SCIENCE OLYMPIAD

Since 35 YEARS 1984

Exploring the World of Science

Division B Rules Manual

Division B (Gr. 6-9)

WELCOME TO THE 2019 SCIENCE OLYMPIAD!

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

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

Division C (Grades 9-12) Membership Rules

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

Division B (Grades 6-9) Membership Rules

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

Students Below Grade Level Designations

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

Science Olympiad Team Membership

Science Olympiad requires that all teams (up to 15 members) competing in any Science Olympiad Tournament (Invitational, Regional, State or National) must be a member of Science Olympiad and pay the national fee (currently $60, paid as part of the state membership). There is no exception to this requirement, regardless of what teams from the same school are called (Varsity, JV, Alternate Team, Extra Team, Team Two, Team B). No school, region or state Science Olympiad organization is allowed to alter or amend these national membership requirements. Please see the Science Olympiad Copyrights and Use Statement outlining use of Science Olympiad Rules and procedures at sanctioned tournaments.

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

SCIENCE OLYMPIAD
DIVISION B RULES MANUAL

Table of Contents

- Please read the General Rules on the next page - they apply to all events. Note: all changes are in **bold**.
- Coaches: Please remember to register early for the Science Olympiad Summer Institute – it sold out last year!
- Please visit the official Science Olympiad web site: www.soinc.org for Membership Information, Team Size Requirements, Clarifications/Rules Changes, FAQs, New Store Items, news, tips, resources, and other valuable information.

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

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

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

ANATOMY & PHYSIOLOGY

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 human Cardiovascular, Lymphatic, and Excretory systems.

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

2. **EVENT PARAMETERS:**
   Each team may bring one 8.5" x 11" sheet of paper that may contain information on both sides in any form and from any source along with two **stand-alone** non-programmable, non-graphing calculators.

3. **THE COMPETITION:**
   Participants will complete a written test limited to the following topics. Topics listed in *italics* will only be assessed at the National Tournament.
   a. **CARDIOVASCULAR SYSTEM:**
      i. Anatomy and **physiology** of the cardiovascular system
      ii. The Heart - chambers and valves of the heart, electrical stimulation of myocardial tissue, pacemaker tissue, interpreting ECG (EKG) readings **on strips**
      iii. Blood Vessels – **structure and function of** arteries, arterioles, veins, venules, capillaries, **including the functionality of Startling's forces in the capillaries**
      iv. Blood - plasma, hematocrit, red blood cells, oxygen transport, hemoglobin **and cooperative binding of oxygen**, platelets and blood clotting, regulation of blood plasma volume and acidity, blood typing & basic genetics of ABO, Rh, blood types
      v. Measurement of the pulse rate and blood pressure **with appropriate instrumentation**
      vi. Calculations include systolic and diastolic pressure, mean arterial pressure, stroke volume & cardiac output
      vii. Effects of exercise, smoking, alcohol, caffeine, and drugs on the cardiovascular system
      viii. Understand disorders: Congestive Heart Failure, Atrial Fibrillation, Myocardial Infarction, Atherosclerosis, Bradycardia, and Tachycardia
      ix. *Treatments and/or prevention for all **disorders** listed above **as well as disseminated intravascular coagulation and capillary leak syndrome***
      x. ***Lethal & non-lethal cardiac strip (EKG) pattern interpretation:***
         (1) ***Division B only: Atrial Fibrillation, Pulseless Electrical Activity, Ventricular Tachycardia***
         (2) ***Division C only: Torsades, Premature Ventricular Contractions, Supraventricular Tachycardia***
   b. **LYMPHATIC SYSTEM:**
      i. Anatomy and **physiology** of the lymphatic system
      ii. **Similarities and differences between Primary, Secondary, and Tertiary lymphoid tissues**
      iii. **General Lymphatic structures -** lymph nodes, lymph ducts, lymphatic capillaries, tissue fluid
      iv. **Structure and function of the Thymus**
      v. **Structure and function of the Spleen**
      vi. **Understand disorders: Lymphedema, Hodgkin lymphoma, non-Hodgkin lymphoma, Lymphadenopathy**
      vii. ***GI Contributions to Immune Function and Absorption of Fats/Lipids in the tract***
      viii. ***Treatments and/or prevention for all disorders listed above***
   c. **EXCRETORY SYSTEM:**
      i. Anatomy and **physiology** of the excretory system
      ii. Basic anatomy of the urinary system including kidneys, ureters, bladder, and urethra
      iii. Structure and function of the nephron
      iv. Formation of urine, **Gross Filtration Rate** calculation, tubular secretion, and tubular absorption
      v. Understand disorders: **Kidney stones, Urinary Tract Infections, Glomerulonephritis, Renal failure**, **Incontinence**
      vi. *Additional diseases: Prostatitis, and BPH (Benign Prostatic Hyperplasia), **Glomerulosclerosis***
      vii. *Treatments and/or prevention for all **disorders** listed above*

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

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the **updated** Anatomy and Physiology CD and Bio/Earth Science CD; other resources are on the event page at soinc.org.

THIS EVENT IS SPONSORED BY THE SOCIETY FOR NEUROSCIENCE

BATTERY BUGGY

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

1. **DESCRIPTION:** Teams will construct a vehicle that uses electrical energy as its sole means of propulsion to travel a specified distance and stop as close as possible to a **Target** Point.

   A TEAM OF UP TO: 2   **IMPOUND:** Yes   **EVENT TIME:** 8 minutes

2. **EVENT PARAMETERS:**
   a. Participants must bring **and impound** a vehicle, batteries, additional/spare parts, and a Practice Log.
   b. Participants may bring but **need not impound** tools, measuring devices, and a stand-alone calculator of any type.

3. **CONSTRUCTION PARAMETERS:**
   a. Participants will design a vehicle to travel between 9 and 12 meters as quickly as possible and come to a complete stop. **The team may choose to attempt a Bonus described later in these rules**.
   b. Electrical energy used by the vehicle for any purpose, including propulsion, must be stored in a maximum of 8 (eight) AA 1.2 to 1.5-volt common, commercially available batteries, individually labeled by the manufacturer. Rechargeable batteries are allowed. Batteries must not be installed until immediately prior to the run. All sources of energy must be in a location as to be available for inspection by the Event Supervisor. Battery holders are permissible, as long as the labels on the individual cells can be inspected during impound.
   c. **The vehicle must be constructed so that when it comes to a complete stop the batteries are no longer powering the motor.**
   d. **Any battery containing lithium or lead acid is not permitted**. Teams using these batteries will not be permitted to run and will receive only participation points.
   e. All energy for propulsion must be electric and come from the batteries. Any non-propulsive functions (e.g., a braking system) may be powered by either electric or non-electric storage devices. If electrical, the voltage must come from the same batteries being used for propulsion.
   f. Participants may purchase or make components (e.g., motors, gearboxes, bodies, and chassis). Electrical components are limited to batteries, wires, motors, switches, resistors, potentiometers, and mechanical relays. **Electric/electronic tools of any sort, except a stand-alone calculator, are prohibited**.
   g. Wheels and/or treads in their entirety must fit in a 30.0 cm wide x 60.0 cm long space during the entire run. **Axles and other parts of the vehicle may extend beyond these parameters**.
   h. **An approximately ¼" round** wooden dowel must be attached to the front end of the vehicle. The dowel must be approximately perpendicular to the floor. It must be the leading part of the vehicle at all times. **The dowel attachment device may not extend more than 0.5 cm beyond the front of the dowel**.
      i. The dowel must extend at least 20.0 cm above the floor.
      ii. The dowel must also extend to within 1.0 cm of the track's surface so that its front bottom edge will be the vehicle's Measurement Point for distance measurements.
   i. Only the wheels and/or treads of the vehicle are allowed to contact the floor at any time during run(s).
   j. 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.

4. **PRACTICE LOG:**
   a. **Teams must record the vehicle distance from the Target Point, run time, wheel setting, and Bonus can distance, if used, of at least 10 practice runs while varying at least one vehicle parameter.**
   b. Logs will be impounded **and returned to participants when they are called to compete**.

5. **THE COMPETITION:**
   a. The exact Target Distance (in 50.0 cm intervals for regional, 10.0 cm intervals for state and 1.0 cm intervals for national tournaments) will be chosen by the Event Supervisor and announced after the impound period. All teams will have the same Target Distance. **Participants must inform the Event Supervisor if they will attempt the Bonus prior to each run**.
   b. Only the participants and the Event Supervisors are allowed in the impound and event areas. Once participants enter the event area, they must not leave or receive outside assistance, materials, or communication.
   c. Participants will be given an Event Time of 8 minutes to perform the following actions and start up to 2 runs. If the second run has started before the 8-minute period has elapsed, it will be allowed to run to completion. The Event Time will not include time used by the Event Supervisor for measuring.

Participants may not use AC outlet power during their 8 minutes.

i. Participants may adjust their vehicle before each run (e.g., change its speed, distance, directional control, change batteries, or make changes from impounded parts).

ii. Participants may use their own measuring devices to verify the track dimensions during their allotted time. They may not verify the distance by rolling the vehicle on or adjacent to the track surface between the Start and Target Points. They may not roll the vehicle on the floor of the event track the day of the event without tournament permission. If permitted, only participants may be present.

iii. Participants may clean the track during their 8 minutes, but the track must remain dry at all times. No wet and/or tacky substances may be applied to the track, wheels, or treads.

iv. Participants must place the tip of the vehicle's Measurement Point on the Start Point and align the vehicle. Sighting and aligning devices placed on the track are permitted but must be removed before the run. Vehicle-mounted sighting and aligning devices may be removed at the participants' discretion prior to each run.

v. Participants must start the vehicle using any part of an unsharpened #2 pencil with an unused eraser, supplied by the Event Supervisor, **in a motion approximately perpendicular to the floor**, to actuate some sort of switch. They may not touch the vehicle to start it, hold it while actuating the switch, or "push" the vehicle to get it started.

vi. The entire vehicle, including batteries, must move forward together. A run occurs if the vehicle moves after the switch is actuated.

vii. If the vehicle does not move upon actuation, it will not count as a run and the team may request to set up for another run but will not be given additional time.

d. Once the vehicle begins a run, the participants must wait until called by the Event Supervisor to retrieve it. **Timing is paused for all measurements**. The 8-minute time resumes once participants pick up their vehicle or begin to make measurements.

e. Competition Violations would include participants following the vehicle down the track or the vehicle passing the 0.5 m Line but stopping before the 8.50 m Line.

f. A Failed Run occurs if the time and/or distance cannot be measured for a run (e.g., the vehicle starts before the Event Supervisor is ready, the participants pick up the vehicle before it is measured, the vehicle's Measurement Point doesn't reach the 0.50 m Line, the vehicle runs backward at the start, the vehicle does not stop using its own braking system).

g. **Teams may earn the Bonus by having their vehicle navigate between two cans located on the Bonus Line of the track. Prior to each run the participants place the inner can at a distance of their choice between 0.0 cm and 100.0 cm from the outside can on the Bonus Line. The Event Supervisor will then record the inner distance between the two cans along the Bonus Line. All parts of the vehicle must travel between the two cans to earn the Bonus. A vehicle moving either of the cans will not receive the Bonus.**

h. The Event Supervisor will review with the team the data and penalties recorded on their scoresheet.

i. Teams who wish to file an appeal must leave their vehicle with the Event Supervisor.

6. **THE TRACK:**

a. The track will be on a smooth, level, and hard surface. At the Event Supervisor's discretion, more than one track may be used. Teams will be given the option to choose which track they will use. **Both runs will be made on the same track**.

b. The Event Supervisor will use approximately 5.0 cm by 2.5 cm (2 in. x 1 in.) pieces of tape to mark the Start and Target Points with the Start and Target Point marked in the center of each piece of tape. The distance between the Start and Target Points will be measured to within 0.1 cm of the Target Distance. **The timing lines are marked with pieces of 2.5 cm wide tape at least 2.0 m long, 0.50 m and 8.50 m from the Start Point, centered on and perpendicular to an imaginary center line. The edges of the tapes closer to the Start Point defines these lines. A Bonus Line is marked with tape halfway between the Start Point and Target Point extending perpendicular from an imaginary center line 1.0 m to the left when facing the Target Point.**

c. **The Event Supervisor will use two weighted cans with diameters 7.0 - 8.0 cm, height ≥ 10.5 cm positioned standing upright with their centers on the Bonus Line to create an obstacle for the teams. The outer can is placed by the Event Supervisor so that its rightmost edge is 1.0 m from the imaginary center line. The cans will be removed if the team does not want to attempt the Bonus for a specific run. Refer to soinc.org for a diagram of the track.**

d. A photogate timing system is highly recommended. See www.soinc.org for information. If used, the system must be installed at the 0.50 m Line and the 8.50 m Line with the lasers at a height of 17.0 ±

2.0 cm. A minimum of a single manual timer should be used as a backup. If no photogate system is available, 3 timers should be used along with a laser system, with the middle time being the official Run Time.

7. **SCORING:**
   a. Low score wins. The Final Score is the better of the two Run Scores; negative scores are possible.
   b. **Run Score for each run = Run Time** + 2x Distance Score + **Bonus + Penalties**.
   c. Run Time starts when the dowel on the vehicle reaches 0.50 m and ends when it either completely stops or passes 8.50 m. The Run Time is recorded in seconds to the precision of the timing device used.
   d. The Distance Score is a point to point measurement of the distance from the Measurement Point to the Target Point measured to the nearest 0.1 cm.
   e. **Bonus = -0.5 x (110 - distance between the cans to the nearest 0.1 cm).**
   f. Teams with incomplete Practice Logs will incur a Penalty of 250 points. Teams without impounded Practice Logs will incur a Penalty of 500 Points. Practice Log Penalties do not affect Tier placement.
   g. Tiers:
      i. Tier 1: A run with no violations.
      ii. Tier 2: A run with any competition violations.
      iii. Tier 3: A run with any construction violations.
      iv. Tier 4: A vehicle not impounded during the impound period.
   h. Ties will be broken the following categories in the listed order:
      i. the lower Bonus Distance
      ii. the lower Distance Score
      iii. the lower Time Score
      iv. the lower score of the other run
   i. Teams who cannot complete a run within their 8 minutes or have 2 Failed Runs will be given participation points.
   j. Scoring Example: The run took 8.53 seconds, came to rest 10.4 cm from the Target Point with a Bonus distance of 50.0 cm, and the vehicle incurred no Penalties.

Run Time	8.53 seconds	=	8.53	pts.
Distance Score	2 x 10.4 cm	=	20.8	pts.
Bonus	[-0.5 x (110-50.0)]	=	-30.0	pts.
+ Penalties	0	=	0.0	pts.
Run Score			-0.67	pts.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Battery Buggy Video Download and Problem Solving/Technology CD; other resources are on the event page at soinc.org.

THIS EVENT IS SPONSORED BY ACE HARDWARE SCIENCE

BOOMILEVER

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 Boomilever meeting requirements specified in these rules **to support a minimum load** and achieve the highest structural efficiency.

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

2. **EVENT PARAMETERS:**
   a. Each team is allowed to enter only one Boomilever, built prior to the competition.
   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 proper eye protection will not be allowed to compete and be placed in Tier 4.
   c. **Participants may NOT bring any equipment such as levels or squares**.
   d. The Event Supervisor will provide the Test Apparatus (see Section 5) **and tools/materials for measurement**.

3. **CONSTRUCTION PARAMETERS:**
   a. The Boomilever must be a single structure, with no separate 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 and adhesive. Wood may never be painted, color enhanced, or have **tape**/preprinted/paper labels affixed. Ink barcodes or markings from the construction process may be left on the wood.
      ii. There are no limits on the cross-sectional sizes of individual pieces of wood. Wood may be laminated by the team without restriction.
      iii. Adhesive is a substance used to join two or more materials together **and may be used only for this purpose**. Any commercially available adhesive may be used (e.g., glue, cement, cyanoacrylate, epoxy, hot melt, polyurethane and super glues). Adhesive tapes are not allowed.
   b. **The Boomilever must be designed to attach to the testing wall using the Mounting Hook (5.a.ii.)**.
   c. **The Boomilever must support the Loading Assembly (5.b.) at the loading point which must be between 40 cm and 45 cm from the testing wall (4.Part II.e.ii.)**.
   d. **The loading point on the Boomilever must be constructed to permit placement of and completely support the Loading Assembly (5.b.)**.
   e. **Before and throughout loading, no portion of the Boomilever may touch the testing wall below the Contact Depth Line which is more than 20 cm (Div. B) or 15 cm (Div. C) below the center of the hole for the Mounting Hook (5.a.iii.).**
   f. Participants must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org.

4. **THE COMPETITION:**

   Part I: Check-In
   a. **The team will present their Boomilever for inspection & measurement using materials provided.**
   b. The team will place their Boomilever on the scale so the event supervisor can determine the mass, in grams to the nearest 0.01 g.
   c. The team must submit their Estimated Load Score (6.b.) to be used as a tie breaker (6.d.).
   d. No alterations, substitutions, or repairs may be made to the Boomilever after the check-in process is started.
   e. 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 prior to testing.

   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 setup and test their Boomilever to maximum load or failure.
   c. The participants must place the Boomilever on the Testing Wall and assemble the Loading Assembly as required to load the Boomilever. If necessary, participants may disassemble the Loading Assembly. The bucket must be mounted to allow enough clearance above the floor for the bucket to tilt or the Boomilever to deflect.

d. The participants will be allowed to adjust the Boomilever until they start loading sand. Once loading of sand has begun, the Boomilever must not be further adjusted.
e. **The event supervisor will verify the Boomilever is placed properly for testing:**
   i. **Only attached to the Testing Wall by the Mounting Hook (5.a.ii.)**
   ii. **The loading point meets requirements as measured horizontally from the Testing Wall to the centerline of the chain on the Loading Assembly (5.b.)**
   iii. **No portion of the Boomilever touches the Testing Wall below the Contact Depth line (3.e.)**
f. Participants will load the sand into the bucket and be allowed to safely and effectively stabilize the bucket from movement caused by sand loading. Direct contact with the bucket by participants is NOT allowed. The bucket may only be stabilized by the using the tips of the **provided** bucket stabilizing sticks (5.d.).
g. Loading stops immediately when the **Boomilever touches below the Contact Depth line (3.e.)**, failure occurs, or when time expires; any parts of the Boomilever in the bucket when loading stops will be removed.
h. Boomilevers that fail before supporting 15,000 g will be scored according to the actual **load** supported at time of failure **(6.b.)**, measured to the nearest gram or best precision available. Failure is defined as the inability of the Boomilever to carry any additional load or any part of the load being supported by anything other than the Boomilever. Incidental contact by the chain/eyebolt with the Boomilever is not failure.
i. More than one Test Apparatus may be used. Teams will be given a choice of which apparatus they will use.
j. Teams who wish to file an appeal must leave their Boomilever with the event supervisor.
k. The supervisor will review with the team the data recorded on their scoresheet.

5. **<u>TEST APPARATUS</u>:**
a. The Testing Wall must be as follows:
   i. **Vertical, solid, and rigid surface with dimensions minimum of 40.0 cm wide x 30.0 cm high. Constructed of ¾" grade plywood or other suitable material, with a smooth, hard, low friction surface that does not bend when loaded**.
   ii. **The Mounting Hook must be 4" steel J-bolt made of ¼" nominal round stock, have a 5/8" nominal inside hook diameter with a threaded ¼" mounting end [e.g., National Hardware barcode stock number N232-892 (UPC 038613228917), ¼" by 4" or exact equivalent shall be used]**.
   iii. **One Mounting Hook must be attached to the Testing Wall by the Supervisor with the "opening" up and installed to allow 2.5 cm +/- 0.1 cm clearance between the wall and the closest edge of the Hook. The Hook must be secured in place with a hex nut and flat washer on the front side and a wing nut and flat washer on the back side of the Testing Wall. The Hook must be horizontally aligned by centering between the sides of the Testing Wall approximately 5.0 cm below its top. The centerlines of the holes must be visible on the face of the Testing Wall.**
   iv. **A horizontal Contact Depth line must be clearly visible on the Testing Wall. It must be drawn below the centerline of the hole for the Mounting Hook as defined in rule 3.e.**
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. ¼" threaded eyebolt (1" nominal eye outside diameter), no longer than 3", and a ¼" wing nut
   iii. A chain and S-hook that are suspended from the Loading Block
   iv. **An approximately five-gallon plastic bucket with handle and hook to be suspended from the chain**.
c. Sand or other clean, dry free-flowing material (hereafter "sand").
d. Two (2) Bucket Stabilizing Sticks each made from of 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.

6. **SCORING:**
   a. **High score wins. Score = Load Score (g)/Mass of Boomilever (g)**.
   b. The Load Score is the measured load supported, including the Loading Assembly (5.b.) and sand, but may not exceed 15,000 g. **The lowest Load Score is the mass of the Loading Assembly**.
   c. Boomilevers will be placed in four tiers as follows:
      i. Tier 1: **Holding 3,000 g or more** and no violations
      ii. Tier 2: **Holding less than 3,000 g** and no violations
      iii. Tier 3: **Holding any load** with any violations
      iv. Tier 4: Unable to be loaded for any reason (e.g., cannot accommodate Loading Block, Loading Assembly, or failure to wear eye protection) and will be ranked by Lowest mass
   d. Ties are broken as follows:
      i. Estimated Load Score (4.Part I.c.) closest to, without exceeding, the actual Load Score (6.b.)
      ii. Lowest Boomilever mass
   e. Example score calculations:
      i. Boomilever 1: mass = 15.12 g, load supported = 12,134 g, Score = 802.5
      ii. Boomilever 2: mass = 12.32 g, load supported = 13,213 g; Score = 1,072.5

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Boomilever Video Download and Problem Solving/Technology CD; other resources are on the event page at soinc.org.

THIS EVENT IS SPONSORED BY ARCELORMITTAL

CIRCUIT LAB

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

1. **DESCRIPTION:** Participants must complete tasks and answer questions about electricity and magnetism.

   A TEAM OF UP TO: 2 **EYE PROTECTION:** None. **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. Participants may remove information or pages for their use during the event.
   b. Each team may also bring writing utensils, and two stand-alone calculators of any type for use during any part of the event.
   c. Event supervisors must provide any material & measurement devices required for the hands-on tasks.
   d. Participants may bring their own basic multimeters for use in place of provided ones at the discretion of the event supervisor.

3. **THE COMPETITION:**

   Part I: Written Test
   a. The written test consisting of multiple choice, true-false, completion, or calculation questions/problems will assess the team's knowledge of electricity and magnetism.
   b. Unless otherwise requested, answers must be in metric units with appropriate significant figures.
   c. The test will consist of at least one question from each of the following areas:
      i. Historical perspective of the electricity discoveries made by Volta, Ohm, Tesla, Hertz, & Faraday
      ii. Properties of electric charge/fields, sources/hazards of static electricity, Coulomb's Law, capacitance
      iii. Direct current (DC) characteristics, sources, uses, simple circuit diagrams, DC hazards
      iv. Alternating current (AC) characteristics, sources, uses, AC hazards
      v. Concepts and units of current, voltage, resistance, power, energy, and using Ohm's law
      vi. Magnetic poles/fields, electromagnets, transformers, motors/generators, right-hand rule
      vii. Electrical control devices including 3-way light switch circuits
      viii. Simple measurements, constructions, and configurations of a circuit and individual components
      ix. Fundamental characteristics and operation of a light emitting diode (LED)
      x. **Division C only** - Simple circuit analysis using Kirchhoff's Voltage & Current Laws
      xi. **Division C only** - Basic digital logic and digital logic operations
      xii. **Division C only** - Time constant of a RC circuit
      xiii. **Division C only** - Electrical characteristics of a silicon PN junction
      xiv. **Division C only** - Basics and application of Operational Amplifiers (OpAmps)
   d. Topics not included in the competition are: semiconductors, AC circuit theory, inductance, non-linear devices, three-state logic gates, sequential logic, and oscilloscopes.

   Part II: Hands-On Tasks
   a. The hands-on portion will consist of at least one task at a station(s) for the teams to complete.
   b. Participants must be familiar with the operation of breadboards and how to use them.
   c. The hands-on tasks, or stations, may include but are not limited to:
      i. Determine the value of a mystery resistor in a circuit using only voltage measurements.
      ii. Calculate the power supplied to a circuit.
      iii. Given some wires, batteries, resistors, and 2 LEDs, hook them up so the LEDs are equally bright.
      iv. Construct an electromagnet using some wire, a bolt and battery.

4. **SCORING:**
   a. High score wins.
   b. Points will be awarded for correct answers, measurements, calculations, and data analysis. Supervisors are encouraged to provide a standard form for competitors to show measurements/calculations.
   c. The written portion of the competition will account for 50-75% of each team's score. No single question will count for more than 10% of the total points possible on the written test.
   d. The hands-on portion of the competition will account for the remaining 25-50% of each team's score.
   e. Ties will be broken using pre-selected task(s)/question(s) that will be noted on the written test.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Chem/Phy Science CD; other resources are on the event page at soinc.org.

THIS EVENT IS SPONSORED BY THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

CRIME BUSTERS

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

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

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

2. **EVENT PARAMETERS:**
   a. **Each 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. This sheet of paper may be laminated or placed in a sheet protector.
   b. **Each team may bring any or all of the items listed as Recommended Lab Equipment for Division B Chemistry Events, posted on soinc.org.** Students not bringing these items will be at a disadvantage. The supervisor will not provide them.
   c. Teams may bring only specified items. Other items not listed, including calculators, 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. Students must bring and 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 a host requires a specific type, they must notify teams. Shoulder length hair or longer must be tied back. Students who unsafely remove their safety clothing/goggles or are observed handling any of the material or equipment in an unsafe manner will be penalized or disqualified from the event.
   e. Supervisor will provide:
      i. Iodine reagent (KI solution)
      ii. 1M HCl
      iii. Chromatography materials plus containers
      iv. Waste container(s)
      v. Wash bottle with distilled water (no more than 250 mL)
   f. The supervisor may provide:
      i. Other equipment (e.g., microscope, probes, calculator, etc.)
      ii. Candle & matches if fibers given
      iii. Differential density solutions or other method of determining density of polymers if plastics given
      iv. Reagents to perform additional tests

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

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

   b. The collected evidence and other data given may be used in a mock crime scene.
   c. **Qualitative Analysis**: Participants will identify evidence (unknowns) by performing tests such as solubility, acidity, magnetic property, color, density, and odor. Every team will have the same set of unknowns (evidence). The scenario will identify which containers hold mixtures and if the mixtures are made of two or three materials. The unknown common materials will be taken from the following lists.
      i. **Solids**: Anhydrous sodium acetate, yeast, vitamin C (ascorbic acid), *calcium carbonate (powdered limestone), *table salt (NaCl), *sugar (crystal), *flour, *calcium sulfate $2H_2O$ (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.
      ii. Fibers - the difference between animal, vegetable, and synthetic; not specific kinds of fibers.
      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. No calculations are expected to be performed.
f. **Crime Scene Physical Evidence**: Participants will also demonstrate their skill in analyzing evidence from a variety of other sources such as:
   i. **Fingerprints**: Participants may be asked to identify different patterns on fingerprint evidence such as the difference between whorls, loops, and arches.
   ii. **DNA evidence**: Participants may be asked to compare DNA chromatograms/electropherograms from materials found at the scene to those of the suspects.
   iii. **Shoeprints & tire treads**: Participants may be asked to compare prints and make conclusions such as direction and speed of travel. No calculations are expected to be performed.
   iv. **Soil**: Participants may be given the composition of soil found at the scene or on the suspects and asked to determine if this implicates any of the suspects.
   v. **Spatters**: Analyze spatter patterns for speed and direction of impact. No calculations are expected to be performed.
g. **Analysis**: Participants will be asked to write an analysis of the crime scene explaining not only which pieces of evidence implicate which suspect and why the suspect(s) was (were) chosen as the culprit(s), but also why the other suspects were not chosen. They will also answer any other crime scene analysis questions posed by the event supervisor.
h. Teams will dispose of waste as directed by the event supervisor.

4. **SCORING:**

a. 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. First tiebreaker is Part 3.g. Second tiebreaker is Part 3.c. Third tiebreaker is 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 the Science Crime Busters CD and Science Crime Busters Manual; other resources are on the event page at soinc.org

DENSITY LAB

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

1. **DESCRIPTION:** Participants compete in activities and answer questions about mass, density, number density, area density, concentration, pressure, and buoyancy.

   A TEAM OF UP TO: 2 **EYE PROTECTION:** B **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. Participants may remove information or pages for their use during the event.
   b. Each team may also bring writing utensils, and two stand-alone calculators of any type for use during any part of the event.
   c. Event supervisors will provide any material and measurement devices required for the hands-on tasks. Teams will not use their own measurement devices.

3. **THE COMPETITION:**
   Part I: Written Test
   a. The written test consisting of multiple choice, true-false, completion, or calculation questions/problems will assess the team's knowledge of mass, density, number density, area density, concentration, temperature, pressure, and buoyancy.
   b. Unless otherwise requested, answers must be in metric units with appropriate significant figures.
   c. The test will consist of at least one question from each of the following areas:
      i. Density of solids, liquids, and gases
      ii. Determination of concentrations limited to: mass/mass, mass/volume, volume/volume percentages, parts per million (ppm), and parts per billion (ppb)
      iii. Behavior of gases according to the gas laws: Ideal Gas, Boyle's, Charles', Gay-Lussac's, and Avogadro's
      iv. Archimedes' Principle

   Part II: Hands-On Tasks
   a. The hands-on portion of the competition will consist of at least one task at a station(s) for the teams to complete.
   b. **Tasks, or stations, will relate to the above content and may include but are not limited to**:
      i. For a given container of gas, measure its volume and mass, and calculate the mass density.
      ii. Given a small bag of Skittles, determine the number density of the green Skittles in the bag.
      iii. Given a helium balloon and a balance determine the mass that the balloon could theoretically lift.
      iv. Determine the depth to which a solid object will sink when placed in water.
      v. Determine the density of a material at different temperatures (e.g., air or water).

4. **SCORING:**
   a. High score wins.
   b. The written portion of the competition will account for 50-75% of each team's score. No single question will count for more than 10% of the total points possible on the written test.
   c. The hands-on portion of the competition will account for the remaining 25-50% of each teams score.
   d. Points will be awarded for correct answers, measurements, calculations, and data analysis. Supervisors are encouraged to provide a standard form for competitors to show measurements/calculations.
   e. Ties will be broken using pre-selected task(s)/question(s) that will be noted on the written test.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Density Lab Video Download and Chem/Phy Science CD; other resources are on the event page at soinc.org.

DISEASE DETECTIVES

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

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

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

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.

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

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

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

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

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

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the **updated** Disease Detectives CD and Bio/Earth Science CD; other resources are on the event page at soinc.org.

THIS EVENT IS SPONSORED BY THE CENTERS FOR DISEASE CONTROL (CDC)

DYNAMIC PLANET

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

1. **DESCRIPTION:** Students will use process skills to complete tasks related to glaciers, glaciation, and long-term climate change.

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

2. **EVENT PARAMETERS:**
   a. Each team may bring four 8.5" x 11" sheets of paper containing information on both sides in any form and from any source. The sheets may be **laminated** or in sheet protectors without annotations affixed.
   b. Each team may bring two **stand-alone non-programmable, non-graphing** calculators.

3. **THE COMPETITION:**
   Participants will be presented with one or more tasks, many requiring the use of process skills (e.g., observing, classifying, measuring, inferring, predicting, communicating, and using number relationships) from the following topics:
   a. Glacier formation: Properties of ice, ice crystal structure, and formation of glacial ice from snow & firn
   b. Glacial mass-balance and flow: ablation and accumulation zones, equilibrium line, influence of bed (wet or dry, bare rock, and sediment), and relation of flow to elevation and gradient
   c. Glacier/ice sheet types and forms: valley/**alpine (cirque, hanging, piedmont)**, ice sheet/**continental including** ice stream, ice shelf, ice rise, ice cap, ice tongue, & the geographic distribution **of these features**
   d. Glacial features: crevasses, ogives, icefalls, what they are, & what they indicate about flow and melt
   e. Formation of landscape features:
      i. Erosional - cirque, tor, U-shaped valley, hanging valleys, aretes, horns, **striations & grooves, and Rôche moutonnée**
      ii. Depositional – moraines **(end/terminal, recessional, lateral, medial, ground),** kettles, kames, drumlins, eskers, and **erratics**
   f. Glacial hydrology: Surface melt, surface lakes, moulins, drainage and subglacial lakes, & Jökulhlaups
   g. Global connections of glaciation:
      i. Atmosphere - greenhouse gases, insolation, and aerosols
      ii. Oceans - sea level change and ice sheet variation
      iii. Lithosphere - Isostatic effects on Earth's crust
   h. History of ice on Earth:
      i. Neoproterozoic snowball Earth
      ii. Late Paleozoic ice ages
      iii. Eocene Oligocene Transition and the impact of opening oceanic seaways
      iv. Pleistocene onset of Northern Hemisphere glaciation
   i. Ice cores as archives of past environments including gases, aerosols, and stable isotope composition
   j. Sedimentary sequences produced in glacial environments in the marine and terrestrial realms
   k. Milankovitch cycles' role in producing climate cyclicity and role in dating
   l. The Laurentide Ice Sheet retreat & melting history; impact on river drainage; and oceanic circulation
   m. Modeling rates and size of ice sheet changes (e.g., marine ice sheet instability, ice shelf buttressing)
   n. Methods of studying glaciers & what they tell you: Altimetry, radar, Landsat, seismology, and gravity
   o. Recent records of cryospheric change: (e.g., Larsen B, Kilimanjaro, Amundsen Sea Embayment)

4. **SAMPLE QUESTIONS/TASKS:**
   a. Analyze and interpret glacial features on a USGS topographic map or satellite image.
   b. Analyze a geologic map of glacial deposits to determine the sequence of events over the course of several episodes of advance and retreat.
   c. Interpret oxygen isotope data from a marine sediment core to identify changes in sea level caused by global ice volume changes.
   d. Apply glaciological principles to predict where one might find meteorites in ice fields.

5. **SCORING:**
   a. High score wins. Points will be awarded for the quality and accuracy of responses.
   b. Ties will be broken by the accuracy and/or quality of answers to pre-selected questions.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Dynamic Planet and Bio/Earth Science CDs; other resources are on the event page at soinc.org.

THIS EVENT IS SPONSORED BY THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

ELASTIC LAUNCHED GLIDER

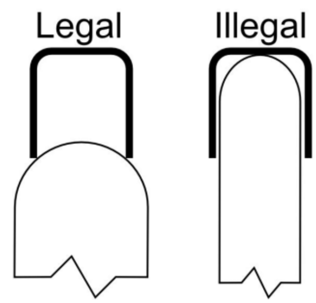
See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

1. **DESCRIPTION:** Prior to the tournament teams design, construct, and test elastic-launched gliders to achieve the maximum time aloft.

   A TEAM OF UP TO: 2 **EYE PROTECTION:** B **IMPOUND:** No **EVENT TIME:** 5 minutes

2. **EVENT PARAMETERS:**
   a. Teams may bring up to 2 gliders **for final inspection**, flight log(s), and any tools.
   b. Participants must wear eye protection. Participants without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows.
   c. Event Supervisors will provide all measurement tools and timing devices.

3. **CONSTRUCTION PARAMETERS:**
   a. Gliders may be constructed from published plan(s), commercial kits and/or student designs.
   b. Participants must not use any components with pre-glued joints or pre-covered surfaces.
   c. The glider **may be constructed only of the following materials**: wood, foam, paper, plastic film, carbon fiber, tape, thread, and/or glue.
   d. Ballast may be any malleable non-metallic substance.
   e. The functional components may be attached to each other using tape, thread, or glue.
   f. The mass of the glider throughout the flight must be **≥ 3.5 g and ≤ 10.0 g**.
   g. Wingspan must not exceed **30.0 cm** at any time.
   h. The blunt nose of the fuselage, when inserted into a lip balm cap with inside dimensions of ~1.57 cm deep and ~1.37 cm wide must not touch the end.



   i. The Launch handle(s), excluding elastic, must be less than 1 m long in any orientation, **be supported completely by a participant**, and be of a safe configuration. **The elastic used in the launch handle must be non-metallic and must be in contact with the glider throughout the launch. Elastic must remain on the launch handle. If elastic leaves the launch handle, timing will end for that flight**.
   j. Each glider must be labeled so the Event Supervisor can easily identify the team to which it belongs.

4. **THE COMPETITION:**
   a. The event will be held indoors with tournament officials announcing the room dimensions (approximate length, width, and ceiling height) in advance of the competition. Tournament officials will do their best to minimize the effects of environmental factors (i.e., air currents).
   b. Once participants enter the cordoned off competition area to practice, to trim, for inspection, or to compete they must wear eye protection at all times and not receive outside assistance, materials, or communication. Teams violating these rules must be ranked below all other teams. Spectators will be in a separate area. **Only participants may handle aircraft components until the event ends.**
   c. During inspection each team must present a flight log of recorded data. Data must include 4 or more parameters (3 required and at least 1 additional) for 10 or more test flights prior to the competition. The required parameters are: 1) estimated/recorded peak flight height after launch, 2) approximate length of elastic (relaxed), and 3) Flight Time. The team must choose an additional parameter beyond those required (e.g., orbit diameter, cross section of elastic launch loop, height at transition to glide pattern, launch angle).
   d. At the Event Supervisor's discretion:
      i. Multiple official flights may occur simultaneously according to the Event Supervisor's direction.
      ii. Test flights may occur throughout the contest but must yield to any official flight.
      iii. No test flights will occur in the final half-hour of the event's last period, except for teams that declare a trim flight during their 5-minute flight period.
   e. A self-check inspection station may be made available to participants for checking their glider and launch handle dimensions prior to being measured by the officials.
   f. Participants must present their glider(s), launch handle(s), and flight log for inspection immediately prior to their 5 official flights. Event Supervisors are strongly urged to return flight logs after inspection. Timers will follow teams as they prepare and launch their gliders.
   g. Gliders must be launched from a launch handle by a single participant who must be at floor level.
   h. Teams may make up to a total of 5 official flights using 1 or 2 gliders.
   i. After check-in teams will be given a 5-minute Flight Period, starting when their first flight (trim or official) begins. Any flight beginning within the 5-minute period must be permitted to fly to

ELASTIC LAUNCHED GLIDER (CONT.)

completion. Participants may make any adjustments/repairs/trim flights and may switch gliders or launch handles during their 5-minute Flight Period.

j. **Gliders will be placed on the ground at the location where the participants choose to make their first flight. Once a team picks up their glider the team will have 1 minute to launch their first flight (trim or official). If successful, they earn a Starting Bonus applied to their Final Score. If they fail to launch in one minute their 5-minute Flight Period begins without the Starting Bonus.**

k. Participants must declare to the Timers before any launches during their Flight Period whether it is an official flight or trim flight. If teams do not indicate the flight type before the launch, it will be considered official. Teams will not be given extra time to recover or repair their gliders.

l. Time Aloft for each flight starts when the glider leaves the launch handle and stops when any part of the glider touches the floor, stops moving due to an obstruction (such as a glider landing on a girder or basketball hoop), **the elastic leaves the handle**, or the judges otherwise determine the flight to be over.

m. Event Supervisors are strongly encouraged to utilize 3 Timers on all flights. The middle value of the 3 Timers will be the official Time Aloft for that flight, recorded in seconds to the precision of the device used.

n. Gliders must only be launched while aimed at any point on the ceiling. Participants must not aim for the walls, spectators, low obstructions, etc.

o. Participants must not steer their gliders during the flight.

p. In the unlikely event of a collision with another glider, a team may elect a re-flight. The decision to re-fly may be made after the glider lands. Timers are allowed to delay a launch to avoid a possible collision. The 5-minute period does not apply to such situations.

5. **SCORING:**

a. High Score wins. A Team's Final Score is the sum of their three longest **Accumulated Flight Scores after multipliers and penalties are applied**.

b. **A Length Bonus multiplier of 1.10 will be applied to each flight where that glider is used if that glider's fuselage can straddle a 32 cm opening (i.e., longer than 32.0 cm)**.

c. **A Starting Bonus of a 1.10 multiplier will be applied to the Final Score of any team that begins its 5-minute Flight Period in 1-minute or less.**

d. Teams with incomplete flight logs will have 10% deducted from their Final Score.

e. Teams without flight logs will have 30% deducted from their Final Score.

f. Teams with Construction or Competition violations will be ranked after all teams that do not violate those rules.

g. Ties will be broken by the longest non-scored Time Aloft.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Elastic Launched Glider Video and Problem Solving/Technology CD; other resources are on the event page at soinc.org.

THIS EVENT IS SPONSORED BY THE ACADEMY OF MODEL AERONAUTICS (AMA)

EXPERIMENTAL DESIGN

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

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

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

2. **EVENT PARAMETERS:**
   a. Participants must bring goggles and writing utensils. Chemicals that require other safety clothing will not be used.
   b. Division B teams may bring one timepiece, one linear measuring device, and one **stand-alone** non-programmable non-graphing calculator.
   c. Division C teams may bring one timepiece, one linear measuring device, and one **stand-alone** calculator of any type.
   d. The event supervisor will provide each team with identical sets of materials either at a distribution center or in an individual container.
   e. The event supervisor will supply a report packet, based on the Experimental Design Checklist posted on the event page at soinc.org, for recording their experimental information and data.

3. **THE COMPETITION:**
   a. The teams must design, conduct, and report the findings of an experiment actually 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 the first half of the report packet so they can focus on designing and conducting their experiment**.
   c. **After the first 20 minutes, participants will receive the last half of the report packet and while they may continue experimenting, participants will also begin to analyze their data and report findings**.
   d. Each team must use at least two of the provided materials to design and conduct an experiment. The materials will be listed on the board or placed on a card for each team. If provided, both the card and the container will be considered part of the materials. The identity of the materials will be unknown until the start of the event.
   e. When a team finishes, all materials must be returned to the event supervisor along with all written materials and reports.

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 in the following order:
      i. Variables
      ii. Procedure
      iii. Analysis of Results (Claim, Evidence, & Reason)
      iv. Graph
      v. **Raw** Data Table
   d. Any participant not following proper safety procedures will be asked to leave the room and will be disqualified from the event.
   e. **The final score of a team will be multiplied by 0.95 if they do not follow cleanup procedures.**
   f. **The final score of a team will be multiplied by 0.75 if their experiment does not address the assigned question/topic area.**
   g. **The final score of a team will be multiplied by 0.25 if they do not conduct an experiment (i.e., performing a dry lab, making up data or trials).**

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Experimental Design CD and Problem Solving/Technology CD; other resources are on the event page at soinc.org

EXPERIMENTAL DESIGN CHECKLIST

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

Part I - Design and Construct Experiment

A. Hypothesis (6 pts)

② ① ⓪ Statement predicts a relationship or trend **between the independent and dependent variables**
② ① ⓪ Statement gives specific direction to the predictions(s) (e.g., a stand is taken)
② ① ⓪ A rationale is given for the hypothesis.

B. Variables (**16 pts**)

a. Independent Variable (IV) (6 pts)
② ① ⓪ IV correctly identified
② ① ⓪ IV operationally defined
② ① ⓪ At least three levels of IV given

b. Dependent Variable (DV) (**4** pts)
② ① ⓪ DV correctly identified
② ① ⓪ DV operationally defined

c. Controlled Variables (CV) (**6** pts)
② ① ⓪ One CV correctly identified
② ① ⓪ Two CVs correctly identified
② ① ⓪ Three CVs correctly identified

C. Experimental Control (Standard of Comparison) (4 pts)

② ① ⓪ SOC correctly identified and makes logical sense for the experiment
② ① ⓪ Reason given for selection of SOC

D. Materials (6 pts)

② ① ⓪ Materials listed separately from procedure
② ① ⓪ All materials used are listed
② ① ⓪ **No extra materials are used**

E. Procedure with Diagrams (12 pts)

② ① ⓪ Procedure well organized
② ① ⓪ Procedure is in a logical sequence
② ① ⓪ Repeated trials
② ① ⓪ Diagram of the experimental setup provided
④ ③ ② ① ⓪ Enough information is given so another could repeat procedure

F. Qualitative Observations (8 pts)

② ① ⓪ Observations about results given
② ① ⓪ Observations about procedure/deviations
② ① ⓪ Observations about results not directly relating to Dependent Variable or other data
② ① ⓪ Observations given throughout the course of the experiment

G. Quantitative Data - Data Table (10 pts)

② ① ⓪ All raw data is given
② ① ⓪ All data has units
② ① ⓪ Table(s) labeled properly
② ① ⓪ **Reports most relevant data**
② ① ⓪ All data reported using correct figures (significant figures C Division only)

(revised 08/22/18)

Part II – Data, Analysis and Conclusions

H. Graphs (10 pts)

② ① ⓪ Appropriate type of graph used
② ① ⓪ Graph has title
② ① ⓪ Graph labeled properly (axes/series)
② ① ⓪ Units included
② ① ⓪ Appropriate scale used

I. Statistics (6 pts)

② ① ⓪ **Age-appropriate statistics (i.e., best fit, average/mean, median, mode) are used**
② ① ⓪ Example calculations are given with appropriate units
② ① ⓪ **Calculations are accurate**

J. Analysis and interpretation of data (10 pts)

② ① ⓪ All data discussed and interpreted
② ① ⓪ Unusual data points commented on
② ① ⓪ Trends in data explained and interpreted
② ① ⓪ **Interpretations based on statistics used are accurate**
② ① ⓪ Enough detail is given to understand data and all statements must be supported by the data.

K. Possible Experimental Errors (6 pts)

② ① ⓪ Possible reasons for errors are given
② ① ⓪ Important info about data collection given
② ① ⓪ Effect errors had on data discussed

L. Conclusion (8 pts)

② ① ⓪ Hypothesis is evaluated according to data
② ① ⓪ Hypothesis is re-stated
② ① ⓪ Reasons to accept/reject hypothesis given
② ① ⓪ All statements are supported by the data

M. Applications & Recommendations for Further Use (8 pts)

② ① ⓪ Specific suggestions to improve the experiment are given
② ① ⓪ Suggestions for other ways to look at hypothesis are given
② ① ⓪ Suggestions for future experiments are given
② ① ⓪ Practical application(s) of experiment are given

Team #: ________________

School Name: ________________________________

Point Total: _______/106

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

Final Score: _________________

FOSSILS

1. **DESCRIPTION: Teams use fossils to date and correlate rock units as well as demonstrate their knowledge of ancient life by completing tasks related to fossil identification and classification.**

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

2. **EVENT PARAMETERS:**
   a. Each team may bring one magnifying glass, **the Science Olympiad Official Fossil List** and one **standard 3-inch** or smaller, 3-ring binder containing information in any form and from any source attached using the available rings.
   b. **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.**

3. **THE COMPETITION:**
   a. 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. Emphasis will be placed upon task-oriented activities at each station.
   d. Identification will be limited to **specimens** on **the Science Olympiad Official Fossil List**, but other **samples** may be used to illustrate key concepts. Questions will be chosen from the following topics:
      i. Identification of all fossil specimens on **the Science Olympiad Official Fossil List**
      ii. Taxonomic classification **restricted to the hierarchy on the Science Olympiad Official Fossil List**
      iii. Conditions required for a plant or an animal to become fossilized
      iv. Common modes of preservation: **petrification/petrifaction** (e.g., permineralization & mineral replacement including **silicification and pyritization**), cast/mold, imprints, **carbonization**, **unaltered remains**
      v. Uncommon modes of preservation: encasement in amber, mummification, freezing
      vi. Relative dating: law of superposition, original horizontality, cross cutting relationships, unconformities
      vii. Absolute dating: radiometric dating, half-life, carbon dating, volcanic ash layers
      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. Fossil bearing sedimentary rocks: limestone, shale, sandstone, mudstone, coquina
      xi. Modes of life: filter feeder, predator, scavenger, deposit feeder, benthic, pelagic
      xii. Environments: **shallow marine, deep** marine, terrestrial, fresh water
      xiii. Mineral and organic components of **exoskeletons**, shells, and **bones/teeth** (e.g., calcite, aragonite, silica, chitin, **biological apatite**)
      xiv. Adaptations and morphologic features of major fossil groups
      xv. Important paleontological discoveries (**i.e., non-avian dinosaurs with feathers; transitional species such as *Tiktaalik* and *Archaeopteryx***)
      xvi. ***Lagerstätten* (conservation and concentration) and their significance, limited to: Burgess Shale, Beecher's Trilobite Bed, Mazon Creek, Ghost Ranch, Solnhofen Limestone, Yixian Formation (Liaoning), Green River Formation, and LaBrea Tar Pits**
      xvii. **Fossils as evidence for evolutionary trends and patterns such as morphologic adaptations within groups and major evolutionary events (i.e., Cambrian explosion, fish to tetrapods, dinosaurs to birds, whales, horses)**

4. **SAMPLE QUESTIONS/TASKS:**
   a. Identify each fossil, record its mode of preservation, the type of rock the sample is embedded in, and the geologic period it represents.
   b. List samples in order from oldest to most recent.
   c. Based on the fossil and rock associations, determine the environment in which the organism lived.
   d. Construct a range chart and determine the age of the fossil assemblage.

5. **SCORING:**
   a. High score wins. Points will be awarded for the quality and accuracy of responses.
   b. Ties will be broken by the accuracy and/or quality of responses to several pre-identified questions.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Fossil and the Bio/Earth Science CDs; other resources are on the event page at soinc.org.

OFFICIAL FOSSIL LIST

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

KINGDOM PROTOZOA
Phylum Foraminifera (Forams)
1) Order Fusulinida (Fusulinids)
2) Genus *Nummulites*
KINGDOM ANIMALIA
INVERTEBRATES:
Phylum Porifera (Sponges)
3) Genus *Astraeospongia* (calcareous sponge)
4) Genus *Hydnoceras* (glass sponge)
Phylum Bryozoa
(Growth forms: branching, massive, fenestrate)
5) Genus *Archimedes*
6) Genus *Rhombopora*
Phylum Hemichordata
7) Class Graptolithina (Graptolites)
Phylum Cnidaria
Class Anthozoa (Horn & Colonial Corals)
  8) Genus *Favosites*
  9) Genus *Halysites*
  10) Genus *Heliophyllum*
  11) Genus *Hexagonaria*
  12) Genus *Septastraea*
Phylum Arthropoda
13) Subphylum Crustacea (shrimp, lobster, crabs, barnacles, **ostracods**)
14) Order Eurypterida (Eurypterids)
15) Class Insecta (Insects)
Class Trilobita (Trilobites)
  16) Genus *Cryptolithus*
  17) Genus *Calymene*
  18) Genus *Elrathia*
  19) Genus *Isotelus*
  20) Genus ***Eldredgeops*** (formerly *Phacops*)
Phylum Brachiopoda
Class Inarticulata:
  21) Genus *Lingula*
Class Articulata:
  22) Genus *Atrypa*
  23) Genus *Composita*
  24) Genus *Juresania*
  25) Genus *Leptaena*
  26) Genus *Mucrospirifer*
  27) Genus *Platystrophia*
  28) Genus *Rafinesquina*
  29) Order *Rhynchonellida*

Phylum Mollusca
Class Bivalvia (**clams, oysters, mussels**)
  30) Genus *Exogyra*
  31) Genus *Gryphaea*
  32) Genus *Pecten*
  33) Genus ***Glycymeris***
Class Cephalopoda
  34) Subclass Ammonoidea (**Ammonoids**)
(**Goniatites, Ceratites, Ammonites**)
  35) Genus *Baculites*
  36) Genus *Dactylioceras*
Subclass Coleoidea
  Order Belemnitida (**Belemnites**)
    37) **Genus *Belemnitella***
Subclass Nautiloidea (Nautiloids)
    38) Genus *Nautilus*
    39) Genus *Orthoceras*
Class Gastropoda (Snails)
  40) Genus *Conus*
  41) Genus *Cypraea*
  42) Genus *Platyceras*
  43) Genus *Turritella*
  44) Genus *Worthenia*
Phylum Echinodermata
45) Class Asteroidea (**Starfish**)
Class Blastoidea
  46) Genus *Pentremites*
47) Class Crinoidea (stems, columns, calyxes)
48) Class Echinoidea (**regular or irregular echinoids including** sea urchins, sand dollars and heart urchins)
49) Class Ophiuroidea (brittle stars)
VERTEBRATES:
Phylum Chordata
Subphylum Vertebrata
Class Placodermi (Armored Jawed Fish)
  50) Genus **Bothriolepis**
  51) Genus **Dunkleosteus**
Class Chondrichthyes (Cartilaginous Fish)
  52) Superorder Selachimorpha (Sharks)
    53) Genus ***Carcharodon***
    54) Genus *Carcharocles*
      (formerly *Carcharodon)*
      55) Species *C. megalodon*
  56) Superorder Batoidea (Rays)

Note: Numbers indicate that members of that taxon rank should be identifiable to that level. For ranks not underlined, indented ranks are in the rank above it.

Last Updated: 08/08/18

OFFICIAL FOSSIL LIST (CONT.)

Superclass Osteichthyes (Bony Fish)
57) Class Actinopterygii (ray-finned)
Class Sarcopterygii (lobe-finned)
58) Order Coelacanthiformes (Coelacanth)
59) Genus *Tiktaalik*
Class Amphibia (**Amphibians**)
60) Genus *Acanthostega*
61) Genus *Eryops*
62) Genus *Diplocaulus*
Class Reptilia (**Reptiles**)
63) Order Ichthyosauria (Ichthyosaurs)
64) Family Mosasauridae (Mosasaurs)
65) Order Plesiosauria (Plesiosaurs **& Pliosaurs**)
66) Order Pterosauria (Pterosaurs)
Clade Dinosauria (**Dinosaurs**)
Order Saurischia (lizard-hipped)
67) Genus *Allosaurus*
68) **Genus *Diplodocus***
69) Genus *Coelophysis*
70) **Genus *Dilophosaurus***
71) Genus *Plateosaurus*
72) Genus *Velociraptor*
73) Genus *Tyrannosaurus*
Order Ornithischia (bird-hipped)
74) Genus *Iguanodon*
75) Genus *Parasaurolophus*
76) Genus *Stegosaurus*
77) Genus *Triceratops*
78) **Genus *Ankylosaurus***
79) Genus *Dracorex*
Class Aves (**Birds**)
80) Genus *Archaeopteryx*
81) **Genus *Titanis* (Terror Bird)**
Clade Synapsida
Mammal-like reptiles
82) Genus *Dimetrodon* (**pelycosaurs**)
83) Genus *Lystrosaurus* (**therapsids**)
Class Mammalia (**Mammals**)
84) Genus *Basilosaurus* **(prehistoric whale)**
85) Genus *Equus* **(modern horse)**
Genus *Homo* **(human)**
86) Species *H. neanderthalensis*
87) Genus *Mammut* (Mastodon)
88) Genus *Mammuthus* (Mammoth)
89) Genus *Megacerops* **(Brontothere)**
90) Genus *Mesohippus* **(three-toed horse)**
91) Genus *Smilodon* **(saber-toothed cat)**

KINGDOM PLANTAE
Phylum Anthophyta (Flowering plants)
92) Genus *Acer*
93) Genus *Populus*
94) Genus *Platanus*
Phylum Ginkgophyta (Ginkgos)
95) Genus *Ginkgo*
Phylum Lycopodiophyta (Club Mosses)
96) Genus *Lepidodendron* (scale tree)
Phylum Pinophyta (Conifers)
97) Genus *Metasequoia*
98) Phylum Sphenophyta (Horsetails)
99) Genus *Calamites*
100) Genus *Annularia*
Phylum Pteridospermatophyta (Seed Ferns)
101) Genus *Glossopteris*
Phylum Pteridophyta (True Ferns)
102) **Genus *Pecopteris***
OTHER
Trace Fossils:
Trails, Tracks, Trackways,
Borings, Burrows, Tubes
Predation marks, Repair scars
Coprolites
Stromatolites
Amber/copal
Petrified wood
Sedimentary Rocks
Coquina
Limestone (**Chalk/Fossil limestone**)
Sandstone
Shale
Mudstone/Siltstone

Note: Numbers indicate that members of that taxon rank should be identifiable to that level. For ranks not underlined, indented ranks are in the rank above it.

Last Updated: 08/08/18

GAME ON

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

1. **DESCRIPTION:** This event will determine a team's ability to design and build an original computer game using the program Scratch incorporating the scientific theme provided to them by the supervisor.

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

2. **EVENT PARAMETERS:**
   a. Teams must bring a writing utensil(s) and may bring:
      i. Headset(s) to assist in testing audio, and
      ii. A microphone to assist in recording original audio.
   b. No Internet access outside of the Scratch program is allowed. No external resources or computer programs of any kind are allowed. No pre-constructed games, game assets or files are allowed.
   c. Supervisors will provide:
      i. A computer capable of running Scratch. Tournament Directors are encouraged to provide computer specifications to the teams as early as possible; and,
      ii. Scrap paper.

3. **THE COMPETITION:**
   a. The supervisor will assign the teams a broad **scientific** theme that the original computer game will be built around. The **scientific** theme must be the same for all teams and allow students to build games involving some scientific principles associated with the theme.
   b. Students will use the Scratch program (available for download from http://scratch.mit.edu) to create an original computer game based on the assigned **scientific** theme.
   c. When teams are finished, they must save their game following the supervisor's instructions in the specified format in a designated location (i.e., USB drive, desktop, online repository).

4. **SAMPLE GAME THEMES:**
   Some game themes that have been used in the past that are not intended for current tournament use: Wave, Fire, Gravity, Frogs, Newton's Second Law, Light.

5. **SCORING:**
   a. **High score wins**. Scoring of the event will be done using the Game On Rubric found on soinc.org.
   b. Points will be awarded based on the coding and/or game play of the items.
   c. Zero points will be awarded for items not being present in the game or inappropriate content.
   d. Any team caught using outside resources or accessing the internet outside of the scratch program will be asked to leave the room and be disqualified from the event.
   e. Any team not addressing the assigned **scientific** theme in their game will **have their final score multiplied by 0.67** because not addressing the theme is a violation of the spirit of the competition.
   f. Ties will be broken by comparing the point totals in the scoring areas in the following order:
      i. Game Mechanics
      ii. Game Play
      iii. User Control
      iv. Balanced Play
      v. Overall Impression/Originality

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Game On Video Download and Problem Solving/Technology CD; other resources are on the event page at soinc.org.

THIS EVENT IS SPONSORED BY CODE.ORG

HEREDITY

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

1. **DESCRIPTION:** Participants will solve problems and analyze data or diagrams using their knowledge of the basic principles of genetics.

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

2. **EVENT PARAMETERS:**
   Each team may bring one 8.5" x 11" sheet of paper that may contain information on both sides in any form and from any source along with two **stand-alone** non-programmable, non-graphing calculators.

3. **THE COMPETITION:**
   a. This event may be run at stations and may include process skills such as data analysis, predictions, calculations, inferences, and observations.
   b. Participants will be given a combination of genetic problems to solve, pedigrees, karyotypes, or diagrams to analyze. Every attempt should be made to avoid over-emphasis on a particular area. Common genetic disorders will apply to all levels.
   c. At the various levels, possible areas to be tested are limited to the following topics:

Regional and State Tournament Topics		National Tournament Topics (all Regional & State topics + the following)
Monohybrid cross	Dihybrid cross	Pedigree construction & analysis
Dominant & recessive alleles	Sex-linked traits	Production of gametes with Abnormal #'s of chromosomes
Genotype vs. phenotype	Pedigree analysis	Trihybrid cross (probability analysis)
Human sex determination	Multiple alleles	Analysis of karyotypes for deletion, addition, translocation
Gene & protein relationship	DNA structure & replication	**Mutations**
Mitosis, Meiosis & gamete formation	Transcription & translation	Multifactorial traits & Epistasis
Human karyotypes analysis for nondisjunction disorders	Co-dominance & incomplete dominance	**PCR**

4. **SAMPLE QUESTIONS:**
   a. In guinea pigs, short hair (S) is dominant over long hair (s). Two heterozygous dominant guinea pigs are crossed (Ss X Ss). What will be the genotype ratio of their offspring? What will be the phenotype ratio of their hair length?
   b. In mice, the gene for color coat (C) is dominant to the gene for albino (c), and the gene for straight whiskers (S) is dominant to the gene for bent whiskers (s). Two heterozygous dominant mice are crossed CcSs x CcSs. Show the Punnett Square of genotypes for this cross and determine the genotype and phenotype ratios for this cross.
   c. A man who is blood type AB marries a woman who is blood type O. What blood types might be present in their children?
   d. Examine a pedigree and answer the questions about sex of individuals, relationships, phenotype, and genotypes.
   e. Examine a karyotype and answer questions about sex of individual, number of chromosomes, monosomy, trisomy, and genetic disorders.
   f. Examine data and/or diagrams concerning mitosis, meiosis, or DNA structure/replication and answer questions about the processes.

5. **SCORING:**
   a. Highest number of correct solutions will determine the winner.
   b. Selected questions may be used as tiebreakers.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the **updated** Genetics CD and Bio/Earth Science CD; other resources are on the event page at soinc.org.

THIS EVENT IS SPONSORED BY CORTEVA AGRISCIENCE

HERPETOLOGY

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 knowledge** of amphibians and reptiles.
   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes
2. **EVENT PARAMETERS:**
   a. Each team may bring one **2019** Official National Herpetology List as well as one **two-inch or smaller standard** binder containing information in any form and from any source attached using the available rings.
   b. **The 2019 Official National Herpetology List does not have to be secured in the binder.**
   c. **If the event features a rotation through a series of laboratory stations in which the participants interact with samples, specimens, or displays no material may be removed from the binder while at, or in-between, laboratory stations.**
3. **THE COMPETITION:**
   a. Each team will be given an answer sheet on which they will record answers to each section.
   b. Specimens/pictures will be lettered or numbered at each station. The event may include living and preserved specimens, skeletal materials, slides, or pictures of specimens.
   c. Each specimen will have one or more questions accompanying it on some aspect of its life history, distribution, etc.
   d. Participants should be able to do basic identification and answer taxonomy questions to the level indicated on the Official National Herpetology List as well as demonstrate knowledge of anatomy and physiology, reproduction, habitat characteristics, ecology, diet, behavior, conservation, **taxonomy**, sounds, and biogeography.
   e. No more than 50% of the competition will require giving common or scientific names (class, order, **suborder, family**, or genus as indicated on the Official National Herpetology List).
   f. The questions will be distributed between amphibians and reptiles.
   g. The National competition will be based on the **2019** Official National Herpetology List.
   h. **The taxonomic scheme of the 2019 Official National Herpetology List is based upon a combination of traditional and current categories designed to utilize familiar terms widely used in published resources available to the students.**
   i. States may have a modified state or regional list which will be posted on the state website no later than November 1st.
4. **SAMPLE ACTIVITIES:**
   a. Identify the order, **suborder**, family, **and/or** genus of the provided sample.
   b. What conclusion can be drawn about the habitat(s) of the given specimens?
   c. Which of these animals does not fit within this **taxon**?
   d. What unique anatomical feature distinguishes the animal shown in the picture?
   e. **Consider the potential impact of human activities on the survival of amphibians and reptiles.**
5. **SCORING:**
   a. High score wins.
   b. Selected questions may be used as tiebreakers.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Bio/Earth Science CD, Taxonomy CD; other resources are on the event page at soinc.org.

OFFICIAL NATIONAL HERPETOLOGY LIST

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

Class
Order
- **Family**
  - ***Genus (species-none listed*) - common name**

Class Reptilia
Crocodylia – crocodiles and alligators
- **Crocodylidae - crocodiles**
- **Alligatoridae – alligators and caiman**

Testudines (Chelonia) - turtles
- **Chelydridae - snapping turtles**
- **Kinosternidae - musk and mud turtles**
- **Emydidae - box, pond and marsh turtles**
  - ***Terrapene* - box turtles**
  - ***Actinemys* – western pond turtles**
  - ***Malaclemys* - diamondback terrapins**
  - ***Graptemys* - map turtles**
  - ***Trachemys* - sliders**
  - ***Chrysemys* - painted turtles**
  - ***Pseudemys* – cooters and redbellies**
  - ***Clemmys* – spotted turtle**
  - ***Glyptemys* – wood turtle and bog turtle**
  - ***Deirochelys* – chicken turtle**
  - ***Emydoidea* – Blanding's turtle**
- **Testudinidae - tortoises**
- **Cheloniidae - sea turtles**
- **Trionychidae – soft shelled turtles**

Squamata – lizards and snakes

SUBORDER LACERTILA OR SAURIA - LIZARDS
- **Gekkonidae – gecko lizards**
- **Polychridae – anoles**
  - ***Anolis* - anoles**
- **Iguanidae – iguanids**
  - ***Iguana* – green iguana**
  - ***Dipsosaurus* – desert iguana**
  - ***Sauromalus* – chuckwalla**
- **Crotaphytidae – Collared lizards**
- **Phrynosomatidae – earless, spiny, tree, side-blotched and horned lizards**
  - ***Sceloporus* – spiny lizards**
  - ***Cophosaurus & Holbrookia* – earless lizards**
  - ***Uma* – fringe toed lizards**
  - ***Urosaurus & Uta* – tree and side blotched lizards**
  - ***Phrynosoma* – horned lizards**
- **Lacertidae – wall lizards**
- **Teiidae – whiptails**
  - ***Cnemidophorus* – racerunners and whiptails**
- **Scincidae – skinks**
  - ***Eumeces* – skinks**
- **Anguidae – glass lizards and alligator lizard**
  - ***Ophisaurus* – glass lizards**
  - ***Gerrhonotus* – alligator lizard**
- **Helodermatidae – gila monster**

SUBORDER SERPENTES (Ophidia) - SNAKES
- **Leptotyphlopidae – blind snakes**
- **Boidae**
  - ***Charina* – rubber boa and rosy boa**

- **Colubridae – typically harmless snakes**
    - ***Nerodia*** **– water snakes and salt marsh snakes**
    - ***Storeria*** **– brown snakes and redbelly snakes**
    - ***Thamnophis*** **– garter, ribbon, lined snakes**
    - ***Heterodon*** **– hog-nosed snakes**
    - ***Diadophis*** **– ringneck snakes**
    - ***Coluber*** **– racers**
    - ***Masticophis*** **– coachwhips and whipsnakes**
    - ***Opheodrys*** **– green snakes**
    - ***Elaphe*** **– rat snakes**
    - ***Pituophis*** **– pine, bull and gopher snakes**
    - ***Lampropeltis*** **– king and milk snakes**
    - ***Tantilla*** **– crowned and blackhead snakes**
- **Elapidae – coral snakes**
- **Hydrophiidae – sea snakes**
- **Viperidae – (subfamily viperinae) pit vipers**
    - ***Agkistrodon*** **– copperhead and cottonmouths**
    - ***Sistrurus*** **–massasaugas and pigmy rattlesnakes**
    - ***Crotalus*** **– rattlesnakes**

Class Amphibia

Caudata (Urodela) - salamanders

- **Cryptobranchidae – hellbenders**
- **Dicamptodontidae – giant salamanders**
- **Proteidae – mudpuppies and water dogs**
- **Rhyacotritonidae – torrent or seep salamanders**
- **Amphiumidae – amphiumas**
- **Sirenidae – sirens**
- **Ambystomatidae – mole salamanders**
- **Salamandridae – newts**
- **Plethodontidae – lungless salamanders**
    - ***Desmognathus*** **– dusky salamanders & kin**
    - ***Plethodon*** **– woodland salamanders & kin**
    - ***Ensatina*** **- ensatina**
    - ***Aneides*** **– green/climbing salamanders**
    - ***Batrachoseps*** **– slender salamanders**
    - ***Hydromantes*** **– web-toed salamanders**
    - ***Hemidactylium*** **– four-toed salamanders**
    - ***Gyrinophilus*** **– spring salamander**
    - ***Pseudotriton*** **– red and mud salamanders**
    - ***Eurycea*** **– brook salamanders**
    - ***Typhlomolge*** **– Texas and Blanco blind salamanders**

Anura (Salientia) – frogs and toads

- **Scaphiopodidae – spadefoot toads**
    - ***Scaphiopus*** **- spadefoot toads**
- **Bufonidae – true toads**
    - ***Anaxyrus*** **– American toad & oak toad**
- **Hylidae – treefrogs**
    - ***Hyla*** **- gray treefrog & green treefrog**
    - ***Pseudacris*** **– western chorus frog, ornate chorus frog & spring peeper**
    - ***Acris*** **– cricket frogs**
- **Ranidae – true frogs**
    - ***Lithobates*** **– bullfrog, green frog, northern leopard frog & wood frog**
- **Microhylidae – narrow-mouthed toads**
    - ***Gastrophryne*** **– narrow-mouthed toads**

Note: The taxonomic scheme is based upon a combination of traditional and current categories (designed to utilize familiar terms widely used in published resources available to the students)

METEOROLOGY

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

1. **DESCRIPTION:** This event emphasizes understanding of basic meteorological principles with emphasis on analysis and interpretation of meteorological data, graphs, charts, and images.

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

2. **EVENT PARAMETERS:**
   Each team may bring two **stand-alone non-programmable, non-graphing** calculators and four 8.5” x 11” sheets of paper that may contain information on both sides in any form and from any source.

3. **THE COMPETITION:**
   The questions will be from the following Everyday Weather topics:
   a. **The modern atmosphere**: structure including temperature profiles, thickness, composition, seasonal variation, unique characteristics, and atmospheric pollutants
   b. **Solar radiation & seasons**: atmospheric influences on insolation, diurnal & seasonal temperature patterns, Earth’s revolution, rotation and axial tilt
   c. **Water, its properties & its effects on weather**: specific heat, density, sensible and latent heat
   d. **Atmospheric moisture**: humidity, water vapor, cloud types & development, virga, sundogs, rainbows, atmospheric river, training thunderstorms, and hazards such as flooding
   e. **Types & formation of hydrometeors**: snow, rain, ice pellets, freezing rain, dew, frost, etc.
   f. **Atmospheric pressure**: horizontal & vertical gradients, cyclones & anticyclones and their circulations, including Coriolis Effect & friction
   g. **Air masses & fronts**: origin, temperature, density, moisture, advection, atmospheric stability, dry lines, warm, cold, occluded or complex and stationary fronts, frontogenesis, and frontolysis
   h. **Local wind & precipitation**: Chinook and Santa Ana winds, sea & land breezes, valley & mountain breezes, and effects of topography on regional winds & precipitation patterns
   i. **Common storms & other hazardous weather**: cyclogenesis, Alberta Clippers, panhandle hook, nor’easters, dust storms, winter storms, thunderstorms (not severe), fire weather, etc.
   j. **Surface weather station models & maps**: analyze and interpret models & maps (isobars, isotherms, color codes, etc.). In addition, decode & interpret METAR observations.
   k. **Upper air 850, 700, 500 & 300 mb charts**: analyze, interpret & locate jet streams, ridges, & troughs
   l. **Weather instrumentation & technology**: thermometers, anemometers, barometers, satellite imagery (visible, infrared & water vapor), radiosondes, rawinsondes, Doppler radar, wind profilers, rain gauges, snow boards, etc.
   m. **Weather forecasting**: analyze and interpret weather maps, meteograms, isopleths, fronts, Doppler radar images, model predictions, thermodynamic charts (e.g., Stüve diagrams, Skew T/log p), vertical atmospheric profiles plus National Weather Service non-severe forecast products & hazard map advisories, e.g., dense fog, flooding, high winds, etc., associated with non-severe weather
   n. **Temperature indices**: wind chill, heat index, and heating & cooling degree days

4. **SAMPLE QUESTIONS/TASKS:**
   a. Examine a surface weather map and interpret national, regional, and/or local weather conditions.
   b. Use upper air charts with surface maps to predict the trajectories of high- and low-pressure systems.
   c. Interpret local weather conditions using Doppler radar images and/or satellite imagery.

5. **SCORING:**
   a. High score wins. Points will be awarded for the quality and accuracy of responses, the quality of supporting reasons, and proper use of scientific technique.
   b. Selected questions will be used as tiebreakers.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Meteorology and the Bio/Earth Science CDs; other resources are on the event page at soinc.org.

THIS EVENT IS SPONSORED BY THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

MYSTERY ARCHITECTURE

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

1. **DESCRIPTION:** At the beginning of the event, teams will be given a bag of building materials and instructions for designing and building a device that can be tested.

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

2. **EVENT PARAMETERS:**
   a. Each team may bring 1 pair of scissors, **1 flat standard 30 cm (12") ruler**, and 1 pair of pliers.
   b. No other materials, tools, notes, or resources are permitted.

3. **THE COMPETITION:**
   a. Each team will be given a bag containing the same materials and instructions as to the type of device to be constructed. The students will not know the task until they begin the competition.
   b. Examples of materials that may be provided include, but are not limited to: paper cups, drinking straws, paper clips, string, tape, paper, thumbtacks, and craft sticks. Only those materials contained in the bag may be used to build the device. The bag and instructions must not be used. No other materials or adhesives may be part of the finished device.
   c. The devices to be built are limited to an **elevated** bridge, cantilever, **arch** or **tunnel**. If a cantilever is to be built, the event supervisor will supply the fulcrum, and provide a counterbalance. **If a tunnel is to be built, the event supervisor will specify the internal dimension**.
   d. The instructions must identify a Primary Dimension, a Secondary Dimension, whether the device must support a load, and the required duration of load support.
   e. Unless specifically stated in the instructions, devices must be freestanding and must not be attached to a tabletop, floor, ceiling, or other support.
   f. If the device must support a load, a separate identical load of the same dimensions and weight as used for testing will be provided to each team. When finished building, the load must be removed from the device. The event supervisor will direct the participants when to place the official load in/on the device.
   g. Only participants and the event supervisor are allowed in the event area. Once in the event area, they must not leave or receive outside assistance, materials, or communication.
   h. The supervisor will review with the team the data being recorded on their scoresheet.

4. **SAMPLE TASKS & PRIMARY DIMENSIONS:**
   a. For an **elevated** bridge, the Primary Dimension could be the **measurement** between the closest inside supports **plus the height from the base to the lowest bridge support**. If the bridge fails to support the load, the Primary Dimension will be measured from the point of contact to the farther inside support **plus a height score of zero**.
   b. For a cantilever, the Primary Dimension could be measured:
      i. with no load, from the fulcrum to the end of the cantilever,
      ii. with a load, from the fulcrum to the closest point of contact or attachment of the load.
   c. **For an arch, the Primary Dimension could be measured:**
      i. **with no load, from the base to the highest point of the arch**
      ii. **with a load, from the base to the highest point of the load**
   d. For a **tunnel**, the Primary Dimension could be **the measurement of the longest continuously enclosed portion of the tunnel**.

5. **SCORING:**
   a. Highest or lowest score wins depending on instructions.
   b. The Primary and Secondary Dimensions will be measured in cm to the nearest 0.1 cm by the event supervisor. Devices requiring a load will be measured both prior to and after placement of the load **once the duration time concludes**, if successfully held.
   c. Devices without load requirements will be ranked in order of Primary Dimensions as per instructions.
   d. Devices with load requirements will be ranked as follows:
      i. Tier 1: Devices which support the load will be ranked in order of Primary Dimensions after the placement of the load.
      ii. Tier 2: Devices where the load, or its underlying material, contact the table or the event supervisor is unable to measure the height due to movement of the load will be ranked by Primary Dimensions as measured before the placement of the load.
   e. The Secondary Dimension will be used as a Tie Breaker if necessary.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Problem Solving/Technology CD; other resources are on the event page at soinc.org.

POTIONS & POISONS

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 **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. Each participant must bring safety equipment and a writing implement.
   b. Each team may bring **two stand-alone non-programmable, non-graphing calculators** and **one** 8.5" x 11" sheet of paper, in a protector or laminated, with information on both sides in any form and from any source.
   c. **Each team may bring any or all of the items listed as Recommended Lab Equipment for Division B Chemistry Events, posted on soinc.org**. Teams not bringing these items will be at a disadvantage.
   d. Event supervisors will provide for each team: all required reagents and test solutions, any needed probes or other instrumentation, chromatography materials, and the answer sheet. The event supervisor may provide additional items or instructions if necessary but **will not provide Recommended Lab Equipment.**
   e. Participants must bring and 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 a host requires a specific type, they must notify teams. Shoulder length hair or longer must be tied back. Participants who unsafely remove their safety clothing/goggles or are observed handling any of the material or equipment in an unsafe manner will be penalized or disqualified from the event.

3. **THE COMPETITION:**

   Part I: Written Exam
   a. This part will be a multiple-choice and short answer test covering the following topics:
      i. ionic and covalent bonds **identified using conductivity, not electronegativity**
      ii. the difference between mixtures, solutions, and compounds
      iii. techniques to separate components of a mixture
      iv. the differences between physical and chemical changes
      v. balancing simple chemical equations
      vi. effect of dilution on toxicity
      vii. how toxic spills spread in the environment via water, wind, or gravity
      viii. identification of various poisonous plants and animals, and their toxic effects: poison ivy (*Toxicodendron radicans*), **Wild Carrot (*Daucus carota*), Autumn Skullcap (*Galerina marginata*), Henbane (*Hyoscyamus niger*), Oak (*Quercus sp*), Timber Rattlesnake (*Crotalus horridus*), Eastern Coral Snake (*Micrurus fulvius*), Cotton Mouth Snake (*Agkistrodon piscivorus*), Black Widow Spider (*Latrodectus mactans*)**, and Brown Recluse Spider (*Loxosceles recluse*)
      ix. effects & chemistry of common household toxins: Household chemicals: ammonia, hydrogen peroxide, rubbing alcohol, bleach, Epsom salts, vinegar, nutritional supplements containing calcium and iron
      x. information about the following specific environmental toxins: iron **(Ferric), copper, and mercury**.

   Part II: Laboratory Activity
   a. Participants will 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.
   b. Lab activities will be drawn from: chromatography, mixtures of reagents, separation of a mixture, serial dilutions, determination of pH, and conductivity testing.
   c. Participants may mix reagents and be asked to observe changes in temperature or color, production of a gas or a precipitate, the rate of a chemical reaction, or other parameters.

4. **SAMPLE QUESTIONS/TASKS:**
   a. What hazardous chemical may be produced if you mix household bleach and ammonia?
   b. What are the major sources of **mercury** which cause **mercury** poisoning?
   c. What should you do if you find a giant hogweed plant? Why is it dangerous?
   d. Categorize each as a physical or chemical change: 1) iron forms rust when exposed to oxygen, 2) copper melts at 1085 ºC, 3) apple slices turn brown in the air, 4) a sheet of aluminum foil is crumpled into a ball.
   e. Sand and salt are stirred together; is this a mixture, a solution, or a compound?
   f. Given a map, analyze the potential spread patterns of toxic spills via water, wind or gravity.

5. **SCORING:**
   a. High score wins. Part I is worth 60% of the overall score while Part II accounts for 40% of the score.
   b. Ties will be broken using selected questions along with the quality of free response answers.
   c. **A penalty of up to 10% may be given if the area is not cleaned up as instructed by the event supervisor**.
   d. **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 the Chem/Phy Sci CD (CPCD); other resources are on the event page at soinc.org

ROAD SCHOLAR

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

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

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

2. **EVENT PARAMETERS:**
   a. Teams may bring a **stand-alone non-programmable, non-graphing** calculator, a protractor, a ruler, other measuring devices, USGS Map Symbol Sheet, and **hard copies** of other information in any form and from any source **along with colored marking devices consistent with the colors utilized on USGS topographic maps**.
   b. **The equipment and reference materials may be in a container such as a three-ring binder, file folder, box or similar product**. The information **and equipment** may be removed during the event.
   c. The event supervisor will provide all required maps. Event supervisors will check the accuracy of reproduced maps or map sections 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. Answer sheets will include areas for profile and map square. Satellite/aerial photos will be in the visible light spectrum. Participants may NOT write on the maps. Items marked with an asterisk (*) should be written at an introductory level for regional events.

   Topics/Concepts Assessed

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

   b. Highway Map
      i. Distances between features
      ii. Map legend/tables/index
      iii. Map grid system
      iv. Map symbols
      v. City/Regional insets

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

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

4. **SAMPLE QUESTIONS/TASKS:**
   a. Participants may be asked to draw map features listed in 3.c. located within a one-mile PLSS square section.
   b. Participants may be asked to draw a topographic map profile.

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

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Road Scholar and Bio/Earth Science CDs; other resources are on the event page at soinc.org.

ROLLER COASTER

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

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

   A TEAM OF UP TO: 2 **IMPOUND:** Yes **EYE PROTECTION:** B **EVENT TIME:** 8 minutes

2. **EVENT PARAMETERS:**
   a. Participants must bring and impound one Roller Coaster (a track that guides **a ball/sphere), at least one ball/sphere, tools, spare parts, and data/notes before the start of the competition**.
   b. Participants may bring and impound **additional balls/spheres**, but only one will be used during a given run.
   c. Participants must properly wear eye protection at all times. Participants without proper eye protection must be immediately informed and given a chance to obtain eye protection, if time allows. Participants without eye protection will not compete and will be ranked in Tier 4.
   d. The Event Supervisor will provide an unsharpened #2 pencil with an unused eraser, all measurement tools for scoring purposes, and timers.

3. **CONSTRUCTION PARAMETERS:**
   a. The Roller Coaster must be designed so that the **ball/sphere** will travel from a Start Line to a Finish Line in as close to the given Target Time as possible.
   b. **At all times during the competition the device, excluding the ball/sphere, must fit into 50 cm wide x 50 long x 60 cm high box sitting flat on the ground**.
   c. **The ball/sphere must be visible at all times**.
   d. The **ball/sphere** must be held in the ready-to-run position by **an unused** #2 pencil **held only in the participant's hand**. The pencil is provided by the Event Supervisor. The **ball/sphere** is released when a participant removes the pencil from the track.
   e. The **ball/sphere** must travel using only its own gravitational potential energy available at the ready-to-run position. No added energy by use of stored potential energy is allowed (e.g., no springs or rubber bands).
   f. There must be exactly one clearly labeled Start Line and one clearly labeled Finish Line running perpendicular to the direction of **ball/sphere** travel on the track designated before the Target Time is released.
   g. The Start Line and Finish Line positions may not be adjusted **after Impound**. Parts and track can be added or removed, but **the overall dimensions of the device may not change during the competition**.
   h. The device must include a mechanism that safely stops the **ball/sphere** after it crosses the Finish Line.
   i. Magnets, electrical, and electronic devices may not be used for any part of the Roller Coaster.
   j. The device may contain Gaps in the track to earn a Gap Bonus. Gaps are defined as an open span without support or guidance that the **ball/sphere** must pass to continue its run. Gaps must have a horizontal span of at least 5.0 cm from the end of the track the **ball/sphere** leaves measured to the closest part of the track the **ball/sphere** lands on. The beginning and the end of each Gap must be clearly labeled for the Gap to count for points. **The beginning and the end of each Gap must be at least 0.5 cm above the next surface(s) below them**. The **ball/sphere** must travel completely unsupported in the air to earn bonus points. There must be a minimum of 5.0 cm of unbroken track at the end of every gap. Up to 3 distinct, clearly labeled Gaps may be included to earn bonus points. Bouncing a **ball/sphere** off a surface does not count as part of a Gap; a Gap may not end with the **ball/sphere** hitting a wall.
   k. Participants must make sure their **ball/sphere** is captured after each run so it does not leave the Roller Coaster boundary. If the device is deemed unsafe, it will not be allowed to run until safety concerns are resolved to the supervisor's satisfaction.
   l. Participants must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on soinc.org.

4. **THE COMPETITION:**
   a. Only the participants and Event Supervisor will be allowed in the impound and event areas **during the competition**. Once the participants enter the event area **to compete**, they must not leave the area or receive outside assistance, materials, or communications.
   b. The exact Target Time is between **10 s and 60 s** (in 5 s intervals for regional, 2 s intervals for state, and 1 s intervals for national tournaments) and will be chosen by the Event Supervisor. The Target

Time will be the same for all teams at the tournament and will be revealed after all devices and tools are impounded.

c. After retrieving their device from the Impound Area, teams will be given 8 minutes to set up their Roller Coaster and complete up to two scorable runs. Participants may level their Roller Coaster **at the beginning of their time** to account for an uneven floor or table. Electronic levels may be used but **must be removed prior to their first practice or scorable run**.
d. Time used by the Event Supervisor for measuring will not be included in the 8 minutes. A scorable run that begins before the end of the 8-minute time period will be allowed to run to completion.
e. Participants may adjust their Roller Coaster (e.g., modify the track, swap the ball/sphere) before each run.
f. Participants may make as many practice runs as they want in their 8 minutes of competition.
g. Prior to conducting a scorable run, the participants must place the Event Supervisor provided #2 pencil on the Start Line of the device. The **ball/sphere** must be placed completely behind the Start Line.
h. A scorable run must be declared prior to the start of a run. Participants may not touch the device during a scorable run. The **ball/sphere** must cross the Finish Line within **two (2)** minutes **or the run will be declared over and no time points will be awarded**.
i. **The ball/sphere must cross the Finish Line for a scorable run to receive time points. If the ball/sphere fails to cross the Finish Line on a scorable run, that run will still receive Height and Gap Bonus scores. Only Gaps that are successful during a run may receive a Gap Bonus.**
j. **Any scorable run beginning within the 8-minute period will be permitted to run to completion**.
k. Prior to each scorable run, the Event Supervisor will verify that the timekeepers and participants are ready. Three timekeepers are suggested to be used with the middle time recorded as the Run Time, in seconds to the precision of the timing device used. The Event Supervisor will then count aloud “3, 2, 1, Go”. On the word “Go” the participants will remove the pencil from the track.
l. Timing begins on the word “Go” and ends when any of the following happens:
   i. The complete **ball/sphere** crosses the Finish Line.
   ii. **Two** minutes have elapsed since the word “Go”.
   iii. The **ball/sphere** travels outside the boundary of the device.
   iv. The **ball/sphere** stops moving. A **ball/sphere** may pause briefly, but timing stops if movement does not begin within 3 seconds.
m. Teams filing appeals must leave all impounded materials with the Event Supervisor.
n. The Event Supervisor will review with teams the data recorded on their scoresheet.

5. **SCORING:**
a. Highest Final Score wins. The higher of the 2 Run Scores is used as the Final Score.
b. Run Score = Height Score + Time Score + Gap Bonus
c. Height Score = **3 x (60** - device height). The device height is measured in cm **from** the highest part of the device measured to the floor **or the table (if used)**, rounded down to the cm.
d. Time Score = **5** points for every full second of Run Time, rounded down, up to the Target Time, minus the Time Penalty (1 point for every full second of Run Time, rounded down, past the Target Time).
e. Gap Bonus = **5** points for each whole cm measured horizontally from the end of the track the **ball/sphere** leaves, to the closest part of the track the **ball/sphere** lands on. Points are only awarded if the **ball/sphere** successfully reaches the **track on the other side of the Gap and fulfills all requirements in (3.j.)**.
f. Tiers:
   i. Tier 1: A run with no violations
   ii. Tier 2: A run with any violations
   iii. Tier 3: A team with a Roller Coaster not impounded during the impound period
g. Participation points are awarded to teams who cannot start any run within the 8 minutes or have unresolved safety issues.
h. Ties are broken by this sequence:
   i. Biggest Gap Bonus for an individual gap
   ii. Highest Height Score
   iii. Highest Time Score
   iv. Smallest dimensions of the device.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Roller Coaster Video Download and Problem Solving/Technology CD; other resources are on the event page at soinc.org.

SOLAR SYSTEM

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

1. **DESCRIPTION:** Participants will demonstrate an understanding and knowledge of the geologic characteristics and evolution of the Earth's moon and other rocky bodies of the solar system.

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

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

3. **THE COMPETITION:**
   Part I: Written Test
   a. Participants must be knowledgeable about the history and geologic processes involved in the formation and evolution of Earth's moon and other rocky bodies of the solar system.
   b. Participants may be asked to identify geologic surface features and internal structures of the objects listed below as they appear on diagrams, maps, or images.
      i. **Dwarf** Planets: **Pluto, Ceres, Haumea, Makemake, Eris**
      ii. Satellites: Earth's Moon, **Charon, Mimas, Phoebe**
      iii. **General Details of Other Small Bodies**: Asteroid Belt, **Centaurs, Trojans, Trans-Neptunian Objects**
      iv. **Specific Details of: 'Oumuamua and (225088) 2007 OR_{10}**

   Part II: Hands-On/Interpretive Task
   a. Participants will be asked to complete one or more hands-on or interpretive tasks selected from the following topics:
      i. History of and formation processes for the rocky bodies and their specific features
      ii. Remote sensing, imagery, and satellite measurements
      iii. **Missions: New Horizons, Dawn, Cassini, Lucy, Voyager 2**
      iv. Kepler's laws, gravitational effects of the Moon and tides
      v. Rotation, libration, phases, and eclipses
      vi. Surface dating, regolith, volcanism & weathering, cratering & impact processes
      vii. Internal, surface, and atmospheric compositions

4. **SAMPLE PERFORMANCE TASKS:**
   a. Given a set of images of a particular feature, identify the specific name of the feature, how old that feature might be, and explain how the feature was formed.
   b. Describe the internal structure of the object and how this internal structure was determined.
   c. From a set of images, identify types of eclipses and draw diagrams showing the arrangement of the Sun, Moon, and Earth resulting in each type of eclipse.

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

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Bio/Earth Science CD; other resources are on the event page at soinc.org.

THIS EVENT IS SUPPORTED BY NASA'S UNIVERSE OF LEARNING ASTROPHYSICS STEM LEARNING AND LITERACY NETWORK

THERMODYNAMICS

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

1. **DESCRIPTION:** Teams must construct an insulating device prior to the tournament that is designed to retain heat and complete a written test on thermodynamic concepts.

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

   IMPOUND: Yes **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. **Participants may remove pages during the event**.
   b. Each team may also bring tools, supplies, writing utensils, and two **stand-alone** calculators of any type for use during any part of the event. These items need not be impounded.
   c. Each team must impound: their insulating device; **an** unaltered, glass or plastic, standard (height ~1.4 times the diameter) 250 mL beaker; **a device diagram and** copies of graphs and/or tables for scoring.
   d. Event supervisors will supply the hot water, devices for transferring measured volumes of water, **cotton balls**, and thermometers or probes (recommended).
   e. Prior to competition, teams must calibrate devices by preparing graphs/tables showing the relationship **between water temperature and testing parameters**. A labeled device picture/diagram should be included.
      i. Any number of graphs and/or data tables may be submitted but the team must indicate up to four to be used for the Chart Score, otherwise the first four provided are scored.
      ii. Graphs and/or tables may be computer generated or drawn by hand on graph paper. **Each data series counts as a separate graph**. A template is available at www.soinc.org.
      iii. Teams are encouraged to have a duplicate set to use, as those submitted may not be returned.
   f. Participants must wear eye protection during Part I. Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows.
   g. Participants must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org.

3. **CONSTRUCTION PARAMETERS:**
   a. Devices may be constructed of and contain anything **except** the following materials/components: asbestos; mineral wool; fiberglass insulation; **commercially available thermoses/coolers/vacuum sealed devices**.
   b. The device must fit within a:
      i. 20.0 x 20.0 x 20.0 cm cube for Division B
      ii. 15.0 x 15.0 x 15.0 cm cube for Division C
   c. Within the device, participants must be able to insert and remove a beaker that they supply (see 2.c.).
   d. The device must also allow putting a thermometer/probe into the beaker via a hole **≥ 0.50 inches** in diameter all the way through directly above the beaker. The hole's top surface must be < 12 cm above the inside bottom beaker surface. **The hole's bottom surface may be inside the beaker but must not contact the water. Teams may plug the hole with a single cotton ball provided by the supervisor**.
   e. Devices will be inspected to ensure that there are no energy sources (e.g., electric components, battery powered heaters, chemical reactions, etc.) to help keep the water warm. At the event supervisor's discretion, teams must disassemble devices after testing in order to verify the construction materials.
   f. All parts of the device must not be significantly different from room temperature at impound.

4. **THE COMPETITION:**

   Part I: Device Testing
   a. At the start of each competition block, the supervisor will announce the volume of water (**Regionals: 100 mL; States: 75 - 125 mL, 25 mL increments; Nationals: 75 - 125 mL, 5 mL increments**) and the cooling time (Div. B: **25.0** mins; Div. C: **20.0-30.0** mins, **1-minute increments**). These parameters will be the same for all teams.
   b. The event supervisor will announce the temperature of the source water bath (60 - **75** ºC) and the current room temperature. **Supervisors will do their best to keep this the same for all teams but must announce the actual values (in case of minor fluctuations) at the start of each competition block**.
   c. At the start of the competition block, teams will be given 5 minutes to set up or modify their devices and use their graphs and/or tables to begin temperature prediction calculations. Devices that do not meet the construction specs will not be allowed to be tested until brought into specification.

d. **The supervisor, using his/her own measuring device, will dispense the volume of water into each team's beaker. A team may elect to install a beaker in a device prior to this but must leave sufficient access to the beaker**. Teams may secure/close access panels with fastening materials after **receiving water, but must do so in a manner to not delay dispensing to other teams**. Supervisors must record the time each team receives water and the room and source water temperature when dispensed.
e. Teams will use their graphs and/or tables to calculate the temperature of the water in their beaker at the end of the cooling time. **After receiving water, teams will be given at least 3, but no more than 5 minutes to make their final predictions. During this time, teams may use their own thermometers to measure the starting water temperature in their beaker, but after this time must remove them**.
f. At the end of the cooling period, the supervisor will record the ending time and the temperature in the beaker to the best precision of the available instrument. Supervisors may leave thermometers/probes in the devices for the entire cooling period but will announce if they will do so before impound. Otherwise they will insert a thermometer/probe into **the beaker in the device**, wait at least 20 seconds, and record the resulting temperature. Multiple thermometers/probes may be used at the supervisor's discretion.
g. The supervisor will review with the team the Part I data recorded on their scoresheet.
h. Teams filing an appeal regarding Part I must leave their device in the competition area.

Part II: Written Test

a. Teams will take a test on thermodynamics during the remaining time after all devices receive water.
b. Unless otherwise requested, answers must be in metric units with appropriate significant figures.
c. 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.
d. The test will consist of at least **three** questions from each of the following areas:
    i. The history of thermodynamics
    ii. **Definition of temperature**, temperature scales and conversions, definitions of heat units
    iii. **Phases of matter, phase transitions, phase diagrams, latent heat, ideal gas law**
    iv. **Kinds of heat transfer, thermal conductivity, heat capacity, specific heat**
    v. Thermodynamic laws and processes (e.g., Carnot cycle and efficiency, adiabatic, isothermal)
    vi. **Division C only: Radiant exitance, entropy, enthalpy**

5. **SCORING:**
a. High score wins. All scoring calculations are to be done in degrees Celsius (°C).
b. The Final Score = TS + CS + HS + PS; a scoring spreadsheet is available at www.soinc.org.
c. Test Score (TS) = (Part II score / Highest Part II score for all teams) x 45 points
    i. Chart Score (CS) = max of 10 points
    ii. Heat Score (HS) = **20 x (lowest k of all teams) / k**, **where k is from Newton's law of cooling: k = - (1 / cooling time) x ln((start water temp - room temp) / (final water temp - room temp))**
    iii. Prediction Score (PS) = **25 - 2.5*abs(prediction - final temp)**. The minimum PS possible is 0 points.
d. One of the submitted graphs and/or tables, selected by the event supervisor, must be scored as follows for the Chart Score. Partial credit may be given.
    i. 2 points for including data spanning at least one variable range listed in **4.Part I.a.**
    ii. 2 points for including at least 10 data points **in each data series**
    iii. 2 points for proper labeling (e.g. title, team name, units)
    iv. 0.5 points for each graph or table turned in (up to 2 points total as long as they are not the same)
    v. 2 points for including a labeled device picture or diagram
e. If a team violates any COMPETITION rules, their **PS score** will be multiplied by 0.9 and **their k will be multiplied by 1.1** when calculating the scores.
f. If any CONSTRUCTION violation(s) are corrected during Part I, or if the team misses impound, their **PS** will be multiplied by 0.7 and their **k will be multiplied by 1.4** when calculating the scores.
g. Teams disqualified for unsafe operation or do not having a conforming insulating device at the start of Part I receive zero points for their **HS and PS** scores. Teams will be allowed to compete in Part II.
h. Tie Breakers will be applied in the following order: i. Best TS, ii. Best PS, iii. Best HS.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Chem/Phy Science CD; other resources are on the event page at soinc.org.

WATER QUALITY

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

1. **DESCRIPTION:** Participants will be assessed on their understanding and evaluation of aquatic environments.

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

2. **EVENT PARAMETERS:**
   a. Each team may bring one 8.5" x 11" sheet of paper that may contain information on both sides in any form and from any source along with two stand-alone non-programmable, non-graphing calculators, and one salinometer/hydrometer. The sheet of paper may be laminated or contained in a sheet protector.
   b. Participants must wear eye protection during Competition Part III: Water Monitoring and Analysis (3.Part III.). Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows.

3. **THE COMPETITION:**
   a. Each part of the competition will count for approximately 1/3 of the final score.
   b. Scenarios and tasks will be drawn from freshwater locales (e.g., lake, pond, river) and may require analysis, interpretation or use of charts, graphs, and sample data as well as equipment use, collecting and interpreting data, measuring, analyzing data, and making inferences.

   Part I: Freshwater Ecology
   a. This part will consist of multiple choice, matching, fill-in-the-blank and/or short answer questions to assess participant knowledge in areas such as: aquatic ecology, water cycle, nutrient cycling, aquatic chemistry and its implications for life, potable water treatment, wastewater treatment, aquatic food chains/webs, community interactions, population dynamics, watershed resource management issues, sedimentation pollution, and harmful species.
   b. **Division C - State and Nationals only** content includes: life history strategies (e.g., age structure, survival curves, life tables, succession, R and K strategies).

   Part II: Macroflora and Fauna Identification
   a. Participants should be able to identify the immature & adult macroinvertebrates and aquatic nuisance organisms listed below by common name and know their importance as indicators of water/wetland quality.
      i. Class 1 – Pollution Sensitive: Caddisfly, Dobsonfly, Gilled Snails, Mayfly, Riffle Beetle, Stonefly, Water Penny, Water Scorpion
      ii. Class 2 – Moderately Sensitive: Aquatic Sowbug, Crane Fly, Damselfly, Dragonfly, Scuds
      iii. Class 3 – Moderately Tolerant: Blackfly, Flatworm, Leeches, Midge, Water Mite
      iv. Class 4 – Pollution Tolerant: Air Breathing Snail, Midge Fly Bloodworm, Deer/Horse Fly, Tubifex
      v. Class 5 – Air Breathing: Back Swimmer, Giant Water Bug, Mosquito, Predacious Diving Beetle, Water Boatman, Water Strider, Whirligig Beetle
      vi. Aquatic Nuisance Plants: Purple Loosestrife, Eurasian Water Milfoil, and Water Hyacinth
      vii. Aquatic Nuisance Animals: Zebra Mussel, Spiny Water Flea, Asian Tiger Mosquito, & Asian Carp
   b. **Division C teams** are expected to know their general ecology, life cycles, and feeding habits of the immature & adult macroinvertebrates and aquatic nuisance organisms listed above.

   Part III: Water Monitoring and Analysis
   a. Teams must build, calibrate, bring and demonstrate a salinometer/hydrometer capable of measuring saltwater (most likely NaCl) concentrations between 1-10% (mass/volume). Points for salinity testing will be approximately 5% of the total score.
   b. There are no restrictions on size except that the team must build the device to operate within a standard 400 – 600 mL beaker filled with the saltwater solution.
   c. Teams will be expected to estimate the percent salinity measured by their device to the nearest tenth. Full credit will be given ±1% at Regionals and ±0.5% at State/Nationals. Calibration solutions may or may not be provided by the event supervisor.
   d. Participants should be able to understand and interpret data related to testing procedures as well as reasons for collecting data related to salinity, pH, phosphates, turbidity, dissolved oxygen, temperature, nitrates, fecal coliform, total solids, biochemical oxygen demand, and their relationship to one another. No actual, physical tests will be performed on these topics.

4. **SCORING:**
   a. High score wins. Points will be assigned to the various questions and problems.
   b. Selected questions may be used as tiebreakers.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Water Quality CD and Bio/Earth Science CD; other resources are on the event page at soinc.org.

WRITE IT DO IT

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

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

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

2. **EVENT PARAMETERS:**
   a. **The participant who will be doing the writing must bring a writing utensil.**
   b. **No other materials or resources are allowed.**

3. **THE COMPETITION:**
   a. **One participant from each team** is shown an object, which may be abstract but is the same for all teams, built from, but not limited to, such items as science materials, inexpensive materials (e.g., straws, push pins, Styrofoam balls, paper cups, Popsicle sticks, etc.) or commercial sets (e.g., K'nex, Tinker Toys, Lego, Lincoln Logs, etc.). **This participant is not allowed to touch the object unless the event supervisor permits it**.
   b. **The participant viewing the object** has twenty-five (25) minutes to write a description of the object and how to build it. There will be no advantage to finishing early.
   c. Drawings and diagrams of the model or subsections of the model are not allowed. Numerals, words and single letters that fit within the context of the written description are allowed. The participant may use abbreviations and do not have to define the abbreviation. Editing, punctuation, or scientific symbols that fit within the context of the written description are allowed.
   d. The supervisor of the event will pass the description to the remaining 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 the Problem Solving/Technology CD; other resources are on the event page at soinc.org.

CALCULATOR GUIDE

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

Stand-alone non-graphing, non-programmable, non-scientific 4-function or 5-function calculators can be used in the following events: Anatomy & Physiology, Astronomy, Battery Buggy, Circuit Lab, Chemistry Lab, Codebusters, Designer Genes, Density Lab, Disease Detectives, Dynamic Planet, Elastic Launched Gliders, Experimental Design (Both Divisions), Forensics, Geologic Mapping, Heredity, Meteorology, Mousetrap Vehicle, Potions & Poisons, Road Scholar, Sounds of Music, Thermodynamics, Wright Stuff, and Water Quality.

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.

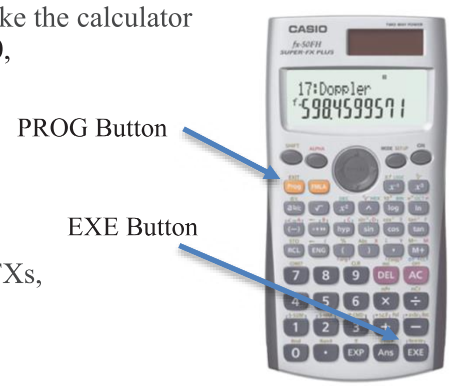
Stand-alone non-programmable, non-graphing calculators, in addition to the above listed calculators, can be used in the following events: Anatomy & Physiology, Chemistry Lab, Dynamic Planet, Designer Genes, Disease Detectives, Experimental Design (Division B.), Forensics, Geologic Mapping, Heredity, Meteorology, Potions & Poisons, Road Scholar, and Water Quality.

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.

Stand-alone, programmable, graphing calculators and **stand-alone non-graphing, programmable calculators,** in addition to the above listed calculators, can be used in the following events: Astronomy, Battery Buggy, Circuit Lab, Density Lab, Elastic Launched Gliders, Experimental Design (Division C), Mousetrap Vehicle, Sounds of Music, Thermodynamics, and Wright Stuff

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

Stand-alone non-graphing, programmable calculators are another type of calculator that can be used in the above listed events. To identify these calculators, 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.



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

EYE PROTECTION

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

Revised (08/07/18)

Possible Division B Schedule for the 2019 National Tournament at Cornell University; Ithaca, New York

Event	7:00 - 8:00 AM	8:15 - 9:15 AM	9:30 - 10:30 AM	10:45 - 11: 45 AM	Noon - 1:00 PM	1:15 - 2:15 PM	2:30 - 3:30 PM
Anatomy & Physiology		01-10	11-20	21-30	31-40	41-50	51-60
Battery Buggy	Impound	Self-Schedule					
Boomilever		Self-Schedule					
Circuit Lab		21-30	31-40	41-50	51-60	01-10	11-20
Crime Busters		51-60	01-10	11-20	21-30	31-40	41-50
Density Lab		Self-Schedule					
Disease Detectives	1-60						
Dynamic Planet		31-40	41-50	51-60	01-10	11-20	21-30
Elastic Launched Glider		Self-Schedule					
Experimental Design	1-60						
Fossils		21-30	31-40	41-50	51-60	01-10	11-20
Game On		11-20	21-30	31-40	41-50	51-60	01-10
Heredity		31-40	41-50	51-60	01-10	11-20	21-30
Herpetology		51-60	01-10	11-20	21-30	31-40	41-50
Meteorology		41-50	51-60	01-10	11-20	21-30	31-40
Mystery Architecture		Self-Schedule					
Potions and Poisons		01-10	11-20	21-30	31-40	41-50	51-60
Road Scholar		01-10	11-20	21-30	31-40	41-50	51-60
Roller Coaster	Impound	Self-Schedule					
Solar System		11-20	21-30	31-40	41-50	51-60	01-10
Thermodynamics	Impound	Self-Schedule					
Water Quality		41-50	51-60	01-10	11-20	21-30	31-40
Write It Do It		41-50	51-60	01-10	11-20	21-30	31-40

Science Olympiad

Since 35 YEARS 1984 ™

Exploring the World of Science

During this 35th Anniversary Season, 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: Cornell University (2019 National Tournament Host), Colorado State University (2018 National Tournament Host), ArcelorMittal, NASA's Universe of Learning Astrophysics STEM Learning and Literacy Network, Ward's Science, Lockheed Martin, Combined Federal Campaign, Corteva Agriscience, NBC Universal Foundation, Google, ACE Hardware, Centers for Disease Control and Prevention (CDC), Discovery Education 3M Young Scientist Challenge, Institute of Electrical and Electronics Engineers (IEEE), National Marine Sanctuary Foundation, National Oceanic and Atmospheric Administration (NOAA), Potbelly Sandwich Works, Texas Instruments, VWR Foundation, Academy of Model Aeronautics, Investing in Communities, SkyCiv, Society for Neuroscience (SfN) and Yale Young Global Scholars. Strategic Partners: Code.org, Digital Manufacturing and Design Innovation Institute (DMDII), Hardware Science, Japan Science and Technology Agency, Million Women Mentors (MWM) and Milwaukee School of Engineering (MSOE).

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

Science Olympiad

Two Trans Am Plaza Drive, Suite 415

Oakbrook Terrace, IL 60181