SCIENCE OLYMPIAD™

Exploring the World of Science

Division B Rules Manual

Division B (Gr. 6-9)

WELCOME TO THE 2025 SCIENCE OLYMPIAD!

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

See our website for info on Membership, Policies and Terms of Use at www.soinc.org

Division C (Grades 9-12) Membership Rules

A team may have up to fifteen (15) members. A maximum of seven (7) 12th grade students is permitted on a Division C team.

Division B (Grades 6-9) Membership Rules

A team may have up to fifteen (15) members. A maximum of five (5) 9th grade students is permitted on a Division B team. Because middle schools that do not have grades 7, 8 or 9 are at a slight disadvantage, they may invite any combination of up to five (5) of their last year's 6th, 7th or 8th grade students to be part of the team. Possible examples can be found on the Science Olympiad website.

Students Below Grade Level Designations

Science Olympiad encourages students to participate in the Division that matches current Science Olympiad grade level designations. However, to support the inclusion of students who wish to participate in Science Olympiad, schools with grade levels lower than those stated in a Division are permitted to invite members below the grade level designations. Participation is limited to age-appropriate events (as determined by a coach, principal or tournament director) and prohibited where safety is a concern (such as the use of chemicals). See Team Qualifications for more information.

Science Olympiad Team Membership

Science Olympiad requires that all teams (up to 15 members) competing in any Science Olympiad Tournament (Invitational, Regional, State or National) must be a member of Science Olympiad and pay the national fee (currently $75, paid as part of the state membership). There is no exception to this requirement, regardless of what teams from the same school are called (Varsity, JV, Alternate Team, Extra Team, Team Two, Team B). No school, region or state Science Olympiad organization is allowed to alter or amend these national membership requirements. Please see the Science Olympiad Copyrights and Use Statement outlining use of Science Olympiad Rules and procedures at sanctioned tournaments.

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

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SCIENCE OLYMPIAD
DIVISION B RULES MANUAL

Table of Contents

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

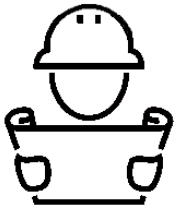
EVENT TYPE DESCRIPTIONS

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

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

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

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



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

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

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

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

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

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

GENERAL RULES

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

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

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

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

AIR TRAJECTORY B

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

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

   A TEAM OF UP TO: 2 **EYE PROTECTION:** B **IMPOUND:** Yes

   CALCULATOR: Class III **APPROXIMATE TIME:** 10 minutes

2. **EVENT PARAMETERS:**
   a. Each team must impound only one launch device, projectiles, **and calibration data (if prepared).** Items must be moveable by the participants without outside assistance. The device must be impounded with the mass(es) detached, which altogether must not exceed the limits in 3.b. **The calibration data are the only papers or notes that the competitors may bring into the competition area and must be impounded.**
   b. Each team may bring tools, supplies, writing utensils, and two stand-alone calculators (Class III) for use (these items need not be impounded).
   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.

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 85.0 cm per side cube, in any orientation chosen by the team.
   b. The launching force must be entirely supplied by the gravitational potential energy from a falling mass less than or equal to 5.000 kg. Any part of the device whose potential energy decreases and provides launch energy is considered part of the mass, with the exception of items of nominal mass, such as strings and thin membranes/plastic container walls. The falling mass may consist of multiple discrete parts, which together count as the total mass.
   c. Devices will be inspected to ensure that there are no other energy sources. At the Event Supervisor's discretion, teams must disassemble devices after competing in order to verify this.
   d. During each launch, the gravitational potential energy must be converted to air pressure or air movement, which is then used to launch the projectile, either directly (e.g., pop gun style, etc.) or indirectly (e.g., using a pneumatic cylinder to swing an arm, etc.).
   e. All device air chambers must start each launch at ambient air pressure and must automatically return to ambient air pressure. Chambers are not required to automatically return to the same shape.
   f. **The competitors must design the device to trigger by using any part of an unsharpened #2 pencil with an unused eraser, provided by the Event Supervisor, to actuate a release mechanism for the falling mass. The pencil may be the release mechanism itself and may extend beyond the dimensions in 3.a. The device must remain in the ready-to-launch configuration without being touched until triggered by the #2 pencil. The trigger must not contribute any significant energy to the launch.**
   g. **Teams must provide a spherical projectile for their device to launch. The projectile must freely fall through a hole with a 3 inch diameter, but not fall freely through a hole with a 1 inch diameter. Also, the projectile must be made out of a material that will not damage floors. Examples of acceptable projectiles include, but are not limited to: ping pong balls, racquet balls, tennis balls, and low density foam balls. Golf balls are not allowed because they are too dense and can damage the floor. Multiple projectiles may be brought for use.**
   h. The launch device must be designed and operated in such a way to not damage or alter the floor.
   i. Electrical components are not allowed as part of the device or triggering device. However, electronic sighting devices, such as laser pointers, that are removed before launch are permitted.

4. **DESIGN LOG: Competitors are not required to submit a design log for scoring, but competitors are encouraged to collect and impound their own calibration data for their device.**

5. **THE COMPETITION:**
   a. Each team will have 8 minutes to set up, adjust and calibrate their device, and launch a max of 2 shots at each target. Measurement time required by the supervisor is not included in the allotted time. **Competitors will be allowed during their setup time to bring their device into compliance if it does not meet all construction parameters.**

b. When instructed by the event supervisor(s), teams must place their device at a location they select in the launch area. Teams may move devices within the launch area and/or adjust them in any way between and before shots. **Teams may change projectiles for each launch.**
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. Before each launch, teams must notify the event supervisor which target they have selected. **When triggering the device, competitors may not touch any part of the device or the triggering mechanism except the #2 pencil.** Any launch, even if unintended or not announced, will count as one of the four launches allowed to a team.
e. 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.
f. 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.
g. If the first shot at a target lands within 500 mm, a bucket shot may be requested in place of the second shot.
h. The supervisor will review with the team the data recorded on their scoresheet.
i. Teams who wish to file an appeal must leave their device with the event supervisor.

6. **COMPETITION AREA:**
   a. The competition area will consist of a near target **that is elevated** and a far target that is at ground level.
   b. The launch area is a rectangular area 1.5 m wide by 1.5 m long (parallel to the launch direction), designated by tape on the floor. Event Supervisors are recommended to use hard surfaces for the floor (e.g., concrete, hardwood, plywood) and not surfaces designed to minimize impact forces (e.g., turf, running tracks).
   c. Two targets, designated by tape on the floor or panels lying on the floor, must be placed in front of the launch area. Supervisors are encouraged to place sand, cat litter, or a similar substance on the ground and target surfaces to help indicate landing spots.
      i. The **near** target surface must be at least a 1.0 m by 1.0 m square and have a marked center point from which measurements will be taken.
      ii. The near target must be centered on an imaginary center line that bisects the launch area and is parallel to the launch direction. **Prior to the start of the competition, the event supervisor will determine the target elevation which will be the same for all teams.**
         (1) **Regional Level: The surface of the near target is either 0.5 m or 1.0 m above the ground.**
         (2) **State Level: The surface of the near target will be between 1.0 m and 1.5 m, inclusive, above the ground**
         (3) **National Level: The surface of the near target will be between 1.0 m and 2.0 m, inclusive, above the ground**
      iii. The far target, designated by tape on the floor, or panels lying on the floor, must be placed in front of the launch area. The target must have a minimum diameter/length/width of 1.00 m and is recommended to be a square shape. It must have a marked center point from which measurements will be taken.
   d. The marked centers of the targets must be between 2.00 m and 8.00 m in front of the launch area in intervals of 1.00 m for Regionals, 0.50 m for States, 10.0 cm for Nationals. A distance of at least 2.00 m (measured parallel to the imaginary center line) must separate the marked centers of the targets.
   e. The marked center of 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 Event Supervisor) will be placed with the opening facing up anywhere between 2.00 m and 8.00 m in front of the launch area and anywhere up to 2.00 m 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. The bucket may not be the same location as the far target.
   g. Target locations, bucket location, **and near target elevation** 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. High score wins. Final Score (FS) = Best NTS + Best FTS + BS (if any). A scoring spreadsheet is available at www.soinc.org.
   b. Near Target Score (NTS) = 2000 minus the straight-line distance, in mm, from the center of the initial projectile impact to the center of the target. Lowest possible NTS is 0.
      i. If no target is announced, or the shot is a bucket shot attempt, NTS = 0 for that shot.
      ii. Eligible impact locations for the near target include the floor, wall, support column, other target, or other objects.
      iii. 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.
      iv. **Participants must impact the elevated surface of the near target in order for a measurement to be taken. Failure to strike the target surface will result in an NTS = 0 for that shot.**
   c. Far Target Score (FTS) = 4000 minus the straight-line distance, in mm, from the center of the initial projectile impact to the center of the target. Lowest possible FTS is 0.
      i. If no target is announced, or the shot is a bucket shot attempt, FTS = 0 for that shot.
      ii. Eligible impact locations for the far target include the floor, wall, support column, other target, or other objects.
      iii. 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.
   d. Bucket Score (BS) – Hitting the bucket at first impact is worth 200 points. Making contact with the inside bottom surface is worth an additional 300 points (for a total of 500 points).
   e. If a team violates any of THE COMPETITION rules, their TS scores for that launch will be multiplied by 0.9.
   f. **Devices will be placed in tiers as follows:**
      i. **Tier 1: Device meets all construction parameters at the time of its first launch**
      ii. **Tier 2: Device still has a construction violation(s) at the time of its first launch**
      iii. **Tier 3: A team with its device and/or projectiles not impounded or uses calibration data notes that were not impounded**
   g. Teams that **are prohibited from launching** due to unsafe operation or **have a Final Score (FS) of 0** will **receive Participation Points only**.
   h. Participants will be informed before the next launch if they have received a penalty.
   i. Tiebreakers:
      i. 1st: highest sum of the Best NTS and Best FTS used for the FS;
      ii. 2nd: highest overall NTS or FTS;
      iii. 3rd: highest FTS not used for the FS;
      iv. 4th: highest NTS not used for the FS.

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

ANATOMY & PHYSIOLOGY B

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

1. **DESCRIPTION:** Participants will be assessed on their understanding of the anatomy and physiology for the **integumentary, skeletal, and muscular systems of the human body.**

   A TEAM OF UP TO: 2 **CALCULATOR: Class II** **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 along with two stand-alone non-programmable, non-graphing calculators (Class II).

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

   a. **INTEGUMENTARY – All levels should understand:**
      i. Functions of the integumentary system **(e.g., physical protection, Vitamin D synthesis, sensation, excretion, temperature regulation, role of the skin in innate immunity)**
      ii. Anatomy and **histological characteristics** of the layers of the skin
      iii. Anatomy and **histological characteristics** of the component parts of the skin: hair **(e.g., types, appearance, growth cycle),** nails, integumentary glands **(e.g., eccrine vs apocrine),** and sensory receptors
      iv. Skin color, skin texture, and the effects of aging on the skin
      v. **Dermatological features (e.g., freckles, moles, scales, calluses, birthmarks, fingerprints)**
      vi. The diseases on each level from the cell to the whole person as listed: **wounds affecting the skin (limited to burns and their classification, sunburn), allergens** (e.g., poison ivy, metals), human papillomavirus (HPV), **infections (limited** to boils, carbuncles, athlete's foot, impetigo, **erysipelas, cellulitis, Hansen's Disease, chickenpox, shingles), common inflammatory disorders** (limited to psoriasis, dermatitis), and skin cancer **(limited to melanoma, basal cell carcinoma, squamous cell carcinoma, Kaposi's sarcoma, Merkel cell carcinoma)**
      vii. Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)

   State and National Level Only:
      viii. Cellular components of cutaneous immune system (e.g., dermal dendritic cells, dermal macrophages)
      ix. Additional disorders: immunologic and inflammatory disorders (limited to rosacea, vitiligo, bullous pemphigoid, Stevens-Johnson syndrome, erythema nodosum, erythema multiforme, alopecia)

   National Level Only:
      x. Additional disorders: **Congenital disorders (limited to albinism, xeroderma pigmentosum), systemic disorders and their effect on skin (limited to acanthosis nigricans), benign lesions (limited to actinic keratosis)**
      xi. Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)
      xii. Aspects of wound healing including, but not limited to: inflammation, necrosis, apoptosis, vasodilation, and clotting

   b. **SKELETAL SYSTEM – All levels should know and understand:**
      i. Bones of the axial and appendicular skeleton; label the basic surface anatomy of a bone as shown on a diagram and/or normal X-ray, CT and MRI
      ii. Name, structure and function of joint types and muscle, **tendon** and ligament attachments that surround the joints and the ranges of motion allowed by each type (e.g., ball and socket)
      iii. **Structure and microscopic function of bones, bone marrow and cartilage (e.g., storage, osteon, blood cell production)**
      iv. **Tension production (e.g., sarcomere length-tension relationship, muscle twitches, motor units)**
      v. **Skeletal system role in calcium and phosphate balance**
      vi. **Effect of hormones (e.g., PTH, vitamin D, estrogen) on the skeletal system**
      vii. **Cellular composition of bones (e.g., RANKL role in bone cell maturation), bone marrow and cartilage**
      viii. **Development and maturation of bones at the cellular and gross anatomical levels**
      ix. Types of vertebrae (e.g., cervical, thoracic and lumbar)
      x. Characteristics and radiological features of bone diseases/disorders from the cell level to the whole person as listed: **osteoarthritis and rheumatoid arthritis (know how to distinguish both from one another), gout,** osteoporosis, **osteomalacia/rickets, scoliosis, kyphosis, lordosis, Tennis elbow, Golfer's elbow, cruciate ligament tears of the knee, meniscus tears of the knee, and septic arthritis**

xi. The effects of exercise and aging on the skeletal system and the diseases mentioned
xii. **Cardiac and smooth muscle roles in the body (e.g., blood circulation, digestive motility)**
xiii. **Fractures, including the** Salter-Harris fracture classification system, **causes, and treatments**

State and National Level Only:

xiv. Additional diseases/disorders: spinal fractures **(including specific classes),** ankylosing spondylitis, achondroplasia, osteosarcoma, **and Ewing sarcoma**

National Level Only:

xv. Additional diseases/disorders to know: **clinical effects of spinal stenosis, foraminal stenosis, and disc herniation on the nervous system, Osgood-Schlatter disease, plantar fasciitis, Paget disease of bone (osteitis deformans), osteoblastoma, giant cell tumor**
xvi. Treatments and/or prevention for <u>all</u> conditions listed above (drugs, surgery, etc.)
xvii. **Label the bones and sutures of the skull. Know the foramina of the skull and what neurovascular structures pass through each.**

c. **MUSCULAR SYSTEM - All levels should know:**
   i. **Functions of the muscular system (e.g., movement, blood circulation, heat production)**
   ii. The interaction of the skeletal and muscular systems to allow movement and **maintain posture**
   iii. **The cellular and gross anatomy of skeletal muscle, cardiac muscle and smooth muscle**
   iv. **Tension Production (e.g., sarcomere length-tension relationship, muscle twitches, motor units)**
   v. **Physiology of the skeletal muscle contraction and relaxation (e.g., neuromuscular junction, excitation-contraction coupling, cross-bridge cycling)**
   vi. **Concepts of skeletal muscle actions (e.g., agonist, antagonist, synergist muscles) of different muscles on the 2025 National Major Skeletal Muscles List**
   vii. Location and identification (e.g., origin, insertion, function) of the muscles on the 2025 National Major Skeletal Muscles List
   viii. Exercise and aging effects on the cellular and gross anatomical structure of the muscular system
   ix. Muscle and tendon injuries and their prevention **(limited to strains and sprains)**
   x. The diseases on each level from the cell to the whole person as listed: **neuromuscular junction disorders (limited to myasthenia gravis, Lambert-Eaton myasthenic syndrome), immunologic and inflammatory disorders (limited to polymyalgia rheumatica, polymyositis, and dermatomyositis), infectious disorders (limited to** botulism, **tetanus, poliomyelitis), and pain syndromes (limited to fibromyalgia, chronic fatigue syndrome,** Carpal Tunnel Syndrome)

State and National Level Only:

   xi. **Energy metabolism in skeletal muscles (limited to phosphocreatine system, glycogen storage and consumption)**
   xii. **Additional diseases: rhabdomyolysis, Duchenne muscular dystrophy, myotonic dystrophy**
   xiii. **Cardiac and smooth muscle roles in the body (e.g., blood circulation, digestive motility)**

National Level Only:

   xiv. Nerve innervation for all muscles on the 2025 National Major Skeletal Muscles List
   xv. **Muscle reflexes (limited to Golgi tendon organ, muscle spindle fibers)**
   xvi. Additional diseases: **congenital disorders and iatrogenic disorders (limited to drug-induced myositis, malignant hyperthermia)**
   xvii. Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)
   xviii. **Effects of steroid medications on muscle health**

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

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

2025 NATIONAL SKELETAL MUSCLES LIST

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

Head and Neck

- Frontalis
- Orbicularis oris
- Orbicularis oculi
- Occipitofrontalis
- Zygomaticus major
- Masseter
- Sternocleidomastoid
- Trapezius
- Buccinator

Move the Upper Extremities

- Pectoralis major
- Latissimus dorsi
- Deltoid
- Teres major
- Biceps brachii
- Triceps brachii
- Brachialis
- Brachioradialis
- Palmaris longus
- Flexor carpi radialis
- Flexor digitorum superficialis
- Extensor carpi radialis
- Extensor digitorum
- Extensor digiti minimi
- Extensor carpi ulnaris
- Infraspinatus
- Supraspinatus
- Subscapularis
- Teres Minor

Muscles of the Trunk

- External intercostals
- Internal intercostals
- Transverse abdominis
- Rectus abdominis
- Serratus anterior
- Diaphragm

Move the Lower Extremities

- Iliopsoas
- Sartorius
- Gluteus maximus
- Gluteus medius
- Tensor fasciae latae
- Adductor longus
- Gracilis
- Semimembranosus
- Semitendinosus
- Biceps femoris
- Rectus femoris
- Vastus lateralis
- Vastus intermedius
- Vastus medialis
- Tibialis anterior
- Gastrocnemius
- Soleus
- Peroneus longus
- Peroneus brevis

CODEBUSTERS B

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

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

   A TEAM OF UP TO: 3 **CALCULATOR:** Class I **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 (Class I).
   b. No resource materials, except those provided by the Event Supervisor, may be used.
   c. The Event Supervisor will provide scratch paper for each team to use.
   d. The exam packet will include **a copy for each team member of** a resource sheet with the Morse Code Table, English/Spanish letter frequencies, Porta Table, Atbash Table, Baconian mappings and modulus inverse tables as needed for the questions on the exam.

3. **THE COMPETITION:**
   a. This event consists of participants using cryptanalysis techniques and advanced ciphers to decrypt messages on a written or computer based exam.
   b. Teams will begin the event simultaneously at the indication of the Event Supervisor.
   c. Teams must not open the exam packet nor write anything prior to the "start" signal, nor may they write anything after the "stop" signal.
   d. Participants are allowed to separate the pages of the test to be free to answer the questions in any order, working individually or in groups, attempting whichever of the questions seem right for them.
   e. The code types that may be used at Division B Regional Tournaments are as follows:
      i. Monoalphabetic substitution using K1, K2, or random alphabets as defined by the American Cryptogram Association (ACA) with or without a hint
         (1) Aristocrats - messages with spaces included but no spelling or grammar errors
         (2) Aristocrats - messages with spaces including spelling/grammar errors
         (3) Patristocrats - messages with spaces removed with letters grouped in sets of 5
      ii. The Baconian Cipher - decrypting ciphertext encoded with the a and b values represented as one or more letters, glyphs, symbols, or character rendering variations (e.g., bold, underline, italic)
      iii. Xenocrypt - no more than one cryptogram can be in Spanish
      iv. Cryptanalysis of the Fractionated Morse Cipher - decrypting Morse code ciphertext encoded as letters and spaces with a "crib" of at least 4 plaintext characters.
      v. Cryptarithms - determining mapping values to letters in base 10 (decimal) mathematical equations and decoding a word or phrase using that mapping
      vi. The Porta Cipher - Decrypting ciphertext given a key
      vii. Cryptanalysis of the Complete Columnar Transposition Cipher - Decrypting ciphertext encoded in 9 columns or less given a "crib" which is no shorter than one less than the number of columns used.
      viii. The Nihilist Cipher - Decrypting ciphertext given the keys
      ix. The Atbash Cipher (In English, not Hebrew)
      x. The Caesar Cipher, also called a shift cipher.
      xi. The Affine Cipher - Decrypting ciphertext given the a and b values
   f. 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 Porta Cipher with a "crib" of at least 3 plaintext characters.
      iv. Cryptanalysis of the Affine Cipher with a "crib" of at least 2 plaintext characters
      v. Cryptanalysis of the Nihilist Cipher with a "crib" that is no shorter than the length of the keyword used.
   g. For aristocrats, patristocrats, and xenocrypts, no letter can ever decrypt to itself.
   h. The first question of the exam will be timed.
      i. The first question will be the decoding of an Aristocrat as defined by 3.e.i.(1)
      ii. A team member should signal when his or her team has broken the cryptogram.
      iii. Before the exam begins, the Event Supervisor will announce the nature of the signal that must be used (e.g., shouting "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.

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

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

4. **SCORING:**

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

b. The scores for each question will be added together to determine the exam score.

c. Unless otherwise specified, the final points will be determined based on the number of errors found in the decoded plaintext as is appropriate to the question.
   i. Two or fewer errors will be scored as correct and result in full credit.
   ii. Each additional error results in a penalty of 100 points but the penalty will not exceed the value of the question. For example, a 400-point question with 5 errors earns 100 points [400 - 3(100)] whereas the same 400-point question with 7 errors would earn 0 points, not -100 points.

d. For answers to Cryptarithm (3.e.v) problems, the final points will be determined based on the number of errors found in the keyword or key phrase
   i. Zero errors are required for full credit.
   ii. Each error results in a penalty of 100 points but the penalty will not exceed the value of the question. For example, a 500-point question with eight (8) errors would earn 0 points, not -300 points.

e. A Timing Bonus can be earned based on the number of seconds it takes a team to correctly decode the first question. The timing bonus is equal to 2 x (600 - number of seconds). For example, 6 minutes = 2 x (600-360) = 480 points.

f. A special Bonus can be earned by solving any of the questions marked as special bonus questions with no penalty points. The bonus will be awarded as follows: One solved = 150 points, Two solved = 400 points, All three solved = 750 points.

g. Scoring example: Team A earns 3600 points on the exam and solved the timed question in 435 seconds and solved one Special Bonus question

   Exam Score = 3600 points
   + Timing Bonus 2(600-435)= 330 points
   + Special Bonus (One=150)= 150 points
   Final Score 4080 points

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

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

CRIME BUSTERS B

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

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

A TEAM OF UP TO: 2 **EYE PROTECTION:** C

CALCULATOR: Class II **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. Each participant may bring one **unique** 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 and one non-programmable calculator (Class II).
   b. Each team may bring any or all of the items listed as Recommended Equipment for Division B Chemistry Events, posted on soinc.org. Teams not bringing these items may be at a disadvantage. The Supervisor will not provide them.
   c. Teams may bring only specified items. Other items not listed are prohibited. The Event Supervisors will check each team's equipment, confiscate non-allowed items, and have the right to penalize the team up to 10% if additional equipment is brought to the event.
   d. Participants must wear goggles, an apron or a lab coat and have skin covered from the neck down to the wrist and toes. Gloves are optional, but if the host requires a specific type, they will notify teams. Pants should be loose fitting; if the host has more specific guidelines, they will notify teams in advance of the tournament. Shoulder-length or longer hair must be tied back. Participants removing safety clothing/ goggles or unsafely handling materials, or equipment will be penalized or disqualified.
   e. The Supervisor will provide:
      i. Iodine reagent (I_2 dissolved in KI solution)
      ii. 1M HCl
      iii. Chromatography materials plus containers
      iv. Waste container(s)
      v. Wash bottle with distilled water (no more than 250 mL)
   f. The Supervisor may provide:
      i. Other equipment (e.g., microscope, probes, calculator, etc.)
      ii. Candle & matches if fibers given
      iii. Differential density solutions or other method of determining density of polymers if plastics given
      iv. Reagents to perform additional tests

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

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

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

d. Polymer Testing/Natural and Man-made Substances: Participants will demonstrate their skill in analyzing evidence from a variety of sources such as:
   i. Hair - the difference between human, dog, and cat; not specific kinds of hair like guard.
   ii. Fibers - the difference between animal, vegetable, and synthetic; not specific kinds of fibers like silk.
   iii. Recyclable Plastics - PETE, HDPE, non-expanded PS, LDPE, PP, PVC, PMMA. Burn tests will not be conducted but burn results may be provided.

e. Paper Chromatography: Participants will analyze evidence from paper chromatography (ink pens, juices, Kool-Aid®, etc.). The paper chromatogram(s) will be collected with the score sheet. **R_f's will need to be able to be calculated.**

f. Crime Scene Physical Evidence: Participants will also demonstrate their skill in analyzing evidence from a variety of other sources such as:
   i. Fingerprints: Participants may be asked to identify different patterns on fingerprint evidence such as the difference between whorls, loops, and arches.
   ii. DNA evidence: Participants may be asked to compare DNA chromatograms/electropherograms from materials found at the scene to those of the suspects.
   iii. Shoeprints & tire treads: Participants may be asked to compare prints and make conclusions such as direction and speed of travel. No calculations are expected to be performed.
   iv. Soil: Participants may be given the composition of soil found at the scene or on the suspects and asked to determine if this implicates any of the suspects.
   v. Spatters: Analyze spatter patterns for speed and direction of impact. No calculations are expected to be performed.

g. Analysis: Participants will be asked to write an analysis of the crime scene explaining not only which pieces of evidence implicate which suspect and why the suspect(s) was (were) chosen as the culprit(s), but also why the other suspects were not chosen. They will also answer any other crime scene analysis questions posed by the Event Supervisor.

h. Teams will dispose of waste as directed by the Event Supervisor.

4. **SCORING:**

a. The team with the highest score wins. Time will not be used for scoring.

b. The score will be composed of the following elements (percentages given are approximate):
   i. 3.c. = 50%
   ii. 3.d. = 10%
   iii. 3.e. = 5%
   iv. 3.f. = 10%
   v. 3.g. = 25%
   vi. Actual point values will be shown at each question.

c. The tiebreakers in order are the score from:
   i. Part 3.g.
   ii. Part 3.c.
   iii. Part 3.d.

d. A penalty of up to 10% may be given if the area is not cleaned up as instructed by the Event Supervisor.

e. A penalty of up to 10% may be given if a team brings prohibited lab equipment to the event.

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

DISEASE DETECTIVES B

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

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

   A TEAM OF UP TO: 2 **CALCULATOR:** Class II **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 (Class II).

3. **THE COMPETITION:**

   a. This event addresses three topics related to disease, injury, health, and disability in populations or groups of people. Each part should count approximately equally towards a team's final score. Questions should be process-oriented and involve skills in evaluation and interpretation. Matching pathogens with specific diseases (i.e. – What causes X disease?) or knowledge of signs, symptoms or epidemiologic characteristics such as incubation or latency periods or infectious dose is not part of this event. However, it is appropriate to provide this information as background information and expect competitors to be able to use it.

   b. The topics for this event are as follows:

      i. Background & Surveillance
         (1) Understand the Clinical Approach (health of individuals) vs Public Health Approach (health of populations)
         (2) Understand the history and development of epidemiology
         (3) Understand the roles of epidemiology in public health and the steps in solving health problems
         (4) Understand the Natural History and Spectrum of Disease. Understand in broad terms the impact of infectious (bacterial, viral, fungal, protist and prion diseases) and noninfectious causes of disease (such as accidents, exposures, and toxicities)
         (5) Understand the basic epidemiological and public health terms found in the glossary of CDC's Principles of Epidemiology in Public Health Practice (e.g., outbreak, epidemic, pandemic, surveillance, risk, vector, etc.)
         (6) Understand the role of Surveillance in identifying health problems, the 5-Step Process for Surveillance, and the types of surveillance and the attributes of a surveillance system

      ii. Outbreak Investigation
         (1) Analyze actual or hypothetical outbreaks given in case scenarios
         (2) Understand Experimental and Observational studies and the Types of Epidemiological Studies – (e.g., case control, cohort, ecological, cross-sectional). Know the advantages and disadvantages of each. Recognize various fundamental study designs and identify which is appropriate to use in analysis of presented outbreak scenarios
         (3) Identify the Steps in an Outbreak Investigation and how they guide hypothesis generation
         (4) Identify the problem using person, place, and time triad to formulate case definitions
         (5) Interpret epi curves, line listings, cluster maps, subdivided tables, PFGE gels, SNP mapping and the PulseNet concept
         (6) Understand the agent, host, environment triad and chain of transmission
         (7) Evaluate data by calculating and comparing simple rates and proportions such as attack rate, relative risk, odds-ratio, and explain their meaning. Determine whether presented data support hypotheses of disease within scenarios, and revise hypotheses as appropriate.
         (8) Apply the Bradford Hill Criteria for Verifying the Cause of presented outbreaks. Compare the accuracy of Bradford Hill criteria, Koch's and Evan's postulates, and newer causality models such as Directed Acyclic graphs, Sufficient/component cause models, and GRADE methods
         (9) Understand the concept of herd immunity. Be able to calculate and interpret herd immunity threshold, basic and effective reproductive numbers

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

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

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

In partnership with the Centers for Disease Control (CDC)

B

DYNAMIC PLANET B - GLACIERS

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

1. **DESCRIPTION:** Participants will demonstrate an understanding of the processes involving the cryosphere of the Earth, with an emphasis on glaciers.

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

2. **EVENT PARAMETERS:**
   a. Each team may bring a binder of any size containing information in any form and from any source. Sheet protectors, lamination, tabs and labels are permitted. If the event features a rotation through a series of laboratory stations where the participants interact with samples, specimens, or displays, no material may be removed from the binder throughout the event.
   b. Each team may bring two stand-alone non-programmable, non-graphing calculators (Class II).
3. **THE COMPETITION:** Participants will be given one or more tasks presented as an exam and/or timed stations. Topics will include the following:
   a. Glacier formation
      i. Properties of ice (e.g., crystal structure, density)
      ii. Formation of glacial ice from snow, névé, firn
      iii. Glacial budget/mass balance: ablation and accumulation, equilibrium line
      iv. Glacial flow: influence of bed (e.g., basal sliding), and relation of flow to elevation and slope
   b. Types of glaciers & their geographic distributions:
      i. Valley/alpine (cirque, hanging, piedmont)
      ii. Ice sheet/continental, including ice stream, ice shelf, ice rise, ice cap, ice tongue
   c. Features in glacial ice:
      i. Crevasses, ogives, icefalls
      ii. Ice shelves and related processes (e.g., calving, marine ice sheet instability, ice shelf buttressing)
   d. Formation of landscape features by glaciers:
      i. Erosional – cirque, tor, U-shaped valley, hanging valleys, arêtes, horns, striations, Rôche moutonnée
      ii. Depositional – moraines (end/terminal, recessional, lateral, medial, ground), kames, drumlins, eskers,
      iii. erratics
      iv. Lakes – tarns, the Great Lakes, Finger Lakes, kettles, moraine–dammed lakes, proglacial lakes
   e. Periglacial processes and landforms (e.g., permafrost, pingos)
   f. Sea ice (ice floe, draft vs freeboard, pressure ridge, formation (e.g., frazil ice, pancake ice))
   g. Glacial hydrology: surface melt, surface lakes, moulins, drainage and subglacial lakes
   h. Global connections of glaciation:
      i. Atmosphere – effect of greenhouse gases & aerosols on glaciation (e.g., amplified melting due to changes in albedo, release of gases from glacial melting)
      ii. Oceans – sea level change and ice sheet variation (thickness and extent)
      iii. Lithosphere – isostatic effects on Earth's crust
      iv. Planetary/orbital influence on glaciation (e.g., Milankovitch cycles)
   i. History of ice on Earth and its evidence (e.g., drop stones, striations, sedimentary deposits), limited to:
      i. Neoproterozoic snowball Earth
         (1) Late Paleozoic ice ages
         (2) Eocene Oligocene Transition and the impact of opening oceanic seaways such as the Drake Passage
      ii. Pleistocene Northern Hemisphere glaciation (e.g., Laurentide Ice Sheet retreat & melting history)
      iii. Recent records of cryospheric change (e.g., Larsen B, Thwaites Glacier, Amundsen Sea Embayment)
   j. Sedimentary sequences produced in glacial environments (e.g., varves, outwash vs till)
   k. Methods of studying glaciers & interpretation of related data:
      i. Altimetry, radar, optical imagery, seismology, and gravimetry
      ii. Ice cores as archives of past environments, including the use of gases, aerosols, and stable isotope compositions
   l. Glacial hazards, including but not limited to ice avalanches and glacial lake outburst floods

4. **SCORING:**
   a. High score wins.
   b. Points will be awarded for the quality and accuracy of answers, the quality of supporting reasoning, and the use of proper scientific methods in responses.
   c. Ties will be broken by the accuracy and quality of answers to pre-selected questions and/or sections.

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

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

B

ECOLOGY B

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

1. **DESCRIPTION:** Students will answer questions involving content knowledge and process skills in the area of ecology and adaptations in featured North American biomes.

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

2. **EVENT PARAMETERS:** Each team may bring only 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 from any source without annotations or labels affixed along with two stand-alone non-programmable, non-graphing calculators (Class II).

3. **THE COMPETITION:**

   This event will be composed of three parts of approximately equal point value. The event will emphasize these process skills as they apply to ecology: defining variables; analyzing data from graphs and tables; presenting data in graphs and tables; forming hypotheses; making calculations and predictions. If stations are used, students must spend the same amount of time at each station.

   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 (including density dependent/independent limiting factors, carrying capacity, doubling time, exponential/logistic growth and how to calculate population growth), extinction, selection and migration. At the regional and state level, the general ecological principles should focus on local and regional ecology.
   b. Part 2: Terrestrial Ecosystems
      i. Ecology of Deserts and Grasslands
      ii. Understand basic concepts of biodiversity (e.g., importance, different types)
   c. Part 3: Human Impact on Ecosystems
      i. Topics such as climate change, invasive species, acid deposition (including acid rain), erosion, and chemical contamination (pollution)
      ii. The pros and cons of using alternative energy and its effect on the environment
      iii. Understand the goals of conservation biology and how they can be **reached**
      iv. Reclamation of disturbed areas versus reintroduction of species

4. **SCORING:** Questions will be assigned point values. Teams will be ranked from highest to lowest score. Ties will be broken by pre-determined tiebreaker questions.

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

This event is supported by Corteva Agriscience

ENTOMOLOGY B

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

1. **DESCRIPTION:** Students will be asked to identify insects and selected immature insects by order and family, answer questions about insects, and use or construct a dichotomous key.

   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, attached using the available rings. Sheet protectors, lamination, tabs, and labels are permitted. If the event features a rotation through a series of laboratory stations where the participants interact with samples, specimens, or displays, no material may be removed from the binder throughout the event.**
   b. **Each team may also have one commercially produced field guide which may be tabbed or annotated.**
   c. **In addition to their resource binder and field guide, each team may bring one (1) copy of either the 2025 National Entomology List or a state or regional insect list if issued.**
   d. **Each team may bring a hand lens or magnifying glass.**
   e. **The Supervisor will provide an answer sheet and if needed, dissecting microscopes.**
3. **THE COMPETITION:**
   a. Teams will be asked to identify an insect's Order, Family or common name and answer a related question(s). Questions are **limited** to topics below and insects are **limited** to those listed on the 2025 National Entomology List
   b. Insect specimens or images (nymph or larva for selected orders and families) will be exhibited so that students will be able to see pertinent features with the unaided eye or a hand lens.
   c. For each specimen, students **will be** asked correlated questions that pertain to the insect's **internal and external anatomy**, ecology, economic characteristics, or management. Ecological characteristics may include habitats, adaptations to the environment, **behavior**, relationships (e.g., symbiosis and competition) with **animals, plants, and public health**, as well as **climate change impacts**.
   d. Economic characteristics may include beneficial or detrimental aspects of insects such as sources of food, medicine, chemicals, or nutrients, and insects as nuisance species.
   e. Management questions may pertain to pest/disease/invasive species concerns, Integrated Pest Management (IPM), conservation, and urban entomology.
   f. One of the **parts of the exam** may involve students using or formulating a simple dichotomous key to identify insects.
4. **SCORING:** The team with the highest score will determine the winner. Selected questions may be used as tiebreakers.

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

2025 NATIONAL ENTOMOLOGY LIST

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

Specimens will be limited to those on the Official list of 29 orders and 100 families. Orders or Families marked by an "*" require that the contestant be able to recognize larvae or nymph forms. The taxonomic scheme is based upon the Insects of North America Princeton Field Guide (2023).

Class Entognatha
- Order Protura - telsontails, proturans
- Order Collembola - springtails, snow fleas
- Order Diplura - diplurans

Class Insecta
- Order Archaeognatha - bristletails
- Order Zygentoma - silverfish, firebrats
- Order Ephemeroptera - mayflies
- Order Odonata - dragon/damselflies *
  - Family Aeshnidae - darners
  - Family Gomphidae - clubtails
  - Family Libellulidae - skimmers
  - Family Lestidae - spread-wing
  - Family Coenagrionidae - narrow-winged
- Order Blattodea - cockroaches/termites
- Order Mantodea - mantids
- Order Notoptera - ice crawlers
- Order Dermaptera - earwigs
- Order Plecoptera - stoneflies
- Order Orthoptera - grasshoppers & crickets
  - Family Tetrigidae - pygmy grasshopper
  - Family Acrididae - short-horned grasshoppers
  - Family Tettigoniidae - katydids
  - Family Gryllacrididae - camel crickets
  - Family Gryllidae - crickets/tree crickets
  - Family Gryllotalpidae - mole crickets
- Order Phasmatodea - walkingsticks
- Order Psocodea - Book/Bark Lice
- Order Hemiptera - true bugs
  - Family Corixidae - water boatmen
  - Family Notonectidae - backswimmers
  - Family Belostomatidae - giant water bugs
  - Family Nepidae - waterscorpions
  - Family Gelastocoridae - toad bugs
  - Family Gerridae - water striders
  - Family Cimicidae - bed bugs
  - Family Miridae - plant bugs
  - Family Reduviidae - assassin bugs
  - Family Phymatidae - ambush bugs
  - Family Tingidae - lace bugs
  - Family Lygaeidae - seed bugs
  - Family Coreidae - leaf-footed bugs
  - Family Pentatomidae - Stink bugs
  - Family Cicadidae - cicadas
  - Family Membracidae - treehoppers
  - Family Cercopidae - froghoppers, spittlebugs
  - Family Cicadellidae - leafhoppers
  - Family Fulgoridae - fulgorid planthoppers
  - Family Aphididae - aphids
  - Family Dactylopiidae - scale(twig or leaf)
- Order Thysanoptera - thrips
- Order Megaloptera - dobsonflies
- Order Neuroptera - lacewings, antlions
  - FamilyChrysopidae - green lacewings
  - Family Myrmeleontidae - antlions *

- Order Coleoptera-beetles
  - Family Cicindelidae-tiger beetles[1]
  - Family Carabidae-ground beetles
  - Family Dytiscidae-predaceous diving beetles
  - Family Gyrinidae-whirligig beetles
  - Family Hydrophilidae-water scavenger beetles
  - Family Histeridae-hister beetles
  - Family Staphylinidae-rove beetles
  - Family Silphidae-carrion beetles
  - Family Lucanidae-stag beetles
  - Family Passalidae-bess beetles
  - Family Scarabaeidae-dung beetles
  - Family Buprestidae-metallic wood-boring/ jewel beetles
  - Family Elateridae-click beetles
  - Family Lampyridae-fireflies
  - Family Cantharidae-soldier beetles
  - Family Lycidae-net-winged beetles
  - Family Cleridae-checkered beetles
  - Family Coccinellidae-lady-bird beetles (ladybugs)
  - Family Tenebrionidae–darkling beetles *
  - Family Meloidae-blister beetles
  - Family Cerambycidae-long-horned beetles *
  - Family Chrysomelidae-leaf beetles
  - Family Curculionidae-weevils
- Order Strepsiptera - Twisted-Wing Parasite
- Order Mecoptera-scorpionflies
  - Family Boreidae- snow scorpionflies
  - Family Panorpidae- common scorpionflies
- Order Raphidioptera - Snakeflies
  - Family Raphidiidae - Raphidiid Snakeflies
- Order Siphonaptera-fleas
- Order Diptera-true flies
  - Family Tipulidae-crane flies
  - Family Culicidae-mosquitoes*
  - Family Chironomidae-midges
  - Family Simuliidae- black flies
  - Family Stratiomyidae-soldier flies
  - Family Tabanidae-horse flies
  - Family Asilidae-robber flies
  - Family Bombyliidae-bee flies
  - Family Syrphidae-hover/flower flies
  - Family Tephritidae-fruit flies, huskfly
  - Family Drosophilidae-pomace flies, fruit/ vinegar flies
  - Family Muscidae-house flies
  - Family Hippoboscidae-louse flies
  - Family Calliphoridae- blow flies*
  - Family Tachinidae-tachinid flies
- Order Trichoptera-caddisflies*
- Order Lepidoptera-moths and butterflies
  - Family Sesiidae-clear winged moths
  - Family Tortricidae- Tortrix moths
  - Family Hesperiidae-skippers
  - Family Papilionidae-swallowtails*
  - Family Pieridae-whites, sulfurs
  - Family Lycaenidae- hairstreaks/blues
  - Family Nymphalidae-brush-footed butterflies
  - Family Danaidae-milkweed butterflies
  - Family Pyralidae- snout moths
  - Family Saturniidae-Giant Silkworm moths*
  - Family Sphingidae-sphinx/hawk moths, hornworms*
  - Family Erebidae - tiger/tussock moths
- Order Hymenoptera-bees/ants/wasps.
  - Family Tenthredinidae- common sawflies
  - Family Siricidae-horntails
  - Family Ichneumonidae-ichneumons
  - Family Cynipidae- gall wasps
  - Family Mutillidae- velvet-ants
  - Family Formicidae-ants
  - Family Vespidae-paper wasps, hornets, yellowjackets
  - Family Sphecidae - thread- waisted wasps
  - Family Colletidae- Plaster bees
  - Family Halictidae- Sweat bees
  - Family Megachilidae- leaf cutter bees
  - Family Apidae-bees

- Subclass Acari - Mites and Ticks
  - Order Ixodida - Ticks
    - Family Ixodidae - Hardbacked ticks

1 Depending on the resource, Cicindelidae-tiger beetles may be classified as part of Carabidae-ground beetles. For the purposes of this list, they are considered separate families

EXPERIMENTAL DESIGN B

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

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

A TEAM OF UP TO: 3 **EYE PROTECTION:** C

CALCULATOR: Class II **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. Participants must bring goggles and writing utensils. Experiments will not require any other safety equipment.
   b. Teams may bring one timepiece, one linear measuring device, and one stand-alone non-programmable non-graphing calculator (Class II). Teams CANNOT use any of these as part of the experiment - they must only be used for their intended function.
   c. The Event Supervisor will provide each team with identical sets of materials either at a distribution center or in an individual container.
   d. The Event Supervisor **must provide the 2-part reporting packet** posted on the event page at soinc.org for teams to record their experimental information and data.
3. **THE COMPETITION:**
   a. The teams must design, conduct, and report the findings of an experiment conducted on site that addresses the assigned question/topic area provided by the Event Supervisor. The assigned question/topic area should be the same for all teams and allow the participants to conduct experiments involving relationships between independent and dependent variables (i.e., height vs. distance).
   b. During the first 20 minutes of the event, participants will receive the assigned question/topic area, materials, and Part I of the report packet. Participants will focus on designing and conducting their experiment.
   c. After the first 20 minutes, participants will receive Part II of the report packet and will focus on analyzing their experiment and reporting findings. Participants may continue experimenting throughout the entire event.
   d. Each team must use at least two of the provided materials to design and conduct an experiment. Teams failing to use at least two items will have their final score multiplied by 0.95. The materials will be listed on the board or placed on a card for each team. If provided, both the card and the container will be considered part of the materials. The identity of the materials will be unknown until the start of the event.
   e. When a team finishes, all materials must be returned to the Event Supervisor including both parts of the report packet.
4. **SCORING:**
   a. High score wins. Scoring will be done using the Experimental Design Checklist found on the Science Olympiad website (soinc.org).
   b. Points will be awarded depending upon the completeness of the response. Zero points will be given for no responses as well as illegible or inappropriate responses.
   c. Ties will be broken by comparing the point totals in the scoring areas of the checklist in the following order:
      i. Analysis of Claim/Evidence/Reasoning
      ii. Procedure and Set-Up Diagrams
      iii. Variables
      iv. Data Table
      v. Graph
   d. Any participant not following proper safety procedures will be asked to leave the room and will be disqualified from the event.
   e. Any team not using at least 2 of the provided materials will have their final score multiplied by 0.95.
   f. Any team not following clean-up procedures will have their final score multiplied by 0.95.
   g. Any team not addressing the assigned question/topic area will have their final score multiplied by **up to** 0.75 based on the extent to which the report deviates from the assigned topic.
   h. Any team not collecting data by conducting an experiment on-site **or falsifying/making up fake data** will have their final score multiplied by 0.25.

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

FOSSILS B

1. **DESCRIPTION:** Teams identify and classify fossils and demonstrate their knowledge of ancient life. Tasks **will be** related to interpretation of past environments and ecosystems, adaptations, evolutionary relationships, and **the** use of fossils in dating and correlating rock units.

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

2. **EVENT PARAMETERS:**
   a. Each team may bring one (1) magnifying glass and one (1) three-ring binder of any size containing information in any form and from any source, attached using the available rings. Sheet protectors, lamination, tabs and labels are permitted.
   b. Each team may also have one commercially produced field guide which may be tabbed and annotated.
   c. In addition to the resource binder and field guide, each team may bring one (1) copy of the **2025** National Fossils List, which does not have to be secured in the binder and two stand-alone non-programmable, non-graphing calculators (Class II). **The Fossil List may be annotated.**
   d. Teams are not permitted to bring samples or specimens to the event.
   e. 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, except for the **2025 National Fossils List.**

3. **THE COMPETITION:**
   a. Where possible, participants will move from station to station, with the length of time at each station predetermined and announced by the Event Supervisor.
   b. Participants may not return to stations but may continue to work on their responses throughout.
   c. Stations will feature task-oriented activities emphasizing application of paleontological concepts.
   d. Identification will be limited to specimens on the **2025** Science Olympiad Fossil List, but other samples may be used to illustrate key concepts.
   e. Questions will be chosen from the following topics:
      i. Identification of fossil specimens on the **2025** National Fossils List
      ii. Taxonomic classification restricted to the hierarchy on the 2025 National Fossils List
      iii. Conditions that favor preservation of fossils (e.g., rapid burial, hard parts, low oxygen environment, escaping destruction)
      iv. Common modes of preservation **and how they occur, including:** petrification/petrifaction (e.g., permineralization & mineral replacement including silicification, pyritization, and phosphatization), cast, external vs. internal molds (steinkerns), imprints, carbonization, unaltered remains (e.g., shells, teeth)
      v. Uncommon modes of preservation: limited to encasement in amber, mummification, freezing, tar
      vi. Bias in the Fossil Record: animals with mineralized hard parts (skeletons or shells) more likely preserved than soft bodied animals; aquatic organisms more likely to be preserved than terrestrial (land) organisms
      vii. Determining the age of fossils and the rocks they are in through relative or absolute dating techniques.
         (1) Relative dating techniques: limited to law of superposition, original horizontality, cross-cutting relationships, unconformities, faunal succession, correlation of rock layers and/or fossils
         (2) Absolute dating techniques: radiometric dating, including half-life, **and** radioactive isotopes used; **limited to** Carbon 14, Potassium/Argon, Uranium/Lead **(U-238/Pb-206); emphasis on understanding how ages are determined using half life graphs and simple calculations, but not complex equations**
         (3) Limitations of relative and absolute dating in determining the age of fossils
         (4) Use of radiometric dating of igneous rocks and volcanic ash along with relative dating techniques to determine the age of fossils.
      viii. The Geologic Time Scale, its organization, major events, the 5 major mass extinctions, and the Pleistocene-Holocene extinction of megafauna. An official ***Science Olympiad Geologic Time Scale*** is posted at soinc.org & should be used for all competitions
      ix. Index Fossils: characteristics and use in determining the age of rocks & geologic formations

x. **Identification of** fossil-bearing sedimentary rocks and their significance in interpreting ancient environments and habitats; **limited to amber, chalk, chert, coquina, fossil limestone, sandstone, and shale**
xi. Modes of life and mobility: benthonic/benthic (infaunal vs epifaunal; sessile vs vagrant); planktonic/planktic; nektonic/nektic (swimmers); terrestrial
xii. Ecologic role and trophic level (role in food web): producers, filter/suspension feeder, predator, scavenger, deposit feeder (detritovore), herbivore
xiii. Differences in plant reproduction through seeds or spores.
xiv. Environments: marine (e.g., shallow marine/shelf, reef, lagoon, deep marine); terrestrial (e.g., tropical, temperate forest, grassland, wetlands, desert, taiga, tundra), fresh water (e.g., lakes, rivers, swamps)
xv. Mineral and organic components of exoskeletons, shells, and bones/teeth (e.g., calcite, aragonite, silica, chitin, biological apatite/calcium phosphate)
xvi. Adaptations and morphologic features and their implications (e.g., serrated sharp teeth in vertebrates indicate predatory behavior)
xvii. Significance of important paleontological discoveries (**e.g.,** non-avian dinosaurs with feathers; transitional species such as *Tiktaalik* and *Archaeopteryx*)
xviii. Paleontological significance of *Lagerstätten* (conservation and concentration) limited to: Burgess Shale, Beecher's Trilobite Bed, Mazon Creek, Ghost Ranch, Solnhofen Limestone, Yixian Formation (Liaoning), Green River Formation, and La Brea Tar Pits
xix. Major evolutionary events, trends, and transitions: (e.g., **Ediacaran biota,** Cambrian Explosion, Ordovician Radiation, Mesozoic Marine Revolution, Mesozoic-Cenozoic Radiation; suture patterns in cephalopods, fish to tetrapods transition, evolution of birds from dinosaurs, evolution of whales, evolution of horses)
xx. Convergent evolution: (e.g., fins in fish, marine reptiles, and mammals; wings in insects, pterosaurs, birds, and bats)
xxi. Interpretation of cladograms to show evolutionary relationships
xxii. Stromatolites, how they form, their role in the history of life and the development of Earth's atmosphere, including the Great Oxygenation Event
xxiii. Trace fossils (ichnofossils) as evidence of fossil behavior. Limited to trails, tracks & trackways, footprints, resting traces, borings, burrows, tubes, predation marks, and coprolites
(1) Use of dinosaur footprints to calculate hip height **and length** of animal
Formulas:
Hip Height = Length of Footprint x 4
Head to Tail Length = Length of Footprint x 10
(2) Use of dinosaur trackway to determine running or walking speed **of bi-pedal dinosaurs**
Formula:
Relative Speed Ratio: Stride Length divided by Hip Height
If the ratio is less than 2.0, the dinosaur was WALKING.
If the ratio is between 2.0 and 2.9, the dinosaur was TROTTING.
If the ratio is greater than 2.9, the dinosaur was RUNNING.

4. **SCORING:**
a. High score wins.
b. Points will be awarded for the quality and accuracy of answers, the quality of supporting reasoning, and the use of proper scientific methods of responses.
c. Ties will be broken by the accuracy and quality of answers to pre-selected questions and/or sections.

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

2025 NATIONAL FOSSILS LIST

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

KINGDOM PROTOZOA

FORAMS (Phylum Foraminifera)*

- Order Fusulinida (Fusulinids)*
  - **Genus *Triticites****
- Order Rotaliida*
  - Genus *Nummulites**

KINGDOM ANIMALIA

SPONGES (Phylum Porifera)*

- Genus *Astraeospongia* (calcareous sponge)*
- Genus *Hydnoceras* (glass sponge)*

BRYOZOANS (Phylum Bryozoa)

- Growth forms: branching, massive, fenestrate
  - Genus *Archimedes*
  - Genus *Rhombopora*

GRAPTOLITES (Phylum Hemichordata)*

- Order Dendroidea (benthic graptolites)*
- Order Graptoloidea (planktic graptolites)*

CORALS (Phylum Cnidaria)

- Order Tabulata (tabulate corals)
  - Genus *Favosites*
  - Genus *Halysites**
- Order Rugosa (rugose corals)
  - Genus *Heliophyllum (horn coral)*
  - Genus *Hexagonaria*
- Order Scleractinia (stony corals)
  - Genus *Septastrea*

ARTHROPODS (Phylum Arthropoda)

- **Order Radiodonta***
  - **Genus *Anomalocaris****
- Subphylum Crustacea (shrimp, lobsters, crabs, barnacles, ostracods)*
- Subphylum Chelicerata
  - Order Eurypterida (Eurypterids)
    - Genus *Eurypterus*
- Class Insecta (Insects)
- Class Trilobita (Trilobites)
  - Order Polymerida (Polymerids)
    - Genus *Cryptolithus*
    - Genus *Calymene*
    - Genus *Elrathia*
    - Genus *Isotelus**
    - Genus *Eldredgeops* (formerly *Phacops*)
  - Order Agnostida (Agnostids)
    - Genus *Peronopsis*

BRACHIOPODS (Phylum Brachiopoda)

- Class Inarticulata
  - Genus *Lingula*
- Class Articulata
  - Genus *Atrypa*
  - Genus *Composita*
  - Genus *Juresania**
  - Genus *Leptaena**
  - Genus *Mucrospirifer*
  - Genus *Platystrophia*
  - Genus *Rafinesquina*

MOLLUSKS (Phylum Mollusca)

- Class Bivalvia (clams, oysters, mussels)
  - Genus *Exogyra*
  - Genus *Gryphaea*
  - Genus *Pecten*
  - Genus *Glycymeris*
  - Genus *Astarte*
  - Genus *Nucula*
- Class Cephalopoda
  - Order Goniatitida (goniatites)*
  - Order Ceratitida (ceratites)*
  - Order Ammonitida (ammonites)
    - Genus *Baculites*
    - Genus *Dactylioceras*
  - Order Belemnitida (Belemnites)
    - Genus *Belemnitella*
  - Order Nautilida (Chambered Nautilus)
  - Order Orthocerida ("Orthoceras")
- Class Gastropoda (Snails)
  - Genus *Conus*
  - Genus *Cypraea*
  - Genus *Platyceras*
  - Genus *Turritella*
  - Genus *Worthenia*

ECHINODERMS (Phylum Echinodermata)

- Class Asteroidea (Starfish)*
- Class Blastoidea
  - Genus *Pentremites*
- Class Crinoidea (stems, columns, calyxes)
- Class Echinoidea (regular or irregular echinoids: sea urchins, sand dollars and heart urchins)
- Class Ophiuroidea (brittle stars)*

Note: Taxa marked by an asterisk (*) are for State and National Tournaments only

2025 NATIONAL FOSSILS LIST (CONT.)

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

VERTEBRATES (Phylum Chordata)

- Superclass Agnatha*
- (Jawless Fish) (Ostracoderms)*
- Class Placodermi (Armored Jawed Fish)
  - Genus *Bothriolepis*
  - Genus *Dunkleosteus*
- Class Chondrichthyes (Cartilaginous Fish)
  - Superorder Selachimorpha (Sharks)
    - Genus *Otodus* (formerly *Carcharocles/ Carcharodon*)
      - Species *O. megalodon*
  - Superorder Batoidea (Rays)*
- Superclass Osteichthyes (Bony Fish)
  - Class Actinopterygii (ray-finned)
    - Genus *Knightia*
    - Genus *Xiphactinus**
  - Class Sarcopterygii (lobe-finned)
    - Genus *Eusthenopteron*
    - Genus *Latimeria* (Coelacanth)
    - Genus *Tiktaalik*
- Class Amphibia (Amphibians)
  - Genus *Acanthostega*
  - Genus *Eryops*
  - Genus *Diplocaulus*
- Class Reptilia (Reptiles)
  - Order Crocodilia (crocodiles)*
  - Order Testudines (turtles)*
  - Order Ichthyosauria (Ichthyosaurs)
  - Order Squamata
    - Family Mosasauridae (Mosasaurs)
  - Order Plesiosauria (Plesiosaurs & Pliosaurs)
  - Order Pterosauria (Pterosaurs)
- Clade Dinosauria (Dinosaurs)
  - Order Saurischia (lizard-hipped)
    - Suborder Theropoda
      - Genus *Allosaurus*
      - Genus *Coelophysis*
      - Genus *Dilophosaurus*
      - Genus *Deinonychus**
      - Genus *Spinosaurus**
      - Genus *Tyrannosaurus*
      - Genus *Velociraptor*
    - Suborder Sauropodomorpha
      - Genus *Brachiosaurus*
      - Genus *Diplodocus*
      - Genus *Patagotitan**
      - Genus *Plateosaurus*
  - Order Ornithischia (bird-hipped)
    - Infraorder Ankylosauria
      - Genus *Ankylosaurus*
    - Infraorder Ceratopsia
      - Genus *Triceratops*
      - Genus *Protoceratops**
    - Infraorder Ornithopoda
      - Genus *Iguanodon*
      - Genus *Parasaurolophus*
      - Genus *Maiasaura*
    - Infraorder Pachycephalosauria
      - Genus *Pachycephalosaurus**
    - Infraorder Stegosauria
      - Genus *Stegosaurus*
- Class Aves (Birds)
  - Genus *Archaeopteryx*
  - Genus *Titanis* (Terror Bird)
  - Genus *Hesperornis**

Clade Synapsida

- Stem Mammals/Proto-Mammals
  - Genus *Dimetrodon* (pelycosaurs)
  - Genus *Lystrosaurus* (therapsids)
  - Genus *Gorgonops* (therapsid)*
- Class Mammalia (Mammals)
  - Genus *Basilosaurus* (prehistoric whale)
  - Genus *Equus* (modern horse)
  - Genus *Mesohippus* (three-toed horse)
  - Genus *Australopithecus* (hominin)*
  - Genus *Homo* (hominin)
    - Species *H. neanderthalensis*
    - Species *H. erectus**
    - Species *H. sapiens*
  - Genus *Mammut* (Mastodon)
  - Genus *Mammuthus* (Mammoth)
    - Species *M. primigenius*
  - Genus *Megacerops* (brontothere)
  - Genus *Megalonyx* (Giant Ground Sloth)*
  - Genus *Smilodon* (saber-toothed cat)
  - Genus *Merycoidodon* (oreodont)*

Note: Taxa marked by an asterisk (*) are for State and National Tournaments only

KINGDOM PLANTAE

SEED PLANTS

SEED FERNS (Division Pteridospermatophyta)

Genus *Glossopteris*

Clade Angiosperms

FLOWERING PLANTS (Division Anthophyta)

Genus *Acer* (Maple)

Genus *Populus* (Aspen & Poplar)

Genus *Platanus* (Sycamore)

Clade Gymnosperms

GINKGOS (Division Ginkgophyta)

Genus *Ginkgo*

CONIFERS (Division Pinophyta)

Genus *Metasequoia*

NON-SEED PLANTS

CLUB MOSSES (Division Lycophyta)

Genus *Lepidodendron* (scale tree)

FERNS & HORSETAILS (Division Polypodiophyta)

Tree Ferns

Genus *Psaronius* (form leaf genus: *Pecopteris*)

Horsetails

Genus *Calamites* (form leaf genus *Annularis*)

TRACE FOSSILS

Limited to:

Trails, Tracks, Trackways, Borings, Burrows, Tubes, Predation marks, Coprolites, Stromatolites

Note: Taxa marked by an asterisk (*) are for State and National Tournaments only

HELICOPTER B

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

1. **DESCRIPTION:** Prior to the tournament, teams will construct, collect data on test flights, analyze and optimize free flight rubber-powered **helicopters** to achieve maximum time aloft.

   A TEAM OF UP TO: 2 **IMPOUND:** No **APPROXIMATE TIME:** 15 minutes

2. **EVENT PARAMETERS:**
   a. Teams may bring up to 2 helicopters, Flight Log, transportation boxes, tools, and equipment.
   b. Teams must bring one or more Measurement Boxes; transportation and measurement boxes may be the same box.
   c. Event Supervisors will provide all other measurement tools and timing devices for scoring purposes.
3. **CONSTRUCTION PARAMETERS:**
   a. Helicopters may be constructed from published plans, commercial kits, competitor's designs, and/or other sources of design. Kits, if used, must not contain any pre-glued joints or pre-covered surfaces.
   b. A flat balsa wood disc, large enough to cover a dime, must be the uppermost part of the helicopter, the part that would touch a flat ceiling first during the flight.
   c. Any materials except Boron filaments may be used in construction of the helicopter and boxes.
   d. The helicopter, in its flight configuration, must fit fully into a team-provided Measurement Box.
      i. The external dimensions of the Measurement Box must fit within a right, rectangular prism of 32.0 cm x 24.0 cm x 47.0 cm, including any external protuberances on the box.
      ii. Typically available 8-ream copy paper boxes should fit within the dimensions. The team is responsible for verifying their own boxes prior to the competition.
   e. "Flight configuration" means the helicopter is fully assembled and ready to fly. For example, no change in chord, span, length, or total lifting area can occur after removing the helicopter from its box and throughout the flight itself. Components that rotate during flight may be rotated such as propellers or rotors to allow the helicopter to fit into the box. The rubber motor(s) does not have to be on the helicopter or wound.
   f. The helicopter may use up to three fixed pitch rotors. There is no maximum limit on the number of blades or their chord. Rotors are defined as one or more separate lifting surfaces, referred to as blades, that contribute lift by rotating on a common path around a vertical axis. There must not be any other lifting surfaces.
   g. Total mass of the helicopter, excluding the rubber motor(s), must be 4.00 g or more.
   h. Participants must construct the rotors themselves. Commercially available rotors or propellers must not be used in whole or part. Commercial rotor thrust bearings may be used.
   i. The helicopter must be powered by rubber motor(s) of any mass. Motor(s) must be removable from the helicopter for check-in. Motors may be lubricated before and/or after check-in. Officials need not mass the motors.
   j. Participants may use any type of winder, but electricity may not be available.
   k. 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.
   l. Each helicopter must be labeled so that the Event Supervisor can easily identify to which team it belongs.
4. **FLIGHT LOGS:**
   a. Teams may present a Flight Log of recorded data for a Bonus. This data must include 6 or more parameters (3 required and at least 3 additional) with data for 10 or more test flights prior to the competition.
      i. The required parameters are:
         (1) Motor size before 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 at landing, estimated/recorded peak flight altitude, the motor torque at landing, propeller pitch, etc.).
   b. All logs will be returned to teams after inspection.
5. **THE COMPETITION:**
   a. The event will be held indoors. Tournament officials will announce the room dimensions (approximate length, width, and ceiling height) in advance of the competition. Tournament officials and the Event Supervisor are urged to minimize the effects of environmental factors such as air currents.

b. Once participants enter the cordoned off competition area to trim, practice, or compete, they must not receive outside materials (except as permitted by the Event Supervisor), assistance, or communication. Only participants may handle helicopters until the event ends. Teams violating this rule will be ranked below all other teams. Spectators will be in a separate area.
c. At the Event Supervisor's discretion:
   i. Multiple official flights may occur simultaneously.
   ii. Practice flights may occur throughout the competition but must yield to any official flight.
   iii. No practice flights will occur in the final half-hour of the event's last period, except for teams that declare a trim flight during their 10-minute Flight Period.
d. Check-in:
   i. Prior to check-in with the Event Supervisor, a self-check inspection station may be made available to participants for checking their Measurement Box(es), and helicopters.
   ii. At check-in, participants will present their helicopters in Measurement Box(es), and Flight Logs for inspection immediately prior to their Flight Period.
   iii. The Event Supervisor will verify the external dimensions of the Measurement Box(es) and that the helicopter fits fully inside the Measurement Box while in its flight configuration. The helicopter's overall dimensions must not change after being removed from the box. This may be verified by showing that the helicopter slides into and out of the box without changing shape at the discretion of the Event Supervisor.
   iv. The participants will remove the helicopter from the box to allow for the mass to be measured.
   v. All motor(s) will be collected and returned to the team at the start of their 10-minute Flight Period.
   vi. Only Participants should handle the helicopters or Measurement Box(es).
e. Flight Period:
   i. The 10-minute Flight Period begins when the Event Supervisor returns the motor(s) to the team.
   ii. Any flight beginning within the 10-minute Flight Period will be permitted to fly to completion.
   iii. Participants may make adjustments/repairs/trim flights during their official Flight Period.
   iv. Before each launch, participants must indicate to the Timers whether a flight is an official flight or a trim flight. A flight is considered official if a team fails to notify the Timer(s) of the flight's status.
   v. Teams must not be given extra time to recover or repair their helicopter.
   vi. Teams may make up to a total of 2 official flights using 1 or 2 helicopters.
   vii. Time aloft for each flight starts when the helicopter leaves the participant's hand and stops when any part of the helicopter touches the floor, the lifting surfaces no longer support the weight of the helicopter (such as the helicopter landing on a girder or basketball hoop) or the Event Supervisors otherwise determine the flight to be over.
   viii. Event Supervisors are strongly encouraged to utilize three (3) timers on all flights. The median flight time in seconds to the precision of the device used is the official time aloft.
   ix. Participants must not steer the helicopter during flight.
   x. Students must be on the floor to launch and must not use artificial aids to increase launch height.
   xi. In the unlikely event of a collision with another helicopter, a team may elect a re-flight. The decision to re-fly may be made after the helicopter lands. Timers are allowed to delay a launch to avoid a possible collision. The 10-minute Flight Period does not apply to such a flight.
f. If requested by the Event Supervisor, the participants must demonstrate that each helicopter still fits fully inside the Measurement Box(es) in the flight configuration. Teams may not manipulate the configuration of the helicopter in order to fit into the box except to rotate components that rotated during flight such as rotors. The helicopter's overall dimensions must not change after being removed from the box. Motor(s) may be removed from the helicopter or left in place during the demonstration.
g. The Event Supervisor will verify with the team the data being recorded on their scoresheet.
h. Teams filing an appeal must leave their helicopter(s), Measurement Box(es), motor(s), and Flight Log in the event area.

6. **SCORING:**
   a. Highest Final Score wins. A team's Final Score is the larger of the team's Flight Scores.
   b. Flight Score for each official flight = Flight Time x Bonus (6.c.)
   c. Flight Log Bonus:
      i. Teams with a complete Flight Log with receive a 20% bonus multiplier (x 1.2)
      ii. Teams with a partial Flight Log will receive a 10% bonus multiplier (x 1.1)
      iii. Teams without a Flight Log will receive no bonus multiplier (x 1.0)
   d. Teams that violate rule(s) under "CONSTRUCTION PARAMETERS" or "THE COMPETITION" that do not have a specific penalty will be ranked after all teams that do not violate those rules.
   e. Ties will be broken by the longest non-scored official Flight Score.

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

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

B

METEOROLOGY B - CLIMATE

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

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

   A TEAM OF UP TO: 2. **CALCULATOR:** Class II **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. **Each team may bring one three-ring binder of any size containing information in any form and from any source, attached using available rings. Sheet protectors, lamination, tabs, and labels are permitted.**
   b. **Each team may bring two stand-alone non-programmable, non-graphing calculators (Class II).**
   c. **If the event features a rotation through a series of stations, no materials may be removed from the binder during the event.**
   d. **Students are expected to have a U.S. map with the state names in the binder.**

3. **THE COMPETITION:**
   a. **The event may be either a written exam format or teams may move from station to station with the length of time at each station predetermined and announced by the event supervisor. Participants may not return to stations, but may change their original answers while at other stations.**
   b. **Emphasis will be placed upon interpretation of data displayed in maps, graphs, images, photographs, charts, and/or tables to analyze climate and changes in the climate of a location/region.**
   c. The questions will address the following weather and climate topics:
      i. **The differences between** weather **and** climate
      ii. Composition **of the atmosphere (troposphere & stratosphere):**
         (1) Natural and anthropogenic greenhouse gases, and their sources
         (2) **Natural and** anthropogenic **sulfur compounds (sulfur dioxide, sulfuric acid, &** sulfates), black carbon aerosols (soot), volcanic particulates, and their impacts as climate forcing agents
         (3) The ozone layer, **its effect on radiation,** and the evolution of the ozone hole
      iii. Earth's radiative energy balance:
         (1) Shortwave and longwave radiation, albedo and emissivity
         (2) Effects of high versus low clouds on shortwave and longwave **radiation**
         (3) **Effects of** cloud composition (ice or water) **on radiation**
         (4) Definition and examples of climate feedbacks that change radiative balance: (water vapor, sea ice-albedo, **snow cover, etc.)**
         (5) **Using the online Rapid Radiative Transfer Model (RRTM) (earth energy budget model) determine the effect(s) of how greenhouse gases and aerosols change the radiative budget; available at https://climatemodels.uchicago.edu/rrtm/.**
      iv. Oceanic and atmospheric circulation mechanisms that affect climate:
         (1) Semi-permanent pressure cells, the three-cell model of atmospheric circulation, and the Walker cell
         (2) Thermohaline circulation and wind-driven oceanic currents, ocean heat transport and connections between sea surface temperature trends and local climate patterns
      v. **Factors that affect climate**
         (1) **Latitude**
         (2) **Elevation and mountain ranges**
         (3) **Proximity to bodies of water and ocean currents**
         (4) **Prevailing and global/planetary winds**
         (5) **Heat capacity: effects of land masses, bodies of water, soil composition and moisture on climate**
      vi. **The effects of rural versus urban areas and vegetation on local climatic conditions**
      vii. **The effects of climate change not limited to: sea level rise, drought, desertification, wild fires, flooding, and migration and extinction of fauna and flora (e.g., insects, birds, trees)**
      viii. Climatic zones and their causes:
         (1) **Koppen climate classification system and each zone's characteristics, but do not memorize the abbreviations**
         (2) Interpret climatographs, trends and their significance

ix. Recent climate trends:
   (1) Modern temperature trends through use of temperature records and datasets (e.g., **https://berkeleyearth.org/**)
   (2) Influence of **El Niño & La Niña (El Niño-Southern Oscillation)** ENSO on climate & typical weather patterns associated with ENSO **https://www.climate.gov/enso**
   (3) Drought and heat **wave** events

x. **Reconstructions of past climate conditions (paleoclimate) using proxy data and/or isotope ratios limited to:** sediment cores, ice cores, **pollen,** tree rings, speleothems **(mineral deposits in caves) & fossil shells**

xi. **Historical climate events limited to:**
   (1) **Pleistocene glaciation (about 2.6 million to 11700 years ago) and Holocene glacial retreat (about 19000 to 12000 years ago)**
   (2) **Little Ice Age (about 1300 to 1850 years ago) and Younger Dryas (about 13,000 to 12,000 years ago)**
   (3) **Year without a Summer (1812) (Mount Tambora)**
   (4) **Eruptions of Krakatoa (1883) and Mount Pinatubo (1991)**

xii. Projected changes in climate:
   (1) **Understand graphs showing climate change scenarios projecting future greenhouse gas concentrations** (Representative Concentration Pathways)
   (2) Understanding and interpreting climate change, **limited to** the projections/**predictions** from models**, not the specific model physics, equations or assumptions.**

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

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

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

METRIC MASTERY B

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

1. **DESCRIPTION:** Teams will estimate and then measure properties of identical objects including mass, area, volume, density, force, distance, time, and temperature. Teams will also perform metric unit conversions.

   A TEAM OF UP TO: 2. **CALCULATOR:** Class II **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. The event will be divided into 3 sections. Sections One & Three combined will involve estimating and measuring properties of objects at stations.
   b. Participants will rotate through 15 - 25 stations to make their estimations in Section One - Estimation, and then in Section Three - Measurement, they will use measuring devices to measure the same or identical objects at the stations. Some of the stations will ask for calculated measurements - measurements that require formula calculations (e.g., calculating the density of an object, surface area, velocity, etc.). The number of calculated measurements will be based on the level of competition per the following:
      i. No more than 20% of the stations at the Regional level
      ii. At least 20% but not more than 40% of the stations at the State level
      iii. At least 40% but not more than 60% of the stations at the National level.
   c. Measuring devices must be kept out of sight during Section One - Estimation.
   d. The property to be estimated or measured and the units of measurement must be identified in the directions at each station. Prior to the competition supervisors must determine the acceptable measurement value with the same equipment that is to be used at each station.
   e. Participants must not bring watches, writing implements, electronic devices (with the exception of a calculator for Section Three), notes, or use any kind of measuring device (e.g., fingers, pieces of paper, pencils, clothing, etc.). Each team may bring two stand-alone non-programmable, non-graphing calculators (Class II) for use during Section Three.
   f. Supervisors must furnish writing implements, paper, and all measuring devices needed for the event.

3. **THE COMPETITION:** For each part participants will be given an answer sheet to record their answers. Each answer sheet must be turned in prior to the next section or the team will lose their score for that section.
   a. **Section One - Estimation:**
      i. Recommended time at each station for the Estimation Section is 30 seconds.
      ii. Participants must not touch or feel any of the objects, unless the station directions specifically state the object may be touched. Participants must be allowed to "heft" an object for estimated masses.
   b. **Section Two - Metric Unit Conversion:**
      i. This part must be after the completion of Section One and before beginning Section Three.
      ii. Participants will have 5 minutes to complete 5 Metric Unit Conversion problems.
      iii. Participants will be asked to convert 5 metric numbers to a specific different metric unit and must not be required to convert from one measurement system to another (e.g., metric to standard).
   c. **Section Three - Measurement:**
      i. Recommended time at each station for the Measurement Section is 60 seconds.
      ii. Measurements must be made using the supervisor-supplied instruments, expressed to the instrument's resolution (the smallest division/markings/graduations on its scale) plus one estimated digit (if appropriate/analog).
      iii. To receive points, measurements must be expressed using the proper resolution and estimated digit appropriate for the instrument(s) provided, and the proper unit of measurement. **Example**: Correct answer = 9.0 cm. If the answer given by the team is 9 cm or 9.0, the answer will be marked wrong.

4. **SCORING:** Final high score wins. Final Score = Estimation Score + Measurement Score + Metric Unit Conversion Score.
   a. **Section One - Estimation:** Scores within 5% of the correct value, as determined by the event supervisor, will be awarded 5 points, within 10% will be awarded 3 points, and within 20% will be awarded 1 point.
   b. **Section Two - Metric Unit Conversions:** Answers must be with the correct unit written to receive 5 pts. All other answers receive zero points. **Example:** Convert 14.56 mm to hm. Correct answer = 0.0001456 hm.

c. **Section Three - Measurements:**
   i. **Direct Measurements:** Measurements (not involving calculations) that are within (+/-) 3 of the estimated digit as determined by the event supervisor, expressed to the instrument's resolution (the smallest division/markings/graduations on its scale) receive 5 pts. All others receive zero points. **Example:** The Supervisor measured the width of a page as 209.1 mm using a ruler whose smallest divisions are 1.0 mm, then any value from 208.8 mm - 209.4 mm would be accepted as correct.
   ii. **Calculated Measurements:** Measurements that require formula calculations (e.g., calculating the density of an object, surface area, velocity, etc.) receive 5 points for answers within the range of the calculated value based on (+/-) 3 of the estimated digit of the direct measurements. All other answers receive zero points. **Example:** Supervisor measured and calculated: 13.45 cm x 22.32 cm = 300.20 cm^2. Range: within -0.03: 13.42 cm x 22.29 cm = 299.13 cm^2, within +0.03: 13.48 cm x 22.35 cm = 301.28 cm^2. Thus any value from 299.13 cm^2 - 301.28 cm^2 would be accepted as correct.

d. **Penalties:** Penalties may be applied to teams who do not return measuring devices to their original locations, do not clean up spills, and/or intentionally alter or damage equipment or objects.

e. Ties will be broken using tiebreaker stations designated prior to the start of the event.

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

B

MICROBE MISSION B

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

1. **DESCRIPTION:** Teams will answer questions, solve problems, and analyze data pertaining to microbes.
   A TEAM OF UP TO: 2 **EYE PROTECTION:** C
   CALCULATOR: Class II **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:** For events with a lab practical portion, each student must wear goggles. 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 (Class II). Any measurements must be made to the precision of the device.

3. **THE COMPETITION:** This Event may be administered as a written test or as a series of lab-practical stations which can include but are not limited to experiments, scientific apparatus, models, illustrations, specimens, data collection and analysis, and problems for students to solve. Participants may be asked to perform simple laboratory procedures such as taking measurements using a microscope or using probes to collect data (sufficient information will be provided at the station to do so). **Questions should emphasize process skills such as quantitative reasoning, making calculations, analyzing and interpreting experimental results, and drawing evidence-based conclusions.** The Event will cover the topics listed below without any overemphasis on any one particular topic. The list of topics and subtopics should be considered exhaustive.
   a. For each of the following topics, participants will be expected to use quantitative reasoning and computational skills, analyze and interpret experimental results, and draw evidence-based conclusions.
      i. Microscopy:
         (1) Identify and describe the parts/functions of bright-field light microscopes.
         (2) Compare and contrast light (i.e., bright-field, dark-field, and phase contrast) and electron microscopy (i.e., TEM and SEM) and be able to identify what type of microscope was used to take provided images.
         (3) Estimate the size of microbes using scale bars.
      ii. Structure and Morphology:
         (1) Describe the basic structure, composition, and function of components of a bacterial cell (i.e., membrane, cell wall, flagella, pilus, fimbria, nucleoid, cytoplasm).
         (2) Contrast Gram (+) and Gram (-) cells and explain the Gram stain procedure.
         (3) Identify bacterial cell shapes (i.e., vibrio, bacillus, coccus, spirochete).
         (4) Describe basic structural components of viruses and their functions.
         (5) State and Nationals only: Describe the structure and function of specialized organelles in bacteria and eukaryotic microbes (i.e., gas vesicles, endospores, contractile vacuoles, eyespots, carboxysomes).
         (6) State and Nationals only: Connect and explain how (1 & 5) are determined by the habitat and life strategy of microbes.
      iii. Culture and Growth:
         (1) Describe applications of different methods to culture bacteria (i.e., liquid vs. agar) and different media used to do this (i.e., selective vs. differential).
         (2) Interpret bacterial growth curves and discuss what is happening at each stage.
         (3) Use plate count data (i.e., CFUs) to calculate the number of cells in a culture.
         (4) Outline the steps of bacterial cell division (i.e., binary fission) and genome replication, including the function and properties of the origin of replication, DNA unwinding element, DnaA, and DNA polymerase.
         (5) Describe how sterilization and disinfection techniques (i.e., heat, ultraviolet radiation, filtration, and chemical) are able to compromise/eliminate microbes.
         (6) State and Nationals only: Understand the limitations of culture-based approaches to study microbes.

iv. Metabolism and Applications:
  (1) Describe microbial metabolic strategies based on carbon and energy sources.
  (2) Describe the primary inputs and outputs of major metabolic processes (i.e., fermentation, oxygenic photosynthesis, nitrogen fixation) and where they occur in the cell.
  (3) Describe the role of microbes in: fermentation in bread baking, soy sauce production, and sauerkraut production; photosynthesis in biofuel production; and nitrogen fixation in the rhizosphere. Connect these applications of microbes to the processes listed in (2).

v. **Evolution & Ecology**
  (1) **Discuss the endosymbiotic theory of organellar evolution.**
  (2) Describe common adaptations to extreme environmental conditions (i.e., temperature, salinity, pH).
  (3) Describe lytic and lysogenic viral life cycles using examples from the Microbes and Agents List.
  (4) **Outline the mechanisms of horizontal gene transfer (i.e., transduction, conjugation, and transformation) and explain the role of horizontal gene transfer and viral infection in microbial evolution.**
  (5) Identify and describe community interactions between microbes (i.e., cooperation/mutualism, commensalism, predation, parasitism).
  (6) State and Nationals only: **Describe applications and limitations of 16S amplicon sequencing, interpret data from 16S amplicon sequencing experiments (i.e., bacterial community composition, alpha diversity, beta diversity).**

b. Microbes and Agents List: **Participants will be expected to be able to describe the general characteristics (i.e., life cycle/replication strategy, genome structure, and morphology). For disease-causing agents, identify what disease they cause. Otherwise, understand their environmental function. Microbes not listed here may be included on the exam, but sufficient background information will be provided to answer questions.**
  i. Bacteria: *Escherichia coli, Rickettsia rickettsii, Mycobacterium leprae, Mycobacterium tuberculosis, Microcystis aeruginosa, Staphylococcus aureus, Helicobacter pylori*
  ii. Archaea: State and Nationals only: *Pyrococcus furiosus*
  iii. Eukaryotes: *Plasmodium falciparum, Saccharomyces cerevisiae, Nannochloropsis sp.*. State and Nationals only: *Paramecium sp.*
  iv. Viruses & other subcellular agents: Escherichia virus T4, Escherichia virus Lambda, Measles virus, Smallpox virus. State and Nationals only: SARS-CoV-2 virus, Human Immunodeficiency Virus, Major Prion Protein

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

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

MISSION POSSIBLE B

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

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

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

EYE PROTECTION: C **APPROXIMATE TIME:** 40 minutes

2. **EVENT PARAMETERS:**
   a. Each Device must pass a safety inspection before operation. Devices with potential hazards or safety concerns must not be permitted to run unless safety concerns are resolved to the satisfaction of the Event Supervisor, otherwise they must receive only participation points.
   b. All participants must properly wear eye protection at all times. Participants without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows. Participants without eye protection will not compete.
   c. At State and National Tournaments, teams must impound their Device, Action Sequence (ASL), any tools or parts that they will use during their set-up time or run. Electric outlet access will not be available.
   d. Event Supervisors will need their own eye protection (e.g., safety glasses), meter sticks, stopwatches, and measuring tape.
   e. Participants must be able to answer questions regarding the design, construction, and operation of the Device per the Building Policy found on www.soinc.org.
3. **CONSTRUCTION PARAMETERS:**
   a. During operation, the Device's outer dimensions should be no greater than 60.0 cm x 60.0 cm x 100.0 cm, in any orientation.
   b. All actions used for scoring must be visible and/or verifiable. The top and at least two vertical walls must be open or transparent for viewing all actions. Actions must be consecutive. Parallel and/or dead-end actions will not count for points. Any action in the Device not designed to contribute to the completion of the Final Action will not count for points.
   c. Each movable/adjustable physical object in the Device must be utilized by at most one assigned action. An object at the end of one action may initiate the next action but must not go beyond the initiation of the second action.
   d. Sensitive components (e.g., springs/mousetraps, dominoes) may be set/placed just before starting the Device.
   e. Use of electricity is prohibited anywhere in the Device.
   f. Candles, flames, matches, hazardous liquids, lead objects (even if encased), gasses, hazardous materials (e.g., rat traps, combustible fuses, dry ice, liquid nitrogen), and unsafe handling of chemicals will not be permitted.
4. **DEVICE OPERATION:**
   a. Start Action: (100 points) Participants must drop an unaltered golf ball, with nothing attached to it, into the Device from a point completely above the Device. The golf ball must fall into the Device and initiate the next action.
   b. Scorable Actions: (50 points each) Participants may have up to 12 scorable unique actions (4.d.i. through 4.d.xii.) to count for points at a tournament. Simple machines required in the actions must be used as the simple machine name implies. For example, a wedge must be "wedged" against an object rather than used as a gate. An axle must turn a wheel or vice-versa for it to be considered a wheel & axle.
   c. The scorable actions may be attempted in any order. Other non-scorable actions may be inserted between those that could count, but the inserted actions will not count for points.
   d. Each of the actions below may be attempted only once for points in the Device.
      i. Rotate a wheel & axle to raise an object at least 10 cm vertically before the raised object initiates the next action.
      ii. Push a wedge to separate two touching marbles so that one moves 20 cm horizontally from its spot and then initiates the next action.
      iii. Remove a wedge that is keeping a golf ball from rolling, so that the golf ball rolls at least 20 cm horizontally to initiate the next action.
      iv. Push or pull an object up an inclined plane with an IMA of at least 2 so that the object is vertically raised at least 10 cm before it initiates the next action.
      v. Use a 3rd class lever to raise an object 10 cm vertically before the object initiates the next action.

vi. Operate a pulley system with IMA of 3 to raise an object at least 10 cm vertically before the object initiates the next action.
vii. Use a marble to knock over a series of 3 dominoes so the last domino moves another marble to initiate the next action.
viii. Use a 2nd class lever to raise an object 10 cm vertically before the object initiates the next action.
ix. Use a single marble to hit a chain of 5 touching marbles so that the last marble moves at least 10 cm horizontally before it initiates the next action.
x. Use water to raise a golf ball via flotation at least 5 cm before the golf ball rolls out of the container to initiate the next action.
xi. Use falling marbles to turn a paddlewheel. The wheel must make at least one full revolution **before** the paddlewheel triggers the next action.
xii. Use an Archimedes screw to raise a marble 20 cm vertically before the marble triggers the next action.

e. Participants may designate one sand timer, an action taking over 10 seconds, to be eligible for bonus points. This timer must not be one of the scorable actions.
i. A 1 point bonus will be awarded for every full second the sand timer runs before the Target Operation Time and before it initiates the next action. The timer may run past the Target Operation Time but will not receive points for the duration after the Target Operation Time or after it starts the next task.
ii. The timer must successfully initiate the next action for any bonus points to count.
iii. If the Sand Timer is activated or touched by a participant or if he/she activates the next action, no points will be awarded for the timer.
iv. For State/National tournaments, the team must demonstrate how this timer is adjusted to account for the increased length of Target Operation Time for the bonus points to count.

f. Final Action:
i. After all other planned scorable actions have been attempted, the Device releases a golf ball attached to the end of a string that forms a pendulum. To count, the pendulum must swing from the release point, swing, and strike a release button/mechanism that raises a STOP Sign completely above the Device. The STOP Sign must be cardboard or poster board, oriented vertically, red and square or octagonal. It must be at least 15 cm high and 15 cm wide.
ii. If the entire sign is vertical and completely higher than the entire Device, 250 points will be awarded. If the sign is only partially above the Device, only 125 points will be awarded.
iii. No part of the sign will be allowed to be the outer boundary of the Device prior to the release button being activated.
iv. If the golf ball strikes the release button/mechanism at the end of its swing, 3 points will be awarded per cm of the shortest straight line distance between the golf ball starting point and the release button/mechanism.

g. Two printed copies of an Action Sequence List must be given to the Event Supervisor at the time of check-in (Regionals)/impound (State and National). The list must indicate the Start and the action initiated by the golf ball, any scorable actions to be attempted, the Sand Timer (if one is included), the action that releases the golf ball pendulum, the straight line distance between the golf ball starting point and the release button/mechanism in cm. The format should be the same as the one posted on the Science Olympiad website. Everything required in the ASL should also be labeled at the proper places within the Device.

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

a. The Target Operation Time is 60 seconds at Regionals/Invitationals, 61 to 90 seconds at State, and 91 to 120 seconds at Nationals. For State and National tournaments, teams will be told the target time at the start of their setup. The target time will be the same for all teams at State and Nationals.
b. Timing and scoring begin when a participant drops the golf ball into the Device. Timing stops when the golf ball pendulum strikes the STOP Sign release button/mechanism, or after 2 x the Target Time has elapsed, whichever comes first.
c. Teams that have a time of twice the Target Time will receive no (zero) points for running time. No negative scores will be given for time.
d. If the Device stops, jams, or fails, the participants will be allowed to adjust it to continue operation up to three times. An adjustment may consist of multiple physical touches and is only completed once the Device runs again on its own. Adjusting only to stall or impact operation time will result in disqualification.

e. If a participant completes a scorable action or makes an adjustment that leads directly to the completion of that action, then that action will not count for points, even if it is part of the Final Action.
f. Participants will not be allowed to touch the Device to release the golf ball pendulum or anything after that point
g. The Supervisor will review with teams the data recorded on the scoresheet.
h. Teams filing an appeal must leave their Device and ASL in the event area.

6. **SCORING:**
   a. High score wins.
   b. Award 50 points if participants use no more than 30 minutes to set up their Device.
   c. Award 25 points if 2 printed copies of the ASL are presented at the proper time.
   d. Award 25 points if ASLs are in proper format.
   e. Award 25 points if the original actions in the ASL are properly labeled in the Device.
   f. Award 25 points if all scorable actions are included and are accurate.
   g. Award 50 points the first time each unique action in 4.d. is successfully completed as described.
   h. Award 100 points for completing the Start Action
   i. Award 250 points for completing the Final Action as described in 4.f. or 125 points if partially completed.
   j. Award 3 points for each cm of the shortest straight line distance from the golf ball starting point to the STOP Sign release button/mechanism if the golf ball on the pendulum strikes the release button/mechanism.
   k. Award 2 points for each full second (truncated down) of operation up to Target Operation Time. Devices running twice the Target Time will receive zero time points for the run.
   l. Award 1 point per full second that a sand timer runs before the Target Operation Time and initiation of the next action, if all conditions are met, and the next action is initiated by the timer.
   m. Award 0.1 point for each 0.1 cm that the Device dimensions are under 60.0 cm for 2 dimensions and 100 cm for the third dimension. The maximum score awarded for each dimension is 30 points, for a total of 90 points. (Only at in-person tournaments.)
   n. Award 75 points for a Device that has no adjustments during operation.
   o. Teams failing to impound their Device on-time will be ranked after all teams that impounded on-time.
   p. Teams receive only participation points for impounding a Device but not competing, unsafe Devices, Devices with a dimension greater than 110 cm, or Devices that are remotely timed/controlled.

7. **PENALTIES:**
   a. Deduct 2 points for each full second (truncated rounded down) that the Device operates past the Target Operation Time up to 2 x the Target Time seconds.
   b. Deduct 25 points:
      i. For each dimension of the Device that exceeds its limit of 60 or 100 cm
      ii. If the top and 2 vertical walls are not open or transparent.
      iii. For each time the Device is adjusted during operation, up to 3 times. If the Device stops or fails after the third adjustment, scoring stops and the operation time will be 2 x the Target Time in seconds. In this case zero points will be awarded for time.
   c. Deduct 50 points if any solid or liquid leaves the measured dimensions of the Device.
   d. Devices that use electricity within the Device will not be allowed to run.

8. **TIEBREAKERS:**

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

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

OPTICS B

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

1. **DESCRIPTION:** Teams will participate in an activity involving positioning mirrors to direct a laser beam towards a target and complete a written test on the principles of geometric and physical optics.

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

CALCULATOR: Class III **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. Each team may bring one three-ring binder of any size containing information in any form and from any source, attached using the available rings. Sheet protectors, lamination, tabs and labels are permitted. Participants may remove information or pages for their use during any part of the event.
   b. Each team may also bring tools, premade templates, supplies, writing utensils, and two calculators **(Class III)**.
   c. Teams must not bring lasers, mirrors, **other optical devices (aside from personal eyeglasses or contacts), or electronics (other than calculators).**
3. **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 will consist of at least 5 questions from each of the following areas:
      i. Reflection and refraction: Specular & diffuse reflection, **Law of Reflection**, index of refraction, **Snell's law, critical angle**, and prisms (deviation & dispersion)
      ii. Mirrors & lenses: Convex, concave, and plain mirrors and lenses; ray tracing; focal length; real, virtual, erect, and inverted objects and images; magnification
      iii. Color theory: Additive & subtractive color theory; primary & secondary colors; absorption & reflection
      iv. Structure and function of the human eye
      v. State & National Only:
         (1) Structure and function of microscopes, telescopes, and **sextants**
         (2) Structure and function of cameras, glasses, retro reflectors, and periscopes
         (3) Absorption spectra in films, chemicals, & dyes
         (4) **Correction of optical problems in human eyes using lasers**
   d. Questions on the test will use the following mathematical content:
      i. Math expectations for Regional Tournaments:
         (1) Primarily qualitative (non-computational) questions and ray tracing
         (2) Standard arithmetic operations (including ratios)
         (3) Basic 2D geometry required for ray tracing. For example, parallel & perpendicular lines, rays, triangles (similar & congruent), and circles
         (4) **Simple trigonometric relations to enable use of trigonometric functions on a calculator. No angles in radians.**
      ii. **Math expectations for State & National Tournaments:**
         (1) **All Regional expectations.** Exam should still emphasize qualitative questions, but students can expect more computational work.
         (2) Simple algebra manipulations, including solving one equation for one variable

Part II: Laser Shoot

   a. The objective is to reflect a laser beam with mirrors around barriers towards the Target Point located on the wall opposite the laser.
   b. The event supervisor must select a Target Point location that is the same for all teams. Teams must not be informed of the location until it is their turn to compete in Part II of the event.
   c. The Event Supervisor must test the beam's alignment before each team is permitted to see the **LSS (Laser Shoot Setup, as defined in Section 4).**
   d. All mirrors must be placed in a home position designated by the event supervisor before each team is permitted to see the LSS.
   e. When a team is ready to begin, the event supervisor must give a countdown of "3, 2, 1 start" and start a timer. Event Supervisors must give teams a warning when 3 minutes have elapsed.

f. Competitors must make all measurements, calculations, and mirror placement/alignment within a 4-minute time period. Competitors may **place** between 1 and 5 moveable mirrors, **which may be placed on top of templates laid on the base of the LSS.**
g. Timing must stop when 4 minutes have elapsed or the competitors remove the material covering the face of one mirror. Competitors must not make any additional adjustments to the mirrors at that point other than to remove the mirror coverings. The Event Supervisor must not remove the coverings.
h. Competitors must not mark on or modify the LSS **or attach anything to it via adhesive.**
i. Competitors must not touch the laser **or barriers** or change **their** orientations and/or position**s, including for the purpose of placing templates. If they move any of these elements, the team will be assessed a competition penalty and the time for the Event Supervisor to reset the position comes out of the team's setup time.**
j. The laser must not be turned on until timing stops. Once turned on, the Event Supervisor must mark on the paper mounted above the metric scale where the laser strikes it to record the results. Participant tools/templates may remain on the LSS during this process.
k. **Additionally, the Event Supervisor must record the total number of gridlines (defined in 4.g.) the laser beam crosses over or touches from the first reflection from a student-positioned mirror to the beam's termination point. More than one reflection off a mirror (including the barrier mirror) will not be scored for the Team Line Score (TLS), as defined in 5.d, so each mirror should only be placed to have a single reflection off of it.**
l. The Event Supervisor will review with the team the Part II data recorded on their scoresheet.

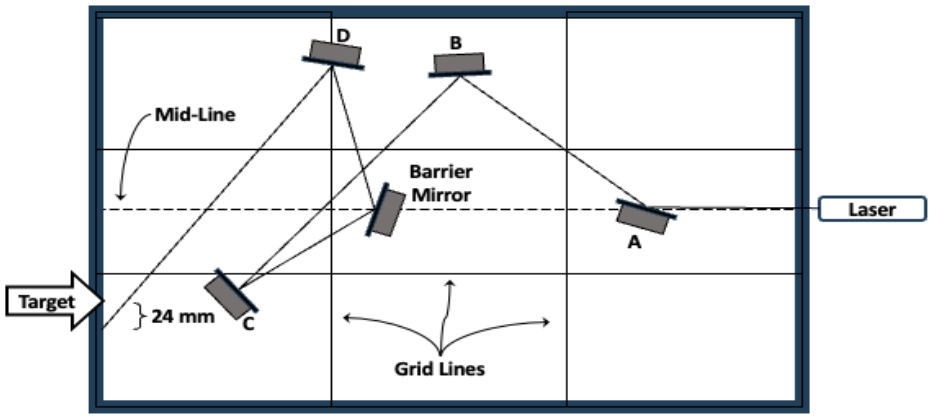
4. **<u>THE COMPETITION AREA</u>:**
a. Example setups are provided on the event page at www.soinc.org.
b. The Event Supervisor will provide the Laser Shoot Setup (LSS), including timers, laser, mirrors and barriers. Multiple LSS's may be used to facilitate all teams being able to compete in a timely manner.
c. The LSS has a horizontal flat surface 56 ± 1.0 cm by 35 ± 1.0 cm enclosed by a 2 ± 0.5 cm thick wall. The bottom surface may be a table top. The height of the wall above the surface is 9 ± 1.5 cm.
d. Five (5) moveable flat mirrors with a width of 5.0 – 8.0 cm must be placed in the LSS and must be back-surface mirrors. Each mirror must be mounted so that it stands vertically (~90 degree angle to the bottom surface), does not have excess mounting material on its sides, has its approximate center at the level of the laser beam and can be easily relocated anywhere in the LSS by the competitors. The mirror faces must initially be covered with a cardboard sleeve or other easily removable non-reflecting, opaque material.
e. A laser is mounted through the approximate center of one of the 35 cm walls at a height of 1.5 - 6.0 cm above the bottom surface. The laser must be securely mounted such that it cannot be moved and the beam is perpendicular to the wall through which it is mounted. The Laser Policy on www.soinc.org must be followed. The laser must remain fixed throughout the entire event.
f. A midline is drawn on the LSS from a point directly below the emitting tip of the laser to a point directly below the center of the laser beam where it strikes the opposite wall.
g. **Additionally, gridlines will be finely drawn on the LSS bottom surface dividing the LSS bottom surface horizontally into three approximately equal rows and vertically into three approximately equal columns, creating 9 Zones of approximately equal dimensions on the bottom of the LSS. The gridlines should extend up the walls and top edges of the laser shoot so they can be seen if a team uses a template.**
h. A metric scale with a resolution of at least 1 mm must be attached horizontally to the other 35 cm wall opposite the laser at the level at which the laser strikes. One of the marks on the scale is the Target Point. A sheet of paper must be also fastened to the wall, with a mark on the paper indicating the Target Point location.
i. **A sixth mirror with construction similar to the others (and covered similarly) must be placed somewhere along the midline to block the laser beam. This barrier mirror may face in any direction at any angle so long as it blocks the laser beam. It must be fixed in the same position and orientation in the LSS for all teams, and positioned such that teams are able to redirect the laser and hit the target. The barrier mirror may be placed on a gridline.**

5. **SCORING:**
   a. Final Score (FS) = ES + **LS** + AS + BS. The maximum possible FS is 100 points. High score wins. A scoring spreadsheet is available on the event page on www.soinc.org
   b. Exam Score (ES) = (Part I score / Highest Part I score of all teams) x 45 points
   c. **Line Score (LS) = (TLS / Highest TLS of all teams) x 20 points**
   d. **Team Line Score (TLS) = the total number of gridlines the laser beam crosses over or touches from the first student-placed mirror to its termination point (see 3.II.k) Some unique cases are scored as follows:**
      i. **Crossing the midline does not count as crossing a gridline.**
      ii. **If the beam crosses at the intersection of 2 gridlines, that counts as two lines crossed**
      iii. **If a beam hits a mirror or the barrier mirror exactly at one gridline, that counts as one line crossed and does not get counted again as the beam leaves the mirror. Similarly, if a beam travels along a gridline, that counts as one line crossed.**
      iv. **If the beam crosses a gridline once and then later in its path crosses the same gridline, that counts as two lines crossed.**
      v. **If a mirror is hit a 2nd time by the beam, the lines crossed immediately after that mirror's 2nd hit are not counted. However, after the beam hits another mirror, lines can continue to be counted.**
   e. **Accuracy Score (AS) = (TAS / Highest TAS) x 25 points**
   f. **Team** Accuracy Score (**TAS**) = (25 – accuracy(in mm)/10) points. The smallest possible **TAS** is 0.
      i. The accuracy is the horizontal distance from the Target Point to the center of where the laser strikes a wall. If the laser strikes another wall instead of the wall the Target Point is on, the accuracy is the sum of the straight-line measurements from the Target Point to the corner along one wall and along the other wall from the corner to the laser dot. **If the laser beam is split and the Event Supervisor determines one beam is brighter, the measurement will be made from the brighter beam. If both appear equal, the beam closer to the target will be used for the measurement.**
      ii. If the laser does not strike **any** wall, the **TAS** is 0, but the **TLS** and BS should still be calculated.
   g. Barrier Score (BS) = **10** points if the laser reflects off the barrier mirror **independent of how many gridlines have been crossed**
   h. Teams that are not allowed to compete in Part II due to unsafe operation of the LSS receive an AS, **LS** and BS of 0, but must still be allowed to compete in Part I.
   i. The AS, **LS**, and BS must be multiplied by 0.9 when calculating the Final Score if the team violates any of the rules in Section 3: THE COMPETITION.
   j. Ties are broken using designated question(s) on the written test. The Event Supervisor must identify tiebreakers to the Participants at the beginning of the competition period.

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

OPTICS B SCORING EXAMPLE

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



Barrier Score (BS) = 10 points for use of the barrier mirror
Team Accuracy Score (TAS) = 25 - (accuracy in mm/10).
The accuracy = 24mm, so TAS = 25 - (24/10) = 22.6 points
Team Line Score (TLS) = 11 points, divided as follows:

BEAM FROM	BEAM TO	EXPLANATION	POINTS
Laser	Mirror A	No points are scored until the beam reflects off a student-placed mirror (3.II.k)	0
Mirror A	Mirror B	Crosses Directly over the Intersection of 2 Gridlines (5.d.ii)	2
Mirror B	Mirror C	Crosses 3 Gridlines & the Midline. This part of the beam crosses 1 gridline that was previously crossed in the beam from A to B, but this is allowed and fully scored (5.d.iv). The Midline crossing scores nothing (5.d.i)	3
Mirror C	Barrier Mirror	Crosses 2 Gridlines	2
Barrier Mirror	Mirror D	Crosses 1 Gridline + Intersects a Mirror on a Gridline (5.d.iii)	2
Mirror D	Wall	Leaves the Mirror located on the Gridline, but does not get counted again (5.d.iii). Crosses 2 Gridlines to terminate on the wall	2

POTIONS & POISONS B

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

1. **DESCRIPTION:** This event is about chemical properties and effects of specified toxic and therapeutic chemical substances, with a focus on household and environmental toxins or poisons.

   A TEAM OF UP TO: 2 **EYE PROTECTION:** C

   CALCULATOR: Class II **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 calculator (Class II).
   b. Each participant may bring one unique 8.5" x 11" sheet of paper, which may be in a sheet protector sealed by tape or laminated, with information on both sides in any form and from any source.
   c. Teams should bring any or all of the items listed on the Division B Chemistry Events Lab Equipment List, posted on soinc.org. Teams not bringing these items will be at a disadvantage, as they are not provided.
   d. Participants must wear goggles, an apron or a lab coat and have skin covered from the neck down to the wrists 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, etc.)

3. **THE COMPETITION:** The competition will be conducted in two parts.
   a. Part 1--Exam: This part should be a multiple-choice and short answer test covering the following subject areas: Students should understand ionic and covalent bonds, and the differences between mixtures, solutions and compounds. Students may be asked how to separate components of a mixture. Students should distinguish between physical and chemical changes. Students may be asked to balance a simple chemical equation. Students may be asked to identify various poisonous plants and animals, and their toxic effects. Students may be given a map and be asked to analyze the potential patterns of spread of toxic spills in the environment via water, wind or gravity. Students should understand the effects and chemistry of common household toxins. Students should understand the effect of dilution on toxicity.

      The test may include information on the following specific toxins:
      i. Household chemicals: ammonia, hydrogen peroxide, rubbing alcohol, bleach, Epsom salts, vinegar, nutritional supplements containing calcium and iron.
      ii. Toxic living organisms: poison ivy (*Toxicodendron radicans*), jequirity bean (*Abrus precatorius*), deadly nightshade (*Atropa belladonna*), foxglove (*Digitalis purpurea*), castor bean (*Ricinus communis*), blue ringed octopus (*Hapalochlaena sp*), black widow spider (*Latrodectus mactans*), cone snail (*Conus sp*), and timber rattlesnake (*Crotalus horridus*)
      iii. Environmental toxins: arsenic, lead, and mercury.
   b. Part 2--Lab: Students should be asked to perform at least one lab task themselves. Other lab exercises may be performed as a demonstration, at the discretion of the event supervisor. Lab activities should be drawn from: chromatography, mixtures of reagents, separation of a mixture, serial dilutions, determination of pH, and conductivity testing. Reagents may be mixed by students or the event supervisor with subsequent observation of changes in temperature or color, production of a gas or a precipitate, the relative rate of a chemical reaction or other parameters. Students may be asked if a particular change is a physical or chemical change.

4. **SCORING:** Part 1: Test questions are worth 60% of the competition Part 2: Lab questions are worth 40% of the score. Selected questions or quality of free response answers will be used to break ties.

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

REACH FOR THE STARS B

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

1. **DESCRIPTION:** Participants will demonstrate an understanding of **late-stage stellar evolution and stellar remnants**, and their observation **across the electromagnetic spectrum**.

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

2. **EVENT PARAMETERS**: Each team may bring two 8.5" x 11" sheets of paper, which may be in sheet protectors sealed by tape or laminated, that may contain information on both sides in any form and from any source without any annotations or labels affixed.

3. **THE COMPETITION:**
   a. Participants **may** be asked to identify the constellations, **star systems**, and deep sky objects on the list below as they appear on star charts, H-R diagrams, and photos in various wavelengths. They **must also** be knowledgeable about the structures, physical properties, and evolutionary stages of all star systems and deep sky objects on the list below. Note: constellations are underlined, *star systems* and *deep sky objects* are italicized. **Exams should NOT contain detailed questions about objects not listed here:**
      i. Aquila: *Hulse-Taylor Pulsar*
      ii. Canis Major: *Sirius*
      iii. Cassiopeia: *Cassiopeia A*
      iv. Cetus: *Mira*
      v. Cygnus: *Cygnus X-1, SS Cygni*
      vi. Dorado: *SN 1987A*
      vii. Draco: *NGC 6543*
      viii. Lyra: *RR Lyrae*
      ix. Ophiuchus: *SN 1604*
      x. Orion: *Betelgeuse*
      xi. Southern Hemisphere: *GW150914*
   b. Participants will be required to demonstrate their knowledge of **late-stage stellar evolution and stellar remnants** by answering questions pertaining to the following topics:
      i. Structure, physical properties, and behavior of the following stages of post-main-sequence stellar evolution and stellar remnants: **red giant branch, asymptotic giant branch, planetary nebulae, white dwarfs, supernovae (all types/subtypes), neutron stars, pulsars, and black holes**
      ii. **Orbits, behaviors, and potential evolution (mass transfer, orbital decay, etc.) of objects in compact binary systems, including (but not limited to): novae, dwarf novae, x-ray binaries, neutron star binaries, and black hole binaries**
      iii. Observation and classification of **post-main-sequence stars and stellar remnants** by spectra, light curves, and physical parameters, including (but not limited to): temperature, luminosity, and mass
      iv. Scientific and engineering design principles associated with the following observatories: JWST, Hubble, Spitzer, Chandra, **Swift**, **Fermi**, and **LIGO**
      v. Basic algebraic understanding of the following concepts using order-of-magnitude estimation, proportions, and scaling relations. **Exam questions should NOT require a calculator to complete.**
         (1) The relationship between stellar temperature, radius, and luminosity
         (2) Magnitude and distance scales, **including period-luminosity relations and standard candles**
         (3) Orbital mechanics and gravitational interaction using Newton's law of universal gravitation, Kepler's laws, the vis-viva equation, and **Schwarzschild radius estimation**

4. **SCORING:** Each task and/or question will have been assigned a predetermined number of points. High score wins. Ties will be broken by the accuracy and thoroughness of responses.

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

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

ROAD SCHOLAR B

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

1. **DESCRIPTION:** Participants will interpret questions based on one or more state highway maps, USGS topographic maps **(or portions thereof)** maps, Internet-generated maps, a road atlas, or satellite/aerial images.

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

2. **EVENT PARAMETERS:**
   a. Teams may bring two stand-alone non-programmable, non-graphing calculators (Class II), protractors, rulers, other measuring devices, USGS Map Symbol Sheets (pre- and post-2010), hand lenses/magnifying glasses, hard copies of other information in any form and from any source, **and at State and National Tournaments, colored pencils consistent with the colors utilized on USGS topographic maps.** The equipment and reference materials may be in a container.
   b. The event supervisor will provide all required maps and images. Participants may NOT write on the maps. If a student-generated map is included, a one mile-square PLSS section will be printed on the answer sheets. Graphing axes will be provided for profile problems. Event supervisors will check the accuracy of scales on reproduced maps or images prior to competition.

3. **THE COMPETITION:** The satellite images, highway, and quadrangle maps may be from one or more states. The event may be presented in a storyline format. Satellite/aerial photos will be in the visible light spectrum.

Topics/Concepts Assessed

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

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

c. Student-Created Map
   i. Map scales
   ii. USGS topographic map symbols
   iii. Distances
   iv. Azimuths and bearings
   v. Public Land Survey System
   vi. State/National only: Colors consistent with USGS Maps

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

4. **SCORING:**
   a. High score wins. Values of questions may be weighted.
   b. Ties will be broken by the accuracy and quality of answers to pre-selected questions.

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

SCRAMBLER B

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

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

   A TEAM OF UP TO: 2 **EYE PROTECTION:** B **IMPOUND:** Yes

   CALCULATOR: Class III **APPROXIMATE TIME:** 12 minutes

2. **EVENT PARAMETERS:**
   a. Each team must bring and impound one Scrambler (with falling mass detached), alignment devices (if used), additional/spare parts, and paper or practice log (if used).
   b. Teams may share launchers, falling mass, and alignment devices between teams from the same school.
   c. Teams may bring data and a stand-alone calculator (Class III) of any type along with non-electronic tools which do not need to be impounded.
   d. All participants must properly wear eye protection at all times. Participants without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows. Participants without eye protection will not be allowed to compete and will receive participation points.
   e. Teams must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org.

3. **CONSTRUCTION PARAMETERS:**
   a. The Scrambler must consist of an egg transport (Vehicle) and an energy propulsion system (launcher and falling mass). These may be separate or combined into a single unit.
   b. The Scrambler (Vehicle and energy propulsion system) including the egg, falling mass, and cushion to protect the floor, in the ready-to-run configuration, must completely fit within an imaginary rectangular box with 100.0 cm x 50.0 cm base and a 100.0 cm height. No part of the Scrambler can be taped or attached to the floor.
   c. All energy used to propel the Vehicle must come from a falling mass not to exceed 2.00 kg. The gravitational potential energy of the falling mass may be converted to other forms of energy. The mass must be part of the energy propulsion system and need not travel with the Vehicle. Any additional sources of kinetic energy must be in their lowest energy state in the ready-to-run configuration. Any part of the Scrambler whose gravitational potential energy decreases and provides energy to propel the Vehicle after the Scrambler is actuated is considered to be part of the falling mass. The falling mass must not directly contact the venue floor by using a pad or similar protective cushion. To facilitate mass measurements, the Scrambler must be impounded with the mass detached.
   d. The stopping mechanism must be contained completely within the Vehicle and work automatically. The Vehicle must not be remotely controlled or tethered. Pre-loaded energy storage devices may be used to operate other Scrambler functions (e.g., braking system) as long as they do not provide kinetic energy to propel the Vehicle.
   e. The egg must rest on two (2) 1/4" to 3/8" wooden round dowels which extend out between 3.0 and 4.0 cm from a solid, rigid, unpadded and flat backstop for the egg. The bottom of the wooden dowels must be between 5.0 and 10.0 cm above the track and within 1.0 cm from the bottom of the backstop. The egg backstop must be built of any rigid material, and it must have a flat surface of 5.0 ± 0.5 cm wide by 5.0 ± 0.5 cm high by 1.27 cm (0.50") or thicker. Nominal blemishes which do not affect the point of contact of the egg with the backstop are allowed. The backstop must be attached to the vehicle in a rigid method that prevents the backstop from moving during impact. A diagram of the backstop will be available on www.soinc.org. One or more violations of this paragraph counts as a single Construction Violation.
   f. Competitors must design the Scrambler to start by using any part of an unsharpened #2 pencil with an unused eraser, provided by the Event Supervisor (ES), to actuate a release mechanism. The pencil may be the release mechanism itself and may extend beyond the dimensions in 3.b. Actuating the release mechanism must not impart additional energy to the Vehicle.
   g. All parts of the Vehicle must move as a whole; no anchors, tethers, tie downs, or other separate pieces are allowed. The only parts allowed to contact the floor during the run are those already in contact with the floor in the ready-to-run configuration. All wheels must be in contact with the floor at launch. Pieces falling off during the run constitutes a Construction Violation.
   h. No electrical or electronic devices may be used (with the exception of any type of calculator).

4. **PRACTICE LOG:** A Practice Log is recommended but not required. The Practice Log may contain paper for the competitors to use and must be impounded in order for the competitors to use during the competition.

5. **THE TRACK:**
   a. The Track must be on a smooth, level, and hard surface with a Terminal Barrier (TB) extending across its end. Space is recommended on each side of the Track and beyond the TB to allow for error in the Vehicle's path. Refer to soinc.org for a diagram of the Track.
   b. The Start Point will be marked on a piece of tape approximately 2.5 cm wide and 5.0 cm long.
   c. The End Point is the point defined by the intersection of the imaginary Center Line and the front edge of the TB. Like the Start Point (rule 5.b.), the End Point will also be marked on a piece of tape attached to the floor.
   d. The imaginary Center Line is a line that connects the Start Point to the End Point. This line does NOT need to be marked by the ES.
   e. Track will have a minimum of 1.5m width.
   f. The TB must be a hard, flat, vertical wall at least 25.0 cm tall, placed perpendicular to the imaginary Center Line that connects the Start Point and the End Point. It must be a minimum of 1.00 m long. The exact Target Distance from the Start Point to the End Point will be between 7.00 m and 10.00 m. At Regionals/Invitationals the interval will be 0.25 m, for States 0.10 m, and for Nationals 0.05 m. The Target Distance will be chosen by the ES and will be announced after the impound period is over.
   g. At the ES's discretion, more than one Track may be used. If so, the team may choose which Track they use, but must use the same Track for both runs.

6. **THE COMPETITION:**
   a. Only participants and the ES will be allowed in the Impound and Track areas. Once participants enter the event area to compete, they must not leave or receive outside assistance, materials, or communication until they are finished competing and have left the event area.
   b. Teams have 8 minutes of Event Time to set up and start up to 2 runs. During this time, they must not increase the falling mass once it has been measured. Scramblers in the ready-to-run configuration before the end of the Event Time will be allowed to complete a run.
   c. The ES must provide uncooked grade A large chicken eggs, one of which is selected by the team immediately prior to their 8-minute Event Time. Tape will be provided by the ES to secure the egg to the Vehicle, with no tape placed on the front or rear 1.0 cm of the egg. The egg's rounded end must be touching the backstop and visible to the ES when attached. The egg must be the foremost point of the Vehicle. At the ES's discretion, the egg may be placed inside a thin transparent plastic bag.
   d. Electric/electronic tools must not be used except for the calculator (2.c.).
   e. In the ready-to-run configuration, the pointed tip of the egg must be placed directly above the Start Point. The launcher may extend in front of the Start Point. The Scrambler must remain in the ready-to-run configuration without being touched until triggered by the #2 pencil. Participants can only touch or hold the #2 pencil and not the Scrambler during the triggering action.
   f. Teams may adjust their Scrambler (e.g., directional control) within their Event Time. The ES may re-verify that the Scrambler meets specifications prior to each run. Timing is paused during any measurements made by the ES.
   g. Teams may use their own non-electronic measuring devices to verify the Track dimensions during their Event Time.
   h. Only non-electronic sighting, alignment, or aiming devices are permitted. If placed on the Track, these devices may only be used within the defined Track area. If placed on the Vehicle, they may be removed at the team's discretion. Devices remaining on the Vehicle will be considered part of the Vehicle. All other devices must be moved behind the Start Point prior to starting a run.
   i. 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.
   j. Substances applied to the device must be approved by the ES prior to use and must not damage or leave residue on the floor, Track and/or event area. Teams may clean the Track during their Event Time, but it must remain dry.
   k. 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 2 runs within the Event Time.

l. Once a run is started, teams must not follow their Vehicle and must wait until called by the ES to retrieve their Vehicle. Timing resumes once the participants pick up their device or begin making their own measurements.
m. If the egg is broken during a run (as defined by cracking the egg enough to leave a wet spot on a paper towel) it is considered a Competition Violation. If the egg breaks on the first run, a second run must not be permitted and is scored as a Failed Run. There is no penalty if an egg breaks prior to the device being actuated before the first launch. A second egg will be provided. The second egg may be a used egg; this will be the ES's choice.
n. If any part of the Vehicle (besides the egg) touches the TB, it is considered a Competition Violation. If the tip of the egg goes past the front face of the TB anytime during the run, it is also considered a Competition Violation.
o. A run will be scored as a Failed Run if one of the following occurs. Construction and/or Competition Violations must still be recorded for Failed Runs.
    i. If the egg is broken on the 1st run, then the 2nd run will be a Failed Run.
    ii. The Vehicle starts before the ES is ready
    iii. The Vehicle's distance or time cannot be measured (e.g., the participants pick it up before it is measured)
    iv. The team pushes the Vehicle down the Track
    v. A team having only one successful run during the 8-minute Event Time will be assessed a Failed Run for a 2nd Run Score. If the Vehicle does not move during the Event Time, the team will be assessed 2 Failed Runs.
p. The ES will review with teams their data recorded.
q. Teams filing an appeal must leave their Scrambler and other impounded material in the event area.

7. **<u>SCORING</u>:**
a. Each team's Final Score is the better of the 2 Run Scores + Final Score Penalties. Low score wins.
b. Run Score = Distance Score + Time Score + Run Penalties
c. Distance Score = 2 pts/cm x Vehicle Distance.
    i. The Vehicle Distance is a point-to-point measurement from the End Point to the pointed end of the egg (or the point of impact for broken eggs) measured to the nearest 0.1 cm.
    ii. The Distance Score for a Failed Run is 2500 points.
d. Time Score = Run Time
    i. The Run Time begins when the Vehicle moves and ends when the Vehicle stops.
    ii. The Run Time is recorded in seconds to the precision of the timing device used.
    iii. The Run Time will be recorded as 0.00 seconds for Failed Runs
    iv. Three timekeepers should be utilized with the middle time used as the official Run Time.
e. Run Penalties:
    i. Competition Violation: 150 points added to the Run Score per violation
    ii. Construction Violation: 300 points added to the Run Score per violation
    iii. Failed Runs can also be assessed Competition and/or Construction violations
f. Final Score Penalties: Scrambler not Impounded: 5000 points added to the team's Final Score.
g. Two or more teams tied with 2 Failed Run scores, without Competition or Construction Violations, will remain scored as ties. Other ties are possible.
h. Tiebreakers in order: 1. Better Vehicle Distance of the scored run; 2. Lower Time Score of the scored run; 3. Better Vehicle Distance of the non-scored run; 4. Better Time Score of the non-scored run.

8. **SCORING EXAMPLES:**
   a. A Scrambler has 2 runs in the allotted time.
      i. In the 1st run, the Vehicle stopped 67.6 cm from the TB center with a Run Time of 7.27 s
      ii. In the 2nd run, the Vehicle stopped 27.6 cm from the TB center with a Run Time of 8.67 s

Distance Score	= 67.6 cm x 2.0 pts/cm	=	135.2
Time Score	= 7.27	=	7.27
1st Run Score		**=**	**142.47**

Distance Score	= 27.6 cm x 2.0 pts/cm	=	55.2
Time Score	= 8.67	=	8.67
2nd Run Score		**=**	**63.87**

Final Score = 2nd Run Score (Better Score) = 63.87pts

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

TOWER B

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

1. **DESCRIPTION:** Teams will design and build a Tower (Structure) constructed of wood, bonded by adhesive, spanning a 20 cm square opening, able to support the loading block at least 50 cm above the test base and allow an 8 cm diameter ring gauge to pass over the top of the tower and lowered down to a point 25 cm above the test base. Bonuses can be obtained by holding 15 kg and spanning a 29 cm circle (rather than the 20 cm square). The structure must meet the requirements specified in these rules to achieve the highest score, which is a combination of structural efficiency and bonus.

A TEAM OF UP TO: 2 **EYE PROTECTION:** B

IMPOUND: No **EVENT TIME:** 6 minutes

2. **EVENT PARAMETERS:**
   a. Each team is allowed to enter only one Structure, built prior to the competition.
   b. All participants must properly wear eye protection at all times (reference Eye Protection Policy found on www.soinc.org). Teams without proper eye protection will be immediately informed and given a chance to obtain eye protection if time allows. Participants not wearing proper eye protection will not be allowed to compete and be placed in Tier 3.
   c. Participants may NOT bring any equipment such as levels or squares.
   d. The Event Supervisor will provide all Test Apparatus (see Section 5) and tools/materials/ring gauge for measurement except for virtual tournaments, the teams must supply all Test Apparatus that fully meets the requirements of Section 5, any deviations from Section 5 will be scored as a construction violation for the team.
3. **CONSTRUCTION PARAMETERS:**
   a. The Structure must be a single assembly with no separate, loose, sliding, or detachable pieces, constructed of wood, and bonded by adhesive. No other materials are permitted.
      i. Wood is defined as the hard, fibrous substance making up the greater part of the stems, branches, trunks, and roots of trees beneath the bark. Wood does NOT include bark, particleboard, wood composites, bamboo or grasses, paper, commercially laminated wood (i.e., plywood), or members formed of sawdust, wood shavings, and adhesive. Wood may never be painted, soaked, or coated in glue, color enhanced, or have tape/preprinted/paper labels affixed. Ink barcodes and/or markings from the construction process may be left on the wood.
      ii. There are no limits on the cross-sectional sizes of individual pieces of wood. Wood may be laminated by the team without restriction.
      iii. Adhesive is a substance used to join two or more materials together and may be used only for this purpose. Any commercially available adhesive may be used (e.g., glue, cement, cyanoacrylate, epoxy, hot melt, polyurethane, and super glues). Adhesive tapes are not allowed.
   b. Structure design requirements:
      i. Must span a 20 cm x 20 cm opening on a Test Base (5.a.).
      ii. May be placed on the Test Base surface in any orientation such that the loading chain is suspended within 2.5 cm of the center of the opening in the Test Base.
      iii. Must support the Loading Block (5.b.i.) a minimum of 50.0 cm above the Test Base. There is no maximum Tower height.
      iv. The portion of the Tower more than 25.0 cm above the Test Base must pass through an 8.0 cm ring gauge (5.g.).
      v. The loading point on the Structure must be constructed to permit placement of the Loading Block (5.b.i.) on the Tower and constructed such that only the Loading Block (5.b.i.) supports the chain and bucket.
      vi. **Bonus Points** (6.c.) can be obtained by designing the Tower to span a 29 cm diameter circle, centered on the 20 cm x 20 cm opening of the Test Base and holding 15.0 kg.
   c. Participants must be able to answer questions regarding the design, construction, and operation of the structure per the Building Policy found on www.soinc.org.

4. **THE COMPETITION:**

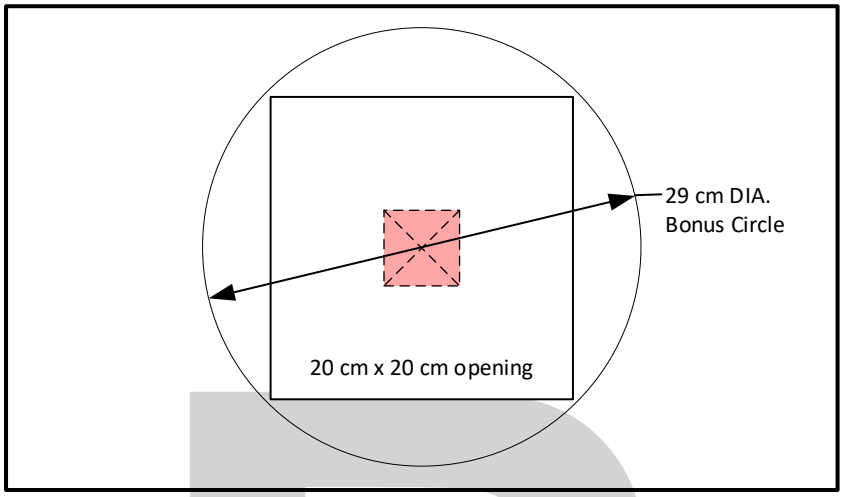
Part I: Check-In

a. The team must present their Structure for inspection & measurement.
b. The team must place their Structure on the Structure Scale (5.e.) so the Event Supervisor or Assistant can determine the mass, in grams, to the nearest 0.01 g or best precision available.
c. The team will measure the Structure height and demonstrate that the ring gauge (5.g.) can be placed over the tower and lowered to a height of 25 cm or less above the Test Base using provided measurement tools so the Event Supervisor or Assistant can determine if the Tower meets the requirements. Measurements shall be in cm to the nearest 0.1 cm.
d. The team must submit their Estimated Load Supported (6.e.i.) to be used as a tiebreaker.
e. No alterations, substitutions, or repairs may be made to the Structure once the check-in process has started.
f. Prior to Part II: Testing: the Event Supervisor will verify that the combined mass of the Loading Assembly with empty bucket does not exceed 1,500 g.
g. 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 Base and assemble the Loading Block Assembly and bucket as required to load the Structure. If necessary, participants may disassemble the Loading Block Assembly but must re-assemble in the same order as presented by the Event Supervisor. 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. The Event Supervisor will check that the loading chain is suspended within 2.5 cm of the center of the opening in the Test Base before loading begins.
f. The Event Supervisor before testing will verify no part of the Tower's span touches or is supported within the 29 cm diameter circle for the Tower to qualify for the "Load Scored Bonus".
g. 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 (5.d.).
h. Loading stops immediately when Structure failure occurs, or time expires. Structure Failure is defined as the inability of the Structure to carry any additional load, or if any part of the load is supported by anything other than the Structure. Incidental contact of the chain/eyebolt with the structure is not a failure. At the Supervisor's discretion, sand may be removed from the bucket if pouring continued after the structure fails or time expires.
i. 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.
j. At the Event Supervisor's discretion, more than one Test Apparatus may be used.
k. The Event Supervisor will review with the team the data recorded on their scoresheet.
l. Teams who wish to file an appeal must leave their structure with the Event Supervisor.

5. **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. Shall have a 29 cm circle drawn on the surface, centered on the 20 cm x 20 cm square opening. The surface outside the 29 cm circle shall be the Load Scored Bonus Zone.



   b. The Loading Assembly will consist of:
      i. A square Loading Block measuring 5 cm x 5 cm x approximately 2 cm high with a hole no larger than 8 mm drilled in the center of the 5 cm x 5 cm faces for a ¼" threaded eyebolt.
      ii. A ¼ inch threaded eyebolt (1-inch nominal eye outside diameter), minimum 2 ¼ inch length to a maximum 4 ½ inch length, and a ¼ inch wing nut. The loading block must be mounted on the eye bolt and be trapped between the "eye" of the eye bolt and the wing nut. The loading block cannot sit on top of the wing nut or be loose.
      iii. A chain and S-hook that are suspended from the eyebolt on the Loading Block
      iv. An approximately five-gallon plastic bucket with handle and hook to be suspended from the chain.
      v. The total combined mass of the Loading Assembly may not exceed 1,500 g.

   c. Sand: Load will be applied using sand or other clean, dry free-flowing material.
   d. 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.
   e. Structure scale: Must be a digital scale. The scale shall have a minimum resolution of 0.1 grams; recommended resolution is of 0.01 gram.
   f. Sand scale and load verification: Must be a digital scale. The scale shall have minimum resolution of 10 grams; recommended resolution is of 1 gram.
   g. Ring gauge: A gauge with an inside diameter of 8.0 to 8.1 cm, not weighing more than 10 g, that retains its shape and flatness when handled. (As an example, a plastic lid from a small butter tub can be made into a gauge by cutting out an 8.0 cm hole in the lid).

6. **SCORING:**
   a. High score wins. Score = [Load Scored (g)/Mass of Structure (g)]
   b. The Load Scored = Load Supported (4.II.i) + Load Scored Bonus (6.c.).
   c. Load Scored Bonus: Structures that ONLY contact the Test Base outside the 29 cm circle and holding 15.0 kg 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. For virtual meets, Test Apparatus not meeting requirements.
      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; No Load Scored Bonus = 1,199
      ii. Structure 2: mass = 10.12 g, Load Supported = 15,000 g + 5,000 g Load Scored Bonus = 1,976

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

This event is supported by the Cleveland-Cliffs Foundation and SkyCiv.

WIND POWER B

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

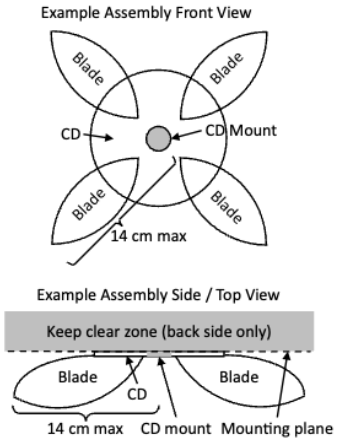
1. **DESCRIPTION:** Teams construct a blade assembly device prior to the tournament that is designed to capture wind power and complete a written test on the principles of alternative energy.

   A TEAM OF UP TO: 2 **EYE PROTECTION:** B **IMPOUND:** No

   CALCULATOR: Class III **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. Each team may bring one three-ring binder of any size containing information in any form and from any source, attached using the available rings. Sheet protectors, lamination, tabs and labels are permitted. Participants may remove information or pages for their use during any part of the event.
   b. Each team may also bring tools, supplies, writing utensils, and two calculators (Class III) for use during any part of the event.
   c. Each team may bring one pre-constructed blade assembly device.
   d. The Event Supervisor will provide the testing materials listed in the COMPETITION AREA section. **Teams should not bring these materials.**
   e. Competitors must wear eye protection during Part II. Teams without proper eye protection must be immediately informed and given an opportunity to obtain eye protection if time allows.
   f. Participants must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy.

3. **CONSTRUCTION PARAMETERS:**
   a. The blade assembly device consists of any kind and number of propeller/pinwheel/rotor blade(s) **and any other pieces** attached to a central disc. **The central disc must be either a mini (8.0 cm in diameter) or a standard (12.0 cm in diameter) commercially-made CD, DVD or Blu-Ray disc intended for data or media storage.**
   b. The central disc must fit on the mount found in a standard CD player. Modification of the disc is not allowed (except to affix the blades via tape, glue, etc.).
   c. When mounted, no part of the blade assembly may have a radial distance from the center of the axis of rotation of more than **14.0 cm**. Note: adjacent diagrams are not to scale.
   d. The blade assembly must be made of only nonmetallic, **nonmagnetic** substance(s). **Only the wind from the fan may power the blade assembly.**
   e. When initially mounted, no part of the blade assembly **including fastening materials** may extend **onto the back of the disc or** behind the mounting plane of the disc. There is no limit on how far forward the blade assembly may extend.



   f. **The device must be designed and operated in such a way as to not damage or alter the support stand or disc mount (e.g., due to excessive weight/torque, residue on the mount).**

4. **DESIGN LOG: Competitors are not required to submit a design log for scoring, but are encouraged to test and calibrate their blade assembly.**

5. **THE COMPETITION:**

   Part I: Written Test
   a. Teams will be given a minimum of 20 minutes to complete a written test consisting of a variety of different question types (i.e., multiple choice, true-false, completion, or calculation).
   b. Unless otherwise requested, answers must be in metric units with appropriate significant figures.
   c. The test will consist of **roughly the same number of questions** from each of the following areas:
      i. Wind power rotor/fan blade design (e.g., types of designs, pros/cons of designs, ways to improve designs, sources of loss, **concepts related to blade design**)
      ii. Power generators (e.g., **types of generators, concepts related to generator design**)
      iii. Power storage (e.g., how is the power stored during charging and how is it used during discharge, concepts relating to methods of power storage)
      iv. Power transmission **and distribution** (e.g., ways electricity is transmitted, how power is lost in transmission, ways to reduce power loss)

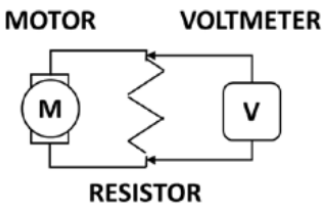
v. **Processes of siting and installing of commercial and individual wind applications, power transmission and distribution systems, and power storage systems**
vi. **Historical milestones of wind power development. Historical and current applications of wind power.** Environmental, ecological, and land use impacts of wind power

Part II: Device Testing

a. The blade assembly must be tested once with the fan at a low wind speed and once at a high wind speed**. It is recommended to conduct the low speed test first to ensure no device components detach before attempting the high speed test.**
b. Event Supervisors must check the blade assembly specifications before a team's blade testing period begins. Teams must be notified as soon as possible if a blade assembly does not meet specifications. Event Supervisors may prohibit blade assemblies from being tested if they will damage the testing setup.
c. Teams may modify the blade assembly during their Part II testing period, if time is available. This may be to bring the blade assembly into compliance with event specifications. **Once the blade assembly is determined to meet construction parameters, the rotor blades of the assembly cannot be swapped out for other blades. Doing so constitutes a construction violation.**
d. **Teams have 2 minutes and 15 seconds of set-up time preceding each Measurement Period to attach their blade assembly to the motor/generator mount and position it.** At the request of the students, the Event Supervisor must turn on or off the fan during the set-up to allow the students to better position the blade assembly relative to the fan. No voltage measurements are allowed to be made by or seen by the competitors during the **set-up** period. Teams are allowed to start and stop the blade assembly rotation and reposition the support stand during the **set-up** period.
e. No later than **the end of the set-up** period, with the fan already on and the blade assembly already rotating, the students must tell the Event Supervisor to begin a 30 second Measurement Period. The team must not touch, **modify, influence,** or reposition the blade assembly or support stand during the Measurement Period.
f. **No pieces of the blade assembly may detach while the device is spinning during either set-up time or Measurement Periods.**
g. The Event Supervisor must record the Maximum Voltage that occurs during the Measurement Period and inform the team of the result.
h. The Event Supervisor will review with the team the Part II data recorded on their scoresheet.
i. Teams filing an appeal regarding Part II must leave their blade assembly device in the competition area.

6. **<u>THE COMPETITION AREA</u>:**

a. Example setups are provided on the event page on www.soinc.org
b. The Event Supervisor will provide the testing materials listed below which will be the same for all teams.
   i. 20" multi-speed box fan(s) to be used as the wind source(s)
   ii. Support stand(s) that allow for vertical and horizontal adjustments of the blade assembly
   iii. Motor/generator(s) mounted to the support stand(s), with axis of rotation approximately parallel to that of the fan.
   iv. Load resistor(s) between 5 and 25 ohms (1/4 Watt or greater) wired in parallel with the motor/generator that must have the same value for all teams



   v. Device(s) to measure voltage across the load resistor. Voltage measurement devices that have 'peak hold' or 'max hold' functions are recommended.
c. The fan(s) must be mounted in a fixed position with the bottom of the grill at least 15 cm above the table.
d. There may be one or two test stations. If there are two, one must be used for all low wind speed tests and the other for all high wind speed tests. The load resistors **and motor/generators** at each station are allowed to be different, but must be consistent for all teams.
e. The motor/generator must be equipped with an adapter to accommodate a CD or, if the motor/generator is from a disc player, it must be removed from the disc player and mounted on the support stand.

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

a. Final Score (FS) = ES + LSS + HSS. The maximum possible FS is 100 points. High score wins. A scoring spreadsheet is available at www.soinc.org.
b. Exam Score (ES) = (Part I score / highest Part I score for all teams) x **50 points**

c. Low Speed Score (LSS) = (low speed test Max Voltage / Highest low speed test Max Voltage of all teams) x **25 points**
d. High Speed Score (HSS) = (high speed test Max Voltage / Highest high speed test Max Voltage of all teams) x **25 points**
e. If the team violates any of THE COMPETITION rules, the Max Voltage at that wind speed must be multiplied by 0.9 when calculating the Speed Score.
f. **The Speed Score for a Speed Trial must be zero (0) if a team:**
   i. **Cannot test their device safely**
   ii. **Cannot bring their device into compliance with the CONSTRUCTION PARAMETERS by the start of the Measurement Period**
   iii. **Is not prepared for the Measurement Period by 2 minutes, 15 second of setup (per rule 5.Part II.d.)**
   iv. **Fails to bring a blade assembly device.**
g. Teams with Speed Scores of 0 will be allowed to compete in Part I
h. Tiebreakers
   i. 1st – Best HSS
   ii. 2nd – Best LSS
   iii. 3rd – Specific Test Questions

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

This event is supported by ADM Cares.

B

WRITE IT DO IT B

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

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

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

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

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

TRIAL EVENT RULES EXPLANATION

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

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

For the 2024-2025 season, we are publishing a selection of Trial Events in the 2025 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 2025 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 2026 and beyond.

If a Tournament does choose to run one of the Trial Events published here, a Trial Event from the Trial Event page, or one of their own creation we would ask that you have both event participants and Event Supervisors complete the appropriate post-event evaluation. These evaluations can be found online at soinc.org on the Trial Event page. These brief surveys provide important information to help us fine tune events as well as make decisions about which events are worthy of being part of the Science Olympiad National Competition.

AERIAL SCRAMBLE

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

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

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

2. **EVENT PARAMETERS:**
   a. For Invitational and Regional competitions, teams must bring two unopened kits for inspection and their use. Only kits that, by design, are assembled without adhesives (i.e., Guillows Skystreak, AMA Alpha) and can be disassembled and reassembled to fly again will be accepted.
   b. At the State and National competitions, event supervisors will provide all airplane kits used in the event. Organizers will stipulate the airplane kit to be used in competition at least 2 weeks prior to the competition. Teams will choose two kits for the event from a selection of unopened standardized kits provided by the Event Supervisor. All teams must use the tournament provided standardized kit.
   c. Teams may bring up to 4 rubber motors, each not exceeding 2.0 grams.
   d. Teams may bring winders, assembly tools, fixtures (freestanding from airplanes), sandpaper, adhesive systems, thread, pins, tape, rubber O-rings for motors, clay and their logbook. All items must fit inside a single clear sided container with an approximate footprint of no more than 12” x 12”.
   e. Teams must bring a first aid kit that should contain at least 3 adhesive band-aids and any other first aid equipment the team feels is necessary.
   f. Additionally, teams must bring cutting boards and wax paper to cover any and all work surfaces.
   g. The items in 2.e. and 2.f. do not need to be included in the above referenced (2.d.) tool box.
   h. Any team not using a cutting board will receive a 20% deduction on their final score.
   i. Each team is responsible for their work site. Any debris must be disposed of, and the site cleaned and inspected before official flights are attempted.
   j. Teams will be allowed to attempt two (2) official flights for scoring.
3. **CONSTRUCTION PARAMETERS:**
   a. Only those materials found as part of the two kits will be allowed in model assembly. Glue, tape, pins or clay ballast may be added by teams and are considered as parts of each model.
   b. Boron, carbon fiber, extra wood or foam plastic materials are not allowed in the construction of the aircraft.
   c. The stock rubber motor may be replaced by other rubber elastic loops.
   d. Total mass without motor must be more than 10.0 grams and cannot exceed 25.0 grams.
   e. The wingspan cannot exceed 50.0 cm.
   f. Airplanes must use the propeller provided in the kit, which may not exceed 14.0 cm in diameter.
   g. Motors may have rubber O-rings and be lubricated after check-in.
   h. Airplanes will be labeled in such a way that can be identified by the participants in reference for their logbooks.
4. **THE COMPETITION:**
   a. The event will be held indoors. Tournament officials will announce the room dimensions (approx. length, width and ceiling height) in advance of the competition. Tournament Officials and Event Supervisors are urged to minimize the effects of environmental factors such as air currents. Rooms with minimal ceiling obstructions are preferred over very high ceilings.
   b. The event will be scheduled in hour time slots with no more than 10 teams competing in a time slot. The first 30 minutes will be devoted to complete primary check-in, model assembly and trim flights. The final 20 minutes will be to accomplish the team’s two official flights. These flights will occur in 2-3 team mass launches within a 4-minute scheduled window.
   c. At their scheduled time a team will enter a cordoned off competition area to begin Primary Check-In, where they:
      i. Sign-in and are scheduled, in sequence of their arrival, for an official flight time-slot, as well as receive from or have their model kits inspected by from the Event Supervisors depending upon the type of competition being held.

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

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

5. **SCORING:**

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

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

AGRICULTURAL SCIENCE

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

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 **CALCULATOR:** Class II **APPROXIMATE TIME:** 50 minutes

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

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

AGRICULTURAL SCIENCE NOTEBOOK
SAMPLE SCORESHEET
Total Score 50 points

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

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

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

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

This event is sponsored by Corteva Agriscience

BOTANY

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

1. **DESCRIPTION**: Participants will demonstrate their knowledge of plant life and general botany principles.
   A TEAM OF UP TO: 2 **EYE PROTECTION:** A
   CALCULATOR: Class II **APPROXIMATE TIME:** 50 minutes
2. **EVENT PARAMETERS:**
   a. Each participant may bring one 8.5" x 11" sheet of paper, which may be in sheet protector sealed by tape or laminated, that may contain information on both sides in any form and from any source without any annotations or labels affixed as well as a stand-alone, non-programmable, non-graphing calculator.
   b. Each participant must wear a lab coat and googles when dealing with specimens.
   c. Event Supervisors will provide live/preserved specimens, pictures, tables, graphs of data, microscopes, slides, and any other required equipment for the event. If used, toxic/irritating plants or specimens in liquid (e.g., Algae, protists) must be in closed, non-breakable containers.
3. **THE COMPETITION:**
   a. This event may be run as either a sit-down exam or a series of laboratory stations with questions.
   b. Participants will be expected to master the structure of plant cells, roots, stems, leaves, spore forming bodies and flowers, aspects of plant growth and differentiation, and the transport and storage of gases, water, and nutrition throughout the plant body.
   c. Participants should also have a broad knowledge of the major divisions between groups of plants (i.e., algae vs. multicellular plants, monocot vs. dicot, embryophytes vs. cryptogams, woody vs. herbaceous plants).
   d. In addition to the above listed topics, participants should know:
      i. The history of botany
      ii. Basic plant genetics and reproduction
      iii. Photosynthesis
      iv. Differences between the major taxonomic groups of plants
      v. Paleo-botany and plant evolution
      vi. The role of plants in global energy and nutrient cycles
      vii. Use of plant materials by animals and humans
      viii. Competition in the plant community
      ix. Genetically Modified Organisms (GMOs)
      x. Production of foodstuffs and plant products
      xi. Plant diseases; including nutrient deficiencies and infections
   e. For Division C Only, participants are expected to know:
      i. Principles of horticulture and aquaculture
      ii. Plant biochemistry
      iii. The roles of plants in medicine and environmental management
      iv. Importance of plant diversity
4. **SAMPLE QUESTIONS/TASKS:**
   a. What leaf structure is being shown on this microscope slide?
   b. Using the graph, identify the peak wavelength for chlorophyll absorbance.
   c. Identify three key differences between flowering plants and ferns.
   d. Which plants would be in the next wave of plant succession for the region shown?
   e. Describe the role plants play in the nitrogen cycle.
5. **SCORING:**
   a. High Score wins.
   b. Selected questions will be used to break ties.

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

This event is sponsored by Corteva Agriscience

ENGINEERING CAD

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

1. **DESCRIPTION:** Teams will read a set of engineering drawings and collaboratively create CAD parts and assemblies that match the drawings while incorporating provided components and be able to answer questions about the drawing and generated model.

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

2. **EVENT PARAMETERS:**
   a. Teams will use PTC Onshape on two computers with mice to create the model. Tournament directors will either provide devices or allow teams to bring their own devices depending on the tournament logistics.
   b. **Unauthorized, generative AI tools (e.g., ChatGPT, DALL-E) are not allowed to be used to generate answers under any circumstances during the event.**
   c. Teams must bring writing utensils
   d. No resource materials, except those provided by the Event Supervisor, may be used.
   e. Teams will be provided with a set of engineering drawings (either printed or online) and may receive a starting model that has some parts needed for building the finished model.

3. **THE COMPETITION:**
   a. Teams will CAD parts and an assembly based on the engineering drawings which specify the geometry, materials, and units for each part.
      i. For Regionals, teams will be required to model 2 to 3 components for 1 assembly.
      ii. For State and Nationals, teams will be required to model 4 to 6 components for 1 assembly.
   b. Teams will be required to answer questions about the drawing as well as mass, moment of inertia, and dimensions for individual parts and the completed assembly. Answers will need to be at a specified precision and units.
   c. Students on the team will work collaboratively on the model.

4. **SCORING:**
   a. The high score wins. Final Score = Test Score + Modeling Score.
   b. The test and modeling scores should be weight evenly such that: Max Test Score = Max Modeling Score
   c. Test scores will be based on the precision and/or accuracy of the answer to questions about the modeled parts and drawings.
   d. The scores for each test question will be added together to generate the Test Score.
   e. Modeling score for parts is determined by comparing the **mass** of named parts as specified in the engineering drawing to the correct values. A perfect match for the mass is 20 points and the minimum score is 0 for each part. Points for each part will be calculated as:

$$Individual\ Part\ Score = 20 - 100\ abs\left(\frac{Student_{mass} - Correct_{mass}}{Correct_{mass}}\right)$$

   f. Modeling score for assemblies is determined by comparing each component of the **center of mass** of the named assembly as specified in the engineering drawing to the correct values. A perfect match for the center of mass is 20 points and the minimum score is 0. Points for each assembly will be calculated as:

$$Individual\ Assembly\ Score = 20 - 100\left(\frac{1}{3}abs\left(\frac{Student_{center_x} - Correct_{center_x}}{Correct_{center_x}}\right) + \frac{1}{3}abs\left(\frac{Student_{center_y} - Correct_{center_y}}{Correct_{center_y}}\right) + \frac{1}{3}abs\left(\frac{Student_{center_z} - Correct_{center_z}}{Correct_{center_z}}\right)\right)$$

   g. The individual score for each part and assembly will be added together to generate the Modeling Score.
   h. Tiebreakers: The first tiebreaker is the model score; the team with the highest model score wins the tiebreaker. The second tiebreaker is modeling time; the team with lowest modeling time as measured from the creation of their document to the submission version wins the tiebreaker.

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

This event is sponsored by OnShape

HOVERCRAFT B

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

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

   A TEAM OF UP TO: 2 **EYE PROTECTION:** B **IMPOUND:** Yes

   CALCULATOR: Class III **APPROXIMATE TIME:** 10 minutes

2. **EVENT PARAMETERS:**
   a. Each team must impound only one vehicle, spare parts and **a Design Log for scoring**. **The vehicle must be impounded with the batteries stored separately and presented to the Event Supervisor for inspection.**
   b. Teams may bring tools, supplies, eye protection, and two **stand-alone** calculators (CLASS III) for use. These items need not be impounded.
   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. **The Event Supervisor will provide the testing materials listed in the TRACK section. Teams should not bring their own track or ramp.**
   e. Participants must be able to answer questions regarding the design, construction, and operation of the vehicle per the Building Policy found on www.soinc.org.

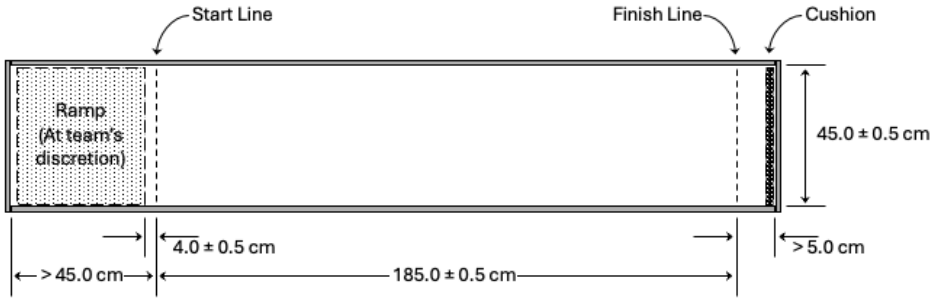
3. **CONSTRUCTION PARAMETERS:**
   a. The vehicle must fit into a 40.0 cm x 40.0 cm x 40.0 cm box when levitated on its inflated skirt. Vehicles must not modify or damage the track.
   b. The vehicle must levitate on a cushion of air as it moves down the track. Participants may be asked to demonstrate levitation by pushing the vehicle slightly down. If it then rises, it is levitating. Continuous contact of the inflated skirt with the base surface, occasional contact of other vehicle components with the base surface, or any contact with the inside edge of the side rails is permitted.
   c. The vehicle may have up to two motors, each rotating one propeller/impeller. All propellers/impellers, including under the device, must have shielding which prevents a 3/8" dowel from touching them.
   d. Commercial batteries, including rechargeables, not exceeding 9.0 V as labeled, may be used to energize the motors on the vehicle. **The label on each battery must be the manufacturer's original label and easily viewable by the Event Supervisor.** Multiple batteries may be connected together as long as the expected voltage across any **two** points does not exceed 9.0 V as calculated by their **individual** labels. The vehicle must not have any other energy sources. Batteries containing lithium or lead are prohibited.
   e. **All motors** must have a switch to permit safe starting **and stopping**. Relying on inserting batteries or twisting wires together to start is not allowed. **If more than one motor is used, they may be combined on the same switch or wired on separate switches.**
   f. Electrical components shall be limited to batteries, wires, motors **(including brushless motors)**, switches, resistors, potentiometers, capacitors, mechanical relays, fans, and blowers. Integrated circuits **(other than those that are an integral part of a commercial motor)** are not permitted.
   g. For timing **and measurement** purposes, the vehicle must have a 1/4" or larger **wooden** dowel vertically attached within 5.0 cm of its front edge such that the top end is at least 20.0 cm above the **track's** surface **when all motors are off**. **The dowel must be placed on the hovercraft so that it will be the first part of the vehicle to break a laser timing beam when the vehicle is traveling forward.**

4. **DESIGN LOG:**
   a. **Teams must submit a Design Log along with their device. The log must include the following:**
      i. **Materials used to construct the device.**
      ii. **A labeled diagram or picture that identifies and describes the parts of the device.**
      iii. **Any number of graphs and/or data tables showing the relationship between voltage and position for various device or testing setup configurations 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.**
      iv. **Graphs and/or tables may be computer generated or drawn by hand on graph paper.**
      v. **Each data series is counted as a separate graph unless the team indicates it should be scored otherwise.**
      vi. **A front cover labeled with the Team Name and the Team Number for the current tournament.**
   b. **All numerical values should be labeled with standard units (e.g. SI or English) appropriate to the dimension being measured. SI units should be the default standard.**

c. **Teams are encouraged to have a duplicate of their Design Log, as the submitted copy may not be returned.**

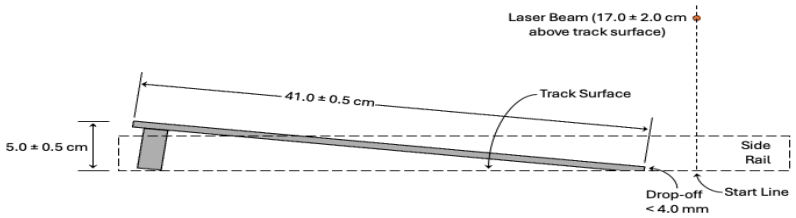
5. **THE COMPETITION:**
   a. **Vehicles violating rules 3c, 3d, or 3e or that are otherwise deemed unsafe in construction or operation by the Event Supervisor will not be allowed to run unless brought into compliance.**
   b. **Event Supervisors will check the vehicle specifications before the team's testing period. Teams must be notified as soon as possible if a vehicle is out of spec. Teams may modify the vehicle to bring it into compliance during their testing period.**
   c. **At the start of their testing period, each team will be given a Target Time (TT). The Target Time will be between 10.0-20.0 seconds in intervals of 2.0 seconds for Regionals, 1.0 second for States, and 0.5 seconds for Nationals. The TT will be the same for all teams.**
   d. Teams have a **testing period** of 8 minutes to adjust and repair their vehicle and make 5 **incomplete** or 2 **complete** runs; whichever comes first. Practice runs are not allowed.
   e. A**n incomplete** run occurs if a vehicle fails to move for 3 seconds **before crossing the finish line** or **the dowel** fails to cross the finish line within (**3 x TT)** seconds. Teams are not allowed to declare a run **as incomplete**. **A run is complete if it is not incomplete.**
   f. **If the vehicle's dowel does not cross the starting line within 3 seconds of launching, it does not count as a run (either complete or incomplete) and teams may reset.** A run will be counted in the scoring as long as it is started before the 8-minute period has elapsed.
   g. **If any part of the vehicle falls off during a run, the team incurs a construction penalty for the run.**
   h. To begin a run, the team will place their vehicle on the track **fully behind** the start line against a wood block **provided by** and placed by the Event Supervisor. The team then activates their vehicle's motor(s).
   i. **If they choose, teams may utilize an Event Supervisor-provided ramp (as described in 6.e) for the launching of their vehicle. In such cases, the Event Supervisor will place the ramp in the same position for all teams. Using the ramp will impact the team's score (7.c.iii), and the time for placing the ramp will come out of the 8-minute period. The team may change this decision for each run.**
   j. The team will give a countdown of "3, 2, 1, launch"; then the Event Supervisor will remove the wood block. Timing starts when the vehicle's dowel crosses the start line and stops when **the dowel** crosses the finish line. **If photogates are used, the dowel must be the first part of the vehicle to break the laser beams at both the start and finish lines.**
   k. The team must not touch their vehicle after the dowel crosses the starting line until it passes the finish line or the Event Supervisor declares **an incomplete** run**. If touched, the run is counted as complete with a DS and a TS of 0.**
   l. **If a run is declared incomplete, the Event Supervisor will record the distance from the finish line to the position of the dowel at the time the run was declared incomplete. The team's testing period time will pause while the Event Supervisor makes measurements and will resume when the measurement time is done.**
   m. The Event Supervisor will review with the team the data recorded on their scoresheet.
   n. A team filing an appeal must leave their vehicle in the competition area.

6. **THE TRACK:**



   a. The Event Supervisor will supply a **45.0** ± 0.5 cm wide and at least **240** cm long track on a non-carpeted floor or other firm base surface, such as a countertop or large board. The outside boundary of the track is composed of **rails** each with a height at least 30.0 mm (standard 2x4 framing studs recommended). The Event Supervisor will also supply a cushioned barrier to stop vehicles and a small wood block to hold the vehicle at the start line. Example setups are at www.soinc.org.

b. Each **rail** must be securely affixed to the floor, base, or each other.
c. The length of the timed portion of the track is fixed at **185.0** ± 0.5 cm. A start line must be marked that is at least **45.0** cm from the end of the track. The finish line must be marked **185.0 ± 0.5 cm from the start line** and a cushioned barrier at least **5.0** cm **past** it must block the channel.
d. A photogate timing system is highly recommended. **If used, the system will be installed at the start and finish lines with the beams at a height of 17.0 ± 2.0 cm.** At least one manual timer should be used as a backup. If photogates are not being used, three timekeepers should be utilized with the **median** time used as the official Run Time; lasers are recommended to be placed at the start and finish lines so the timekeepers only have to watch for the flash of light as the dowel cuts through the laser beam. **Time is recorded in seconds to the device precision if photogates are used, or to the tenth of a second if manual timers are used**.
e. **The Event Supervisor must provide a removable ramp that competitors may use for the launching of their vehicle. The ramp should have a smooth, flat surface and must span the width of the track between the rails. The height of the ramp is 5.0 ± 0.5 cm and the length of the ramp's surface is 41.0 ± 0.5 cm. When the ramp is placed on the track, the edge where the vehicle exits the ramp must be 4.0 ± 0.5 cm behind the start line. At the bottom of the ramp, where it meets the track surface, the transition should be reasonably smooth, with a drop-off from the ramp surface to the track surface of no more than 4.0 mm. See https://bit.ly/hovercraft2025 for information on how to build a ramp and track.**



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

7. **SCORING:**
a. Final Score (FS) = **Best Run Score** + CS; maximum FS = 100. High score wins. A scoring rubric is available at www.soinc.org.
b. **Run Score = DS + TS**
c. **Distance Score (DS):**
   i. **Complete Run: Distance Score = 30**
   ii. **Incomplete Run: Distance Score = 30 x (185 - (distance from the finish line in cm)) / 185**
   iii. **If the ramp is utilized, the Distance Score is multiplied by 0.5 for that run.**
d. **Time Score (TS):**
   i. **Complete Run: Time Score = 60 x (1 - abs(runtime - TT)/(2 x TT))**
   ii. **Incomplete Run: Time Score = 0**
   iii. **The smallest possible Time Score is 0.**
e. One of the submitted graphs and/or tables, selected by the Event Supervisor, must be scored as follows for the Chart Score (CS, max of 10 points). Partial credit may be given.
   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, **axis titles**, units)
   iv. 0.5 points for each **distinct** graph or table turned in (up to 2 points total)
   v. **1** point for a labeled device diagram
   vi. **1 point for including a labeled front cover with team name and number**
f. Teams without any runs or that were prevented from running for unsafe operation receive participation points.
g. The TS and **DS** for a run will be multiplied by **0.6** if any CONSTRUCTION violation(s) were present **during that run** or if the team misses impound.
h. **A team violating any COMPETITION rules during a run will have their TS and DS multiplied by 0.9 for that run.**
i. Tie Breakers: 1st - **2nd Best Run Score**; 2nd - **2nd Best TS**; 3rd – **DS on 2nd Best Run; 4th - Fewest Incomplete Runs**

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

REMOTE SENSING B

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

1. **DESCRIPTION:** Participants will demonstrate an understanding of the basic principles of remote sensing and use imagery, data, and maps to complete tasks related to earth system processes. An understanding of mapping principles is a component of this event.

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

2. **EVENT PARAMETERS:**
   a. Each team may bring one three-ring binder of any size containing information in any form and from any source attached using the available rings. Sheet protectors, lamination, tabs and labels are permitted. If the event features a rotation through a series of laboratory stations where the participants interact with samples, specimens, or displays; no paper may be removed from the binder throughout the event.
   b. Each participant may bring a metric ruler, a protractor, and a non-programmable, non-graphing calculator (Class II) dedicated to computation.
3. **THE COMPETITION:** Participants will be given one or more tasks presented as an exam and/or timed stations. The event will consist of questions and activities testing concepts related to the collection and use of remote sensing data to observe and study terrestrial processes in the Earth system. Questions will address the following topics:
   a. Fundamentals of mapping as applied to topographic maps, satellite maps, and other maps generated from remotely sensed data
      i. Marginal information
      ii. Symbology and cartographic design: location/scale/legend, symbols & features, contours, elevation
      iii. Measurements and projections:
         (1) Distance between features in English and metric units
         (2) Azimuths
         (3) Latitude and longitude in degrees, minutes, seconds, and decimal degrees
         (4) Universal Transverse Mercator (UTM) grids and coordinates
   b. Remote sensing concepts
      i. Fundamental definitions and properties: electromagnetic spectrum, refraction and refractive indices, polarization
      ii. Types of sensors, limited to: active vs. passive, visible light, infrared/UV, radar
      iii. Types of satellite orbits and their purposes, limited to: low earth, medium earth, high earth, polar/non-polar, geostationary
      iv. Image characteristics: spatial, temporal, spectral, radiometric
      v. Effects on data collection, limited to: absorption and scattering by atmospheric aerosols, refraction and refractive indices, surface temperature, reflectance, elevation, polarization
      vi. Instrumentation, limited to: scanning systems, multispectral imaging systems, optical and infrared imagers, radiometers, synthetic aperture radar
   c. Interpretation and analysis of remote sensing images and data sets, limited to the types of sensors listed in 3.b.ii, from the following satellites only: different spectral combinations from Landsat 5-9 (TM, ETM, OLI), Sentinel-1A/1B, Sentinel-2A/2B, Terra (limited to: MODIS, ASTER), Shuttle Radar Topography Mission (SRTM). Questions will focus on land usage and monitoring in relation to society and human impact, limited to:
      i. Land Cover Classification Systems
         (1) Supervised and Unsupervised classification maps
         (2) National Land Cover Database (NLCD/CONUS) Land Cover Change Index
         (3) Implications on habitat loss, land cover change, urbanization, deforestation, damage assessment
      ii. Geohazards
         (1) Volcanoes
         (2) Landslides
         (3) Flooding
         (4) Wildfires

4. **SAMPLE QUESTIONS/TASKS:**
   a. Order the types of waves from lowest to highest frequency: radio, UV, visible light, infrared
   b. What are three advantages of using data from active instead of passive sensors?
   c. How would you interpret thermal IR images and optical images for evidence of landslides?
   d. Using the maps provided of the same region at two different times, qualitatively describe the land use change. Does this change most likely indicate an increase or decrease of the local human population?
5. **SCORING:**
   a. High score wins.
   b. Points will be awarded for the quality and accuracy of responses.
   c. Selected questions may be used as tiebreakers.

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

B

DIV. B CHEMISTRY LAB EQUIPMENT LIST

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

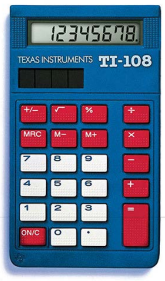
Each team may bring any or all of the items listed below for use in Division B Chemistry Events. Teams not bringing these items will be at a disadvantage as Event Supervisors will not provide the listed lab equipment. A penalty of up to 10% may be given if a team brings prohibited lab equipment to the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

Item & Expected Use	Likely to be used in:			
	Crime Busters	Can't Judge a Powder	Food Science	Potions and Poisons
Box - Containing all of the kit materials	X	X	X	X
Graduated Cylinders (10 - 100 mL) - Measuring volumes		X	X	X
Beakers (50 - 500 mL) - Doing reactions, developing chromatograms	X	X	X	X
Erlenmeyer Flasks (50 - 250 mL) - Doing reactions		X	X	X
Test Tubes - Mix Chemicals, heat chemicals	X	X	X	X
Test Tube Brush - Clean Test Tubes	X	X	X	X
Test Tube Holder - Holds test tubes for heating	X	X	X	X
Test Tube Rack - Hold Test Tubes	X	X	X	X
Petri Dishes - Doing reactions, developing chromatograms	X	X	X	X
Spot Plates - Doing reactions in semi-micro scale, testing solubility, pH	X	X	X	X
Slides - To put hairs, crystals, or fibers on for use with a microscope	X			
Cover Slips - To prevent items from coming off slides	X			
Droppers - Add small amounts of liquids to reactions	X	X	X	X
Spatulas or spoons - Getting small amounts of solids out of containers	X	X	X	X
Stirring Rods - Stirring mixtures	X	X	X	X
Thermometer - Determining the temperature of a solution		X	X	X
Metal Tongs, Forceps, or Tweezers - Holding objects, retrieving objects from liquids	X	X	X	X
pH paper/meter - Test acidity or alkalinity of solution	X	X	X	X
Hand Lens - Magnification of small items for identification	X	X		
9V or less Battery Conductivity Tester - Determining ionic strength of solution		X	X	X
Paper Towels - Cleaning	X	X	X	X
Pencil - Writing, Marking Chromatogram	X		X	X
Ruler - Measuring lengths	X	X	X	X
Magnets – For extraction and identification of iron filings	X	X	X	X

CALCULATOR CLASS DESCRIPTIONS

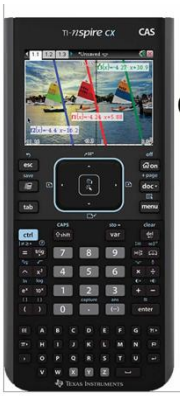
See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

The following document was prepared to offer some guidance to teams as they select calculators for use in different Science Olympiad events. **The calulator class listed in the event rules is the most complex calculator level allowed for the event. It is acceptable to use a lower calculator class in the event (e.g., Class III calculator is allowed for the event students are therefor allowed to use a class I, class II or class III calculator).** By no means are the calculators listed here inclusive of all possible calculators; instead they are offered as common examples. The decisions of the event supervisors will be final.



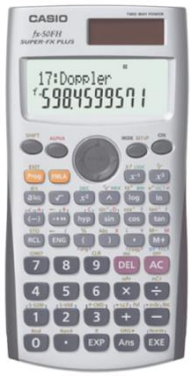
Class I - Stand-alone non-graphing, non-programmable, non-scientific 4-function or 5-function calculators are the most basic type of calculators and often look like the one shown to the right. These calculators are limited to the four basic mathematics functions and sometimes square roots. These calculators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

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



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

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



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

EYE PROTECTION GUIDE

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

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

Participant/Coach Responsibilities: Participants are responsible for providing their own protective eyewear. Science Olympiad is unable to determine the degree of hazard presented by equipment, materials and devices brought by the teams. Coaches must ensure the eye protection participants bring is adequate for the hazard. All protective eyewear must bear the manufacturer's mark Z87. At a tournament, teams without adequate eye protection will be given a chance to obtain eye protection if their assigned time permits. If required by the event, participants will not be allowed to compete without adequate eye protection. This is **non-negotiable**.

Corresponding Standards: Protective eyewear used in Science Olympiad must be manufactured to meet the American National Standards Institute (ANSI) standard applicable at its time of manufacture. The current standard is ANSI/ISEA Z87.1-2015. Competitors, coaches and event supervisors are not required to acquire a copy of the standard. The information in this document is sufficient to comply with current standards. Water is not a hazardous liquid and its use does not require protective eyewear unless it is under pressure or substances that create a hazard are added.

Compliant Eyewear Categories: If an event requires eye protection, the rules will identify one of these three categories. Compliance is simple as ABC:

CATEGORY A

- Description: Non-impact protection. They provide basic particle protection only
- Corresponding ANSI designation/required marking: Z87
- Examples: Safety glasses; Safety spectacles with side shields; and Particle protection goggles (these seal tightly to the face completely around the eyes and have direct vents around the sides, consisting of several small holes or a screen that can be seen through in a straight line)

CATEGORY B

- Description: Impact protection. They provide protection from a high inertia particle hazard (high mass or velocity)
- Corresponding ANSI designation/required marking: Z87+
- Example: High impact safety goggles

CATEGORY C

- Description: Indirect vent chemical/splash protection goggles. These seal tightly to the face completely around the eyes and have indirect vents constructed so that liquids do not have a direct path into the eye (or no vents at all). If you are able to see through the vent holes from one side to the other, they are NOT indirect vents
- Corresponding ANSI designation/required marking: Z87 (followed by D3 is the most modern designation but, it is not a requirement)
- Example: Indirect vent chemical/splash protection goggles

Examples of Non-Compliant Eyewear:

- Face shields/visors are secondary protective devices and are not approved in lieu of the primary eye protection devices below regardless of the type of vents they have.
- Prescription Glasses containing safety glass should not be confused with safety spectacles. "Safety glass" indicates the glass is made to minimize shattering when it breaks. Unless these glasses bear the Z87 mark they are not approved for use.

Notes:

1. A goggle that bears the Z87+ mark and is an indirect vent chemical/splash protection goggle will qualify for all three Categories A, B & C
2. VisorGogs do not seal completely to the face, but are acceptable as indirect vent chemical/splash protection goggles

AVAILABLE TEAM RESOURCES

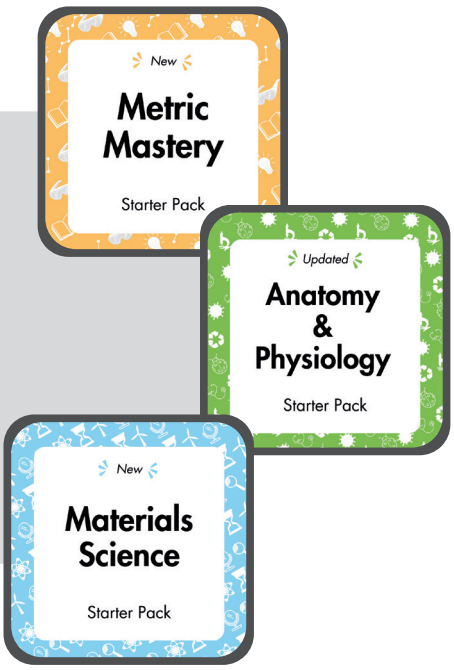
See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

STORE OFFERINGS FOR 2025

STORE.SOINC.ORG

STARTER STACKS & PACKS

Use these resources to kick off your 2025 season! Starter Packs include notes and practice tests for individual events. Build your own Stacks for any of your specific events to save money.



NATIONAL TEST PACKETS

Check out the tests from the 2024 National Tournament! You can access packets that include tests, answer keys, and results from the past five National Tournaments.

UPCOMING EVENTS

- **10/5/24 -** The ***Virtual Student Workshop*** offers students the chance to interact with SO alums and receive presentations about their specific events. This one-day event lasts five hours and provides an excellent chance for students to excel in the 2025 season.
- **7/8/25 - 7/10/25** In our ***Virtual Bootcamp*** participants gain early access to the 2026 Rules, engage with experts, and choose sessions that fit their interests. Registration includes instructional videos, live sessions and a hard copy draft of the 2026 Rules.
- **7/16/25 - 7/18/25** The ***Summer Build Clinic*** provides a deep dive into the new events for the 2026 season. This is a great opportunity to collaborate with presenters and other coaches, as well as gain hands-on experience for the upcoming season. This event is for coaches, not students.

SCIENCE OLYMPIAD'S FUNDRAISING PARTNER

DOUBLE GOOD POPCORN

It's time to boost your team's funds! Sell delicious popcorn and pocket 50% of the profits. Plus, the popcorn ships straight to your customers! Set up your fundraiser at soinc.org/doublegood.

Learn More!

NATIONAL TOURNAMENT SCHEDULE

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

2025 National Tournament Division B Schedule
University of Nebraska – Lincoln
Lincoln, Nebraska Saturday, May 24, 2025

Event	7:00 – 8:00 AM	8:00 - 9:00 AM	9:10 – 10:10 AM	10:20 – 11:20 AM	12:00 – 1:00 PM	1:10 – 2:10 PM	2:20 – 3:20 PM	7:30– 9:30 PM
Air Trajectory	Impound	Self-Schedule						
Anatomy & Physiology		31-40	41-50	51-60	1-10	11-20	21-30	
Codebusters		41-50	51-60	1-10	11-20	21-30	31-40	
Crime Busters		51-60	1-10	11-20	21-30	31-40	41-50	
Disease Detectives		11-20	21-30	31-40	41-50	51-60	1-10	
Dynamic Planet		31-40	41-50	51-60	1-10	11-20	21-30	
Ecology		41-50	51-60	1-10	11-20	21-30	31-40	
Entomology		21-30	31-40	41-50	51-60	1-10	11-20	
Experimental Design		1-10	11-20	21-30	31-40	41-50	51-60	
Fossils		1-10	11-20	21-30	31-40	41-50	51-60	
Helicopter		Self-Schedule						
Meteorology		11-20	21-30	31-40	41-50	51-60	1-10	Closing Ceremony
Metric Mastery		11-20	21-30	31-40	41-50	51-60	1-10	
Microbe Mission		1-10	11-20	21-30	31-40	41-50	51-60	
Mission Possible	Impound	Self-Schedule						
Optics		51-60	1-10	11-20	21-30	31-40	41-50	
Potions and Poisons		21-30	31-40	41-50	51-60	1-10	11-20	
Reach for the Stars		41-50	51-60	1-10	11-20	21-30	31-40	
Road Scholar		51-60	1-10	11-20	21-30	31-40	41-50	
Scrambler	Impound	Self-Schedule						
Tower		Self-Schedule						
Wind Power		31-40	41-50	51-60	1-10	11-20	21-30	
Write It, Do It		21-30	31-40	41-50	51-60	1-10	11-20	

SCIENCE OLYMPIAD™

Exploring the World of Science

Science Olympiad wishes to acknowledge the following business, government and education leaders for partnering with our organization. Working together, we can increase global competitiveness, improve science and technology literacy and prepare the STEM workforce of the future. Thanks to: University of Nebraska-Lincoln (2025 National Tournament Host), Michigan State University (2024 National Tournament Host), NASA's Universe of Learning Astrophysics STEM Learning and Literacy Network, Science Olympiad USA Foundation, Avantor Foundation, Ward's Science, Corteva Agriscience, Ramboll, Cleveland-Cliffs Foundation, Combined Federal Campaign, Double Good Foundation, Google, ADM Cares, Amcor Cares Foundation, Cambridge Centre for International Research, Centers for Disease Control and Prevention (CDC), Discovery Education 3M Young Scientist Challenge, InGenius Prep, National Free Flight Society, North American Association for Environmental Education, National Oceanic and Atmospheric Administration, Onshape, SkyCiv, Texas Instruments, TKS World, University of Delaware, Catalent, Investing in Communities and Yale Young Global Scholars. Strategic Partners: Japan Science and Technology Agency, mHUB, Midnight Science Club, Million Women Mentors, MxD Digital Manufacturing Institute, NBC Universal Foundation, STEMConnector.

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

Science Olympiad

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