEDs, working principles, and applications.**
  - vi. **The process of calibration - working with raw data and determining real world relationships.**
  - vii. **Operational knowledge of basic Device components.**
- b. Unless otherwise requested, answers must be in metric units with appropriate significant figures.
- c. While working on the written test teams are not allowed to use any laptops they may have brought with them.



## 6. **SCORING:**

- a. The team with the highest Total Score wins.
- b. A Total Score for each team will be determined as follows:
  - i. **Total Concentration Accuracy Score (Maximum 60 points-45 at Regional).**  
**Accuracy Score = 60/45 pts - (total of the relative error of the 3 or 4 concentration measurements x multiplier)**
    - (1) **Maximum relative error x multiplier per station is 15.0**
    - (2) **Regional Multiplier = 20**
    - (3) **State Multiplier = 30**
    - (4) **National Multiplier = 40**
  - ii. **Correct LED colors (Maximum 12-16 points) 4 points are awarded for the correct LED colors (as determined by the concentration measured by the Device) at each station.**
  - iii. Design Log (Maximum 28 points) 4 points are awarded for each correct section of the Design Log as well as being able to answer questions about each section.
  - iv. Written Test (Maximum 30 points)
- c. Tiebreakers: a) the lowest sum of the total **Relative Error**; b) highest written test score; c) **shortest time for the written test.**
- d. Teams with any construction or competition violations will be ranked behind teams without violations.

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

**This event is sponsored by Texas Instruments**



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

**A TEAM OF UP TO: 2**

**APPROXIMATE TIME: 50 minutes**

2. **EVENT PARAMETERS:**

Each team may bring one 8.5" x 11" sheet of paper, which may be in a sheet protector sealed by tape or laminated, that may contain information on both sides in any form and from any source without any annotations or labels affixed along with two stand-alone non-programmable, non-graphing calculators.

3. **THE COMPETITION:**

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

**Part I: Background & Surveillance**

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

**Part II: Outbreak Investigation**

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

**Part III: Patterns, Control, and Prevention**

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

4. **SCORING:**

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

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

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

**Recommended Resources:** The Science Olympiad Store ([store.soinc.org](http://store.soinc.org)) carries a variety of resources to purchase for this event; other resources are on the Event Pages at [soinc.org](http://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 focus on fresh water (e.g., residential, industrial or natural), The Clean Water Act (1972 & 1977 – certain pages specified at the end), wastewater operator’s certification manual (Indiana March 2018 revision) and its applications, and various testing of particular analytes using standardized curves (either interpreted or created).

**A TEAM OF UP TO:** 2

**EYE PROTECTION:** C

**EVENT TIME:** 50 minutes

## 2. **EVENT PARAMETERS:**

- Teams should bring pencils for graphing and answering questions, a ruler (12-15 in.) for best fit line approximation, two stand-alone non-programmable, non-graphing calculators, and one three-ring binder of any size containing information in any form and from any source attached using the available rings. Sheet protectors are permitted. Participants may not remove information or pages during the event.
- Event Supervisors will provide samples to be tested and **any** other reagents, glassware, information (e.g., periodic table, charts, instrumentation) are appropriate for the task(s) participants are asked to perform.
- 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.
- Teams should bring any or all of the items listed as Recommended Lab Equipment for Division C Chemistry Events, posted on [soinc.org](http://soinc.org). Teams not bringing these items will be at a disadvantage, as they are not provided.

## 3. **THE COMPETITION:**

- The competition will consist of a series of tasks that could include hands-on activities, questions about a topic, interpretation of experimental data (e.g., graphs, diagrams), generating a standardized curve using data provided, using a given standardized curve to determine unknowns, or observation of an experiment set up & running.** Supervisors are encouraged to use computers or calculators with sensors/probes. Participants may be asked to collect data using probe-ware that has been set up & demonstrated by the Supervisor. The Supervisor may provide Participants with data sets collected by such sensors/probes following demonstration of the data collection. Data will be presented in tabular and/or graphic format & students will be expected to interpret the data. Participants should be aware that nomenclature, formula writing & stoichiometry, **concentration conversions** are essential tools of chemistry & may always be part of an event.
- Participants will generate one standardized curve by serial dilution at the Regional level, two to three curves at the State level, and three or more at the National level. Standardized curves will be generated either from data given about standards already read, reading standards provided, or making and reading standards (State & National level only).
- No hazardous analytes will be used in this event. Analytes identified as hazardous will be measured in a safe and non-invasive manner (typically colorimetric or by probe such as a millivolt reading). Analytes which are to be determined may come from the following list. Analytes of interest with respect to all water types are as follows:

- |                                      |                             |
|--------------------------------------|-----------------------------|
| i. Ammonia                           | vii. Conductivity           |
| ii. Phosphorous                      | viii. pH                    |
| iii. COD – High Range                | ix. Salinity                |
| iv. COD – Low Range                  | x. Total Dissolved Solids   |
| v. Residual Chlorine (colorimetric)  | xi. GC-MS of regulated PCBs |
| vi. Low Level Chlorine (Amperometry) |                             |

## 4. **SAMPLE QUESTIONS/TASKS:**

- Teams may answer questions concerning the standardized curves in general.  
**Standard Curve:** Participants may be given a standard of known concentration and asked to make a series of dilutions. The dilutions will then be read and recorded. Values will be entered and teams with the better  $R^2$  value (i.e. - value closest to  $R^2 = 1.000$ ) may be awarded additional points or used as a tie breaker at the discretion of the event supervisor.



- b. Teams may answer questions about how to choose the appropriate wavelength for a particular analyte.
  - c. Teams may answer questions about the relationship between absorbance and transmission.
  - d. When given data, teams may have to recreate the standardized curve and use it to determine unknown values. These values will then be used to answer questions about permit limits, violations, etc. Any question where a comparison must be made, with respect to limits, will have those limits provided by the event supervisor.
  - e. Teams will be required to generate by hand a standardized curve (graph paper required – 10 sq/in.).
  - f. All teams must include on their graph the best fit line and its equation.
  - g. Teams may be asked questions about the best fit lines.
  - h. Teams may be asked questions about the Clean Water Act (*CWA 1972 or 1977*) – (*pages 1-59 of “Introduction to the Clean Water Act” or CWA 1972, pages 150-234 of “The Clean Water Act” 1977, & ALL pages (86 total) of the Wastewater Operator Certification Manual*).
5. **SCORING:**
- a. The score will be comprised of approximately 60% of the points for wet chemistry tasks/making & interpreting standardized curves, 20% of the points for equations and interpreting data, and approximately 20% of the points for questions on the Clean Water Act and the Indiana Wastewater Operators Manual.
  - b. The team with the highest score wins.
  - c. Time will not be used for scoring but could be part of the event.
  - d. Ties may be broken by the accuracy of the standardized curves, or selected questions chosen by the event supervisor. In other words, the closer the  $R^2$  value is to 1.000 for standardized curves, the greater the points awarded.
  - e. A penalty of up to 10% will be applied if the team’s area is not cleaned up as instructed by the event supervisor.

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



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:**

- Participants must bring goggles and writing utensils. Experiments will not require any other safety equipment.
- Division B teams may bring one timepiece, one linear measuring device, and one stand-alone non-programmable non-graphing calculator.
- Division C teams may bring one timepiece, one linear measuring device, and one stand-alone calculator of any type.
- The Event Supervisor will provide each team with identical sets of materials either at a distribution center or in an individual container.
- The Event Supervisor will supply a report packet, based on the Experimental Design Checklist, posted on the event page at [soinc.org](http://soinc.org), for recording their experimental information and data.

3. **THE COMPETITION:**

- 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).
- 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.
- 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.
- Each team must use at least two of the provided materials to design and conduct an experiment. The materials will be listed on the board or placed on a card for each team. If provided, both the card and the container will be considered part of the materials. The identity of the materials will be unknown until the start of the event.
- When a team finishes, all materials must be returned to the Event Supervisor including both parts of the report packet.

4. **SCORING:**

- High score wins. Scoring will be done using the Experimental Design Checklist found on the Science Olympiad website ([soinc.org](http://soinc.org)).
- 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.
- Ties will be broken by comparing the point totals in the scoring areas of the checklist in the following order:
  - L. Analysis of Claim/Evidence/Reasoning
  - F. Procedure and Set-Up Diagrams
  - C. Variables
  - H. Data Table
  - I. Graph
- Any participant not following proper safety procedures will be asked to leave the room and will be disqualified from the event.
- Any team not following clean-up procedures will have their final score multiplied by 0.95.
- Any team not addressing the assigned question/topic area will have their final score multiplied by 0.75.
- 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](http://store.soinc.org)) carries a variety of resources to purchase for this event; other resources are on the Event Pages at [soinc.org](http://soinc.org)



## 2022 Experimental Design Division C Checklist

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

### Part I – Design and Construction of the Experiment (66 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) (i.e., a stand is taken)  
 ② ① ① A rationale is given for the hypothesis.

#### C. Variables (20 pts)

##### a. Independent (IV) & Dependent (DV) Variable (12 pts)

- ④ ③ ② ① ① IV Correctly identified and defined

- ④ ③ ② ① ① Levels of IV given

- ④ ③ ② ① ① DV Correctly identified and defined

##### b. Controlled Variables (CV) & Constants (8 pts)

- ② ① ① First CV correctly identified

- ② ① ① Second CV correctly identified

- ② ① ① First Constant correctly identified

- ② ① ① Second Constant correctly identified

#### D. Experimental Control (Standard of Comparison) (4 pts)

- ② ① ① SOC logically identified for the experiment  
 ② ① ① Reason given for selection of SOC

#### E. Materials (4 pts)

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

#### F. 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 Procedure detailed enough to repeat experiment accurately

#### G. Qualitative Observations (6 pts)

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

#### H. Quantitative Data - Data Table (10 pts)

- ② ① ① All raw data is provided  
 ② ① ① Condensed data table with only the data to be graphed is provided  
 ② ① ① Tables and columns labeled properly  
 ② ① ① All data has units  
 ② ① ① Example calculations for derived variables are given

### Part II – Data, Analysis and Conclusions (94 pts)

#### I. 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

#### J. Statistics (14 pts)

- ④ ③ ② ① ① Statistics of Central Tendency used (i.e., best fit, median, mode, mean)  
 ④ ③ ② ① ① One example calculation is given for each statistic with units  
 ④ ③ ② ① ① Statistics of variation are included (i.e., minimum, maximum, range, standard deviation)  
 ② ① ① Calculations are accurate

#### K. Significant Figures (12 pts)

- ④ ③ ② ① ① Data is reported using correct significant figures  
 ④ ③ ② ① ① Graph completed using correct significant figures  
 ④ ③ ② ① ① Statistics are reported using correct significant figures

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

- ② ① ① Statistics Claim completed logically  
 ② ① ① Statistics Evidence completed logically  
 ② ① ① Statistics 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

#### M. 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.

#### N. 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

#### O. Applications & Recommendations for Further Use (6 pts)

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

\*\*\*Continued on back \*\*\*



# EXPERIMENTAL DESIGN CHECKLIST (CONT.)

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://www.soinc.org) as they apply to every event.



## P. Abstract (16 pts)

- |   |   |   |   |   |  |
|---|---|---|---|---|--|
| ④ | ③ | ② | ① | ① | Brief and well-organized                             |
| ④ | ③ | ② | ① | ① | Contains the Statement of the Problem and Hypothesis |
| ④ | ③ | ② | ① | ① | Describes the research procedure                     |
| ④ | ③ | ② | ① | ① | Includes major findings and conclusion               |

School: \_\_\_\_\_ Team# \_\_\_\_\_

Point Total: \_\_\_\_\_/160

Deduction multiplier(s): \_\_\_\_\_

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

Final Score: \_\_\_\_\_



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

**A TEAM OF UP TO: 2**

**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.
- b. Each team may bring any or all of the items listed as Recommended Lab Equipment for Division C Chemistry Events, posted on [soinc.org](http://soinc.org), to use during this event and two stand-alone calculators of any type. Teams not bringing these items will be at a disadvantage. The Supervisor will not provide them.
- 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:
  - i. iodine reagent ( $I_2$  dissolved in KI solution)
  - ii. 2M HCl
  - iii. 2M NaOH
  - iv. Benedict's solution
  - v. a hot water bath
  - vi. a Bunsen burner or equivalent BTU heat source to perform flame tests
  - vii. a waste container
  - viii. chromatography materials (e.g., beakers, Petri dishes, etc.)
  - ix. a wash bottle with distilled water
- e. The Supervisor may provide:
  - i. other equipment (e.g., a microscope, probes, etc.)
  - ii. candle & matches if fibers given
  - iii. differential density solutions or other method of determining density of polymers if plastics given
  - iv. reagents to perform other tests

3. **THE COMPETITION:**

- a. The competition will consist of evidence from Parts 3.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 c. # of samples	Part d. # of samples	Part e. # of chromatograms	Part f. # of topics	Part g.
Regional	3-8	5-9	1 type + Mass Spectra	1-2	Required
State	6-10	6-12	1-2 types + Mass Spectra	1-3	Required
National	10-14	10-18	1-3 types + Mass Spectra	3-5	Required

- b. The collected evidence and other data given may be used in a mock crime scene.
- c. Qualitative Analysis: Participants may be asked to identify the following substances: sodium acetate, sodium chloride, sodium hydrogen carbonate, sodium carbonate, lithium chloride, potassium chloride, calcium nitrate, calcium sulfate, calcium carbonate, cornstarch, glucose, sucrose, magnesium sulfate, boric acid, and ammonium chloride (there will be no mixtures). All teams will have the same set of solids to identify.
- d. Polymers: Participants may be asked to identify:
  - i. Plastics: PETE, HDPE, non-expanded PS, LDPE, PP, PVC, PMMA, PC – Participants will not perform any burn tests on these plastics, but the Supervisor may provide burn test results on them
  - ii. Fibers: cotton, wool, silk, linen, nylon, spandex, polyester - burn tests will be permitted on the fibers
  - iii. Hair: human, bat, cow, squirrel, and horse - participants will need to know hair structure including medulla, cortex, cuticle, and root



- e. Chromatography/Spectroscopy: Participants will be expected to separate components using paper chromatography, TLC, and/or analyze mass spectra. Participants may be expected to measure  $R_f$ s.
  - f. Crime Scene Physical Evidence:
    - i. Fingerprint Analysis: Participants will be expected to know the 8 specific fingerprint patterns (plain arch, tented arch, radial loop, ulnar loop, plain whorl, central pocket whorl, accidental whorl, and double loop whorl). Participants should also be familiar with the common fingerprint development techniques of dusting, iodine fuming, ninhydrin, and cyanoacrylate fuming. Participants should understand terminology such as bifurcation, ridges, island, enclosure, loop, whorl, and arch. Participants should be able to answer questions about skin layers and how fingerprints are formed. Participants may be asked questions on the different methods of detecting fingerprints and the chemistry behind each of these methods.
    - ii. DNA: Participants may be asked to compare DNA chromatograms/electropherograms from materials found at the scene to those of the suspects. Participants will be expected to know how DNA is copied. See <http://educationalgames.nobelprize.org/educational/chemistry/pcr/>
    - iii. Glass analysis: Participants may be asked to use index of refraction to determine the type of a glass found broken at a crime scene. They may be asked to analyze which hole or fractures occurred before others based on a piece of glass available for examination or a picture of a piece of glass.
    - iv. Entomology: Participants may be asked to identify how long an animal has been dead based on the type of insects found on the body at the scene.
    - v. Spatters: Participants may be asked to analyze actual spatters or photographs of spatters to determine the angle and velocity with which the liquid approached the solid object bearing the spatter & the spatter origin direction.
    - vi. Seeds and Pollen: Participants may be asked to compare pictures of seeds/pollen found at the scene with either seeds/pollen found on the suspects or seeds/pollen from different country regions.
    - vii. Tracks and Soil: Participants may be asked to match tire tracks or footprints found at the scene to tires or shoes of the suspects. Participants may be given the composition of soil found at the scene or on the suspects and asked to determine if this implicates any of the suspects.
    - viii. Blood: Participants may be asked to identify the ABO blood type using artificial blood (Event Supervisor required to provide instructions on how the typing system works) or participants may be asked to identify if a blood sample, either prepared microscope slide or pictures of microscope slide, is human, avian, mammalian, or reptilian/amphibian.
    - ix. Bullet striations: Participants may be asked to match the striations on bullets or casings found at the crime scene and fired from a given gun.
  - g. Analysis of the Crime: Participants will be asked to write an analysis of the crime scene explaining not only which pieces of evidence implicate which suspect and why the suspect(s) was (were) chosen as the culprit(s), but also why the other suspect(s) were not chosen. They will also answer any other crime scene analysis questions posed by the Event Supervisor.
  - h. Teams will dispose of waste as directed by the Event Supervisor.
4. **SCORING:**
- a. High score wins. Time will not be used for scoring.
  - b. The score will be composed of the following elements (percentages given are approximate):
  - c. Part 3.c.  $\approx$  20%, Part 3.d.  $\approx$  20%, Part 3.e.  $\approx$  15%, Part 3.f.  $\approx$  15%, and 3.g.  $\approx$  30%.
  - d. Ties will be broken by the highest score on the analysis of the crime scene, which includes the reasons why certain suspects have been eliminated or others remain in the pool of possible criminals.
  - e. A 10% penalty may be given if the area is not cleaned up as designated 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](http://store.soinc.org)) carries a variety of resources to purchase for this event; other resources are on the Event Pages at [soinc.org](http://soinc.org)



1. **DESCRIPTION:** Teams design, build, and test one Vehicle and Ramp that uses the Vehicle's gravitational potential energy as its sole means of propulsion to reach a target as accurately as possible.

**A TEAM OF UP TO:** 2

**IMPOUND:** Yes

**EYE PROTECTION:** None

**EVENT TIME:** 10 minutes

2. **EVENT PARAMETERS:**

- Each team must bring and impound one Vehicle, one Ramp, alignment devices (if used), a Practice Log, and additional/spare parts as well as counterweights used to secure the Ramp. Teams from the same school may share a Ramp if it is compatible with their Vehicle.
- Teams may bring data and a stand-alone calculator of any type along with **non-electronic** tools which do not need to be impounded.
- 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](http://www.soinc.org).

3. **CONSTRUCTION PARAMETERS:**

- All propulsive energy must come from the gravitational potential energy of the mass of the Vehicle. The entire Vehicle must start from an elevated, non-horizontal position on the team's Ramp. A release mechanism must be included as part of the Ramp to hold the Vehicle in the ready-to-run configuration until triggered by the participants.
- Conversion of the Vehicle's gravitational potential energy is permissible, but any additional sources of kinetic energy must be in their lowest energy state in the ready-to-run configuration. Pre-loaded energy storage devices may be used to operate other Vehicle functions (e.g., braking system) as long as they do not provide kinetic energy to propel the Vehicle.
- The Vehicle's total mass must not exceed 2.000 kg.
- Electronic components and electric devices are not permitted.
- A jumbo paperclip (i.e. the large ones) must be attached to the front of the Vehicle and bent so that ONE end of it is pointing down toward the surface of the Track between 1/2" and 3/4" above it. The paperclip must not be cut or shortened. The paperclip must clear the 3/8" dowel placed across the Track. The end of the paperclip must be easily accessible by the Event Supervisor - no part of the Vehicle, except the wheels, may extend more than 0.5 cm beyond it. It will be the Vehicle's Measurement Point for distance measurements.**
- The Vehicle and the Ramp including the release mechanism, in the ready-to-run configuration, must completely fit within an imaginary rectangular box with a 50.0 cm x 50.0 cm base and a height of 100.0 cm. A starting pencil used as part of the release mechanism may extend beyond the dimensions of the imaginary box. A sighting/aiming device, if left on the Ramp or Vehicle in the ready-to-run configuration, must fit within the imaginary box.
- All parts of the Vehicle must move as a whole; no anchors, tethers, or other separate pieces are allowed. The only parts of the Vehicle allowed to contact the floor during the run are wheels/treads. Pieces falling off the Vehicle or Ramp during the run constitutes a construction violation.

4. **PRACTICE LOG:**

- The Practice Log must include 3 or more parameters (2 required and at least 1 additional) for 10 or more practice runs. The required parameters are the Target Distance and the Vehicle Distance from Target. Each team must choose an additional 3rd parameter beyond those required (e.g., # of axle turns for braking, alignment angle) to test. Logs must include the Team name and number.
- Logs must be impounded and will be returned when the team is called to compete.
- 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.**
  - 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**



## 5. THE COMPETITION:

- a. Only participants and the Event Supervisors will be allowed in the Impound and Track areas. Once participants enter the event area to compete, they must not leave or receive outside assistance, materials, or communication.
- b. Teams have 10 minutes of Event Time to set up and start up to 3 runs. Vehicles in the ready-to-run configuration before the end of the Event Time will be allowed to complete a run.
- c. **Electric/electronic** tools must not be used except for the calculator (2.b.).
- d. In the ready-to-run configuration, the Vehicle and Ramp must be entirely behind the Start Line. The Vehicle and Ramp must remain at the starting position without being touched.
- e. Teams may adjust their Vehicle or Ramp (e.g.; change the Vehicle's mass, distance, directional control) within their Event Time; the Event Supervisor may re-verify that the Vehicle and Ramp meets specifications prior to each run. Timing is paused during any measurements made by the Event Supervisor. Timing resumes once the participants pick up their Vehicle or begin making their own measurements. Teams may use their own **non-electronic** measuring devices to verify the Track dimensions during their Event Time.
- f. Only **non-electronic** sighting/aiming devices are permitted. If placed on the Track, they must be removed before each run. If placed on the Vehicle or Ramp, they may be removed at the team's discretion. Sighting and aiming devices left on the Vehicle during its run must not cause the Vehicle's mass to exceed 2.000 kg.
- g. Teams must not roll the Vehicle on the floor of the Track on the day of the event without tournament permission. If permitted, only participants may be present.
- h. Substances applied to the Vehicle or Ramp must be approved by the Event Supervisor prior to use and must not damage or leave residue on the floor, Track and/or event area. Teams may clean the Track during their Event Time but it must remain dry.
- i. Teams must start their Vehicle by using any part of an unsharpened #2 pencil with an unused eraser, supplied by the Event Supervisor, to actuate a release mechanism on the Ramp. The pencil may be used as all or part of the release mechanism and can extend outside of the dimensions defined in 3.f. While actuating the release mechanism, teams must not touch or push the Vehicle nor the Ramp. Actuating the release mechanism must not impart additional energy to the Vehicle. Once they start a run, teams must not follow their Vehicle and must wait until called by the Event Supervisor to retrieve their Vehicle.
- j. If the vehicle does not move upon actuation of the release mechanism, it does not count as a run. The team may continue to work on their device in order to attempt 3 runs within the Event Time.
- k. A Failed Run can occur if the Vehicle starts before the Event Supervisor is ready, if its distance cannot be measured (e.g., the participants pick it up before it is measured), or if the team pushes the vehicle down the track. If a team has a Failed Run, any Construction and/or Competition violations must be recorded for that Run as well. A team having only one successful run during the 10 minute Event Time will be assessed a Failed Run for a 2nd run score. If the Vehicle does not move during the Event Time, the team will be assessed 2 Failed Runs.
- l. Teams filing an appeal must leave their Vehicle, Ramp, and Practice Log in the event area.

## 6. THE TRACK:

- a. The Track will be on a smooth, level, and hard surface. Refer to [soinc.org](http://soinc.org) for a diagram of the Track.
- b. The Start Point is marked on a piece of tape approximately 2.5 cm wide, on the edge of the tape closest to the Target Point. This front edge will be the Start Line. The tape should extend at least 0.50 m on either side of the Start Point, perpendicular to the imaginary center line connecting the Start and Target Point.
- c. The Target Point will be marked on a piece of approximately 5.0 cm by 2.5 cm tape. The exact Target Distance from the Start Point to the Target Point will be between **2.00 m** and **5.00 m**. At Regionals the interval will be 0.50 m, for States 0.25 m, and for Nationals 0.05 m. The Target Distance will be chosen by the Event Supervisor and will be announced after the impound period is over.
- d. **A single  $\frac{3}{8}$ " hardwood round dowel will span the Track 1.00 m from the Start Line perpendicular to the imaginary center line connecting the Start and Target Point. The dowel must extend at least 0.50 m on either side of the Start Point. The dowel must be securely taped and/or weighed down at its ends to hold it in place.**
- e. At the Event Supervisor's discretion, more than one Track may be used. If so, the team may choose which Track they use, but must use the same Track for both runs.



## 7. **SCORING:**

- a. Each team's Final Score is the sum of their 2 best Run Scores out of their 3 runs + any Final Score Penalties. Low score wins.
- b. The Run Score for each run = Distance Score + Run Penalties
- c. The Distance Score =  $1\text{pt./cm} \times \text{Vehicle Distance}$ . The Distance Score for a Failed Run is 2500 points.
- d. The Vehicle Distance is the point-to-point distance from the **Vehicle's** Measurement Point to the Target Point in centimeters measured to the nearest 0.1 cm.
- e. **The Time Score for each run is the time it takes from when the Gravity Vehicle begins to move down the ramp until it comes to a complete stop recorded to the nearest 0.1 s. The Time Score will be used as a tiebreaker.**
- f. Run Penalties:
  - i. Competition Violation: 1500 points added to each Run Score that has 1 or more Competition Violations.
  - ii. Construction Violation: 3000 points added to each Run Score that has 1 or more Construction Violations.
- g. Final Score Penalties:
  - i. Incomplete Practice Log: 250 points added to the team's Final Score.
  - ii. Missing or not Impounded Practice Log: 500 points added to the team's Final Score.
  - iii. Vehicle Not Impounded: 10000 points add to the team's Final Score.
- h. Two or more teams tied with 2 Failed Run scores, without Competition or Construction Violations, will remain scored as ties. Other ties are possible.
- i. Tiebreakers in order: **1. Better Vehicle Distance of the 2 scored runs; 2. Lower Time Score of the Better Vehicle Distance of the 2 scored runs; 3. Better Vehicle Distance of the non-scored run.**

### **SCORING EXAMPLE:**

A Vehicle does 3 runs in the allotted time but the team's Practice Log is incomplete.

The 1st run has 2 Competition Violations, a Time Score of 4.3 s and a Vehicle Distance of 57.8 cm.

The 2nd run has a Competition Violation, a Time Score of 3.9 s and a Vehicle Distance of 143.9 cm.

The 3rd run has no Violations, a Time Score of 4.1 s and a Vehicle Distance of 87.5 cm.

1st run's Run Score:  $57.8 \text{ pts} + 1500 \text{ pts} = 1557.8 \text{ pts}$

2nd run's Run Score:  $143.9 \text{ pts} + 1500 \text{ pts} = 1643.9 \text{ pts}$  (highest **number of** points, not counted in Final Score)

3rd run's Run Score: 87.5 pts

Final Score = 1st run's Run Score + 3rd run's Run Score + Incomplete Practice Log  
=  $1557.8 \text{ pts} + 87.5 \text{ pts} + 250 \text{ pts} = 1895.3 \text{ pts}$

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

**This event is sponsored by Lockheed Martin**



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

**A TEAM OF UP TO:** 2

**APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**

**Each team may bring one 8.5" x 11" sheet of paper, which may be in a sheet protector sealed by tape or laminated, that may contain information on both sides in any form and from any source without any annotations or labels affixed along with two stand-alone non-programmable, non-graphing calculators.**

3. **THE COMPETITION:** This event will be composed of three sections of approximately equal point value. This may include analysis, interpretation or use of charts, graphs and sample data. Note: Green Generation is designed for a two year rotation – the first year (**2022**) will cover aquatic issues, air quality issues and climate change while the second year (**2023**) will cover terrestrial issues and population growth issues.

a. Part 1: Review of the General Principles of Ecology

i. General Principles of Ecology – food webs and trophic pyramids, nutrient cycling, community interactions, population dynamics, species diversity and indicator species **and invasive species (2022 and 2023)**

ii. Overview of Aquatic Environments – freshwater, estuaries, marine (**2022**)

b. Part 2: Problems resulting from human impacts on the quality of our environment

i. Aquatic Environmental Issues – Water Pollution, Ocean Dead Zones, Water Diversion, Overfishing **and Habitat Destruction, Impacts on Excess Nutrients (2022)**

ii. Air Quality Issues – Acid rain, Air Pollution, Nuclear Pollution, and **Atmospheric Deposition (2022)**

iii. Climate Change – Effects on Plants, Animals, and Ecosystems, Greenhouse Effect, and Ozone Depletion (**2022**)

c. Part 3: Solutions to reversing/reducing human impacts that harm our environment

i. Legislation and Economic Opportunity for Solving Problems (Div. C) (**2022 and 2023**)

ii. Sustainability Strategies – Environmental Stewardship of Aquatic Ecosystems (**2022**)

iii. Bioremediation Strategies (**2022**)

iv. **Pollution Prevention**

v. **Green Infrastructure**

4. **SCORING:**

a. **High score wins.**

b. **Selected questions will be used to break ties.**

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

**This event is sponsored by Corteva Agriscience**



# IT'S ABOUT TIME

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://www.soinc.org) as they apply to every event.

1. **DESCRIPTION:** Teams will answer questions related to time and they may construct and bring one non-electrical device to measure time intervals between 10 and 300 seconds.

**A TEAM OF UP TO: 2 EYE PROTECTION:** None **IMPOUND:** Yes **APPROX. TIME:** 50 minutes

2. **EVENT PARAMETERS:**

- a. The event supervisor must hide from view any clocks present in the competition room.
- b. 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.
- c. Each team may also bring tools, supplies, writing utensils, and two stand-alone calculators of any type for use during any part of the event. These items need not be impounded.
- d. Each team must impound only one device and all components that are integral to its operation (e.g. water, sand, etc.), a device diagram, and copies of graphs and/or tables for scoring. Components needed to set up, calibrate, and clean up (e.g. tools, clean-up supplies, reference materials, other time keeping devices) need not be impounded.
- e. The impounded device and any storage boxes must be clearly marked with the team's school name and competition number. At impound, the device and all impounded components must be able to fit into an 80.0 cm x 80.0 cm x 80.0 cm cube and be moveable by the competing team members without outside assistance. The device may be larger after setting up for Part II.
- f. The device must be designed and operated in such a way that it does not damage or alter the competition area.
- g. 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](http://www.soinc.org).
- h. The device must be constructed to be able to provide a distinct audible and/or visual signal at the end of a time interval set by the competitor.
- i. Prior to competition, teams must calibrate devices by preparing graphs/tables showing the relationship between elapsed times and device configuration parameters. 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](http://www.soinc.org).
  - iii. Teams are encouraged to have a duplicate set to use, as those submitted may not be returned.

3. **CONSTRUCTION PARAMETERS:**

- a. Examples of acceptable non-electrical devices include water or sand glasses, simple or torsional pendulums, or oscillating springs.
- b. Commercial counters, tally devices, timepieces or their parts are not allowed. Commercial balances, scales, test tubes, beakers, graduated cylinders, and burettes are not considered counters and are allowed.
- c. The device must be constructed to contain spillage.
- d. The device must be constructed to minimize possible impacts on other teams when running (e.g., as quiet as possible, occupies a reasonable amount of space when set up, etc.).

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



## 5. THE COMPETITION:

### 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 test must consist of at least four questions from each of the following areas:
  - i. Time standards (e.g., UTC, sidereal time, leap years/seconds, time zones, daylight savings time, text-based time formats, and the Gregorian, Hebrew, Islamic, Julian, and Persian calendars)
  - ii. Physics of modern timekeeping devices (e.g., atomic clocks, quartz clocks, electronic oscillations)
  - iii. Historical time keeping devices (e.g. pendulum clocks, water clocks, sundials, ancient astronomical observatories, early clocks and watches, primary timekeeping mechanisms)
  - iv. Waves and frequencies (e.g., electromagnetic waves, frequency analysis, harmonics, normal modes, resonance)
  - v. State and Nationals only - Dynamical systems (e.g., equations of motion, planetary motion, gravity, relativity, half-life)
  - vi. State and Nationals only - Computer representations of time, methods of time synchronization, and situations in which accurate time keeping has significant impact, e.g., navigation, electronic financial transactions, the Internet of Things, security protocols, and signal multiplexing

### Part II: Device Testing

- a. Teams must be allowed to interact with their device before, during, between and after the time trials, except while the device is actively timing a time trial.
- b. The event supervisor must pre-select a different target interval (as described under SCORING) for each of 3 time trials. The same target intervals must be used for all teams. Teams must be informed of the selected intervals at the start of their competition block. Time trials must run in the order listed in the SCORING section.
- c. At the start of the competition block, teams will be given 5 minutes to setup or modify their devices and use their graphs and/or tables to calibrate them. Devices that do not meet construction specs will not be allowed to be tested until brought into specification. All other time keeping devices (e.g., watches, cell phones, etc.) must then be collected by the event supervisor prior to the start of the time trials.
- d. While all teams are working on Part I, the Event Supervisor will individually call each team to a station. Multiple identical stations may be used.
- e. Prior to the start of a team's time trials, the team must demonstrate the audible and/or visual signal that the device makes when it is done timing an interval.
- f. Event Supervisors are strongly encouraged to utilize 3 Timers on all time trials. The median time in seconds to the precision of the device used, recorded by the 3 Timers, is the official time trial value. The Event Supervisor will make sure 3 timers are ready and then signal a team member to make a loud announcement of, "3, 2, 1, START!" Then a team member will proceed to start the device. Timers will stop when the device signal is audible and/or visible.
- g. Teams must then have at least 90 seconds at Regionals, 60 seconds at States, 30 seconds at Nationals to configure and prepare their device for the next time trial.
- h. Teams must completely clean up before leaving the competition area.
- i. The Supervisor will review with the team the Part II data recorded on their scoresheet.
- j. Teams filing an appeal regarding Part II must leave their device in the competition area.



## 6. SCORING:

- a. High score wins; Final Score (FS) = ES + TT1 + TT2 + TT3 + CS. The maximum possible FS is 100 points. A scoring spreadsheet is available at [www.soinc.org](http://www.soinc.org).
- b. Teams must start with the points listed below per time trial (TT), for a total of 45 possible points for TT1 + TT2 + TT3.
- c. Points must be deducted from the initial points as described below. The score for a trial must NOT be less than zero. There must not be any carry-over of penalty points between trials. The trial interval ranges and points deducted are:

Time Trial #	Time Interval Range	Points Deducted / $\pm 0.1$ sec error	Initial Points
Trial 1	10 to 90 sec	0.3 pts. per 0.1 sec	15
Trial 2	60 to 300 sec	0.2 pts. per 0.1 sec	15
Trial 3	10 to 300 sec	0.1 pts. per 0.1 sec	15

- d. Exam Score (ES) = (Part I score / Highest Part I score for all teams) x 45 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 the possible time range
  - ii. 2 points for including at least 10 data points in each data series
  - 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). Different series of tests measuring the same variables are considered distinct graphs or tables
  - v. 2 points for including a labeled device diagram
- f. If a team violates a COMPETITION rule, their TT1, TT2, and TT3 scores will be multiplied by 0.9.
- g. If any CONSTRUCTION violation(s) are corrected during the competition block, or if the team misses impound, their TT1, TT2, and TT3 will be multiplied by 0.7.
- h. Teams with no device, no time estimates, or that do not make an honest attempt to utilize a device to determine the time periods receive TT1, TT2, and TT3 of 0. Such teams will be allowed to compete in Part I (the written test).
- i. Tiebreakers: 1<sup>st</sup> - best score from Time Trial 3, 2<sup>nd</sup> - designated questions from the test.

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



1. **DESCRIPTION:** Participants will be assessed on their knowledge of North American birds.

**A TEAM OF UP TO:** 2

**APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**

- a. Each team may bring one 2” or smaller three-ring binder, as measured by the interior diameter of the rings, containing information in any form and from any source along with one commercially produced field guide not contained in the binder. Sheet protectors, lamination, tabs and labels are permitted in both the binder and field guide.
- b. If the event features a rotation through a series of stations where the participants interact with samples, specimens or displays; no material may be removed from the binder throughout the event.
- c. In addition to a binder, each team may bring one unmodified and unannotated copy of either the **2022** National Bird List or a **2022** Official State Bird List which does not have to be secured in the binder.

3. **THE COMPETITION:**

- a. The competition may be run as timed stations and/or as a timed slides/PowerPoint presentation.
- b. Specimens/pictures will be lettered or numbered at each station. The event may include preserved specimens, skeletal material, recordings of songs, and slides or pictures of specimens.
- c. For each station, Regional tournaments will have questions about 1 bird per station, State tournaments will use no more than 2 birds per station, and the National Tournament may use 3 or more birds per station.
- d. Each team will be given an answer sheet on which they will record answers to each question.
- e. No more than 50% of the competition will require giving order, family, and/or common name.
- f. Participants should be able to do basic identification to the level indicated on the Official List. States may have a modified state or regional list. See your state web site.
- g. States may have a modified state or regional list which will be posted on the state website no later than November 1st.
- h. The National competition will be based on the **2022** National Bird List.
- i. Each specimen will have one or more questions accompanying it on some aspect of its life history, distribution, anatomy and physiology, reproduction, habitat characteristics, ecology, diet, behavior, conservation and biogeography.
- j. The ecology questions may pertain to any ecological aspect of the species, including behavior, habitat, niche, symbiotic relationships, trophic level, adaptive anatomy such as bill size and shape, migration, distribution or occurrence (e.g., rare, common, special concern, endangered).

4. **SAMPLE ACTIVITIES:**

- a. Identify the order, family, and/or common name of the provided sample.
- b. What conclusion can be drawn about the habitat(s) of the given specimens?
- c. Which of these animals does not fit within this taxon?
- d. What unique anatomical feature distinguishes the animal shown in the picture?
- e. Consider the potential impact of human activities on the survival of birds.

5. **SCORING:**

- a. High score wins.
- b. Selected questions may be used as tiebreakers.

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



# 2022 NATIONAL BIRD LIST

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://www.soinc.org) as they apply to every event.



Kingdom – ANIMALIA

Phylum – CHORDATA

Subphylum – VERTEBRATA

Class - AVES

*Family Group (Family Name)*

Common Name

**ORDER: Anseriformes**

**Ducks, Geese, and Swans (*Anatidae*)**

Black-bellied Whistling-duck

Snow Goose

Canada Goose

Trumpeter Swan <sup>♂</sup>

Wood Duck

Mallard <sup>♂</sup>

Northern Shoveler

Green-winged Teal

Canvasback

Hooded Merganser

**ORDER: Galliformes**

**Partridges, Grouse, Turkeys, and Old**

**World Quail (*Phasianidae*)**

\*Ring-necked Pheasant

Ruffed Grouse <sup>♂</sup>

Wild Turkey

**New World Quail (*Odontophoridae*)**

Northern Bobwhite <sup>♂</sup>

**ORDER: Gaviiformes**

**Loons (*Gaviidae*)**

Red-throated Loon

Common Loon <sup>♂</sup>

**ORDER: Podicipediformes**

**Grebes (*Podicipedidae*)**

Pied-billed Grebe

Red-necked Grebe

**ORDER: Procellariiformes**

**Albatrosses (*Diomedeidae*)**

Laysan Albatross

Shearwaters and Petrels

(*Procellariidae*)

Northern Fulmar

**ORDER: Pelecaniformes**

**Pelicans (*Pelecanidae*)**

American White Pelican

**Bitterns, Herons, and Allies (*Ardeidae*)**

American Bittern <sup>♂</sup>

Great Blue Heron

Snowy Egret

Green Heron

Black-crowned Night-heron

**Ibises and Spoonbills**

(*Threskiornithidae*)

Roseate Spoonbill

**ORDER: Suliformes**

**Cormorants (*Phalacrocoracidae*)**

Double-crested Cormorant

**Darters (*Anhingidae*)**

Anhinga

**Frigatebirds (*Fregatidae*)**

Magnificent Frigatebird

**ORDER: Ciconiiformes**

**Deep-water Waders (*Ciconiidae*)**

Wood Stork

**ORDER: Falconiformes**

**Caracaras and Falcons (*Falconidae*)**

Crested Caracara

American Kestrel

Peregrine Falcon

**ORDER: Accipitriformes**

**Osprey (*Pandionidae*)**

Osprey

**Hawks, Kites, Eagles, and Allies**

(*Accipitridae*)

Bald Eagle <sup>♂</sup>

Northern Harrier

Cooper's Hawk

Red-tailed Hawk <sup>♂</sup>

Golden Eagle

**ORDER: Cathartiformes**

**New World Vultures (*Cathartidae*)**

Turkey Vulture

California Condor

**ORDER: Gruiformes**

**Rails, Gallinules, and Coots (*Rallidae*)**

Clapper Rail

Sora <sup>♂</sup>

Purple Gallinule

American Coot

**Cranes (*Gruidae*)**

Whooping Crane <sup>♂</sup>

**ORDER: Charadriiformes**

**Lapwings and Plovers (*Charadriidae*)**

American Golden-Plover

Killdeer <sup>♂</sup>

**Oystercatchers (*Haematopodidae*)**

American Oystercatcher

**Stilts and Avocets (*Recurvirostridae*)**

Black-necked Stilt

American Avocet

**Sandpipers, Phalaropes, and Allies**

(*Scolopacidae*)

Spotted Sandpiper

Ruddy Turnstone

Dunlin

Wilson's Snipe

American Woodcock

**Gulls, Terns, and Skimmers (*Laridae*)**

Laughing Gull <sup>♂</sup>

Ring-billed Gull

Herring Gull

Least Tern

Caspian Tern

Black Tern

Black Skimmer

**Auks, Murres, and Puffins (*Alcidae*)**

Common Murre

Tufted Puffin

**ORDER: Columbiformes**

**Pigeons and Doves (*Columbidae*)**

Mourning Dove <sup>♂</sup>

Common Ground-Dove

\*Rock Pigeon

**ORDER: Cuculiformes**

**Cuckoos, Roadrunners, and Anis**

(*Cuculidae*)

Black-billed Cuckoo <sup>♂</sup>

Greater Roadrunner

1) Special Characters: <sup>♂</sup> indicates vocalizations that may be tested & \* indicates an introduced, widespread Species

2) The taxonomic scheme is based upon the 7th edition Checklist of North American Birds, American Ornithologists' Union, and [www.allaboutbirds.org](http://www.allaboutbirds.org)  
Cornell University Laboratory of Ornithology.



# 2022 NATIONAL BIRD LIST

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://www.soinc.org) as they apply to every event.



## ORDER: Strigiformes

### Barn Owls (*Tytonidae*)

Barn Owl

### Typical Owls (*Strigidae*)

Great Horned Owl <sup>F</sup>

Snowy Owl

Barred Owl <sup>F</sup>

Screech Owl

## ORDER: Caprimulgiformes

### Nightjars and Allies (*Caprimulgidae*)

Chuck-will's-widow <sup>F</sup>

Common Nighthawk

## ORDER: Apodiformes

### Swifts (*Apodidae*)

Chimney Swift

### Hummingbirds (*Trochilidae*)

Ruby-throated Hummingbird <sup>F</sup>

## ORDER: Coraciiformes

### Kingfishers (*Alcedinidae*)

Belted Kingfisher <sup>F</sup>

## ORDER: Piciformes

### Woodpeckers and Allies (*Picidae*)

Red-headed Woodpecker

Yellow-bellied Sapsucker

Downy Woodpecker

Northern Flicker <sup>F</sup>

Pileated Woodpecker

## ORDER: Passeriformes

### Tyrant Flycatchers (*Tyrannidae*)

Olive-sided Flycatcher

Eastern Phoebe

Vermilion Flycatcher

Great Crested Flycatcher <sup>F</sup>

Eastern Kingbird

Scissor-tailed Flycatcher

### Shrikes (*Laniidae*)

Loggerhead Shrike

### Vireos (*Vireonidae*)

Warbling Vireo

Red-eyed Vireo

### Jays and Crows (*Corvidae*)

Steller's Jay

Blue Jay <sup>F</sup>

Black-billed Magpie

American Crow <sup>F</sup>

Common Raven

### Larks (*Alaudidae*)

Horned Lark

### Swallows (*Hirundinidae*)

Purple Martin

Cliff Swallow

Barn Swallow

### Chickadees and Titmice (*Paridae*)

Black-capped Chickadee <sup>F</sup>

Tufted Titmouse <sup>F</sup>

### Nuthatches (*Sittidae*)

Red-breasted Nuthatch <sup>F</sup>

White-breasted Nuthatch

### Creepers (*Certhiidae*)

Brown Creeper

### Wrens (*Troglodytidae*)

Cactus Wren

Marsh Wren

Carolina Wren <sup>F</sup>

### Dippers (*Cinclidae*)

American Dipper

### Kinglets (*Regulidae*)

Golden-crowned Kinglet

Ruby-crowned Kinglet

### Gnatcatchers (*Poliptilidae*)

Blue-gray Gnatcatcher

### Thrushes (*Turdidae*)

Eastern Bluebird

Wood Thrush <sup>F</sup>

American Robin <sup>F</sup>

### Mockingbirds and Thrashers

(*Mimidae*)

Gray Catbird

Northern Mockingbird <sup>F</sup>

Brown Thrasher

### Waxwings (*Bombycillidae*)

Cedar Waxwing

### Wood-Warblers (*Parulidae*)

Yellow Warbler

Magnolia Warbler

Yellow-rumped Warbler

Black-throated Green Warbler

Black-and-white Warbler

American Redstart

Ovenbird

Kentucky Warbler

Common Yellowthroat <sup>F</sup>

### New World Sparrow

(*Passerellidae*)

Spotted Towhee <sup>F</sup>

Black-chinned Sparrow

Lark Sparrow

Harris's Sparrow

White-crowned Sparrow

Chipping Sparrow

Dark-eyed Junco

### Longspurs and Buntings (*Calcariidae*)

Lapland Longspur

Snow Bunting

### Cardinals and Allies (*Cardinalidae*)

Northern Cardinal <sup>F</sup>

Indigo Bunting

Painted Bunting

Scarlet Tanager

### Blackbirds (*Icteridae*)

Bobolink

Red-winged Blackbird <sup>F</sup>

Western Meadowlark <sup>F</sup>

Yellow-headed Blackbird

Common Grackle

Brown-headed Cowbird

Baltimore Oriole <sup>F</sup>

### Fringillids and Allies (*Fringillidae*)

Red Crossbill

American Goldfinch

Evening Grosbeak

House Finch

Pine Siskin

### Old World Sparrows (*Passeridae*)

\*House Sparrow

### Old World Starlings (*Sturnidae*)

\*European Starling

1) Special Characters: <sup>F</sup> indicates vocalizations that may be tested & \* indicates an introduced, widespread Species

2) The taxonomic scheme is based upon the 7th edition Checklist of North American Birds, American Ornithologists' Union, and [www.allaboutbirds.org](http://www.allaboutbirds.org)  
Cornell University Laboratory of Ornithology.



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

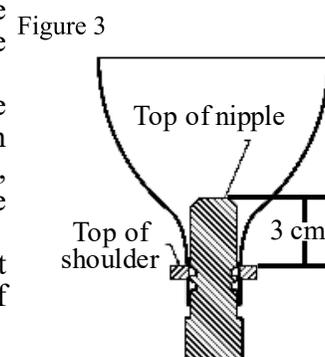
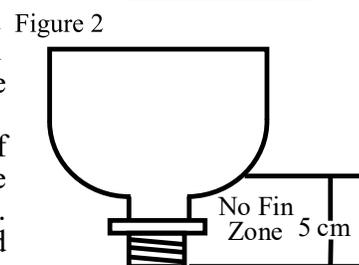
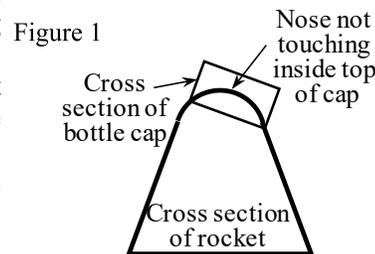
**A TEAM OF UP TO: 2    IMPOUND: No    EYE PROTECTION: B    EVENT TIME: 8 minutes**

## 2. **EVENT PARAMETERS:**

- Teams must provide **up to three rockets, three unaltered ping pong balls and three student made parachutes. Commercially produced parachutes are not allowed.**
- Parachutes must be attached to ping pong balls with tape only. The ping pong ball attached to the parachute assembly makes up the parachute payload system.
- 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.
- Event Supervisors must provide a launcher (that uses a Schrader valve), an air pump, a pressure gauge, and timing devices. Teams may bring their own manual bicycle pump with a pressure gauge to use, but it must attach to the launcher provided by the Event Supervisor.
- This event should be held inside with a high ceiling (greater than 20 feet recommended). Tournament directors must provide the ceiling height (in feet) to teams at least 1 month in advance. Extreme care must be taken to protect the floor and ceiling of any inside facilities used for practice and competition.

## 3. **CONSTRUCTION PARAMETERS:**

- Rocket pressure vessels must be made from a single **20 oz, in measured volume**, or less plastic carbonated beverage bottle with a nozzle opening internal diameter of approximately 2.2 cm (a 1/2-inch Schedule 40 PVC pipe must fit tightly inside the nozzle opening) and a standard neck height from flange to bottle's opening of under 1.6 cm. The bottle label must be presented at check in.
- The structural integrity of the pressure vessel must not be altered. This includes, but is not limited to: physical, thermal or chemical damage (e.g., cutting, sanding, using hot or super glues, spray painting).
- The nose of the rocket must be rounded or blunt at the tip and designed such that when a standard bottle cap (~3.1 cm diameter x 1.25 cm tall) is placed on top of the nose, no portion of the nose touches the inside top of the bottle cap (see Figure 1).
- Only tape must be used to attach fins and other components to the outside of the pressure vessel. Nothing may be added to or placed on the inside of the pressure vessel. No glues of any type may be used on the pressure vessel. Metal of any type is prohibited anywhere on the rocket or parachute payload system.
- Fins and other parts added to the bottle must be 5 cm or higher above the level of the bottle's opening, to ensure rockets fit on the launcher (see Figure 2).
- All energy imparted to the rocket/parachute payload system must originate from air pressure provided by the tire pump; no water. Gases other than air, explosives, liquids including water, chemical reactions, pyrotechnics, electrical devices, elastic powered flight assists, throwing devices, remote controls, and tethers are prohibited at any time.
- At the National Event the launcher nipple will extend into the rocket 1.173 in +/- 0.2 in (3.0 cm +/- 0.5 cm) above the top side of the shoulder of the bottle (see Figure 3).



## 4. **PRACTICE LOG:**

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



- b. For each rocket design, the team needs to prepare a graph showing estimated/recorded peak flight height (feet) vs Pressure (psi). The graph(s) must be printed out from an electronic source. Hand drawn graphs are not allowed.
  - c. If a 3-D printer, laser cutter, CNC machine or similar device was used as a tool to build the team's device, or any component thereof, the following information must also be supplied in the log.
    - i. Information about the tool hardware, software, materials, and supplies used
    - ii. Details of the source of any digital files (e.g.; CAD, STL, OBJ) utilized by the tool including but not limited to when and where the file was obtained, including the web address if downloaded from the internet
    - iii. Descriptions of how the team constructed the final device from the tool created components
  - d. Data on the graph must match the 15 or more recorded test flights for each rocket design.
  - e. Rocket designs without flight logs and graphs will be penalized a -10 second penalty for each scorable flight.
  - f. All submitted logs will be returned to teams.
5. **THE COMPETITION:**
- a. Teams must arrive at the competition site ready to launch with proper eye protection to have their rocket(s) inspected for safety. **If the Event Supervisor has safety concerns that cannot be addressed to their satisfaction rockets will not be launched.**
  - b. Teams will have **8 minutes to make a total of three launches using any combination of rocket, ping pong ball and parachute that the team presented for inspection at check in.**
  - c. **When teams are called to launch, the 8 minute timer starts when the team enters the launch area. Teams that brought their own manual tire pump will connect it to the pressure vessel connection of the launcher.** Teams will load their rocket onto the launcher. Once the rocket is loaded, but NOT pressurized, teams will place the parachute payload system on or in the rocket. After the payload parachute system is loaded it cannot be manipulated. Teams will then pressurize the rocket to the pressure (psi) of choice based on their practice log data. At no time should the pressure vessel (bottle) be pressurized beyond the lesser value of **50 psi** or the maximum pressure determined by the Event Supervisor for safe operations given ceiling height at the tournament location. The Event Supervisor will check the gauge on the pump to ensure the rocket is pressurized to the psi chosen and justified by the team's data.
  - d. The Event Supervisor will make sure 3 timers are ready and then signal a team member to make a loud announcement of, "3, 2, 1, LAUNCH!" Then a team member will proceed to launch the rocket. After launching, the team will prepare for the next launch.
  - e. Timing begins when the rocket separates from the launcher and stops when the parachute payload system lands.
  - f. If the parachute payload system does not separate from a rocket, timing is from when the rocket separates from the launcher to when any part of rocket touches the ground.
  - g. If any part of a rocket or parachute payload system hits the ceiling or any part connected to the ceiling (e.g., a rafter, light, basketball hoop), then timing is stopped at the instant of contact.
  - h. If a rocket fails to separate from the launcher because of a problem with the supplied launcher then the launch never occurred and the launch can be restarted.
  - i. All times for each launch **MUST** be recorded for breaking ties. Time aloft is recorded in hundredths of a second. The middle value is the officially recorded **flight** time.
  - j. Teams filing an appeal must leave their rocket(s), parachute payload system(s), and Practice Log(s) in the event area.
6. **SCORING:**
- a. **Ranking is determined by the sum of the two greatest times of flight of the 3 launches.**
  - b. **Rockets and/or parachute payload systems violating 2.c, 3.a.-f will not be launched. Rockets violating rules 4.a.-b. will be penalized with a -10 second penalty for each scorable flight.** Teams unable to make any launches will receive participation points only.
  - c. **Ties will be broken by the greatest time aloft of the parachute payload system from each team's un-scored 3rd launch.**

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



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

**A TEAM OF UP TO:** 2

**APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**

- a. Each team may bring four 8.5" x 11" sheets of paper that contain information on both sides in any form and from any source.
- b. Each participant may bring a metric ruler, a protractor, and a non-programmable, non-graphing calculator dedicated to computation.

3. **THE COMPETITION:**

- a. The event will consist of questions and activities testing concepts related to the collection and use of remote sensing data to observe and study climate change processes in the Earth system.
- b. The test should be divided equally, approximately 25 % on each, across the following topic areas:
  - i. Remote sensing instrumentation and physics: active vs. passive sensors; optical and infrared imagers; radiometers; LiDAR; radar altimetry; precipitation radar; blackbody radiation; Planck function, Wein's Law; Stefan-Boltzmann Law; beam attenuation; absorption and scattering by aerosols; refraction and refractive indices; scattering, **gravity**.
  - ii. Interpretation of remote sensing images and data sets from the following satellites: Atmospheric and sea-surface temperature (GOES-16, ATMS and CrIS on NPP); global mean temperature; energy flux (CERES on NPP); optical, infrared and Doppler radar imagery of clouds and precipitation (MODIS, CALIPSO, CloudSat); CO<sub>2</sub> cycle (OCO-2); aerosol scattering, absorption and optical depth (MODIS); detection of trace gas concentrations by satellites (OCO-2, AURA); sea level rise and surface waves (radar altimeters, especially Topex-Poseidon, Jason-1 and Jason-3, **Grace**).
  - iii. Climate processes and climate change: greenhouse gases (concentrations and distribution) and trace gas concentrations; clouds and radiation; aerosol forcing; carbon cycle; surface albedo; comparison of remote sensing data with climate model data
  - iv. Using, applying, and interpreting the output of small-scale models of planetary energy balance

4. **SAMPLE QUESTIONS/TASKS:**

- a. Use a comparison of visible and IR satellite images of clouds to interpret relationships between clouds and outgoing radiation, and to explain how clouds influence the Earth's radiative balance.
- b. Given information characterizing the extinction coefficient of a layer of dust in the atmosphere and the observed reduction in outgoing radiation, calculate the thickness of the dust layer.
- c. Modify a simple energy balance model to include an idealized greenhouse gas response to these CO<sub>2</sub> concentrations and show how this affects global atmospheric temperature.
- d. Interpret a pair of radar altimeter returns to look at differences in significant wave height.
- e. **Interpret signals of changes in groundwater storage from Grace gravity data.**

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

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

**This event is sponsored by Lockheed Martin**



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



## b. Rocks:

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

## 5. SAMPLE ACTIVITIES:

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

## 6. SCORING: High score wins. Selected questions will be used to break ties.

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



# 2022 ROCKS AND MINERALS LIST

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://www.soinc.org) as they apply to every event.



## MINERALS

### Borate Family

Ulexite

### Carbonate Family

Aragonite

Azurite

Calcite

Dolomite

Malachite

Rhodochrosite\*

### Native Element Family

Copper

Diamond

Gold

Graphite

Silver

Sulfur

### Halide Family

Fluorite

Halite<sup>4</sup>

### Oxide/Hydroxide Families

Corundum

Goethite/Limonite

Hematite

Magnetite

Pyrolusite\*

Rutile\*

Zincite\*

### Phosphate Family

*Apatite Group*<sup>1</sup>

Pyromorphite\*

Turquoise\*

Vanadinite\*

### Sulfate Family

Barite

Celestite\*

*Gypsum*<sup>4</sup> varieties:

Alabaster (massive)

Satin Spar (fibrous)

Selenite (crystalline)

### Sulfide Family

Bornite\*

Chalcopyrite

Galena

Pyrite

Sphalerite

Stibnite\*

### Silicate Family

Apophyllite\*

Beryl

Epidote

Kaolinite

Kyanite

Olivine

*Quartz varieties:*

Aventurine

Agate

Amethyst

Chalcedony

Citrine\*

Jasper\*

Milky Quartz

Opal

Rock Crystal

Rose Quartz

Smoky Quartz\*

Sodalite

Staurolite

Stilbite\*

Talc

Topaz

*Tourmaline Group*<sup>1</sup>

Willemite\*

Zircon\*

*Amphibole Group*

Actinolite\*

Hornblende

Tremolite\*

*Feldspar Group*

Plagioclase feldspars

Albite

Labradorite

Potassium feldspars

Amazonite

Orthoclase/Microcline (pink)<sup>2</sup>

*Garnet Group*<sup>1</sup>

Almandine

*Mica Group*

Biotite

Lepidolite\*

Muscovite

*Pyroxene Group*

Augite

Rhodonite\*

Spodumene\*

## ROCKS

### IGNEOUS ROCKS

Andesite

Basalt

Diorite

Gabbro

Granite

Obsidian

Pegmatite

Peridotite

Pumice

Rhyolite

Scoria

Syenite

Tuff

### SEDIMENTARY ROCKS

Banded Iron

Bauxite<sup>3</sup>

Breccia

Chert

Conglomerate

Diatomite

Dolostone

Rock Salt (Halite)<sup>4</sup>

Rock Gypsum<sup>4</sup>

Shale

*Coal varieties:*

Anthracite

Bituminous

Lignite

*Limestone varieties:*

Chalk

Coquina

Fossil Limestone

Oolitic Limestone

Travertine

*Sandstone varieties:*

Arkose

Greywacke

Quartz Sandstone

### METAMORPHIC ROCKS

Amphibolite

Gneiss

Marble

Phyllite

Quartzite

*Schist Varieties:*

Garnet Schist

Mica Schist

Talc Schist (Soapstone)

Serpentinite

Slate

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

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

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

3 - Bauxite has been reclassified as a sedimentary rock.

4 - Rock Salt and Rock Gypsum for identification purposes are considered the same, respectively, as the minerals Halite and Gypsum and do not need to be distinguished.



1. **DESCRIPTION:** Prior to the competition, teams will design, construct, and calibrate a single device capable of launching projectiles onto a target and collect data regarding device parameters and performance.  
**A TEAM OF UP TO:** 2 **EYE PROTECTION:** B **IMPOUND:** Yes **APPROX. TIME:** 10 minutes
2. **EVENT PARAMETERS:**
  - a. Prior to 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, design log, and any projectiles. Items must be moveable by the competitors without outside assistance.
  - c. 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.
  - 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](http://www.soinc.org).
3. **CONSTRUCTION PARAMETERS:**
  - a. When ready-to-launch, the launch device, projectiles, stabilizing weights, and all other device components (except for tools / supplies) must fit in a 60.0 cm per side cube, in any orientation chosen by the team.
  - b. The launch force must be supplied by non-metallic elastic solids such as rubber bands/tubing, wood, plastic, or bungee cords. 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.
  - c. The triggering device is not considered part of the device and activating it must not contribute significant energy to the launch. It must extend out of the launch area, allow for competitors to remain at least 75cm away from the launch area, and does not need to return to the launch area after launch. The triggering device must not pose a danger due to flying parts or excessive movement outside of launch area.
  - d. Teams must provide unmodified (labeling is permitted) tennis, racquet, Ping-Pong, and/or light weight plastic or foam golf balls to be used as projectiles. Teams may change projectiles for each launch.
  - e. The launch device must be designed and operated in such a way to not damage or alter the floor.
  - f. Electrical components are not allowed as part of the device or triggering device.
4. **DESIGN LOG:**
  - a. Teams must submit a design log showing collected device data, which should contain:
    - i. One or more photos and/or diagrams of the device with labels identifying all the major components and detailing their function, along with a brief summary of how the device was built.
    - ii. Any number of graphs and/or tables showing the relationship between various parameters such as arm position or projectile mass and impact position. Graphs/tables may be computer generated or hand drawn on graph paper. Each data series counts as a separate graph. A template is available at [www.soinc.org](http://www.soinc.org).
    - iii. Example calculations showing how to use the graphs/tables to adjust the device for a target position.
  - b. The team must indicate up to four graphs/tables to be scored, otherwise the first four provided are scored.
  - c. All pages of the design log must be affixed together, such as via three ring binder, staples, or paperclips.
  - d. Design logs will be returned to the team after they are done competing.
  - e. **If a 3-D printer, laser cutter, CNC machine or similar device was used as a tool to build the team's device, or any component thereof, the following information must also be supplied in the log.**
    - i. **Information about the tool hardware, software, materials, and supplies used**
    - ii. **Details of the source of any digital files (e.g.; CAD, STL, OBJ) utilized by the tool including but not limited to when and where the file was obtained, including the web address if downloaded from the internet**
    - iii. **Descriptions of how the team constructed the final device from the tool created components**
  - f. **All submitted logs will be returned to teams.**
5. **THE COMPETITION:**
  - a. Each team will have 8 minutes to set up, adjust and calibrate their device, and to launch a max of 2 shots at each target. Measurement time required by the supervisor is not included in the allotted time. Devices that do not meet the construction specs will not be allowed to launch until brought into spec.
  - b. When instructed by the event supervisor(s), teams must place their device at a location they select in the launch area. Competitors must not be within 75 cm of the launch area or in front of the front edge of the launch area during a launch. They may touch only the part of the triggering device that extends at least 75cm outside of the launch area.
  - c. 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.



- d. Teams may move devices within the launch area and/or adjust them in any way between and before shots.
  - e. Before each launch, teams must notify the event supervisor which target they have selected. Any launch, even if unintended or not announced, will count as one of the four launches allowed to a team.
  - f. 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.
  - g. After each launch the event supervisor will indicate to the team when they may approach the target to retrieve their projectile and make measurements to calibrate their device.
  - h. If the first shot at a target lands within 500mm, a bucket shot may be requested in place of the second shot.
  - i. The supervisor will review with the team the data recorded on their scoresheet.
  - j. Teams who wish to file an appeal must leave their device and design log with the event supervisor.
6. **COMPETITION AREA:**
- a. The launch area is a rectangular area 1.0m wide by 1.5m long (parallel to the launch direction), designated by tape on the floor. Tape must also be placed 75cm away from the sides and back of the launch area. Supervisors are recommended to use hard surfaces for the floor (e.g., concrete, hardwood, plywood).
  - b. Two targets, designated by tape on the floor or panels lying on the floor, must be placed in front of the launch area. Targets must have a minimum diameter / length / width of 1.00m and are recommended to be a square shape. Supervisors are encouraged to place sand, cat litter, or a similar substance in the area around the targets to help indicate landing spots.
  - c. The targets must be between 2.00m and 8.00m in front of the launch area (intervals of 1.00m for Regionals, 0.50m for States, 10.0cm for Nationals). A distance of at least 2.00m must separate the targets.
  - d. The near target must be centered on an imaginary centerline that bisects the launch area and is parallel to the launch direction.
  - e. The far target may be anywhere up to 2.00 m (in intervals of 0.5 m for Regionals, 0.25 m for States, and 0.10 m for Nationals) to the right or left of the imaginary centerline.
  - f. If requested, a bucket (~5 gallon size, provided by the supervisor) will be placed (opening facing up) anywhere between 2.00m and 8.00m in front of the launch area and anywhere up to 2.00m to the right or left of the centerline. The bucket may only be on the course when requested so that it is not an obstacle.
  - g. Target and bucket locations and sizes must be announced only after impound is over and must be the same for all teams. Room ceiling height should be considered when setting the distances.
7. **SCORING:** A scoring spreadsheet is available at [www.soinc.org](http://www.soinc.org)
- a. High score wins. Final Score = Best Near TS + Best Far TS + CS + BS (if any).
  - b. Target Score (TS) = 2000 (for the near one) or 4000 (for the far one) minus the straight line distance, in mm, from the center of the initial impact of the projectile to the target. Lowest possible TS is 0.
    - i. If no target is announced, or the shot is a bucket shot attempt, TS = 0 for that shot.
    - ii. Eligible impact locations include the floor, wall, support column, other 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.
  - c. 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 400.
    - i. 60 points for including data spanning at least one variable range listed in 4.a.ii.
    - ii. 60 points for including at least 10 data points in each data series
    - iii. 60 points for proper labeling (e.g., title, team name, units)
    - iv. 30 points for each graph or table turned in (up to 120 points total as long as they are not the same)
    - v. 50 points for including a labeled device picture or diagram
    - vi. 50 points for including at least 2 example calculations
  - d. Bucket Score (BS) – Hitting the bucket at first impact is worth 100 points. Making contact with the inside bottom surface is worth an additional 200 points (for total of 300 points).
  - e. If a team violates any THE COMPETITION rules, their TS scores will be multiplied by 0.9.
  - f. If any CONSTRUCTION PARAMETERS violation(s) are corrected during the allotted competition period, or if the team misses impound, their TS scores will be multiplied by 0.7.
  - g. Teams disqualified for unsafe operation or that do not have a device that is brought into specs during the allotted competition period will have TS and BS scores of 0.
  - h. Participants will be informed before the next launch if they have received a penalty.
  - i. Tiebreakers: 1<sup>st</sup>: highest sum of the two TSs used for the FS; 2<sup>nd</sup> highest overall TS; 3<sup>rd</sup> highest Far TS not used for the FS; 4<sup>th</sup> highest Near TS not used for the FS

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



1. **DESCRIPTION:** Teams must construct an antenna device prior to the tournament that is designed to transmit a signal at 2.4 GHz and complete a written test on the principles of electromagnetic wave propagation.

**A TEAM OF UP TO:** 2

**IMPOUND:** Yes

**APPROX. 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 also bring tools, supplies, writing utensils, and two stand-alone calculators of any type for use during any part of the event. These items need not be impounded.
- Each team must impound their device, a device diagram, and copies of graphs and/or tables for scoring. Bonus points are given for devices impounded in a labeled box.
- The event supervisor will provide the testing materials listed in the COMPETITION AREA section.
- 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](http://www.soinc.org).

3. **CONSTRUCTION PARAMETERS:**

- Each team may bring one pre-constructed antenna device.
- The device must fit within a 15.0 cm x 15.0 cm x 15.0 cm cube during all parts of the competition and must be supported solely by the backplane and the SMA-Female connector mounted in the backplane.
- The device must include an SMA-Male connector that can be connected to the backplane connector.
- The device may be constructed of any materials except for commercial antenna parts or magnets.
- The device must be entirely passive; no batteries, AC power or other energy sources are permitted.
- The device must be designed and operated in such a way to not damage or alter the backplane or SMA-F connector (e.g. due to excessive weight/torque, residue on the metal sheet, etc.). Devices are recommended to weigh less than 300 g.
- Prior to competition, teams must calibrate devices by preparing graphs/tables showing the relationship between power and distance for various device or testing setup configurations. A labeled device diagram should be included.
  - 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.
  - 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](http://www.soinc.org).
  - Teams are encouraged to have a duplicate set to use, as those submitted may not be returned

4. **DESIGN LOG:**

- Teams must submit a Design Log along with their device. The log must include the following:
  - Materials used to construct the device
  - A labeled diagram or picture that identifies and describes the parts
  - Team name, team number, and appropriate metric units for all numerical values
- 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.
  - 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
- All submitted logs will be returned to teams.

5. **THE COMPETITION:**

**Part I: Written Test**

- 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.
- Unless otherwise requested, answers must be in metric units with appropriate significant figures.



- c. The test will consist of at least five questions from each of the following areas:
  - i. The Electromagnetic Spectrum, radio waves, and EM wave propagation
  - ii. Relating velocity, wavelength, and frequency for waves, with emphasis on radio waves
  - iii. Common antenna designs, compare/contrast different types of antennas
  - iv. **STATE AND NATIONAL ONLY - Mathematical questions involving common antenna designs**
  - v. **STATE AND NATIONAL ONLY - Gain patterns, the wave equation, impedance, bandwidth, noise, and information**

## Part II: Device Testing

- a. Teams have a total of 5 minutes to adjust and repair their device, and make 3 connection attempts. Event Supervisors will give teams a warning at 4 minutes. Devices that do not meet the construction specs will not be allowed to be tested until brought into spec.
  - b. Once the 5 minute testing period begins, teams may select a starting distance (at 50.0 cm intervals) at which to have the Event Supervisor place the receiver unit.
  - c. Prior to each connection attempt, teams may connect, disconnect, modify or adjust their antenna device **on the backplane. Teams may not move the transmitting device, which is defined as the backplane, tripod, and wires and connections to the router.** During the process, teams may ask the supervisor **to confirm if the antenna has established a connection** with the transmitter. The supervisor must provide only a yes or no response. The team may not ask the supervisor again during the attempt after receiving a yes response.
  - d. Once a team is ready for testing, they must step at least 5 feet away from the device, and notify the Event Supervisor.
  - e. The Event Supervisor will then measure the average dBm reading over a 10 second period using the receiver unit. Modifications are not allowed during the measurement period.
  - f. Connection with the receiver is defined by an average (over 10 seconds) measured dBm reading equal to or higher than the threshold dBm reading obtained by the Supervisor's 3.1 cm monopole antenna.
  - g. If connection was achieved, the team may elect to move the receiver to a farther distance for their next attempt. If connection was not achieved, they may elect to move the receiver to a closer distance for their next attempt but must not be allowed to move to a farther distance for their next attempt.
  - h. Event Supervisors must record the distance of all attempts and whether the connection was successful.
  - i. Teams that achieve connection at the longest possible distance (as determined by the competition venue) must have their average dBm reading recorded as a bonus.
  - j. The Supervisor will review with the team the Part II data recorded on their scoresheet.
  - k. Teams filing an appeal regarding Part II must leave their device in the competition area.
6. **COMPETITION AREA:**
- a. Example setups are provided on the event page at [www.soinc.org](http://www.soinc.org)
  - b. The Event Supervisor will provide the testing materials listed below, which will be the same for all teams:
    - i. A transmitter that supplies a 2 mW, 2.4 GHz, 802.15.4 encoded signal (e.g. a standard WiFi access point / router with external antennas)
    - ii. **A ~30.0 cm x ~30.0 cm x ~0.5 cm backplane constructed of a non-conducting, low-dielectric material such as MDF, wood, or particle board (the backplane) attached to a tripod with an SMA-Female connector in the middle**
    - iii. Adapters and an antenna cable to connect the transmitter **to the backplane**
    - iv. **A receiver that can display the received power in dBm with at least -80 dBm sensitivity (WiFiInfoView [https://www.nirsoft.net/utills/wifi\\_information\\_view.html](https://www.nirsoft.net/utills/wifi_information_view.html) is recommended for PCs and the Wi-Fi Scanner Tool that is native in Mac OS X.)**
    - v. A 3.1 cm monopole antenna for setting the connection threshold dBm value
  - c. Tournament personnel are encouraged to provide a long space for device testing and share room specifications with all participants at least two weeks before the competition.
  - d. The Event Supervisor will set up the transmitter and receiver on surfaces that are of equal height and at least 50.0 cm above the floor. Once positioned, the setup must stay the same for all teams.
  - e. Prior to the start of competition, the Event Supervisor will test their provided 3.1 cm monopole antenna at a distance of 3.0 m to determine the connection threshold dBm reading.



## 7. SCORING:

- a. Final Score (FS) = ES + AS + CS + IB + MB. The maximum possible FS is 100 points. A scoring spreadsheet is available at [www.soinc.org](http://www.soinc.org).
- b. Exam Score (ES) = (Part I score / highest Part I score for all teams) x 45 points
- c. Antenna Score (AS) = (greatest successful distance / greatest successful distance for all teams) x 38 points
- d. 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.
  - i. 2 points for including data spanning at least 5m distance
  - ii. 2 points for including at least 10 data points in each data series
  - 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). **Different test runs with the same variables measured are considered distinct graphs or tables.**
  - v. 2 points for including a labeled device diagram
- e. Impound Bonus (IB) = 3 points if device impounded in a box labeled with team name & number
- f. Max Bonus (MB) = If multiple teams achieve connection at the maximum distance, the team with the highest dBm reading at the maximum distance will receive a bonus of four points.
- g. AS must be zero if a team has no successful connection attempts, is disqualified for unsafe operation, or fails to bring a device. Such teams will be allowed to compete in Part I.
- h. If any CONSTRUCTION violation(s) are corrected during the competition block, or if the team misses impound, their connection distance will be multiplied by 0.7 when calculating AS..
- i. A team violating any COMPETITION rules during a successful attempt will have their connection distance for that attempt multiplied by 0.9 when calculating AS.
- j. Tie breakers: 1<sup>st</sup> - Best AS; 2<sup>nd</sup> - Best dBm at max distance; 3<sup>rd</sup> - # successful connections; 4<sup>th</sup> - specific test questions

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



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

**A TEAM OF UP TO:** 2

**IMPOUND:** No

**APPROXIMATE TIME:** 11 minutes

2. **EVENT PARAMETERS:**

- a. Teams may bring up to 2 airplanes, any tools, their flight log, and two stand-alone calculators of any type.
- b. Event Supervisors will provide all measurement tools and timing devices.
- c. 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](http://www.soinc.org).

3. **CONSTRUCTION PARAMETERS:**

- a. Airplanes may be constructed from published plans, commercial kits, **competitors' designs, and/or other sources of design.** Kits must not contain any pre-glued joints or pre-covered surfaces.
- b. Any materials except Boron filaments may be used in construction of the airplane.
- c. Total mass of the airplane throughout the flight, excluding the rubber motor, must be 8.00 g or more.
- d. **The wing must not exceed 45.0 cm horizontally projected wingspan and must not exceed 9.0 cm chord (straight line distance from leading edge of wing to trailing edge, parallel to the fuselage). The horizontal stabilizer must not exceed 28.0 cm horizontal projected span and must not exceed 7.0 cm chord.**
- e. The propeller assembly may be built by the participants or purchased pre-assembled. It may include a propeller, a shaft, a hanger, and/or a thrust bearing. The maximum diameter of the propeller is **24.0 cm.** Variable-pitch propellers that include mechanisms to actively change the blade diameter or angle must not be used.
- f. **A rubber motor not to exceed a mass of 1.50 g, including any attachments such as O-rings, must be the sole power for the airplanes after release. It will be massed separately from the airplane. Motors may be lubricated before and/or after check-in. Up to 6 motors may be checked in.**
- g. Participants may use any type of winder, but electricity may not be available.
- h. The airplane(s) must be labeled so that the Event Supervisor can easily identify to which team it belongs.

4. **FLIGHT LOG:**

- a. **Teams must submit a Flight Log along with their plane. The log must include the following:**
  - i. **Materials used to construct the plane**
  - ii. **A labeled diagram or picture that identifies and describes the parts**
  - iii. **Appropriate metric units for all numerical values**
  - iv. **A front cover labeled with the Team Name and the Team Number for the current tournament**
  - v. **Team name, team number, and appropriate metric units for all numerical values**
- b. The submitted Flight Log should contain recorded data covering 6 or more parameters (3 required and at least 3 additional) for 10 or more test flights prior to the competition.
  - i. The required parameters are:
    - (1) 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 height, the motor torque at landing, etc.).
- c. **If a 3-D printer, laser cutter, CNC machine or similar device was used as a tool to build the team's device, or any component thereof, the following information must also be supplied in the log.**
  - i. **Information about the tool hardware, software, materials, and supplies used**
  - ii. **Details of the source of any digital files (e.g.; CAD, STL, OBJ) utilized by the tool including but not limited to when and where the file was obtained, including the web address if downloaded from the internet**
  - iii. **Descriptions of how the team constructed the final device from the tool created components**
- d. **All submitted logs will be returned to teams.**

5. **THE COMPETITION:**

- a. The event 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. Rooms with minimal ceiling obstructions are preferred over very high ceilings.



- 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 components 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 according to the Event Supervisor's direction.
  - ii. Test flights may occur throughout the contest but must yield to any official flight.
  - iii. No test flights will occur in the final half-hour of the event's last period, except for teams that declare a trim flight during their 8-minute Flight Period.
- d. A self-check inspection station may be made available to participants for checking their airplanes prior to check-in with the Event Supervisor.
- e. Participants will present their event materials (airplanes, motors, and logs) for inspection immediately prior to their Preflight Period.
- f. All motors will be collected at check-in and will be re-issued to the team only for their Preflight Period and 8-minute Flight Period. Time taken during the Preflight Period will impact a team's final score (see 6.b.). Timers will follow and observe teams as they are winding their motors. Event Supervisors will return flight logs after inspection.
- g. A team's Preflight Period ends with their first flight, trim or official, which starts their 8-minute Flight Period or if 3 minutes passes after their motor has been returned, whichever comes first.
- h. Any flight beginning within the 8-minute Flight Period will be permitted to fly to completion. Participants may make adjustments/repairs/trim flights during their official 8-minute Flight Period. Before their launches, participants must indicate to the Timers whether a flight is official or a trim flight. A flight is considered official if a team fails to notify a Timer(s) of the flight's status. Teams must not be given extra time to recover or repair their airplanes.
- i. Teams may make up to a total of 2 official flights using 1 or 2 airplanes.
- j. Time aloft for each flight starts when the airplane leaves the participant's hand and stops when any part of the airplane touches the floor, the lifting surfaces no longer support the weight of the airplane (such as the airplane landing on a girder or basketball hoop) or the Supervisors otherwise determine the flight to be over.
- k. 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.
- l. Participants must not steer the airplane during flight.
- m. In the unlikely event of a collision with another airplane, a team may elect a re-flight. The decision to re-fly may be made after the airplane lands. Timers are allowed to delay a launch to avoid a possible collision. The 8-minute Flight Period does not apply to such a flight.
- n. The Supervisor will verify with the team the data being recorded on their scoresheet.
- o. Teams filing an appeal must leave their airplane(s) and Flight Log in the event area.

## 6. **SCORING:**

- a. The base score is the Team's longest single official flight time. Ties will be broken by the longest non-scored official flight time.
- b. Motors will be held by the Event Supervisor until they are returned to the team signaling the start of the Preflight Period. Once a team has been re-issued their motors, prior to their 8-minute Flight Period, a timing official will start a Preflight Period stopwatch. If their first airplane flight (powered or unpowered), trim or official, is launched within 3 minutes of the return of motors a 5% bonus will be added to the base score. After 3-minutes have passed since the return of motors, the 8-minute Flight Period will start and no bonus will be awarded.
- c. A bonus of 10% of the flight time will be added to the flight time of an airplane that has the entire surface of the wing between at least 2 ribs or at least one of the wingtip fences completely marked with black marker or black tissue. If no ribs are present, the whole surface must be black.
- d. Teams with incomplete flight logs will have 10% of their flight time deducted from each flight.
- e. Teams without flight logs will have 30% of their flight time deducted from each flight.
- f. Teams that violate a rule under "CONSTRUCTION" or "THE COMPETITION" that does not have a specific penalty will be ranked after all teams that do not violate those rules.

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

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



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](http://store.soinc.org)) carries a variety of resources to purchase for this event; other resources are on the Event Pages at [soinc.org](http://soinc.org)



# TRIAL EVENT RULES

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://www.soinc.org) as they apply to every event.

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

For the 2021-2022 season, we are publishing a selection of Trial Events in the 2022 Rules Manual. The events presented here are not a comprehensive list of all the events under development. For a full list please visit: <https://www.soinc.org/learn/trial-events>. These particular events are being showcased here because of the topics they address, their approach to challenging Science Olympiad participants and their potential to become part of the competition in the next few seasons. Right now, they still need additional testing and trial. Besides being incorporated into this manual the rules for these events and additional resources are posted at <https://www.soinc.org/learn/trial-events>.

We have incorporated the rules for these Trial Events into the 2022 Rules Manual so that all teams, event supervisors, and tournaments have easy access to them. If conditions allow, we encourage State Chapters and Tournament hosts to run some of these Trial Events as they offer participants looking for an extra challenge the ability to compete against like-minded peers while contributing important information to prepare these events to become part of the competition in 2023 and beyond.

If a Tournament does choose to run one of the Trial Events published here, a Trial Event from the Trial Event page, or one of their own creation we would ask that you have both event participants and Event Supervisors complete the appropriate post-event evaluation. These evaluations can be found online at [soinc.org](http://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](http://store.soinc.org)) carries a variety of resources to purchase for this event; other resources are on the Event Pages at [soinc.org](http://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:**

- 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.
- Each team may bring two stand-alone, non-programmable, non-graphing calculators.

3. **THE COMPETITION:**

- 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.**
- 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:

- 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.
- 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:**

- PART A: What nutrients are supplied by mycorrhizal fungi to their plant hosts? What nutrients are supplied by plants to mycorrhizae?
- 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?
- PART C: Define experimental replicate and explain how many replicates were done in your experiment.
- 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:**

- High score wins. Final Score = Exam score (part A, C, and D) + Notebook score (part 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.
- Selected questions on the exam may be used as tiebreakers.
- Notebook score: Score will reflect the accuracy of the material provided, not whether or not the hypothesis was supported. See sample scoresheet.
  - Hypothesis- 15% of score
  - Variables- 25% of score
  - Experimental Control- 10% of score
  - Methods and Materials- 10% of score
  - Results- 15% of score
  - Conclusions- 25% of score



## AGRICULTURAL SCIENCE NOTEBOOK SAMPLE SCORESHEET Total Score 50 points

- |  |                                |                              |                              |
|--|--------------------------------|------------------------------|------------------------------|
| <b>1) Notebook documents an experiment related to agriculture</b><br>Yes- continue to grade<br>No- notebook score is zero  |                                |                              |                              |
| <b>2) Three clear pictures of both team members working together with their plants</b><br>Yes- continue to grade<br>No- notebook score is zero   |                                |                              |                              |
| <b>3) Hypothesis- 15% of score (7.5 points)</b><br>Statement predicts a relationship or trend.<br>Statement gives a specific direction.<br>A rationale is given.   | 3pts<br>3pts<br>1.5 pts        | 2pts<br>2pts<br>1pts         | 0pts<br>0pts<br>0pts         |
| <b>4) Variables- 25% of score (12.5 points)</b><br>Independent variable correctly identified<br>Dependent variable correctly identified<br>Controlled variables corrected identified                     | 4pts<br>4pts<br>4.5pts         | 2pts<br>2pts<br>2pts         | 0pts<br>0pts<br>0pts         |
| <b>5) Experimental Control- 10% of score (5 points)</b><br>Experimental control correctly identified<br>Reason given for experimental control  | 3pts<br>2pts                   | 2pts<br>1pts                 | 0pts<br>0pts                 |
| <b>6) Methods and Materials- 10% of score (5 points)</b><br>Methods listed<br>Materials listed separately from methods   | 3pts<br>2pts                   | 2pts<br>1pts                 | 0pts<br>0pts                 |
| <b>7) Results- 15% of score (7.5 points)</b><br>Qualitative observations are included<br>Quantitative data is given in a table<br>Quantitative data is given in a graph<br>Relevant statistics are given | 2pts<br>2pts<br>2pts<br>1.5pts | 1pts<br>1pts<br>1pts<br>1pts | 0pts<br>0pts<br>0pts<br>0pts |
| <b>8) Conclusions- 25% of score (12.5 points)</b><br>Hypothesis evaluated according to data<br>Reasons to accept/reject given<br>Statements supported by data  | 4pts<br>4pts<br>4.5pts         | 2pts<br>2pts<br>2pts         | 0pts<br>0pts<br>0pts         |

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

**This event is sponsored by Corteva Agriscience**



1. **DESCRIPTION:** Competitors will be assessed on their knowledge of cybersecurity through hands-on tasks as well as theoretical questions focused in the areas of cryptography and web architecture.

**A TEAM OF UP TO: 2**

**APPROXIMATE TIME: 50 minutes**

2. **EVENT PARAMETERS:**

- a. Each team may bring up to two 8.5" x 11" sheets of paper, which may be in a sheet protector sealed by tape or laminated that may contain information on both sides in any form and from any source without any annotations or labels affixed.
- b. Each team may also bring tools, supplies, and writing utensils. Teams may use the internet during the competition only to access an online IDE, reference the official documentation for their programming language of choice, and visit any other website required for the event by the Event Supervisor. Teams may also provide their own mouse.
- c. Supervisors will provide a computer capable of accessing the internet. Tournament Directors are encouraged to provide computer specifications to the teams at least one month in advance.

3. **THE COMPETITION:**

Both Part I and Part II of the event will be provided to the participants at the beginning of the event. Participants may work on both parts simultaneously during the entire event.

**Part I: Written Test (65%)**

- a. Participants will complete a written test consisting of the topics Cryptography and Web Architecture, as well as general cybersecurity principles and concepts.
  - i. Cryptography
    - (1) The cryptographic protocols are limited to:
      - a. Hashing algorithms
      - b. The XOR operation
      - c. Classical Cryptography: Substitution Ciphers, Transposition Ciphers
      - d. Modern Cryptography: RSA, Diffie Hellman Key Exchange, Block Ciphers, Stream Ciphers, Elliptic Curve Cryptography
    - (2) Identifying vulnerabilities in implementations of cryptosystems
    - (3) Common applications of the topics in the Cryptography section (3.a.i)
    - (4) Post-quantum cryptography
  - ii. Web Architecture
    - (1) History of the internet
    - (2) Web page construction: HTML, CSS, JavaScript, APIs
    - (3) HTTP: requests, responses, headers, query parameters, status codes, verbs
    - (4) URL syntax and structure
    - (5) Storage, session management, and cookies
    - (6) Types of networks and connections including TCP/IP, WiFi, and SOHO and how information travels through these networks
    - (7) Common web exploitation techniques
  - iii. Principles of Cybersecurity
    - (1) Authentication and security best practices
    - (2) Cybersecurity ethics
    - (3) Online safety

**Part II: Hands-On Tasks (35%)**

- a. The programming portion of the hands-on tasks will consist of multiple programming problems. Competitors must use an online IDE to write code, and it is suggested that HackerRank is used to host the problems. Each problem must be solved using any of the following supported languages: C, C++, C++11, Java, Python 2, or Python 3. Only the standard library for these languages may be used.
  - i. Competitors will write code to implement various common algorithms to a variety of problems and test cases. Topics may include, but are not limited to:
    - (1) String manipulation
    - (2) Boolean expressions
    - (3) Control structures
    - (4) Implementation of math operators and integer evaluation, such as primality tests and prime sieves



(5) Recursion

- ii. Test cases for programming challenges will be provided to teams to test their program. The problem statement may include time and memory constraints, and these constraints may vary by language; any given test case will fail if these constraints are not met.
- iii. Each problem will be checked against the answer and the code submitted. Point values may vary between questions based on difficulty and points given may be determined by the number of test cases passed.
- iv. Teams will be required to submit their code to the event supervisor at the end of the event.

4. **SCORING:**

- a. High score wins.
- b. The written portion will account for 65% and the hands-on portion will account for 35% of the total number of available points.
- c. In the written portion, points will be awarded based on accuracy of the responses. In the hands-on portion, points will be awarded based on accuracy of outputs.
- d. Ties will be broken by 1) Part II score, 2) Selected questions from the written test.

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

Topic Rotation

Year	Topic 1	Topic 2
Year 1	Web Architecture	Cryptography
Year 2	Cryptography	Data Forensics
Year 3	Data Forensics	Web Architecture



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  $\geq 22.5$  cm and two must be “3D Pin Supports” with x-coordinates  $\leq -22.5$  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](http://store.soinc.org)) carries a variety of resources to purchase for this event; other resources are on the Event Pages at [soinc.org](http://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 ft<sup>2</sup> 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](http://store.soinc.org)) carries a variety of resources to purchase for this event; other resources are on the Event Pages at [soinc.org](http://soinc.org)

**This event is sponsored by Corteva Agriscience**



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

**A TEAM OF UP TO:** 2

**IMPOUND:** Yes

**EVENT TIME:** 18 minutes

2. **EVENT PARAMETERS:**

- a. Each team must bring and impound one Robotic Vehicle, a practice log, programming unit (except laptops), and any additional/spare parts.
  - i. If the programming unit is a laptop, then a USB Flash Drive must be impounded instead of the laptop. The USB drive must contain only one robot program that is the starting program for the robot.
- b. The practice log is the only paper or notes that the competitors may bring into the event area and must be impounded.
- c. Teams may bring tools which do not need to be impounded. Tools may include a stand-alone non-programmable, non-graphing calculator as defined in the calculator policy found on [www.soinc.org](http://www.soinc.org).

3. **CONSTRUCTION PARAMETERS:**

- a. The autonomous robotic vehicle must be designed and programmed to follow track lines, make decisions at intersections, travel between gates, and stop at a designated target point on the track without external interactions.
- b. Electrical energy used by the Robot for any purpose, including propulsion, must be stored in a maximum of 8 (eight) AA 1.2 to 1.5-volt common, commercially available batteries, individually labeled by the manufacturer. Rechargeable batteries are allowed.
- c. Any battery containing lithium or lead acid is not permitted. Teams using these batteries will not be permitted to run and will receive only participation points.
- d. Batteries and robotic vehicle are to remain separate from the moment they are impounded until after the start of the team's time slot. At Impound, the batteries to be used must be submitted in a non-metallic container free of any items that might cause a short circuit. The robot should be submitted at the same time but physically separate from the batteries. Teams violating any of these conditions will have the opportunity to remedy the situation to the satisfaction of the Event Supervisor should time allow. The Event Supervisor will instruct the teams when to install the batteries and prepare their Robot for its run.
- e. An approximately ¼" round wooden dowel must be attached to the front of the robot. When the robotic vehicle is in the ready-to-run configuration, the dowel must be approximately perpendicular to the floor, extend to within 1.0 cm of the floor, and extend at least 10.0 cm above the floor. The dowel must be the leading part of the Robot at all times and easily accessible by the Event Supervisor. The dowel attachment device may not extend more than 0.5 cm beyond the front of the dowel. The dowel's front bottom edge will be the Robot's Measurement Point for distance measurements.
- f. The entire Robot in the ready-to-run configuration must fit in any orientation in a 30.0 cm by 30.0 cm space of any height.
- g. All parts of the Robot must move as a whole; no tethers or other separate pieces are allowed. The only parts allowed to contact the floor during the run are parts already in contact with the floor in the ready-to-run configuration. Pieces falling off during the run constitutes a construction violation.
- h. 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](http://www.soinc.org).

4. **PRACTICE LOG:**

- a. Teams must record the target time, run time, distance from target, and gates, if used, for at least 10 practice runs while varying (and recording) at least one Robot parameter (path taken, gates, ...) for each run.
- b. Logs must be impounded and will be returned when the team is called to compete.

5. **THE COMPETITION:**

- a. The start point, target point, target time, and number of gates to be passed along with their locations are chosen by the Event Supervisor (ES) and must not be announced until the impound period is over. The number of gates will be up to 3 for regionals, up to 4 for states and up to 6 for nationals. The target time will be chosen between 30 and 60 seconds.
- b. Only participants and the Event Supervisors will be allowed in the event area. Once participants enter the event area to compete, they must not leave or receive outside assistance, materials, or communication.



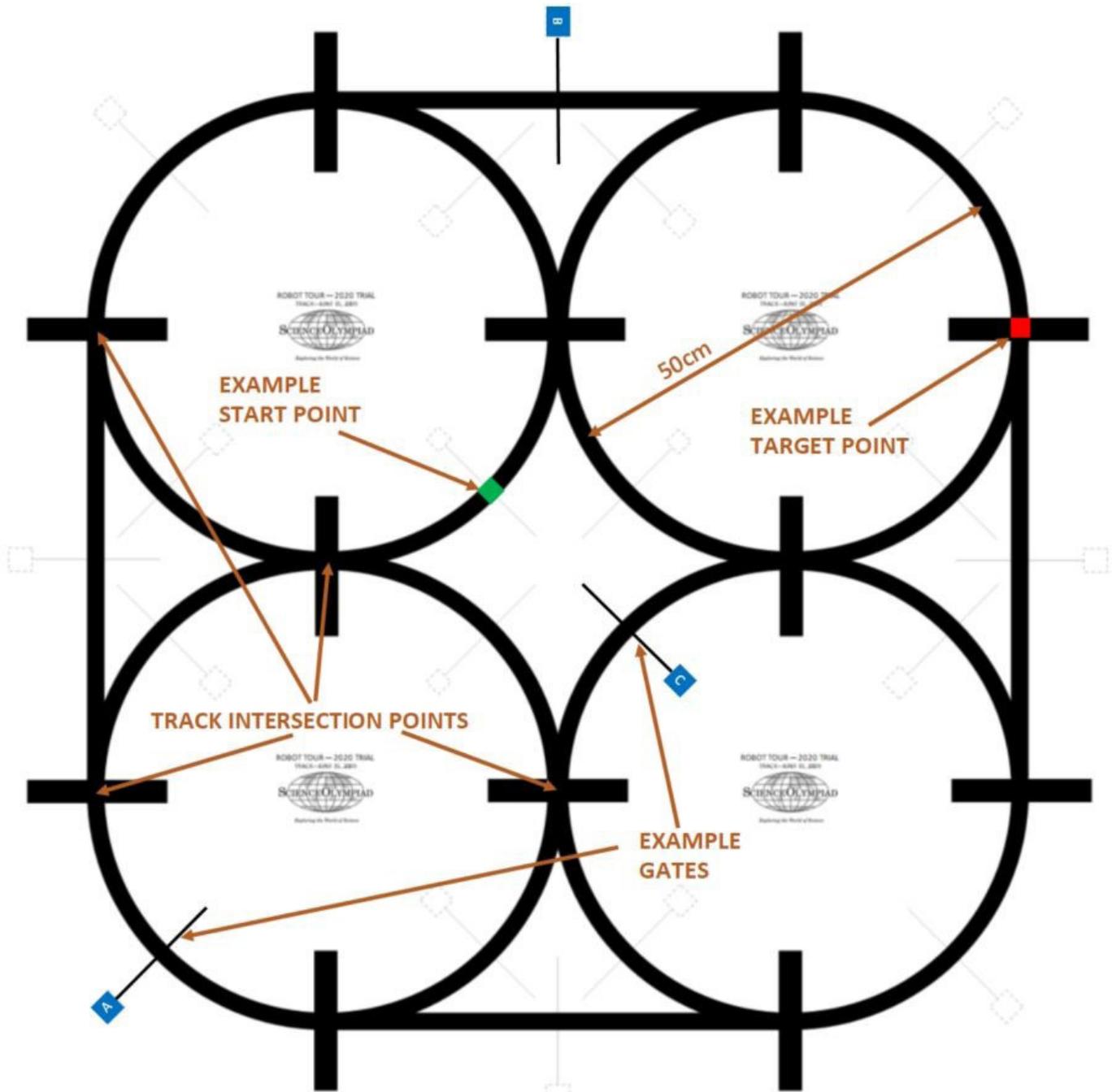
- c. “Participants will be given a maximum 10 minutes for Setup Time and a maximum of 8 minutes for Track Time to perform the following actions. The Event Supervisor will record the total Track Time used, which may affect all scored runs.
    - i. Setup Time starts at the completion of the construction checks and opening the programming software (if programming unit used). Teams are not allowed to test their devices during the Setup Time.
    - ii. Track Time starts once the team begins work at the track area and stops at either 8 minutes or after the team’s last allowed run. The Track Time will not include time used by the Event Supervisor for measuring. If a run has started before the 8-minute period has elapsed, it will be allowed to run to completion. The recorded Track Time must stop at 8 minutes.
  - d. Teams are allowed to make programming changes to achieve the maximum points during their event time.
    - i. If a laptop is the programming unit, then the competitors must open the single program file from the impounded USB drive in front of the Event Supervisor.
    - ii. Teams must only modify the impounded program file during the competition.
    - iii. Opening other files or referencing the Internet will result in their Final Score placed in Tier IV.
  - e. Competitors may not use AC outlet power during their time slot
  - f. Teams may have up to 2 successful runs or 3 failed runs (whichever comes first). Teams may ask to have the run recorded as a failed run and stop the run. Removing a Robot before the end of a run will be recorded as a failed run.
  - g. In the ready-to-run configuration, the Robot’s Measurement Point must be over the Start Point with the Robot in any orientation. The Robot must remain at the starting position without being touched.
  - h. Teams may adjust their Robot (ex: programming changes, physical modifications, ...) during their event time. The Event Supervisor may re-verify that the Robot meets specifications prior to each run.
  - i. Teams must run their Robot on the track provided by the event supervisor. Running the Robot on any surface other than the event track will result in the team’s next run being recorded as a failed run for each occurrence.
  - j. Participants may clean the track during their event time, but the track must remain undamaged and dry at all times. No wet and/or tacky substances may be applied to the track, wheels, or treads.
  - k. Teams must start the Robot using any part of an unsharpened #2 pencil with an unused eraser, supplied by the Event Supervisor, in any motion to actuate a trigger. They may not touch the Robot to start it, hold it while actuating the trigger, or “push” the Robot to get it started. Once they start a run, the participants must not touch their Robot and must wait until notified by the Event Supervisor to retrieve their Robot.
  - l. Run Time starts when the robot begins to move and ends when the Robot comes to a complete stop; recoils are considered part of the Run Time. If the robot does not move within 3 seconds after coming to a stop, the run is considered to have ended; the 3 seconds are not included in the Run Time. Any action occurring after that time does not count as part of the run. The event supervisor is encouraged to use three timers. The middle time of the 3 timers must be the official Run Time. The Run Time must be recorded in seconds to the precision of the timing devices.
  - m. A Gate Bonus is awarded for each Gate crossed in any order. Each Gate may only be counted once. The dowel rod or dowel attachment device must be the first part of the robot to travel across the Gate line.
  - n. A Failed Run occurs for any run that:
    - i. Does not finish within twice the target time
    - ii. The Robot exits the track area as determined by all Robot floor contact points being completely outside of the track’s outer perimeter lines.
    - iii. If the time and/or distance cannot be measured for a Robot (e.g., it starts before the Event Supervisor is ready, the participants pick it up before it is measured).
  - o. If the Robot does not move upon actuation of the trigger, it does not count as a run and the team may set up for another run.
  - p. A team filing an appeal must leave their Robot and programming unit/USB in the competition area.
6. **THE TRACK:**
- a. The track area will be on a smooth, level, and hard surface. See website for track diagram PDFs with different printing options. One of these track PDFs must be used as the competition track.
  - b. The track area will be 4 circles with a diameter of 50cm. The circles are arranged 2 by 2 with the tangent points overlapping. The outer perimeter of the circles is connected by 4 straight lines. The track lines are approximately 1.9cm wide black lines on a white background.



- c. The 12 intersection points are marked by an approximately 2.5 cm wide by 15cm long black line centered and perpendicular to the intersection point.
  - d. Event Supervisor will use an approximately 1.9 cm by 1.9 cm pieces of tape to mark the Start and Target Points, with the Start and Target Point marked in the center each piece of tape. The Start Point may be placed at approximately halfway between any two intersection points. The Target Point may be placed at any intersection point.
  - e. Gates can be placed at approximately halfway between any two intersection points. A Gate cannot be at the same location as the Start point. The Gate is indicated by a 15cm thin line centered on the track line. The Gate line is marked by a single piece of tape 2.5 cm by 2.5cm at one end with a Gate letter (Ex: "A", "B", "R", "X", ...). There must be a gap of 6.0 cm between the Gate tape marker and all track lines.
  - f. At the Event Supervisor's discretion, more than one track may be used. If so, the team may choose which track they use. All runs must be on the same track.
7. **SCORING:**
- a. The team with the lowest Final Score in the wins.
  - b. Each team's Final Score is their lowest Run Score.
  - c. The Run Score for each run:
    - i. Non Failed Run = Time Score + Distance Score + Gate Bonus + Penalties.
    - ii. Failed Run = 750 points + Penalties
  - d. The Time Score for each run is determined by:
    - i. Run Time less than Target Time: Time Score = (Target Time - Run Time) x 2
    - ii. Run Time greater or equal to Target Time: Time Score = (Run Time - Target Time)
  - e. The Distance Score for each run = Robot Distance x 1 point/cm. The Robot Distance is the point-to-point distance from the Measurement Point to the Target Point in centimeters measured to the nearest 0.1 cm.
  - f. Gate Bonus for each run = -15 points for each gate crossed in any order.
  - g. Teams may incur the following Penalties that affect all Run Scores.
    - i. Recorded Track Time will incur a penalty of 1 point for every 10 seconds beyond 4 minutes.
    - ii. Incomplete Practice Logs will incur a Penalty of 250 points.
    - iii. Teams without impounded Practice Logs will incur a Penalty of 500 points.
    - iv. Competition Violation: 500 points added to each Run Score that has 1 or more Competition Violations.
    - v. Robot Not Impounded: 10000 points added to each Run Score.
    - vi. Construction Violation: 1000 points added to each Run Score that has 1 or more Construction Violations.
  - h. Ties must be broken by this sequence: 1. Lower Time Score on scored run; 2. Lower Robot Distance on scored run. 3. Higher number of Gates crossed on scored run. 4. Lower event time used. 5. Next better non-scored run score.
8. **SCORING EXAMPLE:** At a competition, the track has 3 Gates (A, B & C). Target Time is 43s. A team's Robot stopped 21.7 cm from the Target Point with a Run Time of 58.53 sec. Gates "C" and "A" were crossed. The team had a recorded Track Time of 5 minutes and 35 seconds. A valid log was impounded.

Time Score	= (58.53 - 43)	= 15.53
Distance Score	= 21.7cm x 1 pt/cm	= 21.7
Gate Bonus	= 2 Gates x -15 pts/Gate	= -30.00
Log Penalty	= 0	= 0.00
Run Time Penalty	= (5:35 - 4:00) / 10	= 9.5
	= (335 - 240) / 10	=
<b>Run Score</b>		<b>16.73</b>

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

- 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 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.
- Event supervisors will supply the water, and thermometers or probes (recommended). Non-contact thermometers are allowed.
- 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](http://www.soinc.org).

3. **CONSTRUCTION PARAMETERS:**

- Devices may be constructed of and contain any materials (e.g., cardboard, aluminum foil, reflective fabric or material, glue, tape, mirrors, tiles and lenses).
- 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.
- Within the device, participants must be able to insert and remove a beaker that they supply (see 2.b).
- 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.
- 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.
- All parts of the device must not be significantly different from room temperature at the start of the event.
- 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.
  - 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.
  - 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](http://www.soinc.org).
  - Teams are encouraged to have a duplicate set to use, as those submitted may not be returned.

4. **THE COMPETITION:**

**Part I: Written Test**

- 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.
- Unless otherwise requested, answers must be in metric units with appropriate significant figures.
- The competition must consist of at least five questions from each of the following areas:
  - Basic information and definitions about energy, work, heat and heat transfer, temperature, temperature scales, thermal energy and insulation.
  - General information about renewable energy including but not limited to solar, wind, hydroelectric, tidal, ocean thermal energy conversion (OTEC), and geothermal.
  - General information about energy conservation practices including but not limited to recycling, reusing, and using materials with greater efficiency.
  - Mathematical relationships and equations used in determining heat loss and gain, specific heat, and heat transfer.

**Part II: Device Testing**

- 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](http://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) =  $(1 - (\text{abs}(\text{final beaker water temp} - \text{predicted final beaker water temp}) / \text{final beaker water temp}))$ . 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: 1<sup>st</sup> — Best TS; 2<sup>nd</sup> — Best HS; 3<sup>rd</sup> — Best PS

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

**This event is supported by Continental Energy Solutions**



1. **DESCRIPTION:** One participant will write a description of an object and how to build it. The other participant will attempt to construct the object in a computer-aided design (CAD) software from this description.

**A TEAM OF:** 2

**APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**

- a. Only the text-editing software used to write the description and the CAD software are allowed. Tournament officials will determine if the software will be provided by the team or the Event Supervisor. No materials or resources are allowed.
- b. Tournament officials must announce the specific CAD software used at the tournament at least 1 month in advance. At the National Tournament, Write It CAD It will be run as a Trial Event using the free version of **Onshape (onshape.com)**. Any team interested in competing in this Trial Event will need to have their own Onshape account prior to the tournament.

3. **THE COMPETITION:**

- a. One participant (the writer) from each team is shown images (e.g. screenshots) of an object from different angles. Event Supervisors must provide image/screenshots from sufficient angles for the team to reconstruct the object. The object and images are the same for all teams, and the object is built in a CAD software.
- b. The writer has twenty-five (25) minutes to type a description of the object and how to build it. There will be no advantage to finishing early.
- c. Drawings and diagrams of the model or subsections of the model are not allowed. Numerals, words and single letters that fit within the context of the written description are allowed. The participant may use abbreviations and do not have to define the abbreviation. Editing, punctuation, underlining, italicizing, bolding, or scientific symbols that fit within the context of the written description are allowed.
- d. The writer will send their description as a TXT, DOC/DOCX or PDF file to the Event Supervisor.
- e. The Event Supervisor will send the description by the writer and a CAD file with the various pieces to the second team member who will take the description and attempt to recreate (build) the original object in twenty (20) minutes. The CAD file will have all the pieces required to recreate the original object and no additional pieces. These pieces will have been moved and rotated. All teams will receive the same CAD file.
- f. The Event Supervisor will provide instructions for how the builder should submit their completed CAD file.
- g. Each participant in this event is expected to work independently of his or her partner. There should be no sharing of information or communication between partners with the exception of files that are shared through the Event Supervisor. Any communication between partners will result in the disqualification of the team from this event.

4. **SCORING:**

- a. The team that builds the object nearest to the original and has a written description with no drawings or diagrams will be declared the winner.
- b. Each individual piece will receive points as applicable for: proper size, color, location, orientation, and/or connection.
- c. Pieces that are connected correctly beyond an incorrect connection will be counted in the score. No penalty will be assessed for parts that were not used.
- d. Time for the construction phase will be used as a tiebreaker. This time is recorded as the duration between when the Event Supervisor sends the builder the CAD file with description and when the Event Supervisor receives the submitted CAD file from the builder.

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

**This event is sponsored by Onshape**

Each team may bring any or all of the items listed below for use in Division C Chemistry Events requiring laboratory equipment. 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:			
	Chemistry Lab	Forensics	Environmental Chemistry	Materials Science
<b>Box</b> - Containing all of the kit materials	X	X	X	X
<b>10 ml Graduated Cylinder</b> - Measuring volumes	X		X	
<b>25 ml Graduated Cylinder</b> - Measuring volumes	X		X	
<b>100 ml Graduated Cylinder</b> - Measuring volumes	X		X	
<b>50 ml Beakers</b> - Doing reactions, developing chromatograms	X	X	X	X
<b>100 ml Beakers</b> - Doing reactions, developing chromatograms	X	X	X	X
<b>250 ml Beakers</b> - Doing reactions, developing chromatograms	X	X	X	X
<b>400 ml Beakers</b> - Doing reactions, developing chromatograms	X	X	X	X
<b>50 ml Erlenmeyer Flasks</b> - Doing reactions	X		X	
<b>125 ml Erlenmeyer Flasks</b> - Doing reactions	X		X	
<b>250 ml Erlenmeyer Flasks</b> - Doing reactions	X		X	
<b>Test Tubes</b> - Mix Chemicals, heat chemicals	X	X	X	X
<b>Test Tube Brush</b> - Clean Test Tubes	X	X	X	X
<b>Test Tube Holder</b> - Holds test tubes for heating	X	X	X	
<b>Test Tube Rack</b> - Hold Test Tubes	X	X	X	X
<b>Spot Plates</b> - For semi-micro scale reactions, testing solubility, pH	X	X	X	
<b>Petri Dishes</b> - Doing reactions, developing chromatograms	X	X	X	X
<b>Slides</b> - To put hairs, crystals, or fibers on for use with a microscope		X		
<b>Cover Slips</b> - To cover & prevent items from coming off slides		X		
<b>Droppers</b> - Add small amounts of liquids to reactions	X	X	X	X
<b>Spatulas or spoons</b> - Getting small amounts of solids out of containers	X	X	X	X
<b>Metal Tongs, Forceps, or Tweezers</b> - Holding & retrieving objects	X	X	X	X
<b>Stirring Rods</b> - Stirring mixtures	X	X	X	X
<b>Thermometer</b> - Determining the temperature of a solution	X	X	X	
<b>pH or Litmus paper</b> - Test acidity or alkalinity of solution	X	X	X	
<b>Hand Lens</b> - Magnification of small items for identification		X		
<b>Flame Loop</b> - For identification of ions in a compound		X		
<b>Cobalt Blue Glass</b> - To filter out any sodium that might contaminate flame test from hands		X		
<b>Filter Paper</b> - Filter solids from liquids	X		X	
<b>Funnel</b> - Hold Filter Paper	X		X	
<b>9V battery</b> - Electrolysis	X		X	X
<b>Alligator Clip Wires</b> - Connecting meters to metals	X		X	X
<b>Nail</b> - Electrolysis	X		X	X
<b>Piece of Cu metal</b> - Electrolysis	X		X	X
<b>Piece of Zn metal</b> - Electrolysis	X		X	X
<b>Multimeter</b> - Measuring current, voltage, and resistivity	X		X	X
<b>9V or less Battery Conductivity Tester</b> - Determining ionic strength of solution	X	X	X	X
<b>Calipers-mechanical, not digital</b> - Measuring lengths very precisely	X			X
<b>Paper Towels</b> - Cleaning	X	X	X	X
<b>Pencil</b> - Writing, Marking Chromatogram		X		
<b>Ruler</b> - Measuring lengths		X		
<b>Magnets</b> - 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.

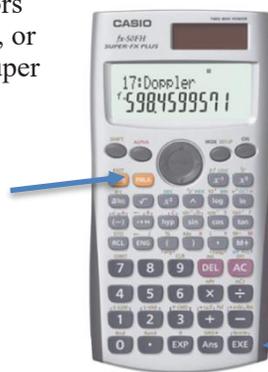


**Class II - Stand-alone non-programmable, non-graphing calculators** look like the calculator to the right or simpler. There are hundreds of calculators in this category but some common examples include: CASIO FX-260, Sharp EL-501, and TI-30X.



**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		
Astronomy		X	X	X	X
Bridge	X				
Cell Biology		X	X		
Chemistry Lab		X	X	X	
Codebusters		X			
Detector Building		X	X	X	
Disease Detectives		X	X		
Dynamic Planet		X	X	X	
Environmental Chemistry		X	X		
Experimental Design		X	X	X	
Forensics		X	X	X	
Gravity Vehicle		X	X	X	
Green Generation		X	X		
It's About Time		X	X	X	
Ornithology	X				
Ping Pong Parachute	X				
Remote Sensing		X	X		
Rocks & Minerals	X				
Trajectory		X	X	X	
WiFi Lab		X	X	X	
Wright Stuff		X	X	X	
Write It Do It	X				
Trial Events					
Aerial Scramble	X				
Agricultural Science		X	X		
Botany		X	X		
Cybersecurity	X				
Digital Structures		X	X		
Home Horticulture		X	X	X	
Robot Tour		X	X	X	
Solar Power		X	X	X	
Write It CAD It	X				



# EYE PROTECTION GUIDE

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://www.soinc.org) as they apply to every event.

This resource was created to help teams comply with the Science Olympiad Policy on Eye Protection adopted on July 29, 2015 and posted on the Science Olympiad Website ([soinc.org](http://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



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

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

For more information about MY SO, please visit [www.soinc.org/myso](http://www.soinc.org/myso)

LESSON PLAN  
(First Wednesday of the month)  
STEM SESSION  
(15th day of the month)  
STEM SHOWDOWN  
(Last Wednesday of the month)

2021-2022  
ACADEMIC YEAR

<b>SEPTEMBER 2021</b> <table border="1"> <tr><th>Su</th><th>Mo</th><th>Tu</th><th>We</th><th>Th</th><th>Fr</th><th>Sa</th></tr> <tr><td></td><td></td><td></td><td>1</td><td>2</td><td>3</td><td>4</td></tr> <tr><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td></tr> <tr><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td></tr> <tr><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td></tr> <tr><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td></td><td></td></tr> </table> <b>EPIDEMIOLOGY</b>	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			<b>OCTOBER 2021</b> <table border="1"> <tr><th>Su</th><th>Mo</th><th>Tu</th><th>We</th><th>Th</th><th>Fr</th><th>Sa</th></tr> <tr><td></td><td></td><td></td><td></td><td></td><td>1</td><td>2</td></tr> <tr><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr> <tr><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td></tr> <tr><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td></tr> <tr><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td></tr> <tr><td>31</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table> <b>FLIGHT</b>	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							<b>NOVEMBER 2021</b> <table border="1"> <tr><th>Su</th><th>Mo</th><th>Tu</th><th>We</th><th>Th</th><th>Fr</th><th>Sa</th></tr> <tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr> <tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td></tr> <tr><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td></tr> <tr><td>21</td><td>22</td><td>23*</td><td>24</td><td>25</td><td>26</td><td>27</td></tr> <tr><td>28</td><td>29</td><td>30</td><td></td><td></td><td></td><td></td></tr> </table> <b>ASTRONOMY</b>	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					<b>DECEMBER 2021</b> <table border="1"> <tr><th>Su</th><th>Mo</th><th>Tu</th><th>We</th><th>Th</th><th>Fr</th><th>Sa</th></tr> <tr><td></td><td></td><td></td><td>1</td><td>2</td><td>3</td><td>4</td></tr> <tr><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td></tr> <tr><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td></tr> <tr><td>19</td><td>20</td><td>21*</td><td>22</td><td>23</td><td>24</td><td>25</td></tr> <tr><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td><td></td></tr> </table> <b>ROCKS &amp; MINERALS</b>	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		<b>JANUARY 2022</b> <table border="1"> <tr><th>Su</th><th>Mo</th><th>Tu</th><th>We</th><th>Th</th><th>Fr</th><th>Sa</th></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td></tr> <tr><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr> <tr><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr> <tr><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td></tr> <tr><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td></tr> <tr><td>30</td><td>31</td><td></td><td></td><td></td><td></td><td></td></tr> </table> <b>ANATOMY &amp; PHYSIOLOGY</b>	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					
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\* The November and December dates of the STEM Showdowns have been adjusted to avoid holidays.

## 2021-2022 Science Olympiad Store Offerings

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



Study materials for all core knowledge & lab events

Tests to practice with from previous National Tournaments



New Coaching Program to support coaches planning their seasons



And Elementary Science Olympiad resources too!



Start shopping today! Visit [store.soinc.org](http://store.soinc.org)



See General Rules, Eye Protection & other Policies on [www.soinc.org](http://www.soinc.org) as they apply to every event.

## 2022 Division C Sample In-Person Tournament Schedule

Event	7:00 – 8:00 AM	8:15 - 9:15 AM	9:30 – 10:30 AM	10:45 – 11:45 AM	12:00 – 1:00 PM	1:15 – 2:15 PM	2:30 – 3:30 PM	7:30– 9:30 PM		
Anatomy & Physiology		51-60	1-10	11-20	21-30	31-40	41-50	Closing Ceremony		
Astronomy		51-60	1-10	11-20	21-30	31-40	41-50			
Bridge		Self-Schedule								
Cell Biology		41-50	51-60	1-10	11-20	21-30	31-40			
Chem Lab		31-40	41-50	51-60	1-10	11-20	21-30			
Codebusters		1-10	11-20	21-30	31-40	41-50	51-60			
Detector Building		21-30	31-40	41-50	51-60	1-10	11-20			
Disease Detectives		11-20	21-30	31-40	41-50	51-60	1-10			
Dynamic Planet		1-10	11-20	21-30	31-40	41-50	51-60			
Environmental Chemistry		51-60	1-10	11-20	21-30	31-40	41-50			
Experimental Design		41-50	51-60	1-10	11-20	21-30	31-40			
Forensics		41-50	51-60	1-10	11-20	21-30	31-40			
Gravity Vehicle		Impound	Self-Schedule							
Green Generation			21-30	31-40	41-50	51-60	1-10		11-20	
It's About Time	Impound	11-20	21-30	31-40	41-50	51-60	1-10			
Ornithology		1-10	11-20	21-30	31-40	41-50	51-60			
Ping Pong Parachute		Self-Schedule								
Remote Sensing		11-20	21-30	31-40	41-50	51-60	1-10			
Rocks & Minerals		21-30	31-40	41-50	51-60	1-10	11-20			
Trajectory		Self-Schedule								
WiFi Lab		31-40	41-50	51-60	1-10	11-20	21-30			
Wright Stuff		Self-Schedule								
Write It, Do It		31-40	41-50	51-60	1-10	11-20	21-30			



*Exploring the World of Science*



# NATIONAL TOURNAMENT SCHEDULE

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://www.soinc.org) as they apply to every event.

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

<b>Division C Tournament Day Schedule</b>						
<b>Events</b>	<b>HST</b>	<b>AKDT</b>	<b>PDT</b>	<b>MDT</b>	<b>CDT</b>	<b>EDT</b>
Trial Events	<i>3:50 AM</i>	<i>5:50 AM</i>	<i>6:50 AM</i>	7:50 AM 1-58	8:50 AM 1-58	9:50 AM 1-58
Codebusters, Dynamic Planet, Ornithology	<i>5:00 AM</i>	<i>7:00 AM</i>	8:00 AM 1-58	9:00 AM 1-58	10:00 AM 1-58	11:00 AM 1-58
Disease Detectives, It's About Time (Test), Remote Sensing	<i>6:10 AM</i>	8:10 AM 1-59	9:10 AM 1-59	10:10 AM 1-59	11:10 AM 1-59	12:10 PM 1-59
Detector Building (Test), Green Generation, Rocks & Minerals	<i>7:20 AM</i>	9:20 AM 1-59	10:20 AM 1-59	11:20 AM 1-59	12:20 PM 1-59	1:20 PM 1-59
Chem Lab, WiFi Lab (Test), Write It Do It	8:30 AM All Teams	10:30 AM All Teams	11:30 AM All Teams	12:30 PM All Teams	1:30 PM All Teams	2:30 PM All Teams
Cell Biology, Experimental Design, Forensics	9:40 AM All Teams	11:40 AM All Teams	12:40 PM All Teams	1:40 PM All Teams	2:40 PM All Teams	3:40 PM All Teams
Anatomy & Physiology, Astronomy, Environmental Chemistry	10:50 AM All Teams	12:50 PM All Teams	1:50 PM All Teams	2:50 PM All Teams	3:50 PM All Teams	4:50 PM All Teams
Codebusters, Dynamic Planet, Ornithology Trial Events	12:00 PM Teams 59-60	2:00 PM Teams 59-60	<i>3:00 PM</i> 1-58	<i>4:00 PM</i>	<i>5:00 PM</i>	<i>6:00 PM</i>
Disease Detectives, It's About Time (Test), Remote Sensing	1:10 PM Team 60	<i>3:10 PM</i>	<i>4:10 PM</i>	<i>5:10 PM</i>	<i>6:10 PM</i>	<i>7:10 PM</i>
Detector Building (Test), Green Generation, Rocks & Minerals	2:20 PM Team 60	<i>4:20 PM</i>	<i>5:20 PM</i>	<i>6:20 PM</i>	<i>7:20 PM</i>	<i>8:20 PM</i>
<p align="center">Times in <i>Italics</i> are for Event Supervisor reference only.            No team will compete in the main Tournament (non-Trial Events) prior to 8:00 AM local time.</p>						
<b>Self-Scheduled Events</b>						
Bridge Detector Building (Device) Gravity Vehicle It's About Time (Device) Ping Pong Parachute Trajectory WiFi Lab (Device) Wright Stuff	<p align="center">Available Event Slots start @ 8:00 AM (PDT).</p>					
<p align="center">The 2022 Science Olympiad National Tournament will be a remote tournament conducted under the Satellite format. Please visit <a href="http://soinc.org">soinc.org</a> for more details.</p>						



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Science Olympiad wishes to acknowledge the following business, government and education leaders for partnering with our organization. Working together, we can increase global competitiveness, improve science and technology literacy and prepare the STEM workforce of the future. Thanks to: Caltech (2022 National Tournament Partner), Arizona State University (2021 National Tournament Partner), NASA's Universe of Learning Astrophysics STEM Learning and Literacy Network, Avantor Foundation, Corteva Agriscience, Combined Federal Campaign, Double Good Foundation, Google, Lockheed Martin, NBC Universal Foundation, Ward's Science, Discovery Education 3M Young Scientist Challenge, Intel, Kinder Morgan Foundation, Centers for Disease Control and Prevention (CDC) Foundation, North American Association for Environmental Education (NAAEE), National Oceanic and Atmospheric Administration (NOAA), Texas Instruments, ThermoFisher Scientific, University of Delaware, Continental Energy Solutions, Hikma Pharmaceuticals, Investing in Communities, National Free Flight Society (NFFS), Onshape, SkyCiv and Yale Young Global Scholars. Strategic Partners: Code.org, Japan Science and Technology Agency, mHUB, Midnight Science Club, Million Women Mentors (MWM), MxD (The Digital Manufacturing Institute) and STEMConnector.

See the Science Olympiad website: [www.soinc.org](http://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

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