SCIENCE OLYMPIAD™

Exploring the World of Science

Division B Rules Manual

Division B (Gr. 6-9)

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WELCOME TO THE 2017 SCIENCE OLYMPIAD

This Rules Manual will help you prepare to compete in any of the 400 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. The Rules Manuals are also available in the iTunes and Google Play Stores.

Division C (Grades 9-12) Membership Rules

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

Division B (Grades 6-9) Membership Rules

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

Students Below Grade Level Designations

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

Science Olympiad Team Membership

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

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

SCIENCE OLYMPIAD KITS AND RESOURCES AVAILABLE NOW!

Please visit store.soinc.org to purchase 2017 manuals, DVDs, teaching materials and CDs for Division B, Division C and Elementary Science Olympiad. Order officially licensed Science Olympiad Kits, supplies and parts for a variety of 2017 Science Olympiad events with your Fall Early Bird Savings: Save 12% on your Ward's Science Olympiad Kit order at wardsci.com/scienceolympiad with promo code SOVIP2016. Don't wait! This limited-time offer ends 12/31/16.

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

SCIENCE OLYMPIAD
DIVISION B RULES MANUAL

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- 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.

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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 only one 8.5" x 11" two-sided page of information in any form from any source and up to 2 non-programmable, non-graphing calculators.

3. **THE COMPETITION**: The test is limited to the following topics:

   a. **NERVOUS SYSTEM - All levels should know:**
      i. The Brain - major regions and their functions
      ii. Identification of simple encephalographic wave forms
      iii. Neural Impulses - cellular anatomy and physiology of glial and supporting cells, synapses and neurotransmitters, action potential generation and propagation, ionic basis of the cellular membrane potential, cellular anatomy and physiology of neurons
      iv. Central Nervous System - organization of the spinal cord, purpose/functions of sleep
      v. Peripheral Nervous System - neuroganglia, action of sensory and motor neurons, understand differences in and purposes of parasympathetic, sympathetic, somatic, and sensory systems
      vi. Disorders: Epilepsy, Alzheimer's Disease, Multiple Sclerosis, Parkinson's Disease, Cerebral Palsy, Shingles (herpes zoster), Glaucoma, Pink Eye (conjunctivitis)
      vii. Effects of the drugs: alcohol, caffeine, nicotine, and marijuana on the nervous system

      National Level Only:
      viii. The Brain - anatomy and physiology of brain function including function and role of specific nuclei clusters and tracts, theories of dreaming, neural impulses - retrograde signaling, purpose and principles of MRIs and EEGs
      ix. Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)

   b. **SENSE ORGANS - All levels should know:**
      i. Types of sensory receptors, General Senses vs. Special Senses
      ii. Mechanisms for the General Senses of touch, pressure, pain, temperature, itch, and proprioception
      iii. Sense Organs – regions of each of the Special Sense Organs and their functions
      iv. Physiology of sight, hearing, balance, smell, and taste
      v. Disorders: myopia, hyperopia, presbyopia, nyctalopia, astigmatism, conjunctivitis, color blindness, otitis media

      National Level Only:
      vi. Neural pathways for vision, depth perception, and hearing
      vii. Additional Disorders: Diabetic Retinopathy, Macular Degeneration, Glaucoma, Otosclerosis, Presbycusis, Meniere's Disease plus treatments and/or prevention of all conditions listed above

   c. **ENDOCRINE SYSTEM - All levels should know:**
      i. The three classes of hormones – steroids, peptides, and amines
      ii. Mechanisms of hormone action – water soluble vs. fat soluble
      iii. Endocrine related problems – hypersecretion, hyposecretion
      iv. Hormone producing glands, their hormones and the functions of each
      v. Disorders: diabetes mellitus, hypoglycemia, Graves' disease, goiter

      National Level Only:
      vi. Endocrine cycles and negative feedback, Autonomic nervous system control of endocrine function
      vii. Additional Disorders: Cushing's Syndrome, Addison's Disease, and Myxedema, Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)

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

Recommended Resources: All reference and training resources including the in-depth **Anatomy and Physiology CD (APCD)** and the introductory **Bio/Earth CD (BECD)** are available on the Official Science Olympiad Store or Website at http://www.soinc.org

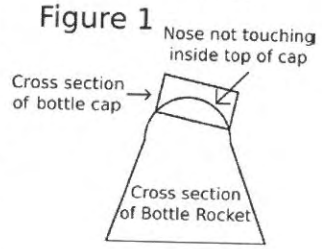
THIS EVENT IS SPONSORED BY THE SOCIETY FOR NEUROSCIENCE (www.sfn.org)

BOTTLE ROCKET

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

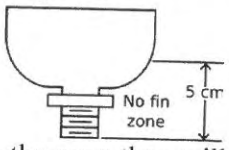
1. **DESCRIPTION**: Prior to the tournament, teams construct up to two rockets designed to stay aloft for the greatest amount of time while carrying a raw Grade A large chicken egg that survives impact.
A TEAM OF UP TO: 2 **IMPOUND**: No **EYE PROTECTION**: B **MAX TIME**: 10 min. for both launches
2. **EVENT PARAMETERS**: Teams must have eye protection and design, build, and bring up to two rockets to the tournament (only 1 launch per rocket). Parts from one rocket must not be used on another rocket. Event Supervisors (ES) must provide **one** egg **for each rocket**, launchers and water. The ES will mark each egg to ensure that teams are using the eggs provided. Teams must use launcher provided by the supervisor.
3. **CONSTRUCTION PARAMETERS**:
   a. Pressure vessels must be made out of a single **1-liter** or less plastic carbonated beverage bottle with a nozzle opening internal diameter of approximately 2.2 cm (a 1/2 inch Schedule 40 PVC pipe must fit tightly inside the nozzle opening). Bottle labels may be removed but must be presented at inspection.
   b. Only tape must be used to attach fins and other components to the pressure vessel. No glues of any type may be used on the pressure vessel. Glue may be used in other parts of the rocket assembly. Metal of any type and commercial model rocket parts are prohibited anywhere on the rocket.
   c. The structural integrity of the pressure vessel must not be altered. This includes, but is not limited to: physical, thermal or chemical damage (e.g., cutting, sanding, using hot or super glues, spray painting).
   d. Alteration to the structural integrity of the pressure vessel results in a safety violation of the rocket and it must not be launched. The ES assess structural integrity by looking through the nozzle and sides of the bottle for discoloration, bubbles, thinning or cuts in the walls.
   e. The nose of the rocket must be rounded at the tip and designed such that when a standard **1**-liter bottle cap (~3.1 cm diameter x 1.25 cm tall) is placed on top of the nose, no portion of the nose touches the inside top of the bottle cap - see Fig. 1.

Figure 1



   f. Explosives, gases other than air, chemical reactions, pyrotechnics, electrical devices, elastic powered flight assists, throwing devices, remote controls, and tethers are prohibited at any time. All energy imparted to the rocket at launch must originate from the water/air pressure combination.
   g. Fins and other parts added to the bottle must be 5 cm or higher above the level of the bottle's opening, to ensure rockets fit on the launcher - see Figure 2.

Figure 2



   h. Rockets must not change shape or deploy any type of recovery system during launch or flight.
   i. Nothing (e.g., glue or tape) may adhere to the egg.
4. **THE COMPETITION**:
   a. Following the safety inspection of the rockets, teams are allowed to inspect and select the eggs they will launch. If a team breaks an egg before launch, they may request another egg but have a penalty of **5** seconds subtracted from their score.
   b. Time begins when called to launch. The team has a total of 10 minutes to add any amount of water to the inspected rockets, load the provided eggs, and launch the rockets (only 1 launch per rocket). Any rocket launched before the time expires must be scored.
   c. Rockets must be launched at a minimum of 45 psi and a maximum of 60 psi. Launch psi must be the same for all teams and will be announced at the beginning of the competition. Once pressurized, teams must not touch or approach the rocket.
   d. Time aloft is recorded in hundredths of a second. Timing begins when the rocket separates from the launcher and stops when any part or piece of the rocket touches the ground, goes out of sight, or is slowed by an obstruction (e.g., a tree or building).
   e. ES is strongly encouraged to use three independent timers on all launches. **All three times should be recorded and** the middle value of the three timers must be the officially recorded time.
   f. Teams must retrieve their rockets and remove the egg in the presence of the ES.
   g. **The ES must verify with the team the correct recording of data on the team scoresheet.**
5. **SCORING**: Rockets in violation of rules **3.a-f** will not be launched due to safety. Teams that are unable to launch both rockets because of safety violations will receive participation points only. Any rocket that violates construction rule **3.g-i**, or has a competition violation will receive a launch time of zero for that rocket. An irretrievable rocket will be scored as if the egg did not survive. Survival is defined as an egg leaving no wet spot on a paper towel. Ranking within each tier is determined by the highest combined time aloft of both rockets: Tier 1: Launches with 2 surviving eggs; Tier 2: Launches with 1 surviving egg; Tier 3: Launches with no surviving eggs. Ties within Tiers: Tiers 1 & 3 ties will be broken by the greatest time aloft by a single rocket; For Tier 2 ties will be broken by the surviving egg's rocket greatest time aloft.

Recommended Resources: All reference and training resources including the **Bottle Rocket DVD** are available on the Official Science Olympiad Store or Website at http://www.soinc.org

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CRIME BUSTERS

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

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

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

2. **EVENT PARAMETERS:** Students may bring only specified items. No other items including calculators are allowed. The event supervisors will check the kits, confiscate non-allowed items, and have the right to penalize a team up to 10% if additional items are in the kit.

   a. **Students may bring** only these items:
      i. Test tubes (brushes & racks), spot plates, well plates, reaction plates 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. Writing instruments
      ix. Paper towels
      x. Pipettes or Droppers
      xi. Each team may bring 5 pages (both sides) containing information in any form from any source (sheet protectors are permitted).

      Note: Students not bringing these items will be at a disadvantage. The supervisor will not provide them.

   b. **Supervisor will provide**:
      i. Iodine reagent (KI solution)
      ii. 1M HCl
      iii. Chromatography materials plus containers
      iv. Waste container(s)
      v. Wash bottle with distilled water (no more than 250 mL)

   c. **The supervisor may provide**:
      i. Other equipment (e.g., microscope, probes, calculator, etc.)
      ii. Candle & matches if fibers given
      iii. Differential density solutions or other method of determining density of polymers if plastics given
      iv. Reagents to perform additional tests

   d. **Safety Requirements:** Students must wear goggles, an apron or a lab coat, and have skin covered from the neck down to the wrist and toes (gloves are optional, but if a host requires a specific type they must notify teams). Long hair, shoulder length 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.

3. **THE COMPETITION:** All competitions will consist of evidence from Parts 3. a-d and analysis of the evidence in Part 3.e. 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 3a (i-iii)	Limit on Mixtures from Part 3.a.i. only	Part b	Part c	Part d	Part e
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

a. **Qualitative Analysis**: Every team gets the same set of unknowns (evidence). The unknowns will be identifiable by performing tests such as solubility, acidity, magnetic property, color, density, and odor. The scenario will identify which containers may hold the mixtures. 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%).

b. **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** (PETE, HDPE, non-expanded PS, LDPE, PP, PVC, PMMA). No burn test allowed but burn results may be provided.

c. **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.

d. **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.

e. **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.

f. The collected evidence and other data given may be used in a mock crime scene.

4. **SCORING:**
   a. The team with the highest score wins. Time will not be used for scoring. The score will be composed of the following elements (percentages given are approximate): 3.a.=50%, 3.b.=10%, 3.c.=5%, 3.d.=10%, and 3.e.=25%. Actual point values will be shown at each question.
   b. First tiebreaker is Part 3.e. Second tiebreaker is Part 3.a. Third tiebreaker is Part 3.b.
   c. Waste will be disposed of as directed by the event supervisor. A penalty of up to 10% may be given if the area is not cleaned up as instructed by the event supervisor.

Recommended Resources: All reference and training resources including the **Science Crime Busters Manual (NCB)** and the **Science Crime Busters CD (CBCD)** are available on the Official Science Olympiad Store or Website at www.soinc.org

DISEASE DETECTIVES

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

1. **DESCRIPTION:** Students 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.**

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

2. **EVENT PARAMETERS:** Each team may bring one 8.5"x11" sheet of paper that may contain information on both sides in any form from any source and up to two non-programmable, non-graphing calculators.
3. **THE COMPETITION: Sample Problems and Resources** may be found at http://www.soinc.org
   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. Students 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. 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. **C Division 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 hypotheses involving qualitative and quantitative data.
   d. Students will be presented with one or more descriptions of public health problems.
   e. Based on these descriptions, they will be expected to do the following:
      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 (more for Div. C-less for 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.
   f. Students 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.
   g. Calculations and mathematical manipulations should be part of the competition. Data may be contrived or modified to make it more appropriate for this age group as long as it does not radically alter results or interpretation.
   h. Process skills may include hypothesis, observations, inferences, predictions, variable analysis, data analysis, calculations, and conclusions.
   i. The level of questioning for B/C competitions should reflect the age-appropriateness for the two groups.
   j. The event format may be exam-based, station-based or a combination of both.
4. **SCORING:**
   a. Points will be assigned to the various questions and problems. Both the nature of the questions and scoring rubric should emphasize an understanding that is broad and basic rather than detailed and advanced.
   b. 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.
   c. Points should be awarded for both quality and accuracy of answers, the quality of supporting reasoning, and the use of proper scientific methods.
   d. Highest number of points will determine the winner. Selected questions may be used as tiebreakers.

Recommended Resources: All reference and training resources including the **Disease Detectives CD** are available at http://www.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**: Students 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 minute

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 from any source. Each **participant** may **also** bring **a "non-graphing" calculator.**

3. **THE COMPETITION:** Participants will be presented with one or more tasks presented as an exam and/or timed stations. An emphasis will be placed on the NGSS Science and Engineering Practices shown on soinc.org. 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. Types of plates, boundaries and margins - with specific examples. Identification of tectonic boundaries from paleogeographic reconstructions.
   d. Types of tectonic basins, processes that form them, and the nature of the sedimentary record for each (rift basin, back arc basin, foreland basin, intermontane basin).
   e. Driving forces of plate tectonics - mantle convection, mantle plumes, subduction.
   f. Plate movement and impacts of plate movement - Wilson Cycle, terranes, orogenic belts, past supercontinents, convergence, divergence, transform motion, associated faults, opening and closing of ocean gateways and landbridges (with impacts on biota).
   g. Aulacogens and hot spots.
   h. Isostatic adjustments - plate thickness, and the impact of mass wasting and glaciation. Hypsometry and the elevation/depth of continental and oceanic crust.
   i. Natural hazards due to plate tectonics - earthquakes, volcanoes, tsunamis and landslides.
   j. Magma formation - geological settings, chemistry, and properties.
   k. Geologic history of North America: Evolution of the North American craton, Rocky Mountains, Appalachian Mountains and Yellowstone Hot Spot.
   l. Interpretation of geophysical data to understand plate tectonics including brittle and ductile deformation in rocks, magnetic anomalies, gravity anomalies, stress, and seismicity.
   m. Engineering and societal practices to mitigate hazards and protect human life in tectonically active areas.

4. **REPRESENTATIVE TASKS:**
   a. Given a map of selected islands and seamounts of the Hawaiian chain accompanied by the approximate age and distance from the Island of Hawaii for each, participants may be asked to plot the movement of the Pacific Plate on a graph and respond to interpretative questions, including calculations, related to that graph.
   b. Using a paleogeographic reconstruction of the late Cretaceous identify the location of major plate boundaries represented (http://cpgeosystems.com/paleomaps.html).
   c. Given a rate of erosion of rock, estimate the actual movement of the mountaintops over time due to isostatic rebound.
   d. Deconstruct geological event histories from block diagrams.

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

Recommended Resources: All reference and training resources including the **Dynamic Planet CD (DPCD)** and the **Bio/Earth CD (BECD)** are available on the Official Science Olympiad Store or Website at http://www.soinc.org.

ECOLOGY

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

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

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

2. **EVENT PARAMETERS:** Each team may bring only one 8.5" x 11" two-sided page of information in any form from any source and up to 2 non-programmable, non-graphing calculators.
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 must spend the same amount of time at each station.

   a. Part 1: Review of the General Principles of Ecology
      i. General Principles of Ecology - food webs and trophic pyramids, nutrient cycling, community interactions, population dynamics (including density dependent/independent limiting factors, carrying capacity, doubling time, exponential/logistical growth and how to calculate population growth), extinction, selection and migration. At the regional and state level, the general ecological principles should focus on local and regional ecology.
      ii. **Division C State and Nationals only:** 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 Tundra, Taiga and Deciduous Forests** (next year's focus: Deserts and Grasslands)
      ii. Understand basic concepts of biodiversity
      iii. **Div. C State and Nationals only:** Be able to apply knowledge of biodiversity (plot maps, simulations of selection effects on populations)
      iv. **Div. C Nationals only:** Understand terminology and be able to calculate biodiversity of sample data (species richness, Simpson index, Shannon-Wiener index)
   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 the goals of conservation biology and how they can be obtained
      iv. Reclamation of disturbed areas versus reintroduction of species
      v. **Division C State and Nationals only:** Be able to answer questions as they pertain 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. List three ways a tundra is different than a taiga.
   d. Compare a tundra with a taiga. 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. Students will be ranked from highest to lowest score. Ties will be broken by pre-determined tiebreaker questions.

   Recommended Resources: All reference and training resources including the **Ecology CD (ECCD)** and the **Bio/Earth CD (BECD)** are available on the Official Science Olympiad Store or Website at http://www.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 a team's 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:** Students must bring goggles and a writing instrument(s) and may bring a timepiece, a ruler, and any kind of calculator. Chemicals that require other safety clothing will not be used.

3. **THE COMPETITION:**
   a. Supervisors must provide teams with identical sets of materials at a distribution center or in a container. 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 is to remain unknown until the start of this event and will be the same for each team. The students must use at least two of the provided materials to design and conduct an experiment.
   b. The supervisor must assign a question/topic area that determines the nature of the experiment. The assigned question/topic area should be the same for all teams and allow students to conduct experiments involving relationships between independent and dependent variables (like height vs. distance).
   c. Supervisors must provide teams with an outline based on the Checklist titles listed below for recording their experiment with additional paper to record data, graphs and procedures.
   d. When the teams are finished, all materials must be returned to the event supervisor along with all written materials. The content of the report must be clearly stated and legible.

4. **SCORING**: Scoring of the event will be done using the checklist below or the expanded one on the website. Zero points will be given for an inappropriate or no response. Points will be awarded dependent upon the completeness of the response. High score wins. Ties will be broken by comparing the point totals in the scoring areas in the following order: Total points for 1-Variables, 2-Procedure, 3-Analysis of Results, 4-Graph, 5-Data Table. Any student not following proper safety procedures will be asked to leave the room and will be disqualified from the event. Any team not addressing the assigned question or topic area will be ranked behind those who do, because not conducting an experiment is a violation of the spirit of the event.

EXPERIMENTAL DESIGN CHECKLIST

a. Statement of Problem: Experimental Question (4 Points)
b. Hypothesis: Including prior knowledge that contributed to hypothesis (8 Points)
c. Variables:
   i. Independent Variable: Factor being manipulated (6 Points)
   ii. Dependent Variable: Factor being measured which responds (6 Points)
   iii. Constants: (Controlled Variables) Factors that are purposefully kept the same (8 Points)
d. Experimental Control (where applicable): (Standard of Comparison) (4 Points)
e. Materials (6 Points)
f. Procedure: Including Diagrams (12 Points)
g. Qualitative Observations During Experiment & Summary of Results: (8 Points)
h. Quantitative Data: including Data Table and for C only use of Significant Figures (12 Points)
i. Graphs: (10 Points)
j. Statistics: Div. B&C: e.g., average (mean), median, mode, range, standard deviation, line of best-fit or other relevant statistics that teams choose (6 Points)
k. Analysis of Results: Interpretation (8 Points)
l. Possible Experimental Errors including identified human errors (6 Points)
m. Conclusion: Include why your results did or did not support the hypothesis: (8 Points)
n. Recommendations for Further Experimentation Based on Your Data & Practical Applications: (8 Points)

Hints: Statement of problem should not have a yes or no answer and should be specific to the experiment being conducted and is not the same as the assigned topic area. Experiments should be simple and have only one independent and one dependent variable and should consist of repeated trials. Variables should be operationally defined.

Recommended Resources: All reference and training resources including the **Experimental Design Guide CD (EXCD)** are available on the Official Science Olympiad Store or Website at http://www.soinc.org

FAST FACTS

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

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

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

2. **EVENT PARAMETERS:** The event supervisor will provide the scoresheets. Students are not allowed to bring any information resources.

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. Categories and letters must not be repeated within a grid or among the three grids used in competition.
   b. Teams will have 6 minutes to complete each round. Teams will write a term, corresponding to the given category and beginning with the given letter, in each of the 25 boxes of the grid. At the end of 6 min. the event supervisor will stop the round. For each round all students should start and stop writing at the same time as directed by the event supervisor. Students beginning before or after the supervisor starts/stops the round will have their scoresheet not scored for that round.
   c. Students are to write their names and school on the scoresheet for each round. A scoresheet without student names and school will not be scored resulting in that scoresheet not being added to the final score.
   d. At the end of each round the supervisor will pick up all scoresheets. Then a new set of scoresheets will be distributed to students. This will be repeated for each of the 3 rounds.
   e. Names of the categories must not be used in the answer.
   f. If a correct response has more than one word, the 1st letter of the first word will be used (e.g., "D" is the 1st letter of 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. Students may not write two or more different forms of a response within a category to get credit for two or more different answers (e.g., Category - "Human Organs", Letters - "I", "L" and "S", and the student writes "small intestine", "large intestine" and "intestine". The student would only get credit for "small intestine" and "large intestine" because these terms are the most precise of the three responses).
   h. If the category asks for the name of a person, both the given (first) and surname (last) of a person must be written. The first letter of the surname must match the required letter (e.g., "D" - Charles Darwin, "C" - Marie Curie).
   i. Incorrect spellings of the word must 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 corrects term in a column =	4 pts.
Three correct terms in a row =	9 pts.	Three corrects term in a column =	9 pts.
Four correct terms in a row =	16 pts.	Four corrects term in a column =	16 pts.
Five correct terms in a row =	25 pts.	Five corrects term in a column =	25 pts.

   b. The round score will be determined by adding the scores from each of the rows and columns. Final score will be determined by adding all of the round scores. Highest total score wins.
   c. Tiebreakers will be determined by the following sequence: 1. Highest individual round score; 2. Second highest individual round score; 3. Third highest individual round score; 4. Total columns/rows with 5 correct; 5. Most columns/rows with 4 correct; 6. Most columns/rows with 3 correct; 7. Most columns/rows with 2 correct.

Recommended Resources: All reference and training resources including the **Problem Solving and Technology CD** are available on the Official Science Olympiad Store or Website at www.soinc.org

FOOD SCIENCE

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

1. **DESCRIPTION**: Students will answer questions about the chemistry of food and **food grains** and **build a simple calorimeter** to determine the energy content of a solid foodstuff.

A TEAM OF UP TO: 2 **IMPOUND**: No **EYE PROTECTION**: C **TIME**: 50 min

2. **EVENT PARAMETERS**:
   a. Each team may bring writing utensils, non-camera calculators, 5 pages (both sides) containing information in any form from any source (sheet protectors are permitted) and a student made calorimeter with a non-mercury thermometer to measure food energy content. Any calorimeter calibration data must be included in the 5 pages. Students may also bring:
      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 or Hydrion paper
      iv. Hand lens(es)
      v. Beral pipettes
      vi. 9-Volt Conductivity tester
      vii. Paper towels

   Note: Students not bringing these items will be at a disadvantage. The supervisor will not provide them.
   b. The event supervisor will provide matches, foodstuff, a source of water and balances/equipment/materials to do laboratory activities.
   c. Safety Requirements: Students must wear goggles, an apron or a lab coat and have skin covered from the neck down to the wrist and toes (gloves are optional, but if a host requires a specific type they must notify teams). Long hair, shoulder length 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.

3. **THE COMPETITION**: The competition will be conducted in two parts.
   a. Part 1: This part of the test will include both experimental tasks and multiple-choice or other questions about the chemistry of food and food grains (**any seed**). Students will be expected to perform laboratory tasks including identifying carbohydrates, lipids, and proteins in foods. Students should be able to measure mass, volume, temperature and pH as well as perform simple chemical/physical tests such as density, moisture content, and percent composition. Detection tests for proteins, lipids and various carbohydrates may be performed using appropriate methods such as Biurets test, Benedicts test, iodine reagent test, and lipid presence tests using brown paper. Questions and activities may also cover topics such as leavening agents, food additives, GMO, gluten and gluten free foods, and caloric value.
   b. Part 2: Calorimetry using a piece of food weighing 1-20 grams. Students must bring a student built non-electric, calorimeter that fits in a 30 cm X 30 cm X 30 cm box. Calorimeters over this size will be penalized 10% of your part 2 score.

4. **SAMPLE ACTIVITIES AND QUESTIONS**:
   - Nutritional labeling
   - Testing of foods (ex. sugars, starches, fats, proteins)
   - Essential fats, vitamins, proteins
   - How cooking changes food chemically
   - Sweeteners
   - Allergens in foods
   - Food preservation
   - Leavening agents
   - RDA (recommended daily allowance) of essential minerals and vitamins and the consequences of not having them

5. **SCORING**:
   a. Part 1: Tasks and questions are worth 85% of the competition.
   b. Part 2: Students are to test a solid piece of food and determine its energy content in joules/gram. This part of the competition is worth 15% of the score.
   c. Ties will be broken using selected questions/tasks from Part 1.

Recommended Resources: All reference and training resources including the **Chem/Phy Sci CD (CPCD)** are available on the Official Science Olympiad Store or Website at www.soinc.org

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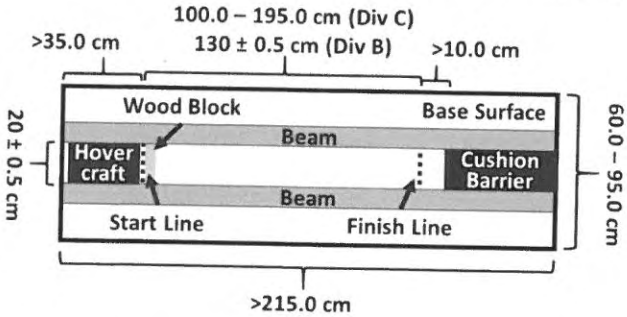
HOVERCRAFT

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

1. **DESCRIPTION**: Competitors may construct a self-propelled air-levitated vehicle with up to two battery-powered motors that turn one propeller each to levitate and move the vehicle down a track. Competitors must also be tested on their knowledge of classic mechanics and related topics.

   A TEAM OF UP TO: 2 **EYE PROTECTION**: B **IMPOUND**: Yes **APPROXIMATE TIME**: 50 minutes

2. **EVENT PARAMETERS**:
   a. All reference materials to be used during all parts of the competition must be initially secured in a 3-ring binder so that regardless of orientation, none can fall out.
   b. Competitors may bring writing utensils and any type of calculators for use during any part of the event.
   c. The vehicle must be placed in a box (vehicle and box must be labeled with the team name and tournament specific team number) and must be impounded. Tools and supplies do not need to be impounded.
   d. Competitors must wear eye protection during Part II. Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows.
3. **THE TRACK**: Example setups are provided on the event page on www.soinc.org
   a. The supervisor must supply two 8' long beams each with a width and height at least 30.0 mm (standard 2x4 metal framing studs recommended to ensure straightness), a cushioned barrier to stop vehicles, a small wood block to hold back the vehicle at the starting line, and a base surface at least 215.0 cm long and between 60.0 and 95.0 cm wide (standard 8' long table or countertop recommended).
   b. Each beam must be clamped or securely affixed to the base with the widest side in contact with the base to form the track side rails. There must be a gap of 20 ± 0.5 cm between them to form the vehicle track.
   c. At one end of the track, a start line must be marked that is at least 35.0 cm from the edge of the track.
   d. At the other track end, the finish line must be marked (see 5.e for location) and a cushioned barrier at least 10.0 cm from the finish line must block the channel.
   e. Multiple tracks may be used to facilitate all teams competing in a timely manner, but the dimensions and specifications of all tracks must be the same.



4. **CONSTRUCTION**:
   a. The vehicle may be made of any material, but must not modify the track.
   b. The length of the vehicle must be between 15.0 and 30.0 cm and cannot exceed 30.0 cm during the run (including any inflated skirts). The vehicle, excluding dowel (see 4.g), must be less than 20.0 cm tall with the propellers in motion when non-levitated.
   c. The mass of the vehicle (including batteries and dowel) must be no more than 2000.0 grams.
   d. It is recommended that the vehicle be adjustable to accommodate variations in track rail width and height.
   e. The vehicle must have no more than two motors each rotating one propeller. Propellers must have shielding with holes less than ¼" in diameter, which the event supervisor must test by trying to pass a ¼" dowel through them.
   f. The entire vehicle, including the propeller(s) and required shielding, must not exceed 19.5 cm in width.
   g. 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 between 30.0 and 35.0 cm above the lowest vehicle surface.
   h. Commercial batteries, 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.
   i. Brushless motors and integrated circuits are not permitted.
   j. The vehicle must be levitated on a cushion of air as it moves down the track. Inflated skirts may remain in contact with the base surface, other vehicle components may occasionally contact the base surface, and continuous contact with the inside edge of the side rails is permitted. Competitors may be asked to demonstrate levitation by pushing the vehicle slightly down. If it then rises it is levitated.
   k. Vehicles must have an electric switch to permit safe starting. A stopping system to stop vehicle motion or shut off the motor is recommended.
   l. Competitors must be able to answer questions regarding the design, construction, and operation of the vehicle per the Building Policy found on www.soinc.org.

5. **THE COMPETITION**:

Part I: Written Test

a. Unless otherwise requested, answers must be in metric units with appropriate significant figures.
b. Teams must be given a minimum of 20 minutes to complete a written test.
c. Questions may be multiple choice, true-false, completion, or calculation problems.
d. The competition must 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. Air cushioned vehicles and applications: history, design, capabilities
   v. Fluid mechanics (Division C only): density, buoyancy, viscosity, Bernoulli's principle, Pascal's law

Part II: Vehicle Testing

e. The length of the timed portion of the track is between 100.0 and 195.0 cm (Division C) / fixed at 130 ± 0.5 cm (Division B). Supervisors must mark the distance on the track.
f. The target time is between 5.0 and 25.0 s. The event supervisor must announce the exact length (Division C only) and time after impound, which must be the same for all teams.
g. Event supervisors must check vehicle specifications during impound or right before a team's testing period begins. Teams must be notified as soon as possible if a vehicle does not meet specifications. Event supervisors may also recheck specifications after a successful run (e.g., to remeasure the mass).
h. Teams must have a total of 8 minutes to adjust and repair their vehicle, and make 5 failed or 2 successful runs (whichever comes first). Event supervisors must give teams a warning at 7 minutes.
i. Teams may modify the vehicle during the impound period or their 8 minutes vehicle testing period, if time is available. This may be to bring the vehicle into compliance with the event specifications.
j. Prior to starting the first run, and without actually turning on the motor, teams must demonstrate a safe starting and stopping process. Vehicle testing period timing must not stop for this demonstration.
k. To begin a run, competitors must place their vehicle on the track directly before the start line. Event supervisors must place a small wood block in front of the vehicle to keep it from moving.
l. When ready, competitors may turn on their motors and indicate that their vehicle is ready.
m. Teams must not touch the vehicle after motors are turned on until the vehicle passes the finish line or the event supervisor declares the run as a failed run.
n. The students must give a countdown of "3, 2, 1, launch". The event supervisor must then release the vehicle by removing the small wood block. Timing must start when the dowel crosses the start line and stop when it crosses the finish line.
o. Supervisors are encouraged to use photogates for more precise timing and use at least one back-up manual timer. If only manual timers are utilized, 3 timers are recommended. The middle value of the 3 timers must be the officially recorded time. Time is recorded in seconds to the device precision.
p. A run must count as long as it is started before the 8-minute period has elapsed.
q. 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 triple the target time, or any part of the vehicle falls off. After a failed run, the team must be allowed to repair and restart their vehicle if time remains in the 8-minute period, for a maximum of 5 failed runs.
r. Teams filing an appeal regarding Part II must leave their vehicle in the competition area.
s. The supervisor must verify with the team the correct recording of Part II data on the team scoresheet.

6. **SCORING:** A scoring rubric is available on the event page on www.soinc.org

a. Mass Score (MS) = (mass of vehicle / mass of heaviest successful vehicle of all teams) x 25 points.
b. Time Score (TS) = (1-(abs (run time – target time) / run time)) x 25 points. The smallest possible TS is 0.
c. Teams with no successful runs or that are disqualified for unsafe operation receive a TS and MS of 0. Teams must still be allowed to compete in Part I.
d. The mass of the vehicle 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.
e. The TS for a successful run must be multiplied by 0.9 when calculating the Final Score if the team violates any of the rules in THE COMPETITION during that run. Rule violations during failed runs do not result in this penalty.
f. Exam Score (ES): (Part I score / Highest Part I score for all teams) x 50 points
g. Final Score (FS) = MS + best run TS + ES. The maximum possible FS is 100 points. High score wins.
h. Tie Breakers: 1st - Best ES; 2nd - Best MS; 3rd – Best other successful run TS; 4th - specific test questions

Recommended Resources: All reference and training resources including the **Hovercraft DVD** and the **Chem/Phy Science CD** are available on the Official Science Olympiad Store or Website at www.soinc.org

INVASIVE SPECIES

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

1. **DESCRIPTION:** This event will test student knowledge of invasive species in local and national ecosystems.

A TEAM OF UP TO: 2

APPROXIMATE TIME: 50 minutes

2. **EVENT PARAMETERS:**

Each **team** may bring one 3-ring binder (any size) containing pages of information in any form from any source. *Note: Currently there is no field guide that includes all of the invasive species. In preparation for this exam students should consider preparing a resource binder based on invasive species on the **Official List** and those identified by their state or regional director **by November 1st**.

3. **THE COMPETITION:**

a. Each team will be given an answer sheet on which they will record answers to each section.
b. The competition may be run as stations and/or as a PowerPoint presentation.
c. Specimens/pictures will be lettered or numbered at each station. The event could include live and preserved specimens, skeletal material, recordings of songs, and slides or pictures of specimens.
d. Participants should be able to do basic identification to the level indicated on the Official List. States may have a state or regional list. See your state web site. No more than 50% of the competition will require providing common or scientific names.
e. Each specimen/picture will have one or more questions accompanying it on some aspect of its life history, distribution, anatomy and physiology, reproduction, habitat characteristics, ecology, diet, behavior, history, control methods, laws and regulation.
f. The ecology questions may pertain to any ecological aspect of the species, including invasive behavior, habitat, niche, trophic level, or adaptive anatomy.
g. The National competition will be based on **National Invasive Species Official List.**

4. **SAMPLE QUESTIONS:**

a. Place in-order the life cycle pictures of a zebra mussel.
b. Which invasive plant (common name) is also a problem host for soybean aphids? (Common Buckthorn)
c. Which genus of trees is threatened by the *Agrilus* genus in America? (*Fraxinus*)

5. **SCORING:**

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

Recommended Resources: All reference and training resources including the **Bio/Earth CD (BECD)** are available on the Official Science Olympiad Store or Website at www.soinc.org There is no universal field guide to the invasive species of the United States - see http://www.invasivespeciesinfo.gov/unitedstates/

THIS EVENT IS SPONSORED BY ORKIN

METEOROLOGY

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

1. **DESCRIPTION**: This event is about the meteorological topic **Severe Storms**.

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

2. **EVENT PARAMETERS**: Each student may bring one non-programmable calculator. Each team may bring four 8.5" x 11" two-sided pages of notes containing information in any form from any source.

3. **THE COMPETITION:** An emphasis will be placed on the NGSS Science and Engineering Practices shown on soinc.org. The tasks or questions will be from the following **Severe Storms** topics:
   a. Air masses, fronts, cyclones, and anticyclones, weather maps, weather stations, global circulation patterns, semi-permanent highs and lows, and scales of atmospheric motion
   b. Mid-latitude cyclones: life cycles, characteristics, structure, and hazards; surface weather maps
   c. All types of thunderstorms, such as air mass, multicell, supercell, dryline; life cycles, characteristics, structure, and hazards
   d. Squall lines & mesoscale convective complexes
   e. Straight line winds, downdrafts, downbursts, gust fronts, micro and macrobursts, derechos, & dust storms
   f. Electrification of clouds, all types of lightning strikes, and lightning direction finders/systems
   g. Tornadoes: life cycles, characteristics, structure, hazards, and Fujita & E-Fujita Scales
   h. Severe winter storms: blizzards, nor'easters, lake effect snowstorms, characteristics and hazards
   i. Observation technologies, including high-resolution surface-based station networks (e.g., Oklahoma Mesonet), aircraft, satellite (particularly IR) imagery, Doppler Radar, interpretation of severe storms including bow echo, tornadic vortex signature (TVS), hook echo, debris ball, etc.
   j. Identify and interpret cloud types associated with severe storms
   k. Hurricanes, Typhoons and Cyclones: life cycles, including Arctic hurricanes, characteristics, structure, hazards, origin/distribution, & Saffir-Simpson Scale
   l. Weather safety (hail, flooding, winds, storm surges, etc.), NOAA warnings and watches, dependable sources of weather information for preparedness and during a severe weather event or outbreak
   m. Precipitation from severe storms: snow, hail, freezing rain, ice pellets and rain
   n. Severe Storm hazards: Flash flood, debris flow, mudslide, avalanche, storm surges, river flooding, winds related to the Special Topics for 2017: Hurricane Patricia-October 2015, Eastern U.S. Blizzard-January 2016, Colorado Floods-September 2013, February 23-24, 2016 Tornado Outbreak. Event supervisors are encouraged to use data from these events to illustrate the processes above.

4. **REPRESENTATIVE ACTIVITIES:** Participants may be asked to:
   a. Interpret surface and upper air maps, meteograms during severe storms, isobars, fronts, Doppler radar imagery, or satellite imagery relating to severe storms
   b. Demonstrate knowledge of the life cycle of different severe storms and be able to associate those conditions with radar and frontal data on weather maps
   c. Relate specific hazardous conditions of severe storms and interpret their significance (e.g., hurricanes, storm surges, straight line damage from derechos vs. tornadic damage patterns)
   d. Using Doppler radar and satellite images to interpret the three-dimensional structure of storms

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

Recommended Resources: The **Bio/Earth CD (BECD),** the **Meteorology CD (MTCD)** and the **Audubon Weather (Meteorology) Guide** are available on the Science Olympiad Store or Website at www.soinc.org. Also see www.education.noaa.gov/Education_Events/Science_Olympiad, www.education.noaa.gov, www.spc.noaa.gov, www.nhc.noaa.gov, www.ametsoc.org/amsedu/dstreme/, ww2010.atmos.uiuc.edu/(Gh)/home.rxml

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.

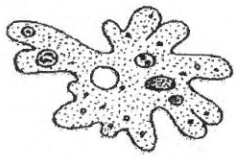
   A TEAM OF UP TO: 2 **EYE PROTECTION**: C **APPROXIMATE TIME**: 50 Minutes

2. **EVENT PARAMETERS**: Students must provide goggles and may bring non-programmable calculators. Each team may bring one 8.5" x 11" sheet of paper that may contain information on both sides in any form from any source. Measurements must be made to the precision of the device.

3. **THE COMPETITION**: The event may be run as timed stations. Students will be given questions pertaining to different types of microbes. 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. Most questions should emphasize age/division appropriate process skills such as: data interpretation from graphs and tables, use of a dichotomous key, drawing conclusions, calculations, metric conversions, determining actual size of the organism, inferences, and making observations. Students may be asked to perform simple laboratory procedures as measurements or using probes (sufficient information will be provided at the station). Possible live specimens may include only baker's yeast, ciliates, amoebae, lichens, and algae. Pictures & prepared slides are appropriate for all microbial types.

   Regional and State Tournaments (B & C): The competition should cover all of the topics and not emphasize just one area such as microbial disease. **Note: Disease questions must be restricted to the 2017 Microbial Diseases on www.soinc.org.**

   a. Different kinds of microscopes and their uses. Parts and their function of light microscopes, principles of microscopy, and magnification and field of view determination.
   b. Recognition and function of nucleus, mitochondria and chloroplasts, and their possible microbial origin.
   c. Differences (e.g., size, environment, structure, prokaryotic vs. eukaryotic, etc.) among prions, viruses, bacteria, Archaea, fungi, algal and animal like protists, and parasite worms.
   d. Roles of microbes in commercial production, spoilage, preservation & decomposition of various foods.
   e. Diseases caused by different kind of microbes and the treatment/prevention of these diseases.
   f. Estimation/calculation of size based on scales in pictures or microscopic information and amount of the visual field occupied.
   g. Growth curves; graph interpretation.
   h. Beneficial microbes vs. Dangerous microbes.



   Division C (only)

   i. Names for and recognition of various bacterial shapes
   j. Gram stain uses and difference between gram$^+$ & gram$^-$
   k. Important aspects of spores & cysts

   National Tournament (B & C)

   l. All state/regional level material
   m. Resistance to various antimicrobial agents
   n. Role of microbes in the causes of plant diseases
   o. Causes and effects of microbial population explosions
   p. Microbial competition

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 acid environment.
   d. A cell is observed through a light microscope at 4x magnification. The cell takes up about half of the visual field. What is the approximate length of this organism?
   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 appears to be the most prevalent?
   f. From this picture identify the organelle, its function, and state which type of microbe it is unique to.
   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. Match the disease with the type of organism that causes it.

5. **SCORING**: Highest score will determine the winner. Selected questions may be used as tiebreakers.

Recommended Resources: All reference and training resources including the **Microbe Mission CD** are available on the Official Science Olympiad Store and Website at http://www.soinc.org.

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MISSION POSSIBLE

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

1. **DESCRIPTION**: Prior to the competition, competitors will design, build, test, and document a Rube Goldberg®-like device that completes a required task through an optional series of simple machines.
A TEAM OF UP TO: 2 **IMPOUND**: At state and national only **EYE PROTECTION**: B
SET-UP TIME: 30 minutes for points **MAX. RUN TIME**: 3 minute limit
2. **EVENT PARAMETERS:** Event Supervisors need meter sticks, stopwatches, and measuring tape. All competitors must properly wear eye protection at all times. Competitors without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows, otherwise not be allowed to compete. Each device must pass a safety inspection before operation. **Flames**, as well as hazardous liquids and materials (e.g., rat traps, lead objects, combustible fuses) and unsafe handling of chemicals will not be permitted. Devices with potential hazards or safety concerns must not be permitted to run unless safety concerns are resolved to the satisfaction of the Event Supervisor; otherwise they must receive only participation points.
3. **CONSTRUCTION PARAMETERS:**
   a. Penalty points will be assessed for Device dimensions during operation greater than 60.0 x 60.0 x 60.0 cm.
   b. The Device must begin with the Start Task and end with the Final Task as listed in Section 4.
   c. After the Start Task, the device must be designed to operate autonomously. A team must be disqualified if the device is remotely timed or controlled.
   d. The device must be designed and constructed to consecutively execute a sequence of transfers from one Simple Machine to another Simple Machine.
   e. The six Simple Machine Types used in transfers that will count for points are levers, pulleys, wheel and axles, inclined planes, screws, and wedges.
   f. All scorable actions and transfers must be visible. The top and at least one vertical wall must be open or transparent for viewing all actions and tasks.
   g. Each task in the device must be designed to contribute to the completion of the Final Task. Parallel and/or dead end tasks are not allowed.
   h. Each movable/adjustable physical object in the device can only be utilized by one assigned task **(i.e., a golf ball used at the beginning of a device may not be used again later in the device).**
   i. **Each object that is a simple machine may only be counted as a simple machine once (i.e., a screw can be the axle of a wheel and axle, but the device must be scored as either a screw or a wheel and axle, it cannot be scored as both).**
   j. Other non-scorable tasks may be incorporated into the device but must contribute to the completion of the Final Task, receive no points and be listed on the Transfer Sequence List (TSL).
   k. **No magnets, batteries or electricity are allowed in the device.**
   l. **No potential energy may be initially stored in objects such as springs, mousetraps, music boxes, and stretched objects. The only potential energy allowed is that of the elastic potential energy in the Start Task and gravitational potential energy.**
   m. 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. **Start Task** (100 pts) **A team member reaches into the device and pulls only one end of a plunger, much like a pinball machine, and releases it to start the action. One spring is allowed because the plunger must return entirely into the device. The device may not be held.**
   b. **Transfers** – Competitors may have up to 18 scorable unique transfers count for points. (See 4.c.)
   c. Scorable transfers are of one Simple Machine Type to a different Simple Machine Type. The initial type of machine in a transfer is counted for points (e.g., a Pulley → Lever 1st Class would count as a Pulley Transfer, while a Lever 1st Class → Pulley would count as a Lever Transfer). **For a transfer to count for points, both simple machines must use mechanical advantages to transfer energy. (Ex: A wheel and axle, just turning, does not count.)**
   d. Each Simple Machine Type may be used to score points up to three times using these criteria:
      i. **Any Class of Lever may be used to initiate each of the three scorable lever transfers to count for points. See 5.m. for additional Levers Bonus.**
      ii. Pulleys must have an ideal mechanical advantage (IMA) > 1 **and lift an object at least 10.0 cm vertically before the object initiates the next action** to count for points.
      iii. An object must be continuously pushed or pulled **without rolling** along a stationary Inclined Plane. **The object must be raised vertically at least 10.0 cm from its starting point before initiating the next action.**
      iv. Wedges must be used to separate **and go between** two touching objects **so that they are no longer touching when one of the two objects initiates the next action** to count for points.
      v. Screws must complete at least **two** full rotations and must have a clearly visible mark proving that it has moved at least **two** full rotations to count for points.

vi. **Rotational force must be applied to a Wheel & transferred to the Axle (or vice-versa) so the mechanical advantage is used to lift an object at least 10.0 cm before the object initiates the next action for the transfer to count for points.**

e. Each scorable type of transfer must be unique. Unique types of transfers can be repeated, but only one instance of a unique transfer can be scorable (e.g. a device has two instances of Pulley → Screw, only one instance would count for points, the second instance of Pulley → Screw would be ineligible for scoring.)

f. **Final Task** (250 pts) – The final action of the device must be **lifting a rectangular flag that is ≥ 50.0 sq. cm so that the flag is entirely above the device. The flag must be made of rigid corrugated cardboard, without bends or folds, and the flag must be easily removed from the flag pole so it can be measured. The flag must work like a common mailbox flag. The team name and number must be clearly recognizable on the flag. Timing stops when the flag stops moving. All parts of the flag must be below the top of the device at the start, and the flag pole must start parallel to the ground. The flag must fit within the dimensions of the device in the ready to run position.**

g. A Transfer Sequence List (TSL) must be submitted to the Event Supervisor at impound or check-in, whichever is first. The TSL must be legible, neat, and an accurate documentation of each action of the device's operation. See www.soinc.org for an example of the format required. Scoring will be based only on the transfers listed in the TSL. All transfers (scorable and non-scorable) must be numbered and documented in the TSL and correspondingly **numbered** in the device.

h. The operation Target Time for maximum points is 60 seconds at Regionals, between 61 and 90 seconds at States, and 91 and 120 seconds at Nationals. Target time is announced **at the beginning of set-up**.

i. Timing and scoring begins when a competitor releases **the plunger**. Timing of the device stops when **the flag stops moving**, or when 180.0 seconds elapse, whichever comes first.

j. If the device stops, jams or fails, the competitors must be allowed to "adjust" it to continue operation. Any obvious stalling to gain a time advantage must result in disqualification.

k. If an action inadvertently starts a transfer out of sequence on the TSL, then all transfers skipped in the listed sequence must not earn points even if they are completed.

l. If a competitor completes a scorable transfer or makes an adjustment that leads directly to the completion of the transfer, then that transfer will not count for points (even if it is part of the Final Task).

m. **The Event Supervisor must verify with the team the correct recording of data on the team scoresheet.**

5. **SCORING**: High score wins.
   a. Teams that impound **or enter** a device, but fail to compete, receive participation points.
   b. 25 pts if the TSL is submitted on time as designated by the tournament director.
   c. 25 pts if the TSL uses the format specified on www.soinc.org.
   d. 25 pts if the TSL is 100% accurate of intended scorable and non-scorable actions and transfers.
   e. 25 pts if all transfers are correspondingly **numbered in the device** as they are numbered on the TSL.
   f. 50 pts if the competitors use no more than 30 minutes to set up their device.
   g. 0.1 pt for each 0.1 cm that the max dimensions of the device (before and during operation, **excluding the height of the raised flag for the Final Task**) are under 60.0 cm x 60.0 cm x 60.0 cm in each axis. Ex: Device measures 40.0 cm x 38.9 cm x 52.4 cm will receive 20.0 + 21.1 + 7.6 = 48.7 pts.
   h. 100 pts for successfully completing the Start Task.
   i. 250 pts for successfully completing the Final Task. **(Raising the entire flag above the device)**
   j. 2 pts for each full second (rounded down) of operation up to the Target Time.
   k. **50** pts for each unique Simple Machine Transfer successfully completed as described. (**900** pts max.)
   l. **50 pts if all three Classes of Levers initiate different successful scorable transfers.**
6. **PENALTIES**:
   a. Minus 1 point for each full second (rounded down) that the device operates past the Target Time up to 180.0 seconds (whichever occurs first).
   b. Minus 25 pts for each dimension of the device that exceeds 60 cm.
   c. Minus 50 pts, one time, for any solid or liquid that detaches and leaves the measured dimensions of the device.
   d. Minus 15 pts for each time the device is touched or adjusted during the operation time.
7. **TIERS:** Unsafe devices must not be allowed to run and teams must only receive participation points. Tier 1: Devices without any violations; Tier 2: Devices with construction violations (excluding dimension violations) or competition violations; Tier 3: Devices impounded after the deadline.
8. **TIE-BREAKING CRITERIA:** Ties are broken by this sequence: 1. Fewest penalty pts; 2. Number of scorable Simple Machines successfully used; 3. Smallest overall dimension (L+W+H) of the device.

Recommended Resources: The **Mission Possible DVD** and training resources are available at www.soinc.org

THIS EVENT IS SPONSORED BY ACE HARDWARE SCIENCE

OPTICS

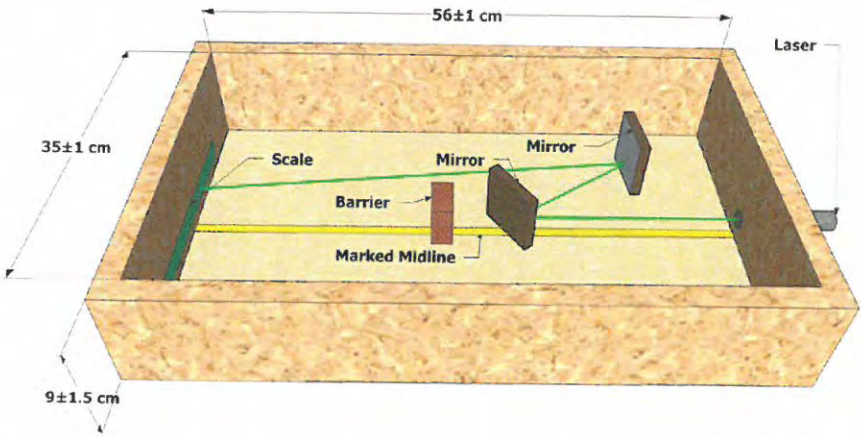
See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

1. **DESCRIPTION**: Teams must participate in an activity involving positioning mirrors to direct a laser beam towards a target. Teams must also be 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. All reference materials to be used during all parts of the competition must be initially secured in a 3-ring binder, so that regardless of orientation none can fall out.
   b. Competitors may bring any measuring tools, premade templates, writing utensils and any type of calculators for use during any part of the competition. Competitors must not bring lasers or mirrors.

3. **LASER SHOOT SETUP**: Example setups are available on the event page on www.soinc.org
   a. The event supervisor must provide the Laser Shoot Setup (LSS), including laser, mirrors and barriers. Multiple LSS's may be used to facilitate all teams being able to compete in a timely manner.
   b. The LSS has a horizontal flat surface 56 ± 1.0 cm by 35 ± 1.0 cm enclosed by a 2 ± 0.5 cm thick wall. The bottom surface may be a table top. The height of the wall above the surface is 9 ± 1.5 cm.



   c. 5 moveable flat mirrors with a width of 5.0 – 8.0 cm must be placed in the LSS and must be back-surface mirrors. Each mirror must be mounted so that it stands vertically (~90 degree angle to the bottom surface), does not have excess mounting material on its sides, has its approximate center at the level of the laser beam and can be easily relocated anywhere in the LSS by the competitors. The mirror faces must initially be covered with a cardboard sleeve or other easily removable non-reflecting, opaque material.
   d. A laser is mounted through the approximate center of one of the 35 cm walls at a height of 1.5 - 6.0 cm above the bottom surface. The laser must be securely mounted such that it cannot be moved and the beam is perpendicular to the wall through which it is mounted. The Laser Policy on www.soinc.org must be followed. The laser must remain fixed throughout the entire event.
   e. 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. The event supervisor must test the beam's alignment before each team is permitted to see the LSS.
   f. 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.
   g. A barrier must be placed somewhere along the midline to block the laser beam (non-perpendicular angles permitted). In Division C only, 2 additional barriers must be placed elsewhere in the LSS.
   h. Barrier(s) must have a width of 2.0 to 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. One barrier must have a mirror similar to the others attached to one side and covered similarly. Competitors must not adjust the mirror's position. In Division C, any of the three barriers may have the mirror.

4. **THE COMPETITION**:
   Part I: Written Test
   a. Unless otherwise requested, answers must be in metric units with appropriate significant figures.
   b. Teams must be given a minimum of 20 minutes to complete a written test.

c. Questions may be multiple choice, true-false, completion, or calculation problems.
d. The competition must consist of at least two questions from each of the following areas:
   i. Law of reflection: specular, diffuse
   ii. Refraction: index of refraction. In Division C also Snell's law & critical angle
   iii. Prism: deviation, dispersion
   iv. Convex, concave, and plain mirrors: ray tracing, focal length, real object, images (real/virtual, erect/inverted, magnification)
   v. Convex and concave lens: ray tracing, focal length, real object, images (real/virtual, erect/inverted, magnification). In Division C also thin lens & lensmaker's equations
   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
   ix. Polarization of light using polarizing films or by scattering
   x. Optical absorption spectra: films, chemicals, dyes

   Division C at State and National Tournaments only:
   xi. Ray tracing of 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

Part II: Laser Shoot

e. The objective is to reflect a laser beam with mirrors around barriers towards the Target Point.
f. The event supervisor must select a Target Point location that is the same for all teams. Teams must not be informed of the location until it is their turn to compete in Part II of the event.
g. All mirrors must be placed in a home position designated by the event supervisor before each team is permitted to see the LSS.
h. When a team is ready to begin, the event supervisor must give a countdown of "3, 2, 1 start" and start a timer. Event Supervisors must give teams a warning when 3 minutes have elapsed.
i. Competitors must make all measurements, calculations, and mirror placement/alignment within a 4 minute time period. Competitors may choose to use between 1 and 5 moveable mirrors.
j. Timing must stop when 4 minutes have elapsed or the competitors remove the material covering the face of one mirror. Competitors must not make any additional adjustments to the mirrors at that point other than to remove the other mirror coverings. The supervisor must not remove the coverings.
k. Competitors must not mark on or modify the LSS.
l. Competitors 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. Competitor tools/templates may remain on the LSS during this process.
n. The supervisor must verify with the team the correct recording of Part II data on the team scoresheet.

5. **SCORING:** A scoring rubric is available on the event page on www.soinc.org
   a. Test Score (TS) = (Part I score / Highest Part I score of all teams) x 50 points
   b. Mirrors Score (MS) = # moveable mirrors the laser reflects off of x 4 points. The max possible MS is 20.
   c. Accuracy Score (AS) = (25 – (accuracy (in mm)/10)) points. The smallest possible AS is 0.
   d. The accuracy is the horizontal distance from the Target Point to the center of where the laser strikes a wall. If the laser strikes another wall instead of the wall the Target Point is on, the accuracy is the sum of the straight line measurements from the Target Point to the corner along one wall and along the other wall from the corner to the laser dot.
   e. If the laser does not strike a wall, AS is 0, but the MS and BS should still be calculated.
   f. Teams that are disqualified for unsafe operation receive an AS, MS and BS of 0, but must still be allowed to compete in Part I.
   g. The AS, MS, and BS must be multiplied by 0.9 when calculating the Final Score if the team violates any of the rules in THE COMPETITION.
   h. Barrier Score (BS) = 5 points if the laser reflects off the barrier mirror
   i. Final Score (FS) = TS + MS + AS + BS. The maximum possible FS is 100 points. High score wins.
   j. Ties are broken using designated question(s) on the written test. The supervisor must identify the tiebreaker to the competitors at the beginning of the competition period.

Recommended Resources: All reference and training resources including the **Chem/Phy Sci CD** are available on the Official Science Olympiad Store or Website at www.soinc.org

REACH FOR THE STARS

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

1. **DESCRIPTION**: Students will demonstrate an understanding of the properties and evolution of stars especially star forming regions and supernova remnants and their observation with different portions of the electromagnetic spectrum: Radio, Infrared, Visible, Ultraviolet, X-Ray and Gamma Ray.

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

2. **EVENT PARAMETERS:** Each team may bring only two 8.5" x 11" two-sided pages of information in any form from any source and may be asked to provide clipboards and red-filtered flashlights.

3. **THE COMPETITION:** This event is divided into two parts. **Notes may be used during both parts.**

   a. **Part I**: Participants **may** be asked to identify the stars, constellations, and deep sky objects included in the lists below as they appear on star charts, H-R diagrams, portable star labs, photos, or planetariums, and **must** be knowledgeable about the evolutionary stages of all stars and deep sky objects on the list below. Note: Constellations are underlined; **Stars** are boldface; *Deep Sky Objects* are italicized.

   Aquarius: *NGC 7293 (Helix Nebula)*
   Aquila: **Altair**
   Auriga: **Capella**
   Bootes: **Arcturus**
   Canis Major: **Sirius**
   Canis Minor: **Procyon**
   Carina: *NGC3603, NGC3372*
   Cassiopeia: *Cas A, Tycho's SNR*
   Cygnus: **Deneb,** *Cygnus X-1*
   Dorado: *30 Doradus, LMC*
   Gemini: **Castor, Pollux,** *Geminga*
   Hydrus: *NGC 602*
   Leo: **Regulus**
   Lyra: **Vega**, *M57 (Ring Nebula)*
   Ophiuchus: **Zeta Ophiuchi**, *Kepler's SNR*
   Orion: **Betelgeuse**, **Rigel** & *M42 (Orion Nebula)*
   Perseus: **Algol**
   Sagittarius: *Sgr A*, M17, M8*
   Scorpius: **Antares**
   Serpens: *M16 (Eagle Nebula)*
   Taurus: **Aldebaran**, *M1 (Crab Nebula), T Tauri*
   Tucana: *SMC*
   Ursa Major: **Mizar, Alcor**
   Ursa Minor: **Polaris**
   Virgo: **Spica**

   b. **Part II**: Participants will be asked to complete one or more hands-on or interpretive tasks selected from the following topics:

      i. Stellar evolution
      ii. Spectral classification of stars
      iii. Observation using multiple portions of the electromagnetic spectrum
      iv. The relationship between stellar temperature, radius, and luminosity
      v. Magnitude and luminosity scales, distance modulus, inverse square law

4. **SAMPLE PERFORMANCE TASKS**:

   a. Given the properties and/or spectra of stars and deep sky objects, participants will identify their proper placement on an H-R Diagram.
   b. Given a set of images observing a star or deep space object with different portions of the electromagnetic spectrum, identify which images correspond to which portion of the spectrum and describe what features are prominent in each observation and why.

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

Recommended Resources: All reference and training resources including the **Audubon Field Guide to the Night Sky** and the **Bio/Earth CD** are available on the Official Science Olympiad Store or Website at www.soinc.org, also: chandra.harvard.edu/, www.nrao.edu/, www.stsci.edu/hst/, www.spitzer.caltech.edu/

THIS EVENT IS SUPPORTED BY:

NASA's Universe of Learning Astrophysics STEM Learning & Literacy Network

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ROAD SCHOLAR

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

1. **DESCRIPTION**: Teams 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**: Participants should bring a protractor and a ruler, and may bring a USGS Map Symbol Sheet, a calculator, notes, reference materials, and other measuring devices. Computers are not permitted. The event supervisor will provide all required maps, question booklets, and response sheets. Event Supervisors will check the accuracy of reproduced maps/map sections prior to competition.

3. **THE COMPETITION**: The highway and quadrangle maps may be from one or more states. The event may be presented in a storyline format. Participants may be asked to draw map features located within a square section using the correct features listed in 3.c. This square will be included on the answer sheet. Participants may be asked to draw a topographic map profile that will be included on the answer sheet. Participants may not write on the maps.

a. **Topographic Map Testing Areas**

i. Map location/series/scale/index/legend
ii. Marginal information
iii. Contours
iv. Magnetic declination
v. Map symbols
vi. Map features
vii. Survey control marks (control stations and spot elevations)
viii. Azimuths and bearings
ix. *Stream gradient (feet per 1000 feet)

x. Distance values between features (both English and metric units)
xi. Geographic coordinate system features and symbols (degrees, minutes, seconds)
xii. Public Land Survey System (PLSS)
xiii. Elevation of features and symbols
xiv. *Slope (feet per 100 feet)
xv. Sector Reference System
xvi. Direction of stream flow
xvii. *Profiles
xviii. Graticule tick marks/**graticule intersections**
xix. *Universal Transverse Mercator (UTM)

b. **Highway Map Testing Areas**

i. Distances between features
ii. Map legend/tables/index
iii. Map grid system
iv. Map symbols
v. City/Regional inserts on the highway map

c. **Student-Created Map Design**

i. Map scales
ii. USGS topographic map symbol
iii. Distances
iv. Azimuths and bearings
v. Public Land Survey System

* Items marked with an asterisk should be written at an introductory level for regional events.

4. **SCORING**: Teams will be ranked according to their point total. Values of questions may be weighted. Ties will be broken by the accuracy and/or quality of answers to pre-selected questions.

Recommended Resources: All reference and training resources including the **Road Scholar/Map Reading Coaches Manual on CD (RDCD)** are available on the Official Science Olympiad Store or Website at www.soinc.org. Also see USGS Science education: education.usgs.gov/ and USGS Topographic Maps: education.usgs.gov/common/secondary.htm#topographic

ROCKS & MINERALS

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

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

   A TEAM OF UP TO: 2 **APPROXIMATE TIME**: 40-50 Minutes

2. **EVENT PARAMETERS**: Each **team** may bring one magnifying glass and one 3-ring binder (any size) containing pages of information in any form from any source.

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. **REPRESENTATIVE STATION 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**: Total scores will determine rankings in this event. Ties will be broken by the accuracy or quality of responses to preselected questions.

Recommended Resources: All reference and training resources including the **Rock & Mineral Teaching Guide (RMCD),** the **Bio/Earth CD (BECD)** and the **National Audubon Society Field Guide to North American Rocks and Minerals** are available on the Official Science Olympiad Store or Website at www.soinc.org, and the **Rocks and Minerals kits** (*excluding only silver, gold, and diamond) may be ordered from Ward's Science Olympiad Kits.

SCRAMBLER

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

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

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

2. **CONSTRUCTION PARAMETERS**:
   a. The Scrambler must consist of an Egg Transport Vehicle (ETV) and an Energy Propulsion System. These may be separate or combined into a single unit. In its ready-to-run configuration, the entire Scrambler, including the egg, must not exceed 0.90 m in any dimension **(L, W, H).**
   b. The ETV must be designed to travel a minimum of 8.5 m, stay within a **2.00** m track width before coming to a complete stop as close as possible to the center of the TB **and be constructed of rigid, non-flexible material throughout the length of the vehicle.**
   c. All energy used to propel the ETV must come from a falling mass not to exceed 2.00 kg. The mass must be part of the Energy Propulsion System and need not travel with the ETV. The vehicle must not contribute to or be the falling mass. Any part of the Scrambler whose gravitational potential energy decreases and provides energy to propel the ETV is considered to be part of the falling mass. The Scrambler must be impounded along with **all falling mass(es) completely detached and the masses combined total not exceeding 2.00 kg**.
   d. The stopping mechanism must be contained completely within the ETV and work automatically. The ETV must not be remotely controlled or tethered.
   e. The egg must rest on two ¼" round wooden dowels extending perpendicularly a maximum of 4.0 cm from a rigid, unpadded and flat (no unfilled holes) backstop for the egg. The bottom of the dowels must be between 5.0-10.0 cm above the track and within 1.0 cm of the bottom of the backstop. **The tips of the horizontal dowels must be 3.0 cm or more in front of any part of the vehicle.** The backstop must be built of a single piece of rigid material **(no soft, cushioning materials e.g. balsa, cork)** and it must have a flat surface of 5.0 ± 0.5 cm wide by 5.0 ± 0.5 cm high by 1.27 cm (0.50") ± 0.5 cm thick, be rigidly attached to the ETV, and be perpendicular to the floor. **Nominal blemishes which do not affect the point of contact of the egg with the backstop are allowed.** For timing, a ¼" wooden dowel must be attached vertically, directly to the top of the rigid backstop. The dowel must extend at least 20.0 cm above the track surface. A diagram of the backstop is available on www.soinc.org. One or more violations of these dimensions must count as a single Construction Violation.
   f. The Event Supervisor (ES) must provide uncooked grade A large chicken eggs, one of which is selected by the team immediately prior to their 8-minute setup time. The ES provides tape to secure the egg to the ETV. No tape may be on the front or rear 1.0 cm of the egg. The egg's rounded end must be touching the backstop and visible to the ES when attached. The egg must be the foremost point of the ETV.
   g. Competitors must start the ETV by using any part of an unsharpened #2 pencil with an unused eraser that must be provided by the ES. The pencil can either actuate a release mechanism or be incorporated into the Scrambler so that when removed the mass will begin to fall. In either case, prior to any run, the team must be able to walk away from the Scrambler in its ready-to-run configuration and have the mass not fall. The pencil is not to be included in the overall dimensions of the Scrambler.
   h. The only parts of the Scrambler allowed to contact the floor are those already in contact with the floor in the ready-to-run position. **All wheels must be in contact with the floor at launch.** Piece(s) detaching from the Scrambler **(e.g. bolts, nuts, drive strings)** and contacting the floor results in a Construction Violation.
   i. The Scrambler must not damage the venue at any time and must be designed to prevent the falling mass from damaging the floor. **A floor protective device does not need to be attached to the device but must remain within the size parameters.**
   j. No electrical or electronic devices may be used on the Scrambler, its alignment devices, or any tools (with the exception of any type of calculator).
   k. 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.

3. **THE TRACK**: The track must be on a smooth, level, and hard surface with a TB extending across its end. Space is needed around the track and beyond the TB to allow for error in the ETV's path.
   a. Approximately 2.5 cm wide tape must define the 0.50 m Line, the 8.50 m Line and Track Width Lines from an imaginary Start Line to the TB. **The Start Point is marked on an approx. 2.5 cm x 5 cm long piece of tape centered between the Track Width Lines.** The center of the TB is marked.
   b. **A 5-gallon bucket with a bottom diameter of 25.0-27.0 cm must be placed on the track, centered at the midpoint between the Start Point and the center of the TB.**
   c. The TB must be at least 25.0 cm tall and perpendicular to the track located at a distance 9.00-12.00 m from the Start **Point** in 1.00 m intervals for Regional, 0.25 m intervals for State and 0.10 m intervals for Nationals. The distance and bucket diameter must be announced after the impound period.

d. A photogate timing system is highly recommended. See www.soinc.org for information. If a photogate system is available, a minimum of a single timer must be used for those runs that do not trigger the system and 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. If used, the system must be installed at the 0.50 m Line and the 8.50 m Line with the lasers at a height of 17.0 ± 2.0 cm.

4. **PRACTICE LOG: Teams must record at least 10 practice runs with at least 3 parameters. The parameters must include distance, time, and any additional parameter. Logs must be impounded.**
5. THE COMPETITION: The entire Scrambler system and any materials needed to repair or bring the Scrambler into compliance must be impounded before the start of the event. Tools for adjusting the Scrambler, test data, measuring and/or calculating devices need not be impounded.
   a. Only competitors and the ES are allowed in the impound and track areas. Once competitors enter the event area, they must not leave or receive outside assistance, materials or communication.
   b. Teams must be given a total of 8 minutes to complete up to 2 runs. During this time teams may adjust their Scrambler. Scramblers ready-to-run that start before the expiration of their 8-minute time period will be allowed to complete a run. Measurements by the ES must not be included in this time.
   c. Teams may use their own measuring devices to verify the track dimensions during their allotted time. **They must not roll the ETV on the floor of the event track the day of the event without tournament permission. If permitted, only team members may be present.**
   d. Substances applied to the ETV must not damage the floor or leave residue on the track and/or event area **and be approved by the ES prior to use**. During their 8-minute time, competitors may clean the track but the track must remain dry at all times.
   e. The **pointed tip of the egg must start on the Start Point**. Other parts of the Scrambler (except the egg) may be in front of the Start Point and oriented any way in the ready-to-run position. See www.soinc.org.
   f. Sighting and/or aligning devices placed on the track are permitted but must be removed before the runs. Mounted sighting and aligning devices may be removed at the team's discretion prior to each run.
   g. The Energy Propulsion System may be held in place to stabilize it during launch, but the ETV must be able to remain at its starting position in ready-to-run configuration without being touched.
   h. If the ETV does not move upon actuation, it does not count as a run and the team may request to set up for another run, but must not be given additional time.
   i. Run Time starts when the dowel of the ETV reaches 0.50 m and ends when it either completely stops or it passes 8.50 m. The Run Time is recorded in seconds to the precision of the timing device used.
   j. Once the ETV starts a run, the competitors must wait until called by the ES to retrieve it. The 8-minute time resumes once competitors pick up their ETV or begin to make their own measurements.
   k. Competition Violations would include competitors following the ETV down the track, any part of the ETV touching the Track Width Lines, the ETV passing the 0.5 m Line but stopping before the 8.50 m Line, egg breaking **on the first or second run**, or any part of the ETV touching the TB before the egg or other violations within the Competition section.
   l. If the egg is broken as defined by "cracking the egg enough to leave a wet spot on a paper towel", the Distance Score must be from the point of impact to the center of the TB. If the egg breaks on the first run, a second run must not be permitted. **If the egg breaks before the first run, a second egg must be provided with a limitation of only one run and a Competition Violation. No extra time is allowed.**
   m. If the time and/or distance cannot be measured for a run (e.g., the ETV starts before the ES is ready, the competitors pick up the ETV before it is measured, or the ETV doesn't reach the 0.50 m line), any part of the ETV passes the TB, or a second run cannot be started in the 8 min., it is a Failed Run.
   n. Teams who wish to file an appeal must leave the Scrambler in impound with the ES.
   o. The ES must verify with the team the correct recording of data on the team scoresheet.
6. SCORING: Low score wins. The Final Score is the better of the two Run Scores.
   a. Run Score = Distance Score + Run Time + Penalties
   b. Distance Score = A point-to-point measurement from the center of the TB to the pointed end of the egg measured to the nearest 0.1 cm.
   c. Teams with incomplete practice logs must incur a Penalty of 250 points. Teams without impounded practice logs must incur a Penalty of 500 points.
   d. A Competition Violation must incur a Penalty of 1000 points per occurrence (max of 4000 pts).
   e. A Construction Violation must incur a Penalty of 5000 points per occurrence (max of 15000 pts).
   f. A Scrambler which was not impounded during the impound period must incur a Penalty of 10000 points.
   g. If the competitors cannot start at least one run within the 8 min or have 2 Failed Runs, they must receive participation points only.
   h. Ties are broken by this sequence: 1. Better non-scored Run Score; 2. Faster Run Time on the scored run.

Recommended Resources: The Scrambler **DVD** and training resources are available at www.soinc.org

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 **MAXIMUM TIME:** 6 minutes
2. **EVENT PARAMETERS:**
   a. Each team is allowed to enter only one Tower, built prior to the competition.
   b. All competitors must properly wear eye protection at all times. Competitors without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows, otherwise not be allowed to compete and be ranked in Tier 4.
   c. The Event Supervisor must provide the Test Apparatus (4.).
3. **CONSTRUCTION PARAMETERS:**
   a. The Tower must span a 20 cm x 20 cm opening on a Test Base (4.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.b.) 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. (No part of the tower may touch or be supported within the 29 cm circle).**
   b. **The Tower must support the Loading Block (4.b.i.) a minimum of 50.0 cm (Div. B) or 60.0 cm (Div. C) above the Test Base. There is no maximum Tower height.**
   c. The loading point on the Tower must be constructed to permit placement of the Loading Block (4.b.i.) and suspended chain (4.b.iii) on and through the Tower, to support the bucket (4.c.).
   d. The Tower must be constructed such that only the Loading Block (4.b.i.) supports the chain and bucket.
   e. The Tower may not be braced against any edge of the Test Base (4.a.) for lateral support at any time.
   f. No portion of the Tower is allowed to extend below the top surface of the Test Base (4.a.) prior to testing.
   g. The Tower must be a single structure, with no separate or detachable pieces.
   h. The Tower must be constructed of wood and bonded by adhesive. No other materials are permitted.
      i. **Wood is defined as the hard fibrous substance that makes 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, or paper labels.
      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.
   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. **TEST APPARATUS:** Supplied by the Event Supervisor
   a. The Test Base must be a solid, level surface as follows:
      i. be at least 55 cm long x 32 cm wide.
      ii. have a smooth, hard, low-friction surface (e.g. hardwood, metal, high-pressure plastic laminate) and be stiff enough that it does not bend noticeably when loaded.
      iii. have a 20 cm x 20 cm square opening at its center.
      iv. **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 Assembly.
   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. Bucket Stabilizing Sticks – Two (2) stabilization sticks, each made up 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. At the Event Supervisor's discretion, more than one Test Apparatus may be used.
5. **COMPETITION:**
   a. **Check-In**
      i. The structure height must be assessed by the Event Supervisor to assure it meets or exceeds the minimum Tower height (3.b.) in cm to the nearest 0.1 cm.

ii. Team members must place their structures on the scale for the Event Supervisor to determine the structure mass, in grams to the nearest 0.01 g.

iii. **The team must submit their Load Scored estimate for the load supported to be used as a tie breaker (6.e). Load supported includes the Loading Block Assembly, bucket and sand.**

iv. No alterations, substitutions, or repairs may be made to the structure after check-in for competition. Once teams enter the event area to compete, they must not leave or receive outside assistance, materials, or communication until they are finished competing.

b. **Testing**

i. The Event Supervisor must verify that the combined mass of the Loading Block Assembly, bucket and sand, is at least 15,100 g but no more than 15,200 g prior to testing.

ii. Team members will have a maximum of 6 minutes to setup their Tower and test it to maximum load, failure, or run out of time.

iii. Team members must place the Tower on the Test Base and assemble the Loading Block Assembly and bucket as required to load the Tower. Team members may disassemble the Loading Block Assembly if necessary. The bucket must be mounted to allow enough clearance above the floor for the bucket to tilt or the Tower to deflect.

iv. Team members must be allowed to adjust the Tower until they start loading sand. Once loading of sand has begun, the Tower must not be further adjusted.

v. **The Event Supervisor must verify that no part of the Tower's span touches or is within the 29.0 cm diameter circle for the Tower to qualify for the "Load Scored Bonus".**

vi. Team members must 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 team members is NOT allowed. Teams choosing to stabilize the bucket must use the bucket stabilization sticks (4.e.). Only the tips of the springs may touch the bucket.

vii. Loading must stop immediately when a failure occurs or when time expires. The Event Supervisor must remove any parts of the structure that have fallen into the bucket and remove any sand added after failure or time expiration.

viii. Towers that fail before supporting 15,000 g must 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 if any part of the load is supported by anything other than the Tower. Incidental contact between the chain/eyebolt and the structure is not failure.

ix. Teams who wish to file an appeal must leave their Tower with the Event Supervisor.

x. **The Event Supervisor must verify with the team the correct recording of data on the team scoresheet.**

6. **SCORING:**

a. The Load Scored is the measured load supported, including the Loading Block Assembly, bucket and sand, but may not exceed 15,000 g. The least possible Load Scored must be the mass of the Loading Block Assembly. Towers that cannot support the Loading Block Assembly must be ranked in Tier 4.

b. **Load Scored Bonus: Towers spanning the 29 cm diameter circle receive a 2,000 gram bonus.**

c. Score = [Load Scored (g) + **Load Scored Bonus** (g)] / Mass of Tower(g)

d. Towers must be scored 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 must be ranked by: 1. Lowest mass; 2. Tallest height.

e. Ties are broken by this sequence: **1. Load Scored estimate (5.a.iii) closest to actual Load Scored (6.a) without going over Load Scored,** 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 = 934.8

iii. Tower 3: mass = 12.32 g, load supported = 13,213 g; Bonus = NO; Score = 1072.5

iv. Tower 4: mass = 12.32 g, load supported = 13,213 g; Bonus = YES; Score = 1234.8

Recommended Resources: Reference and training resources including the **Tower DVD (TWRD)** are available on the Official Science Olympiad Store or Website at www.soinc.org

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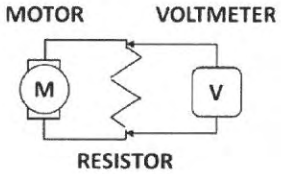
WIND POWER

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

1. **DESCRIPTION:** Teams may build a blade assembly that consists of any kind of propeller/pinwheel/rotor attached to a compact disc (CD), which will be used to capture wind power. Teams must also be tested on their knowledge regarding alternative energy.

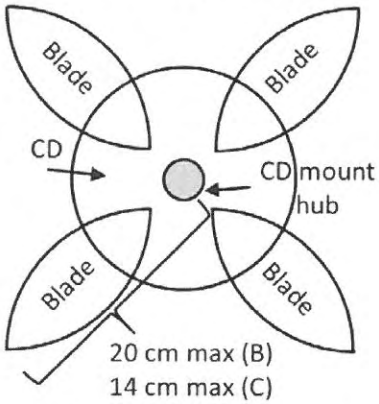
A TEAM OF UP TO: 2 **EYE PROTECTION**: B **IMPOUND**: Yes **APPROX. TIME**: 50 minutes

2. **EVENT PARAMETERS:**
   a. All reference materials to be used during **all parts** of the competition must be **initially** secured in a 3-ring binder so that regardless of orientation none can fall out. Materials such as pencils, pens, protractors, rulers, **any type of** calculators, and any other similar tools may also be used during the **event**.
   b. The blade assembly must be placed in a box (assembly and box must be labeled with the team name and competition #) and must be impounded. Tools and supplies do not need to be impounded.
   c. Competitors must wear eye protection during Part I. Teams without proper eye protection must be immediately informed and given an opportunity to obtain eye protection if time allows.
   d. The supervisor must provide the testing materials listed below (Example setups are provided on the event page on www.soinc.org), which must be the same for all teams:
      i. One or two 20" multispeed box fan(s) to be used as the wind source (**recommended fans listed on www.soinc.org)**
      ii. Support stand(s) that allow for vertical and horizontal adjustments of the blade assembly
      iii. Motor/generator(s) mounted to the support stand(s), **with axis of rotation approximately parallel to that of the fan**
      iv. Load resistor(s) between 5 and **25** ohms (**1/4 Watt or greater)** wired in parallel with the motor/generator that must have the same value for all teams
      v. Device(s) to measure voltage across the load resistor
   e. The motor/generator must be equipped with an adapter to accommodate a standard 12.0 cm CD or if the motor/generator is from a CD player, it must be removed from the CD player and mounted on the support stand.

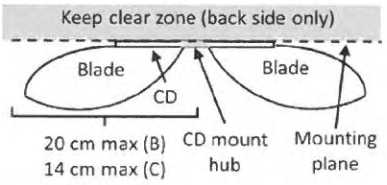


3. **CONSTRUCTION:**
   a. Each team may bring one pre-constructed blade assembly attached to a 12.0 cm **diameter** CD (**teams must not bring the testing materials listed in 2.d.)**. Note: adjacent diagrams do not show CD to scale.
   b. The CD must fit on the mount found in a standard CD player. Modification of the CD is not allowed (except to affix the blades **via tape, glue, etc.**).
   c. When mounted, no part of the blade assembly may have a radial distance from the center of the axis of rotation of more than 20 cm (Div B) / 14 cm (Div C).
   d. The blade assembly must be made of only nonmetallic substance(s).
   e. Commercial kits or third party designs may be used, but must have at least one functional modification, defined as a modification such that the lack of it will result in the assembly working differently or not working.
   f. When **initially** mounted, no part of the blade assembly may extend behind the mounting plane of the CD. This is to ensure clearance with the motor/generator and support stand. There is no limit on how far forward the blade assembly may extend.
   g. Competitors must be able to answer questions regarding the design, construction, and operation of the blade assembly per the Building Policy found on www.soinc.org.

Example Assembly Front View



Example Assembly Side / Top View



4. **THE COMPETITION:**
   Part I: Device Testing
   a. The blade assembly must be tested once with the fan at a high wind speed and once at a low wind speed. There may be one or two test stations. If there are two, one must be used for all high wind speed tests and the other for all low wind speed tests. The load resistors at each station are allowed to be different, but must be consistent for all teams.
   b. The fan(s) must be mounted in a fixed position with the bottom of the grill at least 15 cm above the table.

c. Event supervisors must **check** the blade assembly **specifications during impound or right** before a team's **blade** testing period begins. Teams must be notified as soon as possible if a blade assembly does not meet specifications. **Event supervisors may prohibit blade assemblies from being tested if they will damage the testing setup (e.g. due to excessive weight/torque, residue on the CD mount, etc.)**
d. Teams may modify the blade assembly during the impound period **or** their Part I testing periods, if time is available. **This may be to bring the blade assembly into compliance with the event specifications. Blades not meeting construction specifications at the beginning of the 30 second measurement period must receive a Max Voltage score of 0 for that wind speed.** Modifications are not allowed during the 30 second measurement periods.
e. Teams must complete set-up and device testing in no more than 3 minutes per wind speed. At 2 minutes, the event supervisor must give the team a warning. **Teams that do not complete testing in this time must receive a Max Voltage score of 0 for that wind speed.**
f. Once the 3 minute testing period begins, teams must attach their blade assembly to the motor/generator mount and position it. At the request of the students, the event supervisor must turn on or off the fan during the set-up to allow the students to better position the blade assembly relative to the fan. No voltage measurements are allowed **to be made by or seen by the competitors** during **the testing period**. Teams are allowed to adjust, modify, start and stop the blade assembly rotation **and reposition the support stand** during the testing period.
g. No later than 2 minutes **15 seconds** into the testing period, with the fan already on and the blade assembly **already** rotating **for at least 10 seconds**, the students must tell the event supervisor to begin a 30 second measurement period. The team must not touch **or reposition** the blade assembly **or support stand** during the measurement period.
h. The event supervisor must record the maximum voltage that occurs during the 30 second measurement period **and inform the team of the result**. Voltage measurement devices that have 'peak hold' or 'max hold' functions are recommended.
i. **Teams filing an appeal regarding Part I must leave their blade assembly in the competition area.**
j. **The supervisor must verify with the team the correct recording of Part I data on the team scoresheet.**

Part II: Written Test

k. Teams must be given a **minimum of** 20 minutes to complete a written test.
l. Questions may be multiple choice, true-false, completion, or calculation problems.
m. Unless otherwise requested, answers must be provided in metric units with appropriate significant figures.
n. The test must consist of at least 5 questions **from** each **of** the following areas:
   i. Wind power rotor/fan blade design (e.g., types of designs, pros/cons of designs, ways to improve designs, sources of loss)
   ii. Power generator general questions (e.g., generator design for wind, nuclear, coal, gas, solar, or hydroelectric power plants)
   iii. Power storage questions (e.g., how is the power stored during charging and how is it used during discharge, concepts relating to methods of power storage)
   iv. Power transmission questions (e.g., ways electricity is transmitted, how power is lost in transmission, ways to reduce power loss)
   v. Historical wind power designs (e.g., types of windmills, usage, design pros/cons)

5. **<u>SCORING:</u> A scoring rubric is available on the event page on www.soinc.org**
   a. If the blade assembly stops turning for a period of 10 or more seconds during the measurement period, has any pieces that detach from the assembly, or the team **violates any of THE COMPETITION rules**, the **Max Voltage** at that wind speed must be multiplied by **0.9** when calculating the **Final** Score.
   b. **Both Max Voltages must be multiplied by 0.7 when calculating the Final Score if any construction violation(s) are corrected during either Part I testing periods or if the team misses impound.**
   c. A team's Final Score must be determined as follows (with highest score winning) =

      25 x (Part I low speed Max Voltage / Highest Part I low speed Max Voltage of all teams) +
      25 x (Part I high speed Max Voltage / Highest Part I high speed Max Voltage of all teams) +
      50 x (Part II score / Highest Part II score of all teams)

   d. The **Max Voltages** must be zero if a team is disqualified for unsafe operation, modifying a CD, or fails to bring a blade assembly. Teams must still be allowed to compete in Part II.
   e. Ties must be broken by: 1st the highest high-speed voltage; 2nd the highest low speed voltage.

<u>Recommended Resources:</u> All reference and training resources including the **Wind Power DVD** are available on the Official Science Olympiad Store or Website at http://www.soinc.org

WRIGHT STUFF

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 **TIME**: 8 minutes

2. **EVENT PARAMETERS:**
   a. Teams **may** bring up to 2 airplanes, any tools, and their flight log.
   b. Event Supervisors must 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 **7.5** g or more.
   d. The airplane must be a monoplane (one wing) and the horizontally projected wingspan must not exceed **45**.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 **11.0** cm or less. The maximum horizontally projected stabilizer span is **22.5** cm. The maximum allowable chord of the stabilizer is **8.5** cm.
   e. The propeller assembly may be built by the competitor(s) or purchased pre-assembled **and/or modified**. It may include a propeller, a shaft, a hanger, and/or a thrust bearing. Bushings may be placed in the propeller or thrust bearing to reduce wobble or friction. 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 **1.5** g (including any attachments such as O-rings) must power the airplanes and will be massed separately from the airplane. Motors may be lubricated before and/or after check-in.
   g. The airplane(s) must be labeled in such a way as to be easily identified by the event supervisor. At least one non-horizontal surface on the airplane (such as a fin or dihedral panel) must be covered in a non-transparent, non-white material so it can be identified at its maximum altitude.
   h. 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 must be held indoors. Tournament officials must 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 competitors enter the cordoned off competition area to trim, practice, or compete they must not receive outside assistance, materials, or communication. Teams violating this rule must be ranked below all other teams. Spectators must 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 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 launch, 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 competitors for checking their airplanes prior to check-in with the Event Supervisor.
f. Competitors may use any type of winder, but electricity may not be available.
g. Competitors must present their event materials (airplanes, motors, and logs) for inspection immediately prior to their 2 official flights. Timers must follow and observe teams as they are winding their motors. All motors that meet specifications will be collected at check-in and will be available to the team only for their official flights.
h. Teams may make up to a total of 2 official flights using 1 or 2 airplanes.
i. After check-in, teams must be given an 8-minute Flight Period, starting when their first flight (trim or official) begins. Any flight beginning within the 8-minute period will be permitted to fly to completion. Competitors may make adjustments/repairs/trim flights during their official 8-minute period. Before their launches, competitors 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 Timer(s) of the flight's status. Teams must not be given extra time to recover or repair their airplanes.
j. Time Aloft for each flight starts when the airplane leaves the competitor'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 judges otherwise determine the flight to be over.
k. Event Supervisors are strongly encouraged to utilize 3 Timers on all flights. The median flight time in seconds to the precision of the device used, recorded by the 3 Timers, is the official time aloft.
l. Competitors must not steer the airplane during flight.
m. In the unlikely event of a collision with another airplane, a team may elect a re-flight. The decision to re-fly may be made after the airplane lands. Timers are allowed to delay a launch to avoid a possible collision. The eight-minute period does not apply to such a flight.
n. **The Event Supervisor must verify with the team the correct recording of data on the team scoresheet.**

5. **SCORING:**
   a. The base score is the Team's longest single flight time. Ties will be broken by the longest non-scored official flight time.
   b. 10% of the flight time will be added to flight time of the airplane that has a colored panel on the wing that is at least the length of the wing chord and at least between 2 wing ribs.
   c. Teams with incomplete flight logs must have 10% of their flight time deducted from each flight.
   d. Teams without flight logs must have 30% of their flight time deducted from each flight.
   e. Teams that violate a rule under "CONSTRUCTION" or "THE COMPETITION" that does not have a specific penalty must be ranked after all teams that do not violate those rules.

Recommended Resources: Reference and training resources including the **Wright Stuff CD (WSCD)** and the **Wright Stuff DVD (PROD)** are available on the Official Science Olympiad Store or Website at http://www.soinc.org

THIS EVENT IS SPONSORED BY THE ACADEMY OF MODEL AERONAUTICS

WRITE IT/DO IT

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

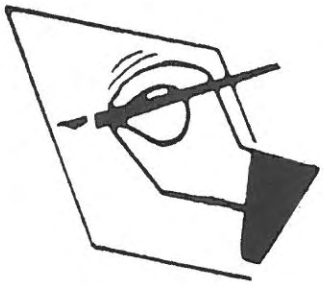
1. **DESCRIPTION**: One student will write a description of an object and how to build it, and then the other student will attempt to construct the object from this description.

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: All reference and training resources including the Problem Solving and Technology CD are available on the Official Science Olympiad Store or Website at www.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 Schedule for the 2017 National Tournament at the Wright State University, Dayton, Ohio

Event	7:00 to 8:00 am	8:15 to 9:15 am	9:30 to 10:30 am	10:45 to 11:45 am	noon to 1:00 pm	1:15 to 2:15 pm	2:30 to 3:30 pm
Anatomy & Physiology		1-10	11-20	21-30	31-40	41-50	51-60
Bottle Rockets		Online schedule					
Crime Busters		1-10	11-20	21-30	31-40	41-50	51-60
Disease Detectives	All Teams						
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	All Teams						
Fast Facts		51-60	1-10	11-20	21-30	31-40	41-50
Food Science		21-30	31-40	41-50	51-60	1-10	11-20
Hovercraft	Impound	Online Schedule					
Invasive Species		41-50	51-60	1-10	11-20	21-30	31-40
Meteorology		31-40	41-50	51-60	1-10	11-20	21-30
Microbe Mission		31-40	41-50	51-60	1-10	11-20	21-30
Mission Possible	Impound	Online Schedule					
Optics		31-40	41-50	51-60	1-10	11-20	21-30
Reach for the Stars		11-20	21-30	31-40	41-50	51-60	1-10
Road Scholar		41-50	51-60	1-10	11-20	21-30	31-40
Rocks & Minerals		21-30	31-40	41-50	51-60	1-10	11-20
Scrambler	Impound	Online schedule					
Towers		Online Schedule					
Wind Power	Impound	11-20	21-30	31-40	41-50	51-60	1-10
Wright Stuff		Online Schedule					
Write It Do It		21-30	31-40	41-50	51-60	1-10	11-20

SCIENCE OLYMPIAD™

Exploring the World of Science

Science Olympiad wishes to acknowledge the following business, government and education leaders for partnering with our organization. Working together, we can increase global competitiveness, improve science and technology literacy and prepare the STEM workforce of the future. Thanks to: Wright State University (2017 National Tournament Host), University of Wisconsin-Stout (2016 National Tournament Host), ArcelorMittal, Combined Federal Campaign, NASA's Universe of Learning Astrophysics STEM Learning and Literacy Network, Lockheed Martin, NBC Universal Foundation, Ward's Science, ACE Hardware, Centers for Disease Control and Prevention (CDC), Discovery Education 3M Young Scientist Challenge, DuPont Center for Philanthropy and Education, DuPont Pioneer, National Marine Sanctuary Foundation, National Oceanic and Atmospheric Administration (NOAA), Orkin/Rollins, Texas Instruments, VWR Foundation, Academy of Model Aeronautics, Chandra X-Ray Center, Investing in Communities, MAKE Magazine, Society for Neuroscience (SfN) and Yale Young Global Scholars. Strategic Partners: American Association for the Advancement of Science (AAAS), Digital Manufacturing and Design Innovation Institute (DMDII), The Groundwater Foundation, Hardware Science, Japan Science and Technology Agency, Maker Education Initiative, Million Women Mentors and Milwaukee School of Engineering (MSOE).

See the Science Olympiad website: www.soinc.org for current information regarding Summer Institutes, Teaching Guides, CDs, DVDs, and Standards

Science Olympiad

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