SCIENCE OLYMPIAD™

Exploring the World of Science

Division B Rules Manual

Division B (Gr. 6-9)

WELCOME TO THE 2018 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 back inside cover - 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 **Clarifications/Rules Changes**, FAQs, New Store Items, Membership Information, News, Team Size Requirements, and other valuable information, tips and resources.

ANATOMY & PHYSIOLOGY

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

1. **DESCRIPTION:** Understand the anatomy and physiology of the human body systems below.
   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 non-programmable, non-graphing calculators **dedicated to computation**.
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. **RESPIRATORY SYSTEM:**
      i. Anatomy and functions of the respiratory system
      ii. Mechanisms of pulmonary ventilation
      iii. Patterns of breathing
      iv. Measures of pulmonary ventilation
      v. Gas exchange and O_2 transport including oxygen disassociation curves
      vi. Effects of exercise and high altitude on the respiratory system
      vii. Understand disorders: COPD, asthma, emphysema, pneumonia, sleep apnea and cystic fibrosis
      viii. *Additional diseases/disorders of: tuberculosis, pulmonary edema, Pleurisy, small cell and non-small cell lung cancer*
      ix. *Blood chemistry and the respiratory rhythm*
      x. *Regulation of the respiratory system*
      xi. *Ability to read a spirogram as related to pulmonary ventilation*
      xii. *Treatments and/or preventions (drugs, surgery, etc.) for ALL conditions listed above*
   b. **DIGESTIVE SYSTEM:**
      i. Anatomy and functions of the digestive system
      ii. Basic anatomy of the component parts of the alimentary canal and accessory organs of digestion
      iii. Anatomy of the four layers of the wall of the alimentary canal
      iv. Comparison of the lining of the esophagus, stomach, small intestine and large intestine
      v. Compare and contrast mechanical and chemical digestion
      vi. Physiology of chemical digestion of proteins, fats and carbohydrates
      vii. Effects of exercise and obesity on the digestive system
      viii. The diseases on each level from the cell to the whole person as listed: stomach & duodenal ulcers, cancers of the digestive system, diarrhea, lactose intolerance, hepatitis, appendicitis
      ix. *Additional diseases: diverticular disease, GERD, Crohn’s Disease and celiac disease*
      x. *The function of the liver and pancreas in the digestive system, including Kupffer cell function*
      xi. *Treatments and/or prevention (drugs, surgery, etc.) for ALL conditions listed above*
   c. **IMMUNE SYSTEM:**
      i. Anatomy and functions of the immune system
      ii. Anatomy and physiology of nonspecific defense system
      iii. Anatomy and physiology of specific defense system
      iv. Physiology of the immune response and allergic reactions
      v. Role of the lymph system in immunity
      vi. Disorders: immunodeficiencies (HIV/AIDS), autoimmune diseases (multiple sclerosis, rheumatoid arthritis & Grave’s Disease), and hypersensitivities (contact dermatitis)
      vii. *Types of Organ Transplants and Prevention of Rejection (allograft and autograft)*
      viii. *Additional disorder: systemic lupus erythematosus and psoriatic arthritis*
      ix. *Treatments and/or prevention for ALL conditions listed above*
4. **SCORING:** High score wins. Selected questions will be used to break ties.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the 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, quickly travels a specified distance, and stops as close as possible to the Finish Point.

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

2. **EVENT PARAMETERS:**
   a. Participants must bring a vehicle, batteries, additional/spare parts, and a practice log; all of which will be impounded.
   b. Participants may bring tools, measuring devices, and a calculator of any type **dedicated to computation**; which will not be impounded.

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 without straying from the track's center. 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. Teams will have the same Target Distance.
   b. Electrical energy used by the vehicle for any purpose, including propulsion, must be stored in a maximum of 8 (eight) AA 1.5-volt common, commercially available batteries, as labeled by the manufacturer. Rechargeable batteries are allowed. Batteries need not be installed until immediately prior to the run. All sources of energy shall be in a location as to be available for inspection by the event supervisor.
   c. Any battery containing lithium and lead acid batteries are prohibited. Teams using these batteries will not be permitted to run and will receive only participation points.
   d. All energy for propulsion must be electric and come from the batteries. Any non-propulsive functions (ex: 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.
   e. Participants may purchase or make components (e.g., motors, gearboxes, bodies, and chassis). Electrical components are limited to batteries, wires, motors, switches, resistors, potentiometers & mechanical relays.
   f. Only non-electric sighting/aiming devices may be used. They may be placed on the track and/or on the vehicle.
   g. Wheels in their entirety must fit in a 30.0 cm wide x 60.0 cm long space of any height during the entire run.
   h. A single ¼ inch or larger wooden dowel must be attached to the front end of the vehicle. The dowel must be approximately perpendicular to the floor and must be the leading part of the vehicle at all times with the exception of a dowel attachment device of no more than 2.0 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 of the Battery Buggy are allowed to contact the floor. Piece(s) detaching from the Battery Buggy (e.g., bolts, nuts, wires) and contacting the floor results in a Construction Violation.
   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. **THE COMPETITION:**
   a. The vehicle, batteries, other interchangeable parts, and practice log must be impounded before the start of the competition.
   b. Only 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 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 finish lines. They must 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. The event supervisor must approve substances applied to the vehicle prior to use. These substances must not damage the floor or leave residue on the track and/or event area. During their 8-minute time, participants may clean the track but the track must remain dry at all times.
      iv. Participants must place the tip of the vehicle's Measurement Point on the Starting Point and align the vehicle. Sighting and aligning devices placed on the track are permitted but must be removed before the run. Non-electric vehicle-mounted sighting and aligning devices may be removed at the participants' discretion prior to each run. Participants must start the vehicle using any part of an unsharpened #2 pencil

with an unused eraser, supplied by the event supervisor, 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. The entire vehicle, including batteries, must move forward together. A run occurs if the vehicle moves after the switch is actuated.

v. 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 must not be given additional time.

d. 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.

e. Once the vehicle begins a run, the participants must wait until called by the event supervisor to retrieve it. The 8-minute time resumes once participants pick up their vehicle or begin to make measurements.

f. Competition Violations would include participants following the vehicle down the track or the vehicle passes the 0.5 m Line but stops before the 8.50 m Line.

g. 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 doesn't reach the 0.50 m Line), the vehicle runs backward at the start of its run, or a run doesn't start in the 8-minute time.

h. Teams who wish to file an appeal must leave their vehicle with the event supervisor.

i. The supervisor will review with teams the data and penalties recorded on the scoresheet.

5. **THE TRACK:**

a. The track will be on a smooth, level, and hard surface with space on each side of the track's center and beyond the finish line to allow for error in the vehicle's path. The track width should be at least 1 m and need not be marked.

b. The event supervisor will use approximately 5 cm by 2.5 cm (2 in. x 1 in.) pieces of tape to mark the Start and Finish Lines with the Start and Finish Point marked in the center of each line. The distance between the Start and Finish Points will be measured to within 0.1 cm of the Target Distance. The event supervisor will also use 2.5 cm (1 in.) tape to define the Center Line, the 0.5 m Line, and the 8.5 m Line.

c. A Photogate timing system is highly recommended. See www.soinc.org for information. 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. If a photogate system is used, a minimum of a single manual timer must be used as a backup. If no photogate system is available, it is recommended that two lasers and three timers be used with the middle time being official.

6. **PRACTICE LOG:**

Teams must record at least 10 practice runs with at least 3 parameters, which must include distance, time, and any additional parameter (e.g., wheel turns for braking, distance from Target). Logs will be impounded and returned.

7. **SCORING:**

a. Low score wins. The Final Score is the better of the two Run Scores; negative scores are possible.

b. Each Run Score is the sum of three (3) components: Time Score, Distance Score, and Center Line Bonus.

c. The Time Score is the Run Time x 2.

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 x 4.

e. A Center Line Bonus of –25 points will be awarded if the center tape remains completely within the vehicle's widest wheelbase while the vehicle travels between the Starting Point and the Target Point. The Bonus will still be awarded even if the vehicle veers off the center tape after the widest wheelbase of the vehicle passes the Target Point.

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.

g. A Competition Violation will incur a Penalty of 1000 points per occurrence (max. of 4000 points).

h. A Construction Violation will incur a Penalty of 5000 points per occurrence (max. of 15000 pts).

i. A vehicle which was not impounded during the Impound Period will incur a Penalty of 10000 points.

j. Ties in a scored run will be broken by: (1) the lower Distance Score; (2) the lower Time Score; (3) the lower score of the other run.

k. Teams who cannot complete a run within the allotted 8 minutes or have 2 failed runs will be given participation points.

l. Scoring Example: The vehicle traveled for 8.53 seconds and came to rest 10.4 cm from the center of the Finish Point. The tape remained within the vehicle's track during the run.

Time Score	8.53 x 2 =	17.06 pts.
Distance Score	10.4 x 4 =	41.60 pts.
Center Line Bonus		-25.00 pts.
Run Score		34.66 pts.

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

CRIME BUSTERS

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

1. **DESCRIPTION:** Given a scenario, a collection of evidence, and possible suspects, students will perform a series of tests that 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 a lab kit containing only these items:
      i. Test tubes (brushes & racks), spot plates, well plates, reaction plates, **beakers,** or similar small containers for mixing
      ii. Something for scooping & stirring
      iii. pH paper
      iv. Magnet(s)
      v. Hand lens(es)
      vi. Microscope slides and cover slips
      vii. Forceps or tweezers
      viii. Paper towels
      ix. Pipettes or Droppers
      x. **10 ml and 25 ml graduated cylinders**
      xi. **9V or less conductivity meter**

      Note: Teams not bringing these items will be at a disadvantage. The supervisor will not provide them.
   b. In addition to their kit, each team may bring **writing utensils** and five 8.5” x 11” sheets of paper that may contain information on both sides in any form and from any source. Other items not listed, including calculators are prohibited. The event supervisors will check each team’s kit, confiscate non-allowed items, and have the right to penalize the team up to 10% if additional items are in the kit.
   c. 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.
   d. **The event supervisor will provide**:
      i. Iodine reagent (KI solution)
      ii. 1 M HCl
      iii. Chromatography materials plus containers
      iv. Waste container(s)
      v. Wash bottle with no more than 250 mL of distilled water
   e. **The event 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 3d.	Part 3e.	Part 3f.	Part 3g.
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**: Students 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 2 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:** Students will demonstrate their skill in analyzing evidence from a variety of sources such as:
   i. **Hair** - the difference between human, dog, cat, not specific kinds of hair.
   ii. **Fibers** - the difference between animal, vegetable, synthetic, not specific kinds of fibers.
   iii. **Recyclable Plastics** – the difference between PETE, HDPE, non-expanded PS, LDPE, PP, PVC, PMMA. Burn tests will not be conducted but burn results may be provided.
e. **Paper Chromatography**: Students 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:** Students will also demonstrate their skill in analyzing evidence from a variety of other sources such as:
   i. **Fingerprints**: Students may be asked to identify different patterns on fingerprint evidence such as the difference between whorls, loops, and arches.
   ii. **DNA evidence**: Students may be asked to compare DNA chromatograms/electropherograms from materials found at the scene to those of the suspects.
   iii. **Shoeprints & tire treads**: Students 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**: Students 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**: Students 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. **<u>SCORING</u>:**
   a. High score wins. Time will not be used for scoring.
   b. The score will be composed of the following elements (percentages given are approximate): 3.c. = 50%, 3.d. = 10%, 3.e. = 5%, 3.f. = 10%, and 3.g. = 25%. Actual point values will be shown at each question.
   c. First tiebreaker is the score for Part 3.g. Second tiebreaker is the score for Part 3.c. Third tiebreaker is the score for Part 3.d.
   d. A penalty of up to 10% may be given if a team's work area is not cleaned up as instructed by the event supervisor.
   e. **A penalty of up to 10% may be given if a team's kit contains prohibited items.**

<u>Recommended Resources</u>: 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.

DISEASE DETECTIVES

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

1. **<u>DESCRIPTION</u>:** Participants will use their investigative skills in the scientific study of disease, injury, health, and disability in populations or groups of people with a focus on Food Borne Illness.

   <u>A TEAM OF UP TO</u>: 2 **<u>APPROXIMATE TIME</u>:** 50 minutes

2. **<u>EVENT PARAMETERS</u>:** 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 **calculators of any type dedicated to computation**.

3. **<u>THE COMPETITION</u>:**
   a. This event combines a basic understanding of biological and physical agents that cause disease with an ability to analyze, interpret, evaluate and draw conclusions from simple data and communicate results to peers. Participants should be able to distinguish between infectious and non-infectious health burdens.
   b. A broad definition of health will be used for this event. Potential topics include health and illnesses (mental, physical, infectious, chronic, environmental, societal, genetic, injuries and health behaviors).
   c. The event format may be exam-based, station-based or a combination of both.
   d. The level of questioning for B/C competitions should reflect the age-appropriateness for the two groups.
   e. This event will include questions based on:
      i. Study design and data collection, creating graphic displays of data, interpreting trends and patterns of epidemiologic data and communicating results.
      ii. **Division C only** (<10% of test): May include recognizing and accounting for potential sources of error, direct and indirect rate adjustment, stratified analysis (e.g., Mantel-Haenszel test) and use of statistical methods to describe data and test hypothesis involving qualitative and quantitative data.
   f. Participants will be given one or more descriptions of public health problems and be expected to:
      i. Generate hypotheses and recognize various fundamental study designs.
      ii. Evaluate the data by calculating and comparing simple rates and proportions.
      iii. Identify patterns, trends and possible modes of transmission, sources or risk factors.
      iv. Recognize factors such as study design/biases that influence results; **this will be emphasized more for Division C and less so for Division B**.
      v. Propose interventions based on promoting positive health behaviors, eliminating or reducing risks of environmental exposures, or disrupting clearly identifiable chains of transmission.
      vi. Translate results/findings into a public health/prevention message for identified populations at risk.
   g. Participants will also be expected to:
      i. Define basic epidemiological and public health terms (e.g., outbreak, epidemic, pandemic, surveillance, risk, vector, fomite, zoonosis, etc.).
      ii. Recognize various categories of disease causing agents & give examples of illnesses caused by each.
      iii. Recognize and understand differences among the major groups of infectious agents (e.g., viruses, bacteria, protistans, fungi and animals).
      iv. Recognize examples of various epidemiologic and public health phenomena such as types of outbreaks and modes of transmission.
   h. Calculations and mathematical manipulations will be part of the competition. Data may be contrived or modified to make it appropriate for the age group as long as it does not radically alter results or interpretation.
   i. Process skills may include hypothesis, observations, inferences, predictions, variable analysis, data analysis, calculations, and conclusions.
   j. Sample Problems and Resources may be found at www.soinc.org

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

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

THIS EVENT IS SPONSORED BY
THE U.S. CENTERS FOR DISEASE CONTROL AND PREVENTION

DYNAMIC PLANET

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

1. **DESCRIPTION:** Participants will demonstrate an understanding of the large-scale processes affecting the structure of Earth's crust.

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

2. **EVENT PARAMETERS:** Each team may bring four 8.5" x 11" sheets of paper that may contain information on both sides in any form and from any source. Each team may bring two non-programmable, non-graphing calculators **dedicated to computation** to use during the event.

3. **THE COMPETITION:** Participants will be given one or more tasks presented as an exam and/or timed stations. An emphasis will be placed on the interconnectivity of Earth's processes **in relation to global and environmental changes in the past, present, and future**. Topics will include the following:
   a. History of the theory of plate tectonics, including key scientists.
   b. Identification of Earth's layers - crust, lithosphere, mantle, asthenosphere.
   c. Driving forces of plate tectonics, types of plates, boundaries and margins.
   d. Types of tectonic basins, processes that form them, and the nature of the sedimentary record for each.
   e. Plate movement and impacts of plate movement - Wilson Cycle, terranes, orogenic belts, past supercontinents, convergence, divergence, transform motion, and associated faults.
   f. Continental drift's role on opening and closure of ocean gateways and land-bridges, with specific reference to ocean circulation changes, climate changes, and biotic migrations.
   g. Isostatic adjustments - plate thickness, and the impact of mass wasting and glaciation. Hypsometry and the elevation/depth of continental and oceanic crust.
   h. Recognition of natural hazards due to plate tectonics, and their mitigation.
   i. Magma formation - geological settings, chemistry, and properties.
   j. Geologic history of North America: Evolution of the North American craton, Rocky Mountains, Appalachian Mountains and Yellowstone Hot Spot.
   k. Interpretation of geophysical data to understand plate tectonics including brittle and ductile deformation in rocks, magnetic anomalies, gravity anomalies, stress, and seismicity.
   l. Geophysical tools to obtain data to interpret physical structure of the Earth.
   m. Geological settings of ores, hydrothermals, hydrocarbons in relation to tectonic processes and features.

4. **SAMPLE QUESTIONS/TASKS:**
   a. Using maps and available datasets, plot the horizontal movement of lithospheric features and respond to interpretative questions, including calculations.
   b. Using a paleogeographic reconstruction of the late Cretaceous identify the location of major plate boundaries represented (https://deeptimemaps.com/).
   c. Deconstruct geological event histories from cross sections and block diagrams.
   d. Interpret expression of Earth's surface features from topographic/bathymetric maps and satellite data.
   e. Given a rate of loading or unloading of ice sheets, estimate vertical lithospheric movement due to isostatic adjustments.
   f. Interpretation of magnetic and gravity anomalies to infer subsurface geological features.

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

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

ECOLOGY

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

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

   A TEAM OF UP TO: 2 **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 non-programmable, non-graphing calculators **dedicated to computation**.

3. **THE COMPETITION:**
   This event will be composed of three sections of approximately equal point value. The event will emphasize these process skills as they apply to ecology: defining variables; analyzing data from graphs and tables; presenting data in graphs and tables; forming hypotheses; making calculations and predictions. If stations are used, students will spend the same amount of time at each station.
   a. Part 1: Review of the General Principles of Ecology
      i. General Principles of Ecology: food webs and trophic pyramids, nutrient cycling, community interactions, population dynamics (including density dependent/independent limiting factors, carrying capacity, doubling time, exponential/logistical growth and how to calculate population growth), extinction, selection, and migration.
      ii. **Divisions B & C: Invitationals, Regionals, & State:** The general ecological principles should focus on local and regional ecology
      iii. **Divisions B & C: State and Nationals**: life history strategies (e.g., age structure, survival curves, life tables, succession, R and K strategies)
   b. Part 2: Terrestrial Ecosystems
      i. **Ecology of the Deserts and Grasslands**
      ii. Understand basic concepts of biodiversity
      iii. **Divisions B & C: State and Nationals**: Understand terminology and be able to calculate biodiversity of sample data - species richness, Simpson index, Shannon-Wiener index
      iv. **Divisions B & C: State and Nationals**: Be able to apply knowledge of biodiversity - plot maps, simulations of selection effects on populations
   c. Part 3: Human Impact on Ecosystems
      i. Topics such as climate change, invasive species, acid rain, erosion, and pollution
      ii. The pros and cons of using alternative energy and its effect on the environment
      iii. Understand what the goals of conservation biology are and how they can be obtained
      iv. Reclamation of disturbed areas versus reintroduction of species
      v. **Division C only: State and Nationals**: Be able to answer questions pertaining to case studies

4. **SAMPLE QUESTIONS:**
   Division B:
   a. From the description of community interactions, create a food web. Then predict what would happen to the food web if the primary producers were greatly reduced in number by a disease.
   b. Given a description of the interaction between two species, identify the type of community interaction.
   c. Provide three reasons how a grassland is different than a desert.
   d. Compare a grassland with a desert. What kinds of adaptations may be common in both environments? How are the organisms in each environment adapted for the rates of nutrient recycling that you would expect to find?
   Division C:
   e. Given a complex food web, create a trophic pyramid and determine the amount of energy in each level when given a quantity of energy entering the producer level.
   f. Students are given a graph depicting the changes in two interacting populations of different species in a habitat. Predict which population is the predator and which is the prey. Give reasons for your choices.
   g. Determine the population growth rate for an area given r (rate of increase) and N (number of individuals).
   h. Students are given three age structures and asked to determine which population has the highest birth rate, death rate, doubling time, and mean age.

5. **SCORING:** Questions will be assigned point values. High score wins. Ties will be broken by pre-determined tiebreaker questions.

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

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 participants' ability to design, conduct, and report the findings of an experiment actually conducted 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. **Each Division B team** may bring a timepiece, **one linear measuring device,** and a **non-programmable non-graphing calculator dedicated to computation**.
   c. **Each Division C team** may bring a timepiece, **one linear measuring device,** and a **dedicated calculator of any kind dedicated to computation**.
   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 an outline, based on **the Experimental Design Checklist posted on the event page at www.soinc.org, to follow when** recording their experiment along with additional paper to record data, graphs and procedure.

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. **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.
   c. 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.
   b. Scoring will be done using the **Experimental Design Checklist** found on the Science Olympiad website (www.soinc.org).
   c. 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**.
   d. 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
      iv. Graph
      v. Data Table
   e. Any participant not following proper safety procedures will be asked to leave the room and will be disqualified from the event.
   f. Any team not addressing the assigned question or topic area will be ranked behind those who do address the assigned question.
   g. Any team not conducting an experiment (i.e., preforming a dry lab) will be ranked behind those who do conduct an experiment.

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.

FAST FACTS

SCIENCE OLYMPIAD

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

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

   A TEAM OF UP TO: 2 **APPROXIMATE TIME**: 50 min.

2. **EVENT PARAMETERS**:
   a. **The participants do not bring anything with them to this event.**
   b. The event supervisor will provide scoresheets **and writing utensils for use during the event**.

3. **THE COMPETITION:**
   a. Each competition will consist of 3 rounds. Each round will begin with the supervisor giving each team the same scoresheet that contains a grid which has 5 different science categories listed along the horizontal axis and 5 different letters listed along the vertical axis. The supervisor will determine the categories and letters to be used in each round.
      i. **Categories will be age appropriate and aligned with grade level science standards.**
      ii. **Categories will not be repeated within a grid or among the three grids used at a competition.**
      iii. **Letters will not be repeated within a grid but may be used in subsequent grids.**
      iv. **Selected letters should have a possible answer for each category in a grid**.
   b. Participants will have 6 minutes to complete each round. Participants will write a term, corresponding to the given category and beginning with the given letter, in each of the 25 boxes of the grid. At the end of 6 min. the event supervisor will stop the round. For each round, all students should start and stop writing at the same time as directed by the event supervisor. Participants beginning before/after the supervisor starts/stops the round will have their scoresheet not scored for that round.
   c. Participants are to write requested team identification information on their scoresheet for each round. Score sheets without requested team identification information will not be scored; resulting in that score sheet not being added to the final score.
   d. At the end of each round the supervisor will pick up all scoresheets, then distribute a new scoresheet to each team. This will be repeated for each of the 3 rounds.
   e. Names of the categories must not be used in the answer.
   f. If a correct response has more than one word, the 1st letter of the first word will be used (e.g., "D" is the 1st letter of the Doppler Effect); Exceptions: The 1st letter of a word following the articles "the" or "a/an" will be considered the 1st letter of the term (e.g., "G" is the 1st letter for the term "The Grand Canyon").
   g. If the category asks for the name of a person, the first letter of the surname (last) must match the required letter (e.g., "D" - Charles Darwin, "C" - Marie Curie) and both the given (first) and surname must be written.
   h. Participants will be given credit for all unique forms of a response within a category. Participants may not use the broader term attached to a unique response as a valid answer within the same category. **(e.g., Category: "Flightless Birds", Letters - "E", 'K", and "P" and the participants write emperor penguin, king penguin, penguin. The terms emperor penguin and king penguin are unique subsets of penguin so the participants would receive credit for emperor penguin, king penguin but not penguin.)**
   i. Incorrect spellings of the word will be allowed if the supervisor is able to determine the intended term. However, the first letter of the response must be correct (e.g., "Krust" would not be allowed for the letter "C" and "Krust" would not count for the letter "K" as the correct spelling is "crust"). All words must be found in an English based science dictionary such as www.thesciencedictionary.com. Abbreviations are not allowed.

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

One correct term in a row =	1 pt.	One correct term in a column =	1 pt.
Two correct terms in a row =	4 pts.	Two correct terms in a column =	4 pts.
Three correct terms in a row =	9 pts.	Three correct terms in a column =	9 pts.
Four correct terms in a row =	16 pts.	Four correct terms in a column =	16 pts.
Five correct terms in a row =	25 pts.	Five correct terms in a column =	25 pts.

   b. The round score will be determined by adding the scores from each of the rows and columns. Final score will be determined by adding all of the round scores. Highest total score wins.
   c. Tiebreakers will be determined by the following sequence: i.) Highest individual round score; ii.) Second highest individual round score; iii.) Total columns/rows with 5 correct; iv.) Most columns/rows with 4 correct; v.) Most columns/rows with 3 correct; vi.) Most columns/rows with 2 correct.

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.

HERPETOLOGY

1. **DESCRIPTION:** This event will test knowledge of amphibians and reptiles.

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

2. **EVENT PARAMETERS:**
   Each team may bring one Official National List along with one commercially produced field guide, which may be annotated and tabbed, or one three-ring binder of any size containing information in any form and from any source attached using the available rings. The information may be removed during the event.

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 and 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, class, sounds and biogeography.
   e. States may have a modified state or regional list which will be posted on the state website no later than November 1st.
   f. No more than 50% of the competition will require giving common or scientific names (class, order or genus as indicated on the Official List).
   g. The questions will be distributed between amphibians and reptiles with an emphasis placed on turtles and snakes with fewer questions on crocodilians.
   h. The National competition will be based on the Official National Herpetology List.

4. **SAMPLE ACTIVITIES:**

   a. Identify the order, family, and genus of the provided sample.
   b. Based on the dental structure of this organism, predict the type of food this organism eats.
   c. What conclusion can be drawn about the habitat(s) of the given specimens?
   d. Which of these animals does not fit within this family?
   e. What unique anatomical feature distinguishes the animal shown in the picture?
   f. Compare and contrast a crocodile with an alligator.

5. **SCORING:** High score wins. Selected questions may be used as tie-breakers.

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

HOVERCRAFT

SCIENCE OLYMPIAD

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

1. **DESCRIPTION:** Participants will be tested on their knowledge of classical mechanics and related topics as well as their ability to construct a self-propelled air-levitated vehicle that moves down a track.
   A TEAM OF UP TO: 2 **EYE PROTECTION:** B **IMPOUND:** Yes **APPROX. TIME:** 50 minutes
2. **EVENT PARAMETERS:**
   a. **Each team may bring one three-ring binder of any size containing information in any form and from any source attached using the available rings. The information may be removed during the written test portion of the event.**
   b. Participants may bring writing utensils and **two calculators of any type dedicated to computation** for use during any part of the event.
   c. The vehicle, **as well as any graphs/tables submitted**, must be labeled with the team name and tournament specific team number and must be impounded. **Bonus points are given for vehicles impounded in a box.** Tools, supplies, **and three-ring binders** do not need to be impounded.
   d. **Prior to competition, teams must calibrate their device by preparing graphs and/or tables showing the relationship between time and distance for various device configurations. A labeled device picture or 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 must be on a separate sheet of paper. 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.**
   e. Participants must wear eye protection during Part II. Participants without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows.
   f. Participants must be able to answer questions regarding the design, construction, and operation of the vehicle per the Building Policy found on www.soinc.org.
3. **CONSTRUCTION:**
   a. The vehicle may be made of any material and **have any mass but must fit into a 40.0 cm x 40.0 cm x 40.0 cm box when levitated with any inflated skirt. Vehicles must not modify or damage the track.**
   b. The vehicle must levitate on a cushion of air as it moves down the track. Participants may be asked to demonstrate levitation by pushing the vehicle slightly down. If it then rises, it is levitating. Continuous contact of the inflated skirt with the base surface, occasional contact of other vehicle components with the base surface, or **any contact** with the inside edge of the side rails is permitted.
   c. The vehicle may have up to two motors each rotating one **propeller/impeller**. **All propellers/impellers, including under the device,** must have shielding **which prevents a 3/8” dowel from touching them.**
   d. **For timing purposes,** the vehicle must have a 1/4” or larger dowel vertically attached within 5.0 cm of its front edge such that the top end is **at least 20.0 cm** above the lowest vehicle surface.
   e. **The vehicle may carry a mass consisting of up to 16 standard, unopened rolls of U.S. pennies provided by the event supervisor (50 pennies per roll, mass ≅ 125 g; 16 rolls ≅ 2 kg).**
   f. Commercial batteries, **including rechargeables**, not exceeding 9.0 V as labeled, may be used to energize the motors on the vehicle. Multiple batteries may be connected together as long as the expected voltage across any points does not exceed 9.0 V as calculated by their labels. The vehicle must not have any other energy sources. **Batteries containing lithium or lead are prohibited. Battery use must follow the Battery Policy at www.soinc.org.**
   g. **Electrical components shall be limited to batteries, wires, motors, switches, resistors, potentiometers, capacitors, mechanical relays, fans, and blowers.** Brushless motors and integrated circuits are **not permitted unless they are an integral part of or embedded into commercially available fans used for cooling electronics or computers.**
   h. Vehicles must have a switch to permit safe starting. **Relying on inserting batteries or twisting wires together to start is not allowed. A stopping system is recommended.**
4. **THE COMPETITION:**
   Part I: Written Test
   a. **Teams will be given a minimum of 20 minutes to complete a written test consisting of multiple choice, true-false, completion, or calculation questions/problems.**
   b. The **written test will** consist of at least five questions from each of the following areas:
      i. Newton’s Laws of Motion: inertia, force, impulse, action-reaction
      ii. Kinematics: projectile velocity, speed, acceleration, position
      iii. Kinetic energy: calculation, momentum, non-relativistic
      iv. ***Division C only - Fluid mechanics: density, buoyancy, viscosity, Bernoulli’s principle, Pascal’s law***
   c. Unless otherwise requested, answers must be in metric units with appropriate significant figures.
   Part II: Vehicle Testing
   d. Teams have a total of 8 minutes to adjust and repair their vehicle and make 5 failed or 2 successful runs; whichever comes first. Supervisors will give a warning at 7 minutes. **Practice runs are not allowed.**

e. A failed run occurs if a vehicle does not meet construction specifications when timing for that run starts, fails to move for 3 seconds at any time, fails to cross the finish line within **45 seconds**, or any part of the vehicle, **including pennies**, falls off. **Teams are not allowed to declare a run a failed run.**
f. A run will count as long as it is started before the 8-minute period has elapsed.
g. The length of the track of the timed portion is **fixed at 165.0 ± 0.5 cm for Division B and variable** between **165.0** and **260.0** cm for Division C. Supervisors will mark the distance on the track and **provide** the length (Division C only) **during the vehicle testing.** The distance will be the same for all teams.
h. The target time is **15.0 seconds.** Supervisors are encouraged to use photogates for timing **with** at least one back-up manual timer. If only manual timers are used, **two (2) lasers** and three (3) timers are recommended **with the middle value being** the officially recorded time. Time is recorded in seconds to the device precision.
i. Supervisors will check vehicle specifications during impound or right before a team's testing period. Teams must be notified as soon as possible if a vehicle is out of spec. Teams may modify the vehicle to bring it into compliance during impound or their 8-minute testing period if time is available.
j. **Participants will be allowed to select between 0 and 16 full rolls of pennies to load on their vehicle during the testing period. The rolls of pennies must be placed on the vehicle so that they may not fall off during a run. The number of rolls used may be changed between runs.**
k. **Participants are not allowed to unroll, break, or alter the packaging of the pennies nor are they allowed to use any adhesives (e.g.; glue, tape) to affix the penny rolls to the vehicle.**
l. To begin a run, a team will place their vehicle, **including the penny load,** on the track at the start line **against the wood block placed by the supervisor. A team then activates their vehicle's motor(s).**
m. The team will give a countdown of "3, 2, 1, launch"; then the supervisor **will remove the wood block.** Timing **starts** when the vehicle's dowel crosses the start line and **stops** when it crosses the finish line.
n. The team must not touch a vehicle **after the dowel crosses the starting line** until **it** passes the finish line or the supervisor declares a failed run**. If touched, the run is successful with a TS and a MS of 0.**
o. The supervisor will review with the team the Part II data recorded on their scoresheet.
p. **A team** filing an appeal regarding Part II must leave their vehicle in the competition area.

5. **THE TRACK:**
a. The supervisor will supply **a 60.0 ± 2.5 cm wide and at least 215.0 cm long track on a non-carpeted floor or other firm base surface, such as a countertop or large board. The outside boundary of the track is composed of** beams each with a width and height of at least 30.0 mm (standard 2x4 framing studs recommended). **The supervisor will also supply** a cushioned barrier to stop vehicles **and** a small wood block to hold the vehicle at the start line. Example setups are at www.soinc.org.
b. Each beam must be securely affixed to the **floor,** base, **or each other**.
c. A start line must be marked that is at least **45.0** cm from the end of the track. The finish line must be marked (see 4.g. for location) and a cushioned barrier at least **5.0** cm **past** it must block the channel.
d. Multiple tracks, **with similar dimensions,** may be used to facilitate teams competing in a timely manner.

6. **SCORING:**
a. Final Score (FS) = **best run** MS + best run TS + ES **+ CS + IB;** maximum FS = 100. High score wins. **The MS and TS may come from different successful runs.** A scoring rubric is available at www.soinc.org.
b. Mass Score (MS) = **(# of penny rolls/maximum # of penny rolls used in a successful run across ALL teams)** x **21** points.
c. Time Score (TS) = **21 - (0.7)(abs(runtime - 15))** points. The smallest possible TS is 0.
d. Exam Score (ES): (Part I score / Highest Part I score for all teams) x **45** points.
e. **One of the submitted graphs and/or tables, selected by the event supervisor, must be scored as follows for the Chart Score (CS, max of 10 points). Partial credit may be given.**
   i. **2 points for including data spanning at least one variable range (e.g. distance, load)2 points for including at least 10 data points**
   ii. **2 points for proper labeling (e.g. title, team name, units)**
   iii. **0.5 points for each graph or table turned in (up to 2 points total as long as they are not the same)**
   iv. **2 points for a labeled device picture or diagram**
f. **Impound Bonus (IB) = 3 points if vehicle is impounded in a box labeled with team name & number.**
g. Teams without successful runs or disqualified for unsafe operation receive a TS and MS of 0. Teams still compete in Part I.
h. The number of penny rolls must be multiplied by 0.7 when calculating the MS if any CONSTRUCTION violation(s) are corrected during the Part II testing period or if the team misses impound.
i. **A team violating any COMPETITION rules during a successful run will have their TS multiplied by 0.9 when calculating the Final Score.** Rule violations during failed runs do not result in this penalty.
j. Tie Breakers: 1st - Best ES; 2nd - Best MS; 3rd - Best other successful run TS; 4th - specific test questions.

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

METEOROLOGY

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

1. **DESCRIPTION:** Participants will use scientific process skills to demonstrate an understanding of factors that influence world climate and use of models to understand/estimate impacts of different changes.
   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 Minutes

2. **EVENT PARAMETERS:**
   Each team may bring two non-programmable, non-graphing calculators **dedicated to computation** 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 tasks or questions will be from the following **climate and climate change topics**:
   a. Understanding of weather vs. climate and the parameters that define both
   b. Composition and evolution of the Earth's atmosphere:
      i. Natural and anthropogenic greenhouse gases, and their sources
      ii. Volcanic particulates, sulfate and black carbon aerosols
   c. Earth's radiative energy balance:
      i. Albedo, longwave and shortwave radiation
      ii. Interactions of radiation with atmospheric greenhouse gases and aerosols. Radiative forcing as a way of comparing impacts
      iii. Impacts of high versus low clouds on climate: shortwave and longwave cloud effects
      iv. Definition and examples of climate feedbacks that change radiative balance: Water vapor feedback, sea ice-albedo feedback
      v. Understanding how changes in greenhouse gases and aerosol change the radiative budget using online RRTM Earth energy budget model; available at http://climatemodels.uchicago.edu/rrtm/
   d. Oceanic and atmospheric circulation mechanisms that affect climate:
      i. Semi-permanent pressure cells and the three-cell model of atmospheric circulation
      ii. Thermohaline circulation and wind-driven oceanic currents, ocean heat transport
   e. Climatic zones and their causes:
      i. Understand the differences between the Köppen and Thornthwaite climate classification systems
      ii. Understand and be able to interpret climatographs, and trends and their significance
      iii. Effects of latitude, longitude and elevation (topography) on climate
      iv. Heat capacity: effects of land masses, bodies of water, soil composition and soil moisture on climate
   f. Recent climate trends:
      i. Modern temperature trends as revealed by the berkeleyearth.org dataset
      ii. Impacts of El Niño and La Niña
      iii. Sea level rise and its causes
   g. Past changes in climate:
      i. Greenhouse gas driven changes - case study of Paleo-Eocene thermal maximum
      ii. Volcanic aerosol driven changes - case study of the Tambora eruption and "Year without a Summer"
      iii. Solar driven climate changes - case study of the Faint Young Sun Hypothesis
   h. Projected changes in climate:
      i. Climate sensitivity and how it is estimated
      ii. **Representative Concentration Pathways**
      iii. Understanding and interpreting climate change projections from models

4. **SAMPLE QUESTIONS/TASKS:** a) Predict the climate zones of a hypothetical island continent given its topography, latitude, and longitude. b) Examine a climatograph & determine if this might be a climate windward or leeward of a mountain range or city. c) Draw a diagram of the elements in the sea ice-albedo feedback, including arrows and plus/minus signs to indicate direction and type. d) Use a time series from the berkeleyearth.org dataset to estimate temperature trend. e) Use the RRTM climate model or model output to estimate the size of a change in greenhouse gases required to balance a change in solar radiation.

5. **SCORING:** High score wins. Points will be awarded according to the quality and accuracy of responses, the quality of supporting reasoning, and correct use of scientific terminology. Selected questions will be used as tiebreakers.

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

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

MICROBE MISSION

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

1. **DESCRIPTION:** Teams will answer questions, solve problems, and analyze data pertaining to microbes.
   A TEAM OF UP TO: 2 **EYE PROTECTION:** C **APPROXIMATE TIME:** 50 Minutes
2. **EVENT PARAMETERS:**
   a. Participants must bring goggles.
   b. 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 and two non-programmable, non-graphing calculators **dedicated to computation**.
3. **THE COMPETITION:**
   a. Participants will apply age appropriate scientific process skills, perform simple laboratory procedures such as measurements, or use probes to collect data based on the information provided to answer the given questions, possibly at timed stations, pertaining to different types of microbes.
   b. Some questions/stations may involve the actual use of a microscope. If no microscopes are available, high quality photographs with appropriate scales may be used instead.
   c. Live specimens are limited to: baker's yeast, ciliates, amoebae, and algae. Pictures & prepared slides are appropriate for all microbial types.
   d. The competition will cover all of the following topics and not emphasize just one area such as microbial disease. Disease questions will be restricted to the 2018 Microbial Diseases on www.soinc.org. **Topics listed in *italics* will only be assessed at the National Tournament.**
      i. Different kinds of microscopes and their uses. Parts & function of the light microscopes, principles of microscopy, and magnification and field of view determination
      ii. Estimation/calculation of size based on scales in pictures or microscopic information and amount of the visual field occupied
      iii. Identification and function of nuclei, mitochondria, chloroplasts, and their possible microbial origin
      iv. Differences (e.g., size, environment, structure, prokaryotic vs. eukaryotic, etc.) among prions, viruses, bacteria, Archaea, fungi, algae and **protozoans**, and **parasitic** worms
      v. **Names for and recognition of various bacterial shapes**
      vi. Diseases caused by microbes, their treatment/prevention, **and resistance to these treatments**
      vii. **Measuring bacterial growth,** growth curves, and graph interpretation
      viii. Beneficial microbes
      ix. **Isolation of bacteria by streaking and serial dilution**
      x. **Division C only -** Gram stain uses and difference between Gram^{+} & Gram^{-}
      xi. **Division C only -** Important aspects of spores & cysts
      xii. *Causes and effects of microbial population explosions*
      xiii. *Microbial competition* ***and communication***
      xiv. ***Microbiomes***
      xv. ***Biofilms***
   e. Measurements must be made to the precision of the device.
4. **SAMPLE QUESTIONS:**
   a. Provide two differences among bacteria, viruses, and fungi.
   b. Using the following key, determine (from pictures) which cell: A, B, or C is considered an alga.
   c. Based on the following graph, determine which organism is best suited for growth in acidic environment.
   d. **What is the approximate length of an organism that takes up about half of the visual field when observed through a light microscope at 400x magnification?**
   e. Students observe a picture of a plate with different colonies on it. Based on the color of the colony, how many different kinds of organisms do you detect? Which type of organism **are** the most prevalent?
   f. From a given picture identify the organelle, its function, and to which type of microbe it is unique.
   g. What type of microbe is involved in the production of most breads?
   h. What type of microbe is responsible for polio?
   i. Based on the following graph, what will be the microbial population/ml after 3.5 hours of growth?
   j. **Given data, determine the minimum inhibitory concentration of an antibiotic.**
   k. **Compare and contrast the given microbes based on their properties**.
5. **SCORING:** High score wins. Selected questions may be used as tiebreakers.

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

THIS EVENT IS SPONSORED BY DUPONT and DUPONT PIONEER

MYSTERY ARCHITECTURE

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:**
   Each team may bring 1 pair of scissors, 1 linear measuring device, and 1 pair of pliers. 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 a tower, bridge, or cantilever. Cantilevers may only be assigned at State or National tournaments. If a cantilever is to be built, the event supervisor will designate the location of, or supply the fulcrum, and provide a counterbalance.
   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 must be provided to each team. When finished building, students must remove the load from their device. When directed by the event supervisor, the students will 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 a tower, the Primary Dimension could be measured:
      i. with no load, to the flat top of the tower,
      ii. with a load, to the top of the supplied load.
   b. For a bridge, the Primary Dimension could be measured between the closest inside supports. If the bridge fails to support the load, the Primary Dimension will be measured from the point of contact to the farther inside support.
   c. 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.

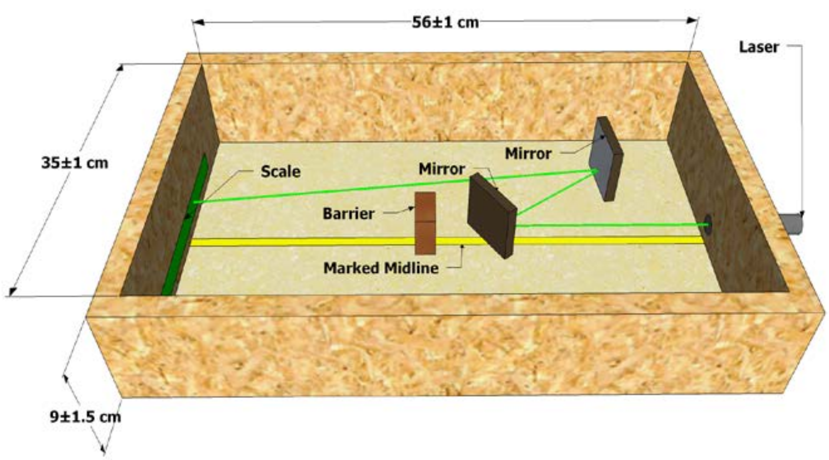
5. **SCORING:**
   a. Highest or lowest score wins depending on construction instructions.
   b. The Primary and Secondary Dimensions will be measured in cm to the nearest 0.1 cm by the Event Supervisor. Devices requiring a load will be measured both prior to and after placement of the load and after the duration time, if successfully held.
   c. Devices with no load requirements will be ranked in order of Primary Dimensions as per construction 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 which do not support the load will be ranked by Primary Dimensions as measured before the placement of the load. Not supporting the load is defined as the load or its underlying material making contact with the table or inability of the event supervisor to measure the height due to movement 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.

OPTICS

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

1. **DESCRIPTION**: Teams participate in an activity involving positioning mirrors to direct a laser beam towards a target and are tested on their knowledge of geometric and physical optics.
   A TEAM OF UP TO: 2 **EYE PROTECTION**: None Required **APPROX. TIME**: 50 Minutes
2. **EVENT PARAMETERS**:
   a. Each team may bring one three-ring binder of any size containing information in any form and from any source attached using the available rings; which may be removed during the event.
   b. Participants may bring any measuring tools, premade templates, writing utensils and two calculators of any type **dedicated to computation** for use during any part of the competition.
   c. Participants must not bring lasers or mirrors.
3. **LASER SHOOT SETUP**:
   a. Example setups are available on the event page at www.soinc.org.
   b. The event supervisor will provide the Laser Shoot Setup (LSS), including laser, mirrors and barriers.
   c. The LSS has a horizontal flat surface 56 ± 1.0 cm by 35 ± 1.0 cm enclosed by a 2 ± 0.5 cm thick wall. The bottom surface may be a table top. **A black surface with a ferrous metal component to which magnets will adhere is recommended. Directions and resources on how to retrofit an existing LSS can be found at www.soinc.org.** The height of the wall above the surface is 9 ± 1.5 cm.
   d. Five moveable flat mirrors with a width of 5.0 – 8.0 cm must be placed in the LSS and must be **front-surface mirrors or back-surface mirrors 1/16 of an inch or less thick.** Each mirror must be mounted so that it stands vertically (~90 degree angle to the bottom surface), does not have excess mounting material on its sides, has its approximate center at the level of the laser beam and can be easily relocated anywhere in the LSS by the participants. **In order to facilitate measurements by competitors, no part of the mirror support may extend in front of the reflective surface.** The mirror faces must initially be covered with a cardboard sleeve or other easily removable non-reflecting, opaque material. **The mirrors may have magnets affixed to them to secure them in place on a ferrous metal bottom surface of the LSS.**



   e. A laser is mounted through the approximate center of one of the 35 cm walls at a height of 1.5 - 6.0 cm above the bottom surface. The laser must be securely mounted such that it cannot be moved and the beam is perpendicular to the wall through which it is mounted. The laser must remain fixed throughout the entire event. The Laser Policy on www.soinc.org must be followed.
   f. A midline is drawn on the LSS from a point directly below the emitting tip of the laser to a point directly below the center of the laser beam where it strikes the opposite wall.
   g. A metric scale with a resolution of at least 1 mm must be attached horizontally to the other 35 cm wall at the level at which the laser strikes. One of the marks on the scale is the Target Point. A sheet of paper must be also fastened to the wall, with a mark on the paper indicating the Target Point location.
   h. The barrier(s) must have a width of 2.0 - 8.0 cm and be tall enough to block the laser beam. They must be fixed in the same position and orientation in the LSS for all teams. The barrier(s) must have a mirror similar to the others attached to one side and covered similarly.
   i. **For Division B only,** a barrier must be placed somewhere along the midline to block the laser beam (non-perpendicular angles permitted).
   j. **For Division C only, three barriers must be placed in the LSS. One will be** somewhere along the midline to block the laser beam (non-perpendicular angles permitted). **The other two will be placed elsewhere in the LSS.**
4. **THE COMPETITION**:
   Part I: Written Test
   a. **Teams will be given a minimum of 20 minutes to complete a written test consisting of multiple choice, true-false, completion, or calculation questions/problems.**
   b. The competition will consist of at least two questions from each of the following areas. **Topics in *italics* are for Division C only and will be exclusively assessed at State and National Tournaments**.

i. Law of reflection: specular, diffuse
ii. Refraction: index of refraction
iii. Prism: deviation, dispersion
iv. Convex, concave, and **plane** mirrors: ray tracing, focal length, real object, images (real/virtual, erect/inverted, magnification)
v. Convex and concave lenses: ray tracing, focal length, real object, images (real/virtual, erect/inverted, magnification)
vi. Operating principles of optical equipment: microscopes, telescopes, cameras, glasses
vii. Visible spectrum: primary/secondary colors, additive/subtractive, absorption/reflection
viii. Structure and function of the parts of the human eye **that produce images and color perception**
ix. Polarization of light using polarizing films or by scattering
x. Optical absorption spectra: films, chemicals, dyes
xi. *Ray tracing **off** two perpendicular or parallel plane mirrors: corner reflector, periscope*
xii. *Ray tracing or measurement to find the focal length of a lens system: real and virtual objects and images (erect/inverted, magnification)*
xiii. *Lasers: theory of operation, difference between coherent and non-coherent light*

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

Part II: Laser Shoot

d. The objective is to reflect a laser beam with mirrors around barriers towards the Target Point.
e. **The event supervisor will select a Target Point location and home position for the mirror(s) that is the same for all teams. Teams will be informed of the Target Point when it is their turn to compete in Part II.**
f. All mirrors **will** be placed in the **designated** home position before each team is permitted to see the LSS.
g. **The supervisor will demonstrate the beam's alignment before each team begins their laser shoot.**
h. When a team is ready to begin, the event supervisor **will** give a countdown of "3, 2, 1 start" and **then** start a timer. Event Supervisors **will** give teams a warning when 3 minutes have elapsed.
i. Participants must make all measurements, calculations, and mirror placements/alignments within a 4-minute time period. Participants may choose to use between 1 and 5 moveable mirrors.
j. Timing stops when 4 minutes have elapsed or the **participants intentionally** remove the material covering the face of one mirror. Participants must not make any additional adjustments to the mirrors other than to remove the other mirror and **barrier** coverings**.** The supervisor must not remove coverings.
k. Participants must not mark on or modify the LSS **nor adjust/move the barrier(s) position.**
l. Participants must not touch the laser or change its orientation and/or position.
m. The laser must not be turned on until timing stops. Once turned on, the event supervisor must mark on the paper mounted above the metric scale where the laser strikes it to record the results. **Only the intended, normally reflected, path of the laser will be counted (e.g. secondary beams due to beam splitting or halos must be ignored).** Participant tools/templates may remain on the LSS during this process.
n. Multiple LSS's may be used to facilitate all teams being able to compete in a timely manner.
o. The supervisor will review with the team the data recorded for Part II on their scoresheet.

5. **SCORING:**

a. A scoring rubric is available on the event page on www.soinc.org.
b. Final Score (FS) = TS + MS + AS + BS. The maximum possible FS is 100 points. High score wins.
c. Test Score (TS) = (Part I score / Highest Part I score of all teams) x **60 points**
d. Mirrors Score (MS) = # moveable mirrors the laser reflects off of x **2 points**. The max possible MS is **10**.
e. Accuracy Score (AS) = (**15** – (accuracy (in mm)/10)) points. The smallest possible AS is 0.
f. **Accuracy** is the horizontal distance from the Target Point to the center of where the laser strikes on **the 35 cm Target Wall**. If the laser strikes another wall, accuracy is the sum of the straight-line measurements from the Target Point to the corner along one wall and along the other wall from the corner to the laser dot. **If the laser does not strike a wall, AS is 0, but the MS and BS are calculated.**
g. **Division B -** Barrier Score (BS) = **15 points** if the laser reflects off the barrier mirror
h. **Division C - Barrier Score (BS) = # of barrier mirrors the laser reflects off of x 5 pts; max pts. possible is 15.**
i. Teams disqualified for unsafe operation receive an AS, MS and BS of 0**, but still compete in Part I.**
j. **Violations of rules in the COMPETITION section result in the AS, MS, and BS being multiplied by 0.9 when calculating the Final Score.**
k. **Ties are broken using test question(s) designated by the supervisor at the start of the competition.**

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

THIS EVENT IS SPONSORED BY CREOL, THE COLLEGE OF OPTICS AND PHOTONICS, UNIVERSITY OF CENTRAL FLORIDA, SPIE, AND THE OSA FOUNDATION

POTIONS & POISONS

SCIENCE OLYMPIAD

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 Team may bring a lab kit containing only these items:
      i. Test tubes (brushes & racks), spot plates, well plates, reaction plates, beakers, or similar small containers for mixing
      ii. Something for scooping & stirring
      iii. pH paper, Hydrion paper
      iv. Magnet(s)
      v. Hand lens(es)
      vi. Microscope slides and cover slips
      vii. Forceps or tweezers
      viii. Paper towels
      ix. Pipettes or Droppers
      x. 10 ml and 25 ml graduated cylinders
      xi. 9V or less conductivity meter

      Note: Teams not bringing these items will be at a disadvantage. The supervisor will not provide them.
   b. In addition, each team may bring writing utensils, two calculators of any type dedicated to computation, and five 8.5” x 11” sheets of paper that may contain information on both sides in any form and from any source. Other items not listed are prohibited. The event supervisors will check each team’s kit, confiscate non-allowed items, and have the right to penalize a team up to 10% if additional items are in the kit.
   c. 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 or longer hair must be tied back. Participants who unsafely remove their safety clothing/goggles or are observed handling any material or equipment in an unsafe manner will be penalized or disqualified.
   d. Event supervisors will provide each team with all required reagents and test solutions, any needed probes or other instrumentation, chromatography materials, and the answer sheet. The event supervisor may provide any other items or instructions deemed necessary.
3. **THE COMPETITION:**
   PART I: Written Exam
   a. This part will be a multiple-choice and short answer test covering the following topics/areas: ionic and covalent bonds; the difference between mixtures, solutions, and compounds; how to separate components of a mixture; distinguishing between physical and chemical changes; balancing a simple chemical equation; identifying various poisonous plants and animals, and their toxic effects; using a map analyze the potential patterns of spread of toxic spills in the environment via water, wind, or gravity; the effects and chemistry of common household toxins; the effect of dilution on toxicity. The test is limited to information on the following specific toxins:
      i. Household chemicals: ammonia, hydrogen peroxide, rubbing alcohol, bleach, Epsom salts, vinegar, nutritional supplements containing calcium and iron.
      ii. Toxic living organisms: Poison Ivy (*Toxicodendron radicans*), Poison Oak (*Toxicodendron diversilobum*), Death-cap mushroom *(Amanita phalloides),* Jimson weed *(Datura sp),* Mayapple *(Podophyllum peltatum),* Ongaonga *(Urtica ferox),* Cane toad (*Rhinella marina*), Pacific newt *(Taricha sp),* Brown recluse spider *(Loxosceles recluse),* and Fattail scorpion (*Androctonus australis*).
      iii. Environmental toxins: iron, arsenic, and lead.

   PART II: Lab
   b. Participants will perform at least one lab activity by themselves. Other lab activities may be performed as a demonstration, at the discretion of the event supervisor. Lab activities may include: chromatography; mixtures of reagents; separation of a mixture; serial dilutions; determination of pH; conductivity testing; observation of changes in temperature, color, production of a gas or a precipitate after reagents have been mixed together by either themselves or the supervisor; calculation of the rate of a chemical reaction or other parameters; and identification of a particular change as either a physical or chemical change.
4. **SAMPLE EXAM QUESTIONS/ACTIVITIES:**
   a. What hazardous chemical may be produced if you mix household bleach and ammonia?
   b. What are the major sources of lead which cause lead poisoning?
   c. What should you do if you find a Jimson weed plant? Why is it dangerous?
   d. You stir together sand and salt. Is this a mixture, a solution, or a compound? How might you separate the salt and sand again?
5. **SCORING:** High score wins. Test questions from Part I are worth 60% of the overall score. Lab questions from Part II are 40% of the score. Selected questions, along with the quality of free response answers, may be used as tiebreakers.

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.

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 non-programmable, non-graphing calculator **dedicated to computation**, protractor, a ruler, and other measuring devices along with one three-ring binder of any size containing a USGS Map Symbol Sheet and other information in any form and from any source, attached using the available rings. The information may be removed during the event.
   b. 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 symbol
   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 located within a one-mile PLSS square section using the correct features listed in 3.c.
   b. Participants may be asked to draw a topographic map profile.

5. **SCORING:** High score wins. Values of questions may be weighted. 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 CD and Bio/Earth Science CD; other resources are on the event page at soinc.org.

ROCKS & MINERALS

1. **DESCRIPTION:** Participants will demonstrate their knowledge of rocks and minerals.

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

2. **EVENT PARAMETERS:**

   Each team may bring one magnifying glass and one three-ring binder of any size containing information in any form and from any source **attached using the available rings; which may be removed during the event.**

3. **THE COMPETITION:**
   a. Emphasis will be placed upon task-oriented activities. Participants will move from station to station, with the length of time at each station predetermined and announced by the event supervisor. Participants may not return to stations, but may change or add information to their original responses while at other stations.
   b. Written descriptions as to how a specimen might react were it to be tested with HCl may be provided. HCl will not be used or provided.
   c. Identification will be limited to specimens appearing on the Official Science Olympiad Rock and Mineral List (see www.soinc.org), but other rocks or minerals may be used to illustrate key concepts.
   d. Tournament Directors may include up to five additional specimens important to their own state. If additional specimens are to be included, all teams must be notified no later than three weeks prior to the competition.

4. **REPRESENTATIVE TOPICS** (may include, but are not limited to):

   Minerals:
   a. Identification
   b. Properties: hardness, luster, streak, cleavage/fracture, density, etc.
   c. Classification: see list
   d. Chemical composition
   e. Mineral habit (e.g., botryoidal, hexagonal, prismatic, bladed)
   f. Methods & environments of formation
   g. Economic importance (e.g., ores, industrial uses, jewelry)

   Rocks:
   h. Identification
   i. Rock cycle
   j. Classification: sedimentary, igneous and metamorphic
   k. Environments of formation
   l. Texture and composition
   m. Bowen's reaction series
   n. Grade of metamorphism

5. **SAMPLE ACTIVITIES:**
   a. Using the materials provided, fingernails included, determine the relative hardness of each of these six minerals. List the specimens, by name and number, in order of increasing hardness.
   b. Match each metamorphic rock with the parent rock from which it may have been formed.

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

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Rocks and Minerals CD, Bio/Earth Science CD and Audubon Field Guide to Rocks and Minerals; other resources are on the event page at soinc.org. A Rocks and Minerals kit, excluding silver, gold, and diamond, may be ordered from Ward's Science Olympiad Kits (wardsci.com).

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 vehicle 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 one Roller Coaster, a track that guides a vehicle (i.e., a ball or sphere), and any number of vehicles. Only one vehicle will be used during a given run.
   b. 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 be ranked in Tier 4.
   c. 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 vehicle will travel from a Starting Line to a Finish Line in as close to the given Target Time as possible.
   b. During operation, the device dimensions can be no greater than 60.0 cm length x 60.0 cm width x 80.0 cm height.
   c. The track must not be enclosed at any point. Funnels are not allowed as they are enclosed tubes.
   d. The vehicle must be held in the ready-to-run position by a #2 pencil with an unused eraser provided by the event supervisor and is released when a participant removes the pencil from the track.
   e. The vehicle 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 vehicle travel on the track. The Start Line and Finish Line position may not be adjusted. Both Lines must be designated during impound before the target time is released.
   g. The device must include a mechanism that safely stops the vehicle after it crosses the Finish Line.
   h. Magnets, electrical, and electronic devices must not be used for any part of the Roller Coaster.
   i. 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 vehicle 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 vehicle leaves measured to the closest part of the track the vehicle lands on. The vehicle must travel completely unsupported in the air to earn bonus points. After landing the vehicle must travel at least 5 cm on the track in the direction of the jump (e.g., a gap may not end with the vehicle hitting a wall). Up to 5 distinct, clearly labeled Gaps may be included to earn bonus points. Bouncing a vehicle off a surface is not allowed to count as part of a gap.
   j. Participants must make sure their vehicles are captured after each run so they do not leave the coaster boundary. If the device is deemed unsafe it must not be allowed to run until safety concerns are resolved to the satisfaction of the event supervisor.
   k. Participants must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org.

4. **THE COMPETITION:**
   a. The Roller Coaster, vehicle(s), tools, spare parts, and data/notes must be impounded before the start of the competition.
   b. Only the participants and event supervisor will be allowed in the impound and event area. Once the participants enter the event area, they must not leave the area or receive outside assistance, materials, or communications.
   c. The exact Target Time is between 20s and 45s (in 5s intervals for regional, 2s intervals for state, and 1s 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.
   d. After retrieving their device from the Impound Area, teams will be given 8 minutes to set up their Roller Coaster and complete up to two scorable runs. Participants are responsible for leveling their Roller Coaster to account for the floor or table. Electronic levels may be used but must be removed prior to a scorable run. 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 make adjustments to their Roller Coaster (e.g., level the Roller Coasters, modify the track, etc.) before each run.
f. Participants may do 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 unused eraser of the #2 pencil they have been given on the Start line of the device. The vehicle must be placed behind the Start Line against the eraser.
h. A scorable run must be declared prior to the start of a run. Participants may not touch the device during the scorable run. The vehicle must cross the Finish Line within one (1) minute or it will be considered a Failed Run and receive a Run Score of Zero.
i. A Failed Run occurs if the time cannot be measured (e.g. it starts before the event supervisor is ready) or if the second run does not start within the 8 minutes. Additional scorable runs are not given for a Failed Run.
j. Prior to each scorable run, the event supervisor will verify that the timekeepers and participants are ready. Three (3) 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.
k. Timing begins on the word "Go" and ends when any of the following happens:
   i. The complete vehicle crosses the finish line.
   ii. One (1) minute has elapsed since the word "Go".
   iii. The vehicle travels outside the boundary of the device.
   iv. The vehicle stops moving. A vehicle may pause briefly, but if movement is not begun within 3 seconds timing is stopped.
l. Teams filing appeals must leave all impounded materials with the event supervisor.
m. The supervisor will review with teams the data recorded on their scoresheet.

5. **SCORING:**
   a. High score wins.
   b. Run Score = Height Score + Time Score + Gap Bonus
   c. Height Score = (100 – device height). The device height is measured in cm as the highest part of the device measured from the floor rounded down to the nearest cm.
   d. Time Score = 2 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 vehicle leaves measured to the closest part of the track the vehicle lands on. Points are only awarded if the vehicle successfully reaches the other side of the track.
   f. Tiers: Teams are ranked using the single run that gives them the best overall rank.
      i. Tier 1: A complete run to the finish line 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 team with a Roller Coaster not impounded during the impound period
   g. Participants who cannot start any run within the 8 minutes, have two Failed Runs, or have any unresolved safety issues are awarded participation points.
   h. Ties are broken by this sequence: i.) Biggest Gap Bonus for an individual gap, ii.) Highest Height Score, iii.) Highest Time Score, and iv.) Smallest dimensions of the device.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Roller Coaster Video 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:** Students 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. Planets: Mercury, Venus, Mars
      ii. Satellites: Earth's Moon, Phobos, Deimos, Io
      iii. Asteroid Belt and Near-Earth Asteroids

   Part II: Hands-On/Interpretive Task
   c. 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. Past, current, and planned missions to study these objects
      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:** High score wins. Each task or question will be assigned a predetermined number of points. Selected questions will be used to break ties.

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

THIS EVENT IS SPONSORED BY NASA'S UNIVERSE OF LEARNING; ASTROPHYSICS STEM LEARNING & LITERACY NETWORK

THERMODYNAMICS

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 **APPROX. TIME:** 50 Minutes

2. **EVENT PARAMETERS:**
   a. Each team may bring one three-ring binder of any size containing information in any form and from any source attached using the available rings. The information may be removed during the event. Each team may also bring tools, supplies, writing utensils, and two calculators of any type dedicated to computation for use during any part of the event. These items need not be impounded.
   b. Each team must impound: their insulating device; 2 identical, unaltered, glass or plastic, standard (height ~1.4 times the diameter) 250 mL beakers; and copies of graphs and/or tables for scoring.
   c. Event supervisors will supply the hot water, devices for transferring measured volumes from the water source to the team's beakers, ice water, thermometers, or probes (recommended). Non-contact thermometers are allowed.
   d. Prior to competition, teams must calibrate their devices by preparing graphs and/or tables showing the relationship between elapsed cooling time and ending water temperature for various quantities of water and starting water temperatures. A labeled device picture or 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 must be on a separate sheet of paper. 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.
   e. 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.
   f. Participants must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org.

3. **CONSTRUCTION:**
   a. Devices may be constructed of and contain any materials except for the following prohibited materials: asbestos, mineral wool, and/or fiberglass insulation.
   b. **For Division B,** the device must fit within a 20.0 cm x 20.0 cm x 20.0 cm cube.
   c. **For Division C,** the device must fit within a 15.0 cm x 15.0 cm x 15.0 cm cube.
   d. Within the device, participants must be able to insert and remove a beaker that they supply (see 2.b.).
   e. The device must also easily accommodate the insertion and removal of a thermometer/probe into the beaker via a hole at least 1.5 cm in diameter all the way through directly above the beaker. The top surface of the hole must be less than 12 cm above the inside bottom surface of the beaker. The hole must remain open and unobstructed during the competition.
   f. Devices will be inspected to ensure that there are no energy sources (e.g., no electrical components, small battery powered heaters, chemical reactions, etc.) to help keep the water warm. At the event supervisor's discretion, teams must disassemble their devices at the end of the testing period in order to verify the materials used in construction.
   g. 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 event supervisors must announce the temperature of the source water bath (60º to 90º C), the volume of water to be used (50 to 150 mL, in 25 mL increments at Regional competitions, 10 mL at State competitions, 1 mL at the National competition) and the amount of cooling time allowed (**Division B: 30.0 minutes; Division C: 20.0 to 40.0 minutes).** These variables will be the same for all teams**.**
   b. The event supervisor will also announce the current room temperature.
   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. Each team, in a staggered sequence, must have the set amount of water poured into each of their 2 beakers, one of which they must then insert into their device, the other must be placed on an open surface next to the device. Nothing must be placed under or immediately around the external beaker. Teams may

secure and/or close access panels with fastening materials after inserting the beaker. Event supervisors must record the time each team receives their water. Teams may utilize their own thermometers to measure the starting water temperature in their beakers.

e. Teams may elect to add up to 50 mL of water from an ice bath to their internal beaker immediately after receiving the hot water for bonus points. Each team may choose their own volume.
f. 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. They must provide the supervisors with their estimate prior to beginning part II.
g. At the end of the cooling period, the event supervisor will record the temperature in each beaker to the best precision of the available instrument. Supervisors may leave thermometers/probes in the devices and the un-insulated beakers for the entire cooling period, but will announce if they will do so before impound. Otherwise they will first insert a thermometer/probe into the un-insulated beaker, wait at least 20 seconds, and record the resulting temperature. The event supervisor will then wipe any residual water off the thermometer/probe and repeat the same process with the beaker inside of the participants' device. Multiple thermometers/probes may be used at the supervisor's discretion.
h. The supervisor will review with the team the Part I data recorded on their scoresheet.
i. Teams filing an appeal regarding Part I must leave their device in the competition area.

Part II: Written Test

j. Teams will take a test on thermodynamic concepts during the remaining time after all devices have been loaded with water. All teams will have the same amount of time to take the test.
k. Unless otherwise requested, answers must be in metric units with appropriate significant figures.
l. 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.
m. The test will consist of at least five questions from each of the following areas:
   i. Temperature scales and conversions, definitions of heat units
   ii. Thermal conductivity, heat capacity, specific heat, latent heat, phases of matter, entropy, enthalpy
   iii. Thermodynamic laws and processes (e.g. Carnot cycle and efficiency, adiabatic, isothermal)
   iv. The history of thermodynamics

5. **SCORING:**
   a. High score wins.
   b. All scoring calculations are to be done in degrees Celsius.
   c. The Final Score = TS + CS + HS + PS + IWB; a scoring spreadsheet is at www.soinc.org.
      i. Test Score (TS) = Part II score / Highest Part II score for all teams) x 45 points
      ii. Chart Score (CS) = max of 10 points
      iii. The Heat Score (HS) = (HRF / Highest HRF of all teams) x 15 points; HRF (Heat Retention Factor) = (internal beaker water temp / external beaker water temp)
      iv. Prediction Score (PS) = (PE / Highest PE of all teams) x 25 points; PE (Prediction Estimate) = (1-(abs (final internal beaker water temp - predicted internal beaker water temp) / final internal beaker water temp)). The minimum PS score possible is 0 points
      v. Ice Water Bonus (IWB) = (volume of ice water in ml /10) 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.a.
      ii. 2 points for including at least 10 data points
      iii. 2 points for proper labeling (e.g. title, team name, units)
      iv. 0.5 points for each 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 HRF, PE, and IWB values will be multiplied by 0.9 when calculating the scores.
   f. If any CONSTRUCTION violation(s) are corrected during the Part I testing period, or if the team misses impound, the HRF, PE, and IWB values will be multiplied by 0.7 when calculating the scores.
   g. Teams that are disqualified for unsafe operation or do not bring an insulating device receive zero points for their HRF, PE, and IWB scores. Teams will be allowed to compete in Part II.
   h. Tie Breakers: 1st - Best TS; 2nd - Best HS; 3rd - Best PS; 4th - Best IWB

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 ACE HARDWARE SCIENCE

TOWERS

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

1. **DESCRIPTION:** Prior to the competition, teams will design and build a Tower meeting requirements specified in these rules to achieve the highest structural efficiency.

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

2. **EVENT PARAMETERS:**
   a. Each team is allowed to enter only one Tower, 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 eye protection will not be allowed to compete and be placed in Tier 4.
   c. The Event Supervisor will provide the Test Apparatus described in **Section 5**.

3. **CONSTRUCTION PARAMETERS:**
   a. The Tower 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, commercial plywood, members formed of sawdust and adhesive. **Wood may never be painted, color enhanced, or have preprinted/paper labels affixed. Ink barcodes or markings from the construction process may be left on wood.**
      ii. There are no limits on the cross-sectional sizes of individual pieces of wood. Wood may be laminated without restriction by the team.
      iii. Adhesive is defined as a substance used to join two or more materials together. Any commercially available adhesive may be used. Adhesives include, but are not limited to: glue, cement, cyanoacrylate, epoxy, hot melt, polyurethane and super glues. Adhesive tapes are not allowed.
   b. The Tower must span a 20 cm x 20 cm opening on a Test Base (5.a.) and may be placed on the Test Base surface in any configuration such that the loading chain is suspended within 2.5 cm of the center of the opening in the Test Base. Bonus Points (6.c.) can be obtained by designing the Tower to span a 29-cm diameter circle, centered on the 20 cm x 20 cm opening of the Test Base.
   c. The Tower must support the Loading Block (5.b.i.) a minimum of 50.0 cm (Division B) or 60.0 cm (Division C) above the Test Base. There is no maximum Tower height.
   d. **The portion of the Tower more than 25.0 cm (Division B) or 20.0 cm (Division C) above the Test Base must pass through an 8.0 cm diameter opening or hole (5.f.).**
   e. The loading point on the Tower must be constructed to permit placement of the Loading Block (5.b.i.) and suspended chain (5.b.iii) on and through the Tower, to support the bucket (5.c.).
   f. The Tower must be constructed such that only the Loading Block (5.b.i.) supports the chain and bucket.
   g. The Tower may not be braced against any edge of the Test Base (5.a.) for lateral support at any time.
   h. No portion of the Tower is allowed to extend below the top surface of the Test Base (5.a.) prior to testing.
   i. Students must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org.

4. **COMPETITION:**
   a. **Check-In**
      i. **The team will measure the Tower height using provided materials** so the event supervisor can determine if it meets or exceeds the minimum Tower height (3.c.) in cm to the nearest 0.1 cm.
      ii. **The team will verify the size restriction (3.d) by passing an 8-cm diameter circular ring gauge freely over the section of the Tower and measuring to the point where the ring rests. The ring may not be forced over any tight spots. If the ring is not level when in the resting position, the measurement will be to the high point of the ring. The ring will be removed before testing.**
      iii. The team will place their Tower on the scale so the event supervisor can determine the mass, in grams to the nearest 0.01 g.
      iv. The team must submit their Estimated Load Scored (6.b.) to be used as a tie breaker (6.e.).
      v. No alterations, substitutions, or repairs may be made to the Tower after check-in for competition.
      vi. The event supervisor will verify that the combined mass of the Loading Block Assembly, bucket and sand, is at least 15,100 grams but no more than 15,200 grams prior to testing.
   b. **Testing**
      i. Once participants enter the event area to compete, they must not leave or receive outside assistance, materials, or communication until they are finished competing.
      ii. Participants will have 6 minutes to setup and test their Tower to maximum load or failure.
      iii. The participants must place the Tower on the Test Base and assemble the Loading Block Assembly and bucket as required to load the Tower. If necessary, participants may disassemble the Loading Block Assembly. The bucket must be mounted to allow enough clearance above the floor for the bucket to tilt or the Tower to deflect.

iv. The event supervisor **throughout testing (e.g., just prior to loading sand, during loading)** will verify that no part of the Tower's span touches or is supported within the 29.0 cm diameter circle for the Tower to qualify for the "Load Scored Bonus".
v. The participants will be allowed to adjust the Tower until they start loading sand. Once loading of sand has begun, the Tower must not be further adjusted.
vi. 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. Teams choosing to stabilize the bucket must only use the tips of the bucket stabilization sticks (5.e.) to touch the bucket.
vii. Loading stops immediately when a failure occurs or when time expires. The event supervisor will remove any parts of the Tower in the bucket or any sand added after failure or time expiration.
viii. Towers that fail before supporting 15,000 g will be scored according to the actual weight supported at time of failure (6.a.), measured to the nearest gram, or best precision available. Failure is defined as the inability of the Tower to carry any additional load, or any part of the load being supported by anything other than the Tower. Incidental contact by the chain/eyebolt with the Tower is not failure.
ix. At the event supervisor's discretion, more than one Test Apparatus may be used.
x. Teams who wish to file an appeal must leave their Tower with the event supervisor.
xi. The supervisor will review with the team the data recorded on their scoresheet.

5. **<u>TEST APPARATUS</u>:**
   a. The Test Base will be a solid, level surface with the following characteristics:
      i. be at least 55 cm long x 32 cm wide, with a 20 cm x 20 cm square opening at its center
      ii. have a smooth, hard, low-friction surface (e.g. hardwood, metal, high-pressure plastic laminate) which is stiff enough that it does not bend noticeably when loaded
      iii. have a 29-cm circle drawn on the surface, centered on the 20 cm x 20 cm square opening
   b. The Loading Block Assembly must 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
   c. An approximately five-gallon plastic bucket with handle and hook to be suspended from the chain.
   d. Sand or other clean, dry free-flowing material (hereafter "sand").
   e. 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.
   f. **A circular ring gauge with an inside diameter of 8.0 to 8.1 cm, not weighing more than 10 g, that retains its shape and flatness when handled. See the event page at www.soinc.org for designs.**

6. **<u>SCORING</u>:**
   a. Score = [Load Scored (g) + Load Scored Bonus (g)] / Mass of Tower (g). High score wins.
   b. The Load Score is the measured load supported, including the Loading Block Assembly, bucket and sand, but may not exceed 15,000 g. The lowest Load Scored is the mass of the Loading Block Assembly.
   c. Load Scored Bonus: Towers spanning the 29 cm diameter circle receive a **5,000** g bonus. No part of the Tower may touch or be supported within the 29 cm circle **throughout testing to earn the Bonus Points**.
   d. Towers will be placed in four tiers as follows:
      i. Tier 1: meeting all the Construction Parameters and no Competition Violations.
      ii. Tier 2: with one or more Competition Violations.
      iii. Tier 3: with Construction Violations or both Competition and Construction Violations.
      iv. Tier 4: unable to be loaded for any reason (e.g., cannot accommodate Loading Block, or failure to wear eye protection), and will be ranked: 1st - Lowest mass; 2nd - Greatest height.
   e. Ties are broken as follows: 1. Estimated Load Scored (4.a.iv.) closest to, without exceeding, the actual Load Scored (6.b.), 2. Lowest Tower mass
   f. Example score calculations:
      i. Tower 1: mass = 15.12 g, load supported = 12,134 g, Bonus = NO; Score = 802.5
      ii. Tower 2: mass = 15.12 g, load supported = 12,134 g, Bonus = YES; Score = 1,133.2
      iii. Tower 3: mass = 12.32 g, load supported = 13,213 g; Bonus = NO; Score = 1,072.5
      iv. Tower 4: mass = 12.32 g, load supported = 13,213 g; Bonus = YES; Score = 1,478.3

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

THIS EVENT IS SPONSORED BY ARCELORMITTAL

WRIGHT STUFF

SCIENCE OLYMPIAD

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 free flight rubber-powered monoplanes to achieve maximum time aloft.

   A TEAM OF UP TO: 2 **IMPOUND:** None **EVENT TIME**: 8 minutes

2. **EVENT PARAMETERS:**
   a. Teams may bring up to 2 airplanes, any tools, and their flight log.
   b. Event Supervisors will provide all measurement tools and timing devices.

3. **CONSTRUCTION PARAMETERS:**
   a. Airplanes may be constructed from published plans, commercial kits and/or a student's design. Kits must not contain any pre-glued joints or pre-covered surfaces.
   b. Any materials except Boron filaments may be used in construction of the airplane.
   c. Total mass of the airplane throughout the flight, excluding the rubber motor, must be **7.00** g or more.
   d. The airplane must be a monoplane (one wing) and the horizontally projected wingspan must not exceed **40**.0 cm. The maximum wing chord (straight line distance from leading edge of wing to trailing edge, parallel to the fuselage) of the wing must be **10.0** cm or less. The maximum horizontally projected stabilizer span is **20.0** cm. The maximum allowable chord of the stabilizer is **7.0** cm.
   e. The propeller assembly may be built by the participants or purchased pre-assembled. It may include a propeller, a shaft, a hanger, and/or a thrust bearing. The propeller must be a single two-bladed propeller with a maximum diameter of 14.0 cm. Variable-pitch propellers that include mechanisms to actively change the blade diameter or angle must not be used.
   f. A rubber motor not to exceed a mass of 1.50 g, including any attachments such as O-rings, must power the airplanes. It will be massed separately from the airplane. Motors may be lubricated before and/or after check-in.
   g. Participants may use any type of winder, but electricity may not be available.
   h. The airplane(s) must be labeled so that the event supervisor can easily identify to which team it belongs.
   i. Students must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org.

4. **THE COMPETITION:**
   a. The event will be held indoors. Tournament officials will announce the room dimensions (approximate length, width and ceiling height) in advance of the competition. Tournament officials and the event supervisor are urged to minimize the effects of environmental factors such as air currents. Rooms with minimal ceiling obstructions are preferred over very high ceilings.
   b. Once participants enter the cordoned off competition area to trim, practice, or compete they must not receive outside assistance, materials, or communication. **Only participants may handle aircraft components until the event ends.** Teams violating this rule will be ranked below all other teams. Spectators will be in a separate area.
   c. During inspection, each team must present a flight log of recorded data. Data must include 6 or more parameters (3 required and at least 3 additional) for 10 or more test flights prior to the competition. The required parameters are: 1) motor size before windup, 2) number of turns on the motor or torque at launch, 3) flight time. The team must choose 3 additional data parameters beyond those required (e.g. turns remaining after landing, estimated/recorded peak flight height, the motor torque at landing, etc.).
   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 8-minute Flight Period.
   e. A self-check inspection station may be made available to participants for checking their airplanes prior to check-in with the event supervisor.
   f. Participants will present their event materials (airplanes, motors, and logs) for inspection immediately prior to their **Preflight Period**.
   g. All motors that meet specifications will be collected at check-in and will be **re-issued** to the team only for their **Preflight Period** and 8-minute **Flight Period**. **Time taken during the Preflight Period will impact a team's final score (see 5.b.).** Timers will follow and observe teams as they are winding their motors. Event supervisors are strongly encouraged to return flight logs after inspection.

h. A teams' **Preflight Period ends with their first flight, trim or official, which starts their** 8-minute Flight Period **or if 9 minutes passes after their motor has been returned, whichever comes first**.
i. Any flight beginning within the 8-minute Flight Period will be permitted to fly to completion. Participants may make adjustments/repairs/trim flights during their official 8-minute Flight Period. Before their launches, participants must indicate to the Timers whether a flight is official or a trim flight. A flight is considered official if a team fails to notify a Timer(s) of the flight's status. Teams must not be given extra time to recover or repair their airplanes.
j. Teams may make up to a total of 2 official flights using 1 or 2 airplanes.
k. Time aloft for each flight starts when the airplane leaves the participant's hand and stops when any part of the airplane touches the floor, the lifting surfaces no longer support the weight of the airplane (such as the airplane landing on a girder or basketball hoop) or the supervisors otherwise determine the flight to be over.
l. Event supervisors are strongly encouraged to utilize three (3) timers on all flights. The median flight time in seconds to the precision of the device used is the official time aloft.
m. Participants must not steer the airplane during flight.
n. In the unlikely event of a collision with another airplane, a team may elect a re-flight. The decision to re-fly may be made after the airplane lands. Timers are allowed to delay a launch to avoid a possible collision. The 8-minute Flight Period does not apply to such a flight.
o. The supervisor will verify with the team the data being recorded on their scoresheet.

5. **SCORING**:
   a. The base score is the Team's longest single official flight time. Ties will be broken by the longest non-scored official flight time.
   b. **Once a team has been re-issued their motors, prior to their 8-minute Flight Period, a timing official will start a Preflight Period stopwatch. If their first airplane flight, trim or official, is launched within 3 minutes of the return of motors a 5% bonus will be added to the base score. If the 8-minute Flight Period begins between 3 minutes and 6 minutes, no bonus is awarded. If the 8-minute Flight Period begins after 6 minutes, 10% will be deducted from the base score. After 9 minutes have passed since the return of motors, the 8-minute Flight Period will start.**
   c. **A bonus of 10% of the flight time will be added to the flight time of an airplane that has the surface of the wing between at least 2 ribs of the leading and trailing edges or at least one of the wing tip fences completely marked with black marker or black tissue. If no ribs are present, the whole surface must be black.**
   d. Teams with incomplete flight logs will have 10% of their flight time deducted from each flight.
   e. Teams without flight logs will have 30% of their flight time deducted from each flight.
   f. Teams that violate a rule under "CONSTRUCTION" or "THE COMPETITION" that does not have a specific penalty will be ranked after all teams that do not violate those rules.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Wright Stuff CD and Wright Stuff Video; other resources are on the event page at soinc.org.

THIS EVENT IS SPONSORED BY THE ACADEMY OF MODEL AERONAUTICS

WRITE IT/DO IT

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

   A TEAM OF: 2 **APPROXIMATE TIME:** 55 Minutes

2. **THE COMPETITION:**
   a. A student is shown an object (which may be abstract, but is the same for all teams and ideally one per team) 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.).
   b. One student 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. 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. Students 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.
   c. 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.
   d. Supervisors will attempt to use different materials than the materials that were used last year.

3. **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.

GENERAL RULES

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

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, students may not leave without the event supervisor's approval and must not receive any external assistance. All electronic devices capable of external communication (including cell phones) must be turned off, unless expressly permitted in the event rule and left in a designated spot if requested.
3. Students, 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.

Tentative Division B Schedule for the 2018 National Tournament at Colorado State University, Ft. Collins, CO

EVENT	7:00-8:00	8:15-9:15	9:30-10:30	10:45-11:45	12:15-1:15	1:30-2:30	2:45-3:45
Anatomy & Physiology		1 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60
Battery Buggy	Impound	Self-Schedule Online					
Crime Busters		21 - 30	31 - 40	41 - 50	51 - 60	1 - 10	11 - 20
Disease Detectives	1 - 60						
Dynamic Planet		1 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60
Ecology		51 - 60	1 - 10	11 - 20	21 - 30	31 - 40	41 - 50
Experimental Design		21 - 30	31 - 40	41 - 50	51 - 60	1 - 10	11 - 20
Fast Facts	1 - 60						
Herpetology		41 - 50	51 - 60	1 - 10	11 - 20	21 - 30	31 - 40
Hovercraft	Impound	Self-Schedule Online					
Meteorology		11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	1 - 10
Microbe Mission		31 - 40	41 - 50	51 - 60	1 - 10	11 - 20	21 - 30
Mystery Architecture		31 - 40	41 - 50	51 - 60	1 - 10	11 - 20	21 - 30
Optics		41 - 50	51 - 60	1 - 10	11 - 20	21 - 30	31 - 40
Potions & Poisons		51 - 60	1 - 10	11 - 20	21 - 30	31 - 40	41 - 50
Road Scholar		51 - 60	1 - 10	11 - 20	21 - 30	31 - 40	41 - 50
Rocks & Minerals		1 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60
Roller Coaster	Impound	Self-Schedule Online					
Solar System		31 - 40	41 - 50	51 - 60	1 - 10	11 - 20	21 - 30
Thermodynamics	Impound	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	1 - 10
Towers		Self-Schedule Online					
Wright Stuff		Self-Schedule Online					
Write It Do It		11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	1 - 10

SCIENCE OLYMPIAD™

Exploring the World of Science

Science Olympiad wishes to acknowledge the following business, government and education leaders for partnering with our organization. Working together, we can increase global competitiveness, improve science and technology literacy and prepare the STEM workforce of the future. Thanks to: Colorado State University (2018 National Tournament Host), Wright State University (2017 National Tournament Host), ArcelorMittal, NASA's Universe of Learning Astrophysics STEM Learning and Literacy Network, Combined Federal Campaign, Lockheed Martin, DuPont Center for Collaborative Research and Education, DuPont Pioneer, NBC Universal Foundation, Ward's Science, Google, ACE Hardware, Centers for Disease Control and Prevention (CDC), CREOL, The College of Optics and Photonics, University of Central Florida, SPIE and the OSA Foundation, Discovery Education 3M Young Scientist Challenge, National Marine Sanctuary Foundation, National Oceanic and Atmospheric Administration (NOAA), Potbelly Sandwich Works, Texas Instruments, VWR Foundation, Academy of Model Aeronautics, Investing in Communities, MAKE Magazine, 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 and Million Women Mentors (MWM).

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

Science Olympiad

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