



Exploring the World of Science

Division C Rules Manual

Division C (Gr. 9-12)

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WELCOME TO THE 2016 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.

Bookmark www.soinc.org today!

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, Junior Varsity, 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 2016 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 2016 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 SOKITS15. Don't wait! This limited-time offer ends 12/31/15.



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SCIENCE OLYMPIAD DIVISION C 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 – sold out last year!
- Please visit the Science Olympiad web site: <http://www.soinc.org> for News, Clarifications, FAQs, Membership Information, Team Size Requirements, New Store Items and other valuable information, tips and resources.

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AIR TRAJECTORY

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

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

A TEAM OF UP TO: 2 **EYE PROTECTION: B** **IMPOUND: Yes** **APPROX. TIME: 8 Minutes**

2. **EVENT PARAMETERS:**

- a. Prior to competition teams are to develop and use performance data and calibration charts to determine the best launch parameters.
- b. Launch devices, copies of graphs, and all materials the teams will use (other than the eye protection and calculators) must be impounded prior to competition, **and be moveable by the competing team members without outside assistance. The device must be impounded with the mass(es) detached, which altogether must not exceed the limits in 3.a.**
- c. Competitors must wear eye protection during device setup and operation. Teams without proper eye protection must be immediately informed and given an opportunity to obtain eye protection if time allows.
- d. Event supervisors may disqualify any apparatus operated in an unsafe manner.

3. **CONSTRUCTION:**

- a. The launching force must be entirely supplied by the gravitational potential energy from a falling mass less than or equal to 3.500 kg (Div C); 5.000 kg (Div B). Any **part of the device** whose potential energy decreases and provides launch energy is considered part of the mass, **with the exception of items of nominal mass, such as strings and thin membranes/plastic container walls.** The falling mass may consist of multiple discrete parts, which together count as the total mass.
- b. During each launch, the gravitational potential energy must be converted to air pressure or air movement, which is then used to launch the projectile, either directly (e.g., pop gun style, etc.) or indirectly (e.g., using a pneumatic cylinder to swing an arm, etc.).
- c. All device air chambers must start each launch at ambient air pressure and must automatically return to ambient air pressure. **Chambers are not required to automatically return to the same shape.**
- d. The launching device, the projectiles, weights used to stabilize the device and all other device components (**except for tools/supplies**) must fit within a cube (**70.0 cm** per side for Div. C and **80.0 cm** per side for Div. B) in a ready-to-launch configuration, in any orientation chosen by the team.
- e. The triggering device is not considered part of the device and **activating it** must not contribute **significant** energy to the launch. It must extend out of the launch area, allow for the competitors to remain at least **75 cm** away from the launch area, and does not need to return to the launch area after launch. The triggering device must not pose a danger to anyone due to flying parts or excessive movement outside of launch area.
- f. Teams must provide unmodified (labeling is permitted) tennis, racquet, Ping-Pong, and/or **light weight plastic or foam** golf balls to be used as projectiles. Teams may change projectiles for each launch.
- g. The launching device must be designed and operated in such a way to not damage or alter the floor.
- h. Electrical components are not allowed as part of the device or triggering device.

4. **THE COMPETITION:**

- a. When instructed by the event supervisor, teams must place their devices at a location they select in a launch area **1.00 m x 1.00 m**, designated by tape on the floor. Tape must also be placed **75 cm** away from the sides and back of the launch area. **Event supervisors are recommended to use hard surfaces for the launch area floor (e.g., concrete, hardwood, plywood).**
- b. Competitors must not be within **75 cm** of the launch area or in front of the front edge of the launch area during a launch. They may touch only the part of the triggering device that extends at least **75 cm** outside of the launch area.
- c. No part of the launching device may extend outside of the launch area before or after a shot. If part of the launching device extends beyond the launch area during the launching action, it must return to and remain in the launch area immediately after the launch without assistance of the competitors.
- d. Two targets, designated by small marks on tape on the floor or panels lying on the floor, must be placed in front of the launch area. Supervisors are encouraged to place sand, cat litter, or similar substance in the area around the targets to help indicate landing spots.
- e. The targets must be placed in front of the launch area at distances between 2.00 m and 8.00 m (in intervals of 1.00 m for Regionals, 0.50 m for States, and 10.0 cm for Nationals). A distance of at least 2.00 m must separate the targets. **The near target must be centered on an imaginary centerline that bisects the launch area and is parallel to the launch direction. The far target may be anywhere up to 2.00 m (in intervals of 0.5 m for Regionals, 0.25 m for States, and 0.10 cm for Nationals) to the right or left of the imaginary centerline.** Target distances must be announced **only** after impound is over and must be the



AIR TRAJECTORY (CONT.)

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

same for all teams. **The far target announced distance will be along the centerline and then the left/right offset.** Room ceiling height should be considered when setting the distances.

- f. Each team will have 8 minutes to setup, adjust, and calibrate its device and to launch a maximum of 2 shots at each target. Teams may change the falling mass, but must not exceed the total impounded mass value. Time required by the event supervisor to measure launch distances must not be included in the allotted time. No practice shots may be allowed but adjustments/resetting may be made to the device between shots.
 - g. Before each launch, teams must notify the event supervisor which target they have selected.
 - h. After each launch the event supervisor must indicate to the competitors when they may approach the targets to make measurements to calibrate their device. Competitors must not touch the targets.
 - i. If the first shot at a target lands within 500 mm, a bucket shot may be requested in place of the second shot. Then, a bucket (~1 to ~5 gallon size, provided by the supervisor) must be placed (opening facing up) on the course **anywhere** between 2.00 m and 8.00 m in front of the launch area and **anywhere** up to 2.00 m to the right or left of the centerline. After impound the location and size of the bucket must be announced and must be the same for all teams. The bucket may only be on the course when requested so that it is not an obstacle. Hitting the bucket at first impact is worth 100 points. Making contact with the inside bottom surface is worth an additional **200 points (for total of 300 points)**. Teams with bucket shot attempt(s) will not have a third and/or fourth tie breaker and in case of a tie, are scored behind those that do.
5. **PENALTIES:** A 100 point penalty must be subtracted each time any of the following occurs, even **if during a non-best target score launch:**
- a. A competitor is warned by the supervisor for not correctly wearing the eye protection.
 - b. A competitor is within **75 cm** of the launch area or in front of the front edge of the launch area when a launch occurs, or approaches a target before the event supervisor indicates they may.
 - c. The team does not give a warning or indicate which target they are aiming for prior to launch. All launches, even if unintended, must count as one of the four team launches.
 - d. Any part of a team's launching device is outside the 1.00 m x 1.00 m launch area prior to or after a launch.
 - e. Teams must be informed of a penalty before the next launch.
6. **SCORING:** High score wins.
- a. Final Score = Best Close Target Score + Best Far Target Score + Graph Score - Penalties + Bucket Shot Points (if any)
 - b. Target Scores
 - i. The Target Score is 2000 (for the close one); 4000 (for the far one) minus the distance, in mm, from the center of the initial impact of the projectile to the respective target.
 - ii. Negative target scores must be assigned a score of 0.
 - iii. If the device fails to launch, teams must receive a score of 0 for that shot.
 - c. Graph Score (max possible = 400)
 - i. Any number of graphs and data tables may be impounded but the competitors must indicate a maximum of four used for the graph score, otherwise the first four graphs are scored.
 - ii. Graphs and tables may be computer generated or drawn by hand on graph paper. Each graph-table pair must be on the same side of a separate sheet of paper. **A template is available at www.soinc.org**
 - iii. One of the indicated graphs, selected by the event supervisor, must be scored as follows:
 - (1) 20 points for completed data table,
 - (2) 20 points for graph,
 - (3) 20 points if graph matches data table on same page,
 - (4) 40 points for proper labeling (title, team name, x & y axis variables, increments with units)
 - iv. Partial credit may be given.
 - v. The score of the scored graph will be multiplied by the number of graphs submitted (up to four, **as long as they are not the same**).
 - d. Teams that violate any of these rules, except for those listed under the penalty section must be ranked behind those that do not.
 - e. Example: If the Best Close Target = 1980, Best Far Target = 2560, Graph Score = 150, Penalties = -200, Bucket Shot Points = 100; then the Final Score is $(1980 + 2560 + 150 - 200 + 100) = 4590$
 - f. Tiebreakers: 1st - higher total of the sum of the two scored shots (to reward consistency); 2nd - lightest total impounded falling mass; 3rd - best non-scored shot at the far target; 4th - non-scored shot at the close target.

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



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. **INTEGUMENTARY SYSTEM:** All levels should know and understand:
 - i. Functions of the Integumentary System
 - ii. Anatomy of the layers of the skin, the component parts of the skin and sensory receptors
 - iii. Skin Color and Texture, Hair and Nails, Integumentary Glands and the effects of aging on the skin
 - iv. The diseases on each level from the cell to the whole person as listed: burns, allergies to allergens (i.e., poison ivy, metals), infections (i.e., boils, carbuncles, athlete's foot, impetigo) and skin cancer
National Level Only:
 - v. Additional disorders: Psoriasis, human papilloma virus (HPV), other types of dermatitis and scabies
 - vi. Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)
 - b. **SKELETAL SYSTEM - All levels should know and understand:**
 - i. Bones of the axial and appendicular skeleton; label the basic surface anatomy of a bone as shown on a diagram and/or normal X-ray, CT and MRI.
 - ii. Name, structure and function of joint types and muscle and ligament attachments that surround the joints and the ranges of motion allowed by each type (e.g., ball and socket).
 - iii. Structures of bones in cross-section.
 - iv. Cellular composition, structure and function of bones, bone marrow and cartilage. (Development and maturation of bones at the cellular and gross anatomical levels)
 - v. How to distinguish between types of vertebrae (e.g., cervical, thoracic and lumbar).
 - vi. Characteristics and radiological features of bone diseases/disorders from the cell level to the whole person as listed: osteoarthritis, osteoporosis, fractures, disc herniation, scoliosis, anterior cruciate ligament tears, medial collateral ligament damage.
 - vii. The effects of exercise and aging on the skeletal system and the diseases mentioned.
National Level Only:
 - viii. Additional diseases/disorders to know: spinal stenosis, achondroplasia, juvenile rheumatoid arthritis, spinal fractures, ankylosing spondylitis, and osteosarcoma.
 - ix. Treatments and/or prevention for **all** conditions listed above (drugs, surgery, etc.).
 - x. Label the bones of the skull. Know the foramina of the skull and what passes through each.
 - xi. Salter-Harris fracture classification system.
 - c. **MUSCULAR SYSTEM - All levels should know:**
 - i. The interaction of the skeletal and muscular systems to allow movement.
 - ii. Muscle fibers - the cellular and gross anatomy of skeletal muscle, cardiac muscle & smooth muscle.
 - iii. Physiology of the skeletal muscle contraction system and the neuromuscular junction.
 - iv. How the skeletal muscles move bone, maintain posture, and produce heat.
 - v. Skeletal muscle actions - origin, insertion, interactions of different muscles.
 - vi. Location and identification of the major skeletal muscles of the body including origin, insertion, and function. See www.soinc.org for a list of the Major Skeletal Muscles.
 - vii. Exercise and aging effects on the cellular and gross anatomical structure of the muscular system.
 - viii. Muscle and tendon injuries and their prevention (i.e., strains and sprains).
 - ix. The diseases on each level from the cell to the whole person as listed: Poliomyelitis, Muscular Dystrophies, Myasthenia gravis, tetanus, myositis.
National Level Only: Kinds of muscle contraction, classes of muscle fibers and their functions, cardiac and smooth muscle roles in the body, muscle sensory systems (e.g. spindles and Golgi tendon organs). Additional diseases: Carpal Tunnel Syndrome, Botulism, Fibromyalgia, and Chronic fatigue syndrome. Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.), Role of the nervous system in muscle function.
4. **SCORING:** High score wins. Selected questions/quality of free-response answers 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)

1. **DESCRIPTION:** Teams will demonstrate an understanding of the basic concepts of mathematics and physics relating to stellar evolution and **star formation and exoplanets.**

A TEAM OF UP TO: 2

APPROXIMATE TIME: 50 minutes

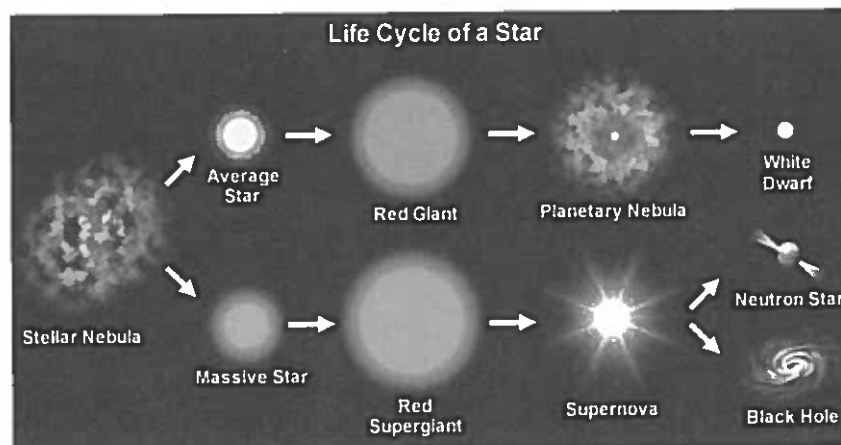
2. **EVENT PARAMETERS:** Each team may bring either two computers (**of any kind**) or two 3-ring binders (any size) containing information in any form from any source, or one binder and one computer. The materials must be inserted into the rings (notebook sleeves are permitted). Each team member is permitted to bring a programmable calculator. No Internet access is allowed.

3. **THE COMPETITION:** Using information which may include Hertzsprung-Russell diagrams, **color-color diagrams**, spectra, light curves, motions, cosmological distance equations and relationships, stellar magnitudes and classification, multi-wavelength images (X-ray, UV, optical, IR, **sub-mm**, radio), charts, graphs, animations and DS9 imaging analysis software, teams will complete activities and answer questions related to:
 - a. Stellar evolution, including spectral features and chemical composition, luminosity, blackbody radiation, color index and H-R diagram transitions, proto-stars, planet formation, T Tauri variables, FU Orionis variables, Herbig Ae/Be stars, brown dwarfs, protoplanetary disks, debris disks, H II regions, molecular clouds, and exoplanets including but not limited to: gas giants, terrestrial planets, super-Earths, mini-Neptunes, and hot Jupiters.
 - b. Use Kepler's laws, rotation and circular motion to answer questions relating to the orbital motions of **planets and planetary systems**; use parallax, spectroscopic parallax, and the distance modulus to calculate distances to **planetary systems**; use **radial velocity and transit timing methods to determine properties of exoplanets**; calculate **surface temperature of an exoplanet to determine habitability.**
 - c. Identify, specify the location and answer questions relating to the content areas outlined above for the following objects: **T Tauri, HL Tauri, AB Aurigae, HAT-P-11b, 51 Pegasi b, WASP-43b, WASP-18b, HD 106906b, WISE 0855-0714, 2MASSJ22282889-431026, M42, Barnard 68; and systems: 55 Cancri, Kepler-186, HD 95086, GD 165, HR 8799.**

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

Recommended Resources: All reference and training resources including the **Astronomy CD** are available on the Official Science Olympiad Store or Website at <http://www.soinc.org> Also see: <http://www.aavso.org/>; <http://chandra.harvard.edu/photo/index.html> ; <http://antwrp.gsfc.nasa.gov/apod/astropix.html>

THIS EVENT IS SPONSORED BY: NASA Astrophysics Division



1. **DESCRIPTION:** Prior to the competition, teams design and build a Bridge meeting these requirements to achieve the highest structural efficiency **while being tested at an angle.**

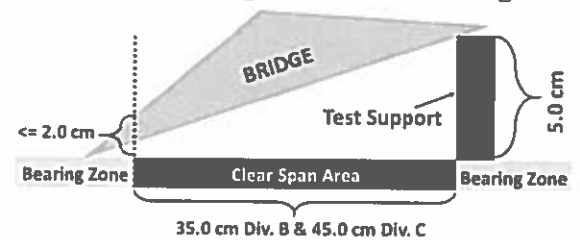
A TEAM OF UP TO: 2 **IMPOUND:** No **EYE PROTECTION:** B **MAXIMUM TIME:** 6 Minutes

2. **EVENT PARAMETERS:**

- Each team is allowed to enter only one Bridge built prior to the competition.
- Team members must wear proper eye protection during the set-up and testing of the Bridge. Teams without eye protection must not test and must be ranked in Tier 4.
- The Event Supervisor must provide all assessment devices, testing apparatus (4), two bucket stabilization sticks (5.b.vii), and clean, dry sand or similar dry, free-flowing material (hereafter "sand").

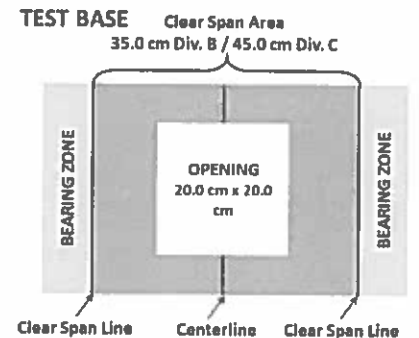
3. **CONSTRUCTION PARAMETERS:**

- The Bridge must span a **horizontal** opening of 35.0 cm (Division B) or 45.0 cm (Division C) and be designed to sit on a **single Test Support** (4.b) set at 5 cm high in one of the **Bearing Zones** (4.a.iv) of the Test Base. The low end of the Bridge must rest in the opposite **Bearing Zone** and the height of the Bridge can be no higher than 2 cm perpendicular to the Test Base surface within that **Bearing Zone**. The Bridge must be capable of meeting the Competition requirements for Testing (5.b).
- There is no maximum length, maximum width or minimum width.
- No portion of the Bridge may extend below the top surface of the Test Base (4.a) prior to testing.
- No portion of the Bridge may be braced against the sides of the Test Support (4.b) at any time.
- The Bridge must accommodate a Loading Block Assembly (4.c) placed in the center of the Bridge span.
- The Bridge must be a single structure constructed only of wood and bonded by adhesive. No other materials are permitted (e.g., no particle board, wood composites, bamboo or grasses, commercial plywood, structural members formed of sawdust and adhesive, paper price labels or paper).
- Any commercially available adhesive may be used. Adhesive is defined as a substance used to join two or more materials together. Adhesives include, but are not limited to: glue, cement, cyanoacrylate, epoxy, polyurethane and super glues. Adhesive tapes are not allowed.
- 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. **TESTING APPARATUS:** Supplied by the Event Supervisor

- The Test Base must be a solid and level surface as follows:
 - Must be at least 55.0 cm long x 32.0 cm wide.
 - Must have a smooth, hard surface (e.g., hardwood, metal, or high-pressure plastic laminate) and be stiff enough so it does not bend noticeably when loaded.
 - Must have an opening approximately at its center approximately 20.0 cm x 20.0 cm.
 - Parallel lines are marked across the width of the surface of the Test Base to indicate the Centerline and the Clear Span Lines. The Centerline divides the Test Base in half perpendicular to the span. The Clear Span Area of 35.0 cm for Division B and 45.0 for Division C is marked by two Clear Span Lines which are drawn equal distance to the left and right of the Centerline. The Bearing Zones are the test base surfaces outside the Clear Span Lines.
- One Test Support must be provided matching the Loading Block specifications (4.c.i).**
- The Loading Block Assembly must consist of:
 - Loading Block:** a square block measuring 5.0 cm x 5.0 cm x approximately 2.0 cm high with a hole **no larger than 8 mm diameter drilled perpendicular** to and centered on the 5.0 cm x 5.0 cm faces for a 1/4" threaded eyebolt.
 - A 1/4" threaded eyebolt (1" nominal eye outside diameter), no longer than 3" and a 1/4" wing nut.
- A chain and S-hooks that are suspended from the Loading Block Assembly.
- An approximately five gallon plastic bucket with a handle to be suspended from the chain and hook.
- The Event Supervisor must verify the combined mass of the Loading Block Assembly, chain, hooks, bucket, and sand is at least 15.100 kg but no more than 15.300 kg prior to testing.
- At the Event Supervisor's discretion, more than one testing apparatus may be used.





BRIDGE BUILDING (CONT.)

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

5. THE COMPETITION:

- a. **Check In** - All Bridges must be assessed prior to testing for compliance with construction parameters.
 - i. Team members must place their Bridge on the scale for the Event Supervisor to determine its mass in grams to the nearest 0.01 grams.
 - ii. No alterations, substitutions, **storage**, or repairs may be made to the Bridge after check-in. Once teams enter the event area to compete, they must not leave, receive outside assistance, materials, or communication.
- b. **Testing**
 - i. Teams must have a maximum of 6 mins. to setup and test their Bridge to the max. load or to failure.
 - ii. **Team members must set the Test Support (4.b) in one of the Bearing Zones (4.a.iv). The Test Support must sit on one of the 2.0 cm x 5.0 cm faces. Team members must place one end of the Bridge on the Test Support (4.b) and that end of the Bridge may not contact the Test Base. The other end of the Bridge must be set in the opposite Bearing Zone (4.a.iv).**
 - iii. **The Event Supervisor will check the height of the bridge at the Clear Span Line of the Bearing Zone where the bridge directly touches the Test Base to assure it does not exceed 2.0 cm. If the bridge exceeds 2.0 cm it is counted as a construction violation.**
 - iv. Team members will place the Loading Block approximately at the center of the test base opening.
 - v. Team members must assemble the Loading Block Assembly, eyebolt, chain and S-hooks, and hang the bucket to load the Bridge. Team members may disassemble the Loading Block Assembly to set up the test. The bucket must be mounted to allow enough clearance above the floor to allow for Bridge deflection.
 - vi. Team members must be allowed to adjust the Bridge until they start loading sand. No adjustment may be made after sand loading has begun.
 - vii. 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 provided by the Event Supervisor. Only the tip of the stabilization stick may touch the bucket. Refer to example on www.soinc.org
 - viii. Bridges that fail before supporting 15.000 kg must be scored according to the actual load supported at time of failure, measured to the nearest gram or best precision available. Failure is defined as the inability of the Bridge to carry any additional load, any part of the Bridge touching the test base **outside of the Bearing Zone (4.a.iv), any contact of the Bridge with the Bearing Zone at the end supported by the Test Support**, or any part of the load supported by anything other than the Bridge. Incidental contact between the chain/eyebolt and the device is not failure. **Incidental pieces falling off the bridge is not failure.**
 - ix. Loading must stop immediately when a failure occurs or when time expires. The Event Supervisor must remove any parts of the Bridge that fell into the bucket and sand added after time has expired or failure.
 - x. Teams who wish to file an appeal must leave their Bridge with the Event Supervisor.

6. **SCORING:** The Load Supported is the measured load supported (including the Loading Block, chain, hooks, eyebolt, wing nut, bucket, and sand) but may not exceed 15.000 kg. The least possible Load Supported must be the mass of the Loading Block. Bridges that cannot support the Loading Block must be ranked in Tier 4.

- a. $\text{Score} = \text{Load Supported (g)} / \text{Mass of Bridge (g)}$
- b. Bridges must be scored and ranked in the first 3 tiers by the highest Score.
- c. Bridges must be scored in four tiers as follows:
 - i. Tier 1: Bridges meeting all the Construction Parameters and no Competition Violations.
 - ii. Tier 2: Bridges with one or more Competition Violations.
 - iii. Tier 3: Bridges with Construction Violations or both Competition and Construction Violations.
 - iv. Tier 4: Bridges unable to be loaded for any reason (e.g., cannot cross the Clear Span, cannot accommodate Loading Block, or failure to wear eye protection) must be ranked by lowest mass.
- d. Ties are broken by this sequence: 1. Lowest Bridge Mass; 2. Widest Bridge, measured at the widest point of the Bridge prior to loading.

7. **SCORING EXAMPLES:** a. Load Supported = 13,235 g, Bridge Mass = 14.27 g, Score = 927.47; b. Load Supported = 15,000 g, Bridge Mass = 16.92 g, Score = 886.52

Recommended Resources: The Bridge Building DVD and the Problem Solving/Technology CD (PTCD) are available on the Official Science Olympiad Store or Website at <http://www.soinc.org>

THIS EVENT IS SPONSORED BY: ARCELORMITTAL

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

A TEAM OF UP TO: 2

EYE PROTECTION: C

APPROXIMATE TIME: 50 minutes

2. **EVENT PARAMETERS:** Students will bring and wear goggles where needed and non-programmable calculators. Each team may bring one 8.5"x11" sheet of paper that may contain information on both sides in any form from any source.
3. **THE COMPETITION:**
- a. The competition may be administered at a series of lab-practical stations such as demonstrations, experiments, scientific apparatus, models, illustrations, specimens, data collection and analysis, and problems for students to solve. Content topics will include:

At the regional and state level:	At the national level:
<ol style="list-style-type: none"> 1) Biological monomers and polymers 2) Cellular homeostasis (pH, osmolarity etc.) 3) Enzymes and inhibition 4) Cell organelles/structures and their functions 5) Differences between eukaryotic and prokaryotic cells 6) Bioenergetics 7) Membrane structure and function including lipid rafts, transport 8) Vesicle formation, fusion 9) Nucleotide triphosphates in energetics and signaling 10) Cell cycle and mitosis, role of cyclins and kinases 11) Chromosome structure 12) Fermentation products and uses 	<p>All topics from state and regional plus:</p> <ol style="list-style-type: none"> 1) Cell communication, membrane receptors, and signal transduction 2) Apoptosis and cancer 3) Cell cytoskeleton and intracellular trafficking 4) Induced pluripotent stem cells 5) Host/virus interactions 6) C₃ vs. C₄ vs. CAM plants 7) Protein folding and related diseases 8) Cancerous vs. healthy cells 9) Genomics and medicine/human health 10) Bioethics relating to above topics

- b. Process skills may include writing hypotheses, determining independent and dependent variables, controlling variables, graphing, analyzing data, interpreting results as well as using and applying technologies.
- c. Questions pertaining to the exact amount of ATP produced during cellular respiration must not be used as the amount of ATP produced varies within a cell.

4. **SAMPLE QUESTIONS:**

- a. Using models, photographs, or illustrations of structures such as organic molecules and cell organelles, identify the structure and describe its function or role in life processes.
- b. Using a light microscope, estimate cell size and determine the 3-dimensional shape of cells. Relate the size and shape of a cell to its function.
- c. Make measurements to calculate surface area to volume relationships. Relate surface area to volume relationships to cell structure and function.
- d. Contrast viruses and cells.
- e. Using the results of gel electrophoresis, identify and compare the different proteins.
- f. Identify substances such as protein, carbohydrates, lipids and vitamin C using reagent tests or data provided.
- g. Calculate the energy content of food from data either given or obtained from calorimeters.



5. **SCORING:** Each correct response will be assigned a point value. The highest score wins. Selected questions may be used as tiebreakers.

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



CHEMISTRY LAB

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

1. **DESCRIPTION:** Teams will complete one or more tasks and answer a series of questions involving the Science processes of chemistry focused in the areas of kinetics and gases.

A TEAM OF UP TO: 2

EYE PROTECTION: C

APPROX. TIME: 50 min.

2. **EVENT PARAMETERS:**

- Students:** Each student must bring safety equipment and a writing implement and each team may bring two non-camera capability calculators and five 8.5" x 11" sheets of paper that may contain information on both sides in any form from any source (sheet protectors are permitted).
- Supervisors:** must provide reagents/glassware/references that are needed for the tasks (e.g., Periodic Table, table of standard reduction potentials, any constants needed).
- 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 consist of a series of tasks similar to those in first year high school courses. These tasks could include hands-on activities, questions about each topic, interpretation of experimental data (graphs, diagrams, etc.), and/or observation of an experiment set up & running.
- Supervisors are encouraged to use computers or calculators with sensors/probes. Teams may be asked to collect data using probe ware that has been set up & demonstrated by the Supervisor or they may provide students with data sets collected by such sensors/probes following demonstration of the data collection. Data will be presented in a tabular and/or graphic format & students will be expected to interpret the data.
- Students should be aware that nomenclature, formula writing & Stoichiometry are essential tools of chemistry & may always be included in the event. Stoichiometry includes mole conversions & percentage yield. For purposes of nomenclature & formula writing, students are expected to know the symbols & charges for the following ions: nitrate, carbonate, phosphate, acetate, sulfate, ammonium, bicarbonate & hydroxide. Students should know how to use the "ite" form of anion (one less oxygen than the "ate" form).

Students should be able to use the periodic table to obtain the charge for monatomic ions (e.g., Na^+ , S^{2-}).

4. **SAMPLE QUESTIONS:**

- Kinetics:** Students will demonstrate an understanding of the principles of kinetics. They must be able to measure reaction rates and identify how and why reaction conditions (temperature, concentration, particle size, and catalysts) affect reaction rates. At the regional level, teams will NOT be asked to determine rate laws experimentally or from data provided. At the state and national levels, teams will be asked to determine rate laws from actual experimentation or data provided, and teams should also be able to determine rate constants with correct units.
- Gases:** Students will complete experimental tasks and answer questions related to the physical properties of gases, effect of greenhouse gases and ozone depletion on our climate, behavior of gases described by the following: Avogadro's law, Boyle's Law, Charles' Law, Dalton's law, Gay-Lussac's law, Graham's Law, and the ideal gas law. Students may be expected to complete labs/activities such as: Determine the: density of a gas, partial pressure of a gas, molar mass of a gas, relative rates of diffusion. Examine the relationship between: Pressure and volume, Pressure and temperature, Temperature and volume

5. **SCORING:** Approximately Kinetics 50% and Gases 50%. Time may be limited at each task, but will not be used as a tiebreaker or for scoring. Ties will be broken by pre-selected questions.

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



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 **Population Growth**.
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 hypothesis 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, protists, 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



ELECTRIC VEHICLE

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

1. **DESCRIPTION:** Teams must design, build, and test one vehicle that uses electrical energy as its sole means of propulsion to travel as quickly as possible and stop close to a Target Point.
A TEAM OF UP TO: 2 **EYE PROTECTION:** None **IMPOUND:** Yes **TIME: 8 minutes**
2. **CONSTRUCTION PARAMETERS:**
 - a. The vehicle must be designed to travel between 9.00 and 12.00 meters and come to a complete stop. The exact distance in these intervals (0.50 m – regionals; 0.10 m – states; 0.01 m - national) must be chosen by the Event Supervisor (ES) and will not be announced until the impound period is over.
 - b. Electrical energy used within the vehicle for any purpose must be stored in common, commercially available batteries labeled with their voltage by the manufacturer. Lead acid batteries are not allowed.
 - c. The vehicle may use no more than 6 individual cells (labeled 1.5 volts or less each), a single 9-volt battery, or a single battery pack (labeled 7.2 volts or less) at any given time during the 8 minutes. Batteries need not be installed until immediately prior to the run. Only electrical energy stored in these batteries may be used to propel the vehicle.
 - d. Additional energy storage devices may be used to operate other functions (e.g., braking system) provided these functions do NOT help propel the vehicle in any way. All sources of energy must be in easily accessible locations for inspection by the ES.
 - e. Components (e.g., motors, gearboxes, motor controls, bodies, and chassis) may be purchased or made by the team members. Electronic components (i.e., solid-state devices such as transistors, integrated circuits, diodes, and microprocessors) are allowed.
 - f. Only the wheels or treads in the ready-to-run configuration must fit in a 35.0 cm x 60.0 cm space. There is no height restriction.
 - g. A single $\frac{1}{4}$ inch wooden round dowel must be attached to the front end of the vehicle. The dowel must be approximately perpendicular to the floor and must be the leading part of the vehicle at all times.
 - i. The dowel must extend to at least 20.0 cm from the floor to interrupt the photogate system whose lasers must be placed approximately 17.0 ± 2.0 cm above the floor.
 - ii. The dowel must also extend to within 1.0 cm of the track's surface so that its front bottom edge will be the vehicle's Measurement Point for distance measurements.
 - iii. No part of the vehicle, except for a dowel attachment device of no more than 2.0 cm, can extend beyond the front of the $\frac{1}{4}$ inch dowel during its entire run.
 - h. Competitors must start the vehicle by using any part of an unsharpened #2 pencil with an unused eraser (provided by the ES) to actuate a button or switch by pushing it perpendicular to the floor (vertical). A non-vertical actuation is a construction violation.
 - i. Sighting, aligning, and guiding devices are allowed, including those that use electricity. Labeled lasers are permitted - see Laser Policy on www.soinc.org.
 - j. The only parts of the vehicle that are allowed to contact the floor during the run are the wheels/treads and those that are already in contact with the floor in the ready-to-run position. Piece(s) falling from the vehicle result in a construction violation.
 - k. The vehicle must not be remotely controlled or tethered. The stopping mechanism must work automatically.
 - l. Competitors 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:** At the Event Supervisor's discretion, more than one track may be used. Teams must be given the option to choose which track they will use. Both runs by a team must be made on the same track.
 - a. The track must be on a smooth, level, and hard surface.
 - b. The ES must use tape approx. 2.5 cm wide and 1.00 m long to mark the track's Starting Line, Target Line, and the lines for timing (0.5 m and 8.5 m from the Starting Line). The Starting Point and Target Point, located at the center of the Starting Line and Target Line, will be clearly marked. If a photogate timing system is used, it must be set across the track at a min. distance of 1.00 m between the laser and the gate.
 - c. A photogate timing system is highly recommended. Go to 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.
4. **THE COMPETITION:** Teams filing an appeal must leave all impounded material with the Supervisor.
 - a. The vehicle, batteries, and spare parts must be impounded before the start of the competition. Tools, data and calculating devices need not be impounded.



ELECTRIC VEHICLE (CONT.)

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

- b. Only competitors and supervisors must be allowed in the impound and track areas during the event. Once competitors enter the event area, they must not leave the area or receive outside assistance, materials, or communication.
 - c. Teams must be given 8 minutes to set up their vehicle and complete up to 2 runs. Vehicles in the ready-to-run configuration that start before the end of the 8-minute time period will be allowed to complete a run.
 - d. In the ready-to-run configuration, teams must place the vehicle anywhere behind the Starting Line. No part of the vehicle can be further than 1.00 m behind the Starting Line. The vehicle must remain behind the Starting Line without being touched.
 - e. Teams may adjust their vehicle before each run (e.g., change its speed, distance, directional control, change batteries) within their 8 minutes providing the vehicle continues to meet specifications.
 - f. Teams may use their own measuring devices to verify the track dimensions during their 8 minutes. They may not roll the vehicle on or adjacent to the track surface between the Starting and Target lines at any time prior to or during the competition.
 - g. Substances that may damage the floor or interfere with subsequent runs must not be applied to the wheels, treads, or floor. During their time, competitors may clean the track but it must remain dry at all times.
 - h. Sighting, aiming and guiding devices placed on the track are permitted but must be removed before the vehicle begins its run. Aligning and sighting devices mounted on the vehicle may be removed at the team's discretion prior to each run.
 - i. If the vehicle 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.
 - j. Run time starts when the dowel of the vehicle reaches the 0.50 m Line and ends when it passes the 8.50 m Line. The Run Time must be recorded in seconds to the precision of the timing device used.
 - k. Once the vehicle starts a run, the competitors must not follow it but must wait until called by the ES.
 - l. The team's 8 minute time is paused when the vehicle stops to allow for the supervisor's measurements. Timing resumes once the competitors pick up their vehicle or begin making their own measurements.
 - m. If the dowel of the vehicle passes the 0.50 m Line but stops before the 8.50 m Line, the timers record the Run Time, which stops when the vehicle comes to a complete stop, and the run is scored with a Competition Violation.
 - n. If a photogate system is used and either the dowel of the vehicle passes the 8.50 m Line outside of the timing system or the vehicle hits part of the system but its dowel still passes the 8.50 m Line, the run is valid and must not be scored with a Competition Violation. The backup timer will stop the watch when the vehicle appears to cross the 8.50 m line.
 - o. A Failed Run occurs if a second run does not occur in the 8 minutes or if the time or distance cannot be measured for a vehicle (e.g., it starts before the ES is ready, if it moves but does not go at least 0.50 m, or the competitors pick it up before it is measured).
5. **SCORING:** Low Final Score wins. The Final Score must be the lower of the 2 Run Scores. The Final Score of a vehicle with one Failed Run must be the other Run Score.
- a. Run Score for each run = Time Score + Distance Score + Penalties
 - b. Time Score = Run Time x 10
 - c. Distance Score = the distance from the Measurement Point to the Target Point in centimeters measured to the nearest 0.1 cm, a point to point measurement. The vehicle may stop on either side of the Target Line.
 - d. Each Competition violation must incur 1000 pts penalty per occurrence for that run (max. of 4000 pts).
 - e. Each Construction Parameters violation must incur 5000 pts penalty for that run (max. of 15000 pts).
 - f. A vehicle not impounded during the impound period must incur 10000 pts penalty for each run.
 - g. Ties must be broken by this sequence: 1. Lower non-used Run Score 2. Lower Time Score of the better-run 3. Lower Distance Score of the better run.
 - h. Teams whose vehicle cannot complete any run within the 8 minutes or those who have two Failed Runs must be given participation points only.

Scoring Example: On its first run, a vehicle stopped 135.8 cm from the Target Point with a Run Time of 6.67 s. On its second run, the vehicle stopped 21.3 cm from the Target Point with a Run Time of 5.85 s and incurred a Competition Penalty of 1000 points. Run #1 Score: $(6.67 \times 10) + 135.8 + 0 = 202.5$ and Run #2 Score: $(5.85 \times 10) + 21.3 + 1000 = 1079.8$ Final Score: 202.5

Recommended Resources: Reference and training resources including the **Electric Vehicle DVD (EVD)** are available on the Official Science Olympiad Store or Website at <http://www.soinc.org>

THIS EVENT IS SPONSORED BY LOCKHEED MARTIN

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 use of Significant Figures for C (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>



FORENSICS

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

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

A TEAM OF UP TO: 2

EYE PROTECTION: C

APPROXIMATE TIME: 50 minutes

2. **EVENT PARAMETERS:**

a. **Students** may bring only these items:

- i. test tubes (brushes & racks), or any devices in which they can perform the tests
- ii. droppers
- iii. funnel(s) and filter paper
- iv. pH or litmus paper
- v. spatulas, plastic spoons, and/or stirring rods
- vi. 9-volt or less conductivity tester (no testers will be allowed that run on AC current)
- vii. thermometer
- viii. flame test equipment (nichrome wire, cobalt blue glass, etc.)
- ix. slides & cover slips
- x. hand lens
- xi. writing instruments
- xii. a pencil and ruler (for chromatograms)
- xiii. paper towels
- xiv. metal tongs
- xv. each team may bring one three-ring binder (any size) containing information in any form from any source that is inserted into the rings (sheet protectors are permitted)
- xvi. **two** non-camera calculators

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

b. **Supervisor will provide:**

- i. iodine reagent (I_2 dissolved in KI solution)
- ii. 2M HCl
- iii. 2M NaOH
- iv. Benedict's solution
- v. a hot water bath
- vi. a Bunsen burner or equivalent BTU heat source to perform flame tests
- vii. a waste container
- viii. chromatography materials (e.g., beakers, Petri dishes, etc.)
- ix. a wash bottle with distilled water

c. **The supervisor may provide:**

- i. other equipment (e.g., a microscope, probes, etc.)
- ii. candle & matches if fibers given,
- iii. differential density solutions or other method of determining density of polymers if plastics given
- iv. reagents to perform other tests

- 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:**

Level	# Part a samples	# Part b samples	Part c chromatograms	Part d	Part e
Regional	3-8	5-9	1 type + Mass Spectra	1-2 topics	Required
State	6-10	6-12	1-2 types + Mass Spectra	1-3 topics	Required
National	10-14	10-18	1-3 types + Mass Spectra	3-5 topics	Required

- a. **Qualitative Analysis:** Substances to identify: sodium acetate, sodium chloride, sodium hydrogen carbonate, sodium carbonate, lithium chloride, potassium chloride, calcium nitrate, calcium sulfate, calcium carbonate, cornstarch, glucose, sucrose, magnesium sulfate, boric acid, and ammonium chloride (there will be no mixtures). All teams will have the same set of solids to identify.



FORENSICS (CONT.)

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

- b. **Polymers:** Students may be asked to identify:
 - i. **Plastics:** PETE, HDPE, non-expanded PS, LDPE, PP, PVC, PMMA, PC - students may not perform any burn tests on these polymers, but the supervisor may provide burn test results on these plastics.
 - ii. **Fibers:** cotton, wool, silk, linen, nylon, spandex, polyester - burn tests will be permitted on the fibers.
 - iii. **Hair:** human, dog, cat, bat, and horse hair - students will need to know hair structure including medulla, cortex, cuticle, and root.
 - c. **Chromatography/Spectroscopy:** Students will be expected to separate components using paper chromatography, TLC, and/or analyze mass spectra. Students may be expected to measure R_fs.
 - d. **Crime Scene Physical Evidence:**
 - i. **Fingerprint Analysis:** Students will be expected to know these 8 **specific fingerprint patterns** (**plain arch, tented arch, radial loop, ulnar loop, plain whorl, central pocket whorl, accidental whorl, and double loop whorl**). Students should also be familiar with the common fingerprint development techniques of dusting, iodine fuming, ninhydrin, and cyanoacrylate fuming. Students should understand terminology such as bifurcation, ridges, island, enclosure, loop, whorl, and arch. Students should be able to answer questions about skin layers and how fingerprints are formed. Students may be asked questions on the different methods of detecting fingerprints and the chemistry behind each of these methods.
 - ii. **DNA:** Students may be asked to compare DNA chromatograms/electropherograms from materials found at the scene to those of the suspects. Students will be expected to know how DNA is copied. See http://nobelprize.org/educational_games/chemistry/pcr/index.html
 - iii. **Glass analysis:** Students may be asked to use index of refraction to determine the type of a glass found broken at a crime scene. They may be asked to analyze which hole or fractures occurred before others based on a piece of glass available for examination or a picture of a piece of glass.
 - iv. **Entomology:** Students may be asked to identify how long an animal has been dead based on the type of insects found on the body at the scene.
 - v. **Spatters:** Students may be asked to analyze actual spatters or photographs of spatters to determine the angle and velocity with which the liquid approached the solid object bearing the spatter & the spatter origin direction.
 - vi. **Seeds and Pollen:** Students may be asked to compare pictures of seeds/pollen found at the scene with either seeds/pollen found on the suspects or seeds/pollen from different country regions.
 - vii. **Tracks and Soil:** Students may be asked to match tire tracks or footprints found at the scene to tires or shoes of the suspects. 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.
 - viii. **Blood:** Students may be asked to identify the ABO blood type using artificial blood (event supervisor required to provide instructions on how the typing system works) or students may be asked to identify if a blood sample, either prepared microscope slide or pictures of microscope slide is human, avian, mammalian, or reptilian/amphibian.
 - ix. **Bullet striations:** Students may be asked to match the striations on bullets or casings found at the crime scene and fired from a given gun.
 - e. **Analysis of the Crime:** 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 could be used in a mock crime scene.
4. **SCORING:** 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):
- a. Part 3.a. 20%, Part 3.b. 20%, Part 3.c. 15%, Part 3.d. 15%, and 3.e. 30%.
 - b. Tiebreaker: Ties will be broken by the highest score on the analysis of the crime scene, which includes the reasons why certain suspects have been eliminated or others remain in the pool of possible criminals.
 - c. A 10% penalty may be given if the area is not cleaned up as designated by the event supervisor.

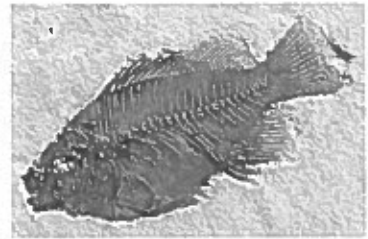
Recommended Resources: Reference and training resources including the **Forensics CD** are available on the Official Science Olympiad Store or Website at <http://www.soinc.org>

1. **DESCRIPTION:** Teams will demonstrate their knowledge of ancient life by completing selected tasks at a series of stations. Emphasis will be on fossil identification and ability to answer questions about classification, habitat, ecologic relationships, behaviors, **environmental adaptations** and the use of fossils to date and correlate rock units.

A TEAM OF UP TO: 2

APPROXIMATE TIME: 50 minutes

2. **EVENT PARAMETERS:** Each team may bring only one magnifying glass, one published field guide that they may tab and write in, and one 3-ring binder (any size) containing information in any form from any source. The materials must be punched and inserted into the rings (sheet protectors are allowed).
3. **THE COMPETITION:** 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. **Identification will be limited to species on the Official Fossil List, but other species may be used to illustrate key concepts.** Questions will be chosen from the following topics:
- Identification of all fossil specimens on the official Fossil List posted at <http://www.soinc.org>
 - Conditions required for a plant or an animal to become fossilized.
 - Common modes of preservation: permineralization, petrification/petrifaction/silicification, mineral replacement, cast/mold, imprint, actual remains. Uncommon modes of preservation: encasement in amber/copal, mummification, freezing, entrapment in tar/asphalt.
 - Relative dating: law of superposition, original horizontality, cross cutting relationships, unconformities (buried erosion surfaces).
 - Absolute dating: radiometric dating, half-life, carbon dating, volcanic ash layers.
 - Geologic Time Scale
 - Index Fossils
 - Fossil bearing sedimentary rocks: limestone, shale, sandstone, mudstone, coquina, etc.
 - Modes of life: filter feeder, predator, scavenger, deposit feeder, benthic, pelagic, etc.
 - Environments: marine, terrestrial, fresh water, etc.
 - Mineral and organic components of skeletons, shells, etc: (calcite, aragonite, silica, chitin)
 - Taxonomic hierarchy: kingdom, phylum, class, order, family, genus, species
 - Adaptations and morphologic features of major fossils groups
 - Important paleontological **places**, events and discoveries including mass extinctions and Lagerstatten.
4. **REPRESENTATIVE STATION TASKS:** Possible questions, tasks, stations and/or examples:
- Identify each fossil and record its mode of preservation.
 - Identify each of the fossils and list them in order from oldest to most recent.**
 - Identify each index fossil and record the geologic period(s) in its stratigraphic range.
 - Based on the fossil and rock associations, determine the environment in which the organism lived.
 - Construct a range chart and determine the age of the fossil assemblage.
 - Identify the Genus of a sample trilobite and the type of rock in which the creature is embedded.**
 - Identify each dinosaur by name, record each specimen's order and the geologic periods in its stratigraphic range.
5. **SCORING:** Points will be awarded for the quality and accuracy of responses. 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 **Smithsonian Fossil Handbook** and the **Fossil CD** are available on the Official Science Olympiad Store or Website at <http://www.soinc.org> The Smithsonian Fossil Handbook will serve as the primary authority on stratigraphic ranges of listed specimens, with the **Audubon Society Fossil Field Guide** as the secondary authority.



GAME ON

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

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

A TEAM OF UP TO: 2

APPROXIMATE TIME: 50 minutes

2. **EVENT PARAMETERS:** No Internet access outside of the Scratch program is allowed. No external resources of any kind are allowed. No pre-constructed games, game assets or files are allowed.

- a. Teams must bring a writing instrument(s) and may bring:
 - i. Headset(s) to assist in testing audio
 - ii. A microphone to assist in recording original audio
- b. Supervisors must provide:
 - i. A computer capable of running Scratch. Tournaments Directors are encouraged to provide computer specifications to the teams as early as possible
 - ii. A broad theme to build their original computer game around
 - iii. Scrap paper

3. **THE COMPETITION:**

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

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

5. **SCORING:** Scoring of the event will be done using the **Game On Rubric** found on www.soinc.org.

- a. Points will be awarded based on the coding and/or game play of the items.
- b. Zero points will be awarded for items not being present in the game or inappropriate content.
- c. Any team caught using outside resources or accessing the internet outside of the scratch program will be asked to leave the room and be disqualified from the event.
- d. Any team not addressing the assigned theme in their game will be ranked behind those who do, because not addressing the theme is a violation of the spirit of the competition.
- e. High Score wins. Ties will be broken by comparing the point totals in the scoring areas in the following order: Total points for 1 - Game Mechanics, 2 - Game Play, 3 - User Control, 4 - Balanced Play, 5 - Overall Impression/Originality.

Recommended Resources: All reference and training resources including the **Game On DVD (GMD)** and the **Game On Rubric** are available on the Official Science Olympiad Store or Website at <http://www.soinc.org>



GEOLOGIC MAPPING

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

1. **DESCRIPTION:** Teams will demonstrate understanding in the construction and use of topographic maps, geologic maps, and cross sections, and their use in forming interpretations regarding subsurface structures and geohazard risks.

A TEAM OF UP TO: 2

APPROXIMATE TIME: 50 min

2. **EVENT PARAMETERS:**

- a. Each team may bring one three-ring binder (any size) containing information in any form from any source. The materials must be inserted into the rings (notebook sleeves are permitted).
- b. Each team should bring a **geologic** compass, protractor, ruler, non-programmable calculator, colored pencils, and an equal-area projection stereonet with tracing paper and pin.

3. **THE COMPETITION:** The event may be composed of a test, stations, or a combination of both that will require the use of knowledge and relevant skills including observing, classifying, measuring, inferring, predicting and using relationships from the following topics:

- a. Topographic and geologic maps
- b. Plate tectonics, rock formation, Earth structure, Earth history, lithologies, and geological principles;
- c. Major structural elements, fold geometries, fault types, erosional patterns, intrusion types, subsurface geometries, and depositional and deformation sequences
- d. Cross-sections topographic profiles, projections of mapped features, and stereonet projections
- e. Bed thicknesses, orientations of planes from points, and map projection types
- f. Geohazards types and methods to assess, monitor, and mitigate the associated risks
- g. Aquifers, underground fluids, and methods of explorations and production

4. **REPRESENTATIVE TASKS:**

- a. Use a topographic map to construct a topographic profile
- b. Use stratigraphic column, geologic map, topographic profile, strike and dip, and bed thickness measurement to construct a cross-section of sub-surface structures
- c. Determine the order of events based on geological principles
- d. Assess geohazard risks based on interpretation of geologic and topographic maps, knowledge of lithologies, tectonic setting, and seismic history
- e. Use a **geologic compass to take measurements of strike and dip and plunge and trend of planes and lines**
- f. Assess potential occurrence of underground fluids through interpretation of geologic map and cross sections

5. **SCORING:**

- a. All questions will have been assigned a predetermined number of points.
- b. The highest score wins. Pre-identified questions will be used as tiebreakers.

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

1. DESCRIPTION:

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

A TEAM OF UP TO: 2

IMPOUND: No

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. Each participant may bring any kind of non-graphing calculator, but no other resources.

3. THE COMPETITION:

This event will be composed of three sections of approximately equal point value. This may include analysis, interpretation or use of charts, graphs and sample data. Note: Green Generation is designed for a two-year rotation - the first year (2015) covered aquatic issues, air quality issues and climate change while the second year (2016) will cover terrestrial issues and population growth issues.

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

- i. General Principles of Ecology - food webs and trophic pyramids, nutrient cycling, community interactions, population dynamics, species diversity and indicator species (2016)
- ii. Overview of Terrestrial Environments - forests, grasslands, deserts, tundra (2016)

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

- i. Terrestrial Environment Issues - Desertification, Deforestation, Soil pollution, Waste Disposal, Mining (2016)
- ii. Population Growth Issues - Habitat Destruction, Farming Practices, Fertilizers & Pesticides (2016)

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

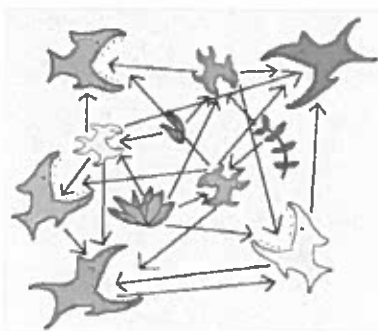
- i. Legislation and Economic Opportunity for Solving Problems (Div. C) (2016)
- ii. Sustainability Strategies - Environmental Stewardship of Terrestrial Ecosystems (2016)
- iii. Bioremediation Strategies (2016)
- iv. Nonrenewable, Renewable, and Alternate Energy Sources (2016)
- v. Waste Management (2016)

4. SCORING:

Questions will be assigned point values. Students will be ranked from highest to lowest score. High score wins. Ties will be broken by pre-determined tiebreaker questions.

Recommended Resources: All reference and training resources including the **Green Generation CD (GGCD)** and the introductory **Bio/Earth CD (BECD)** are available on the Official Science Olympiad Store or Website at <http://www.soinc.org> and see the American Chemical Society (ACS) Climate Science Toolkit at <http://www.acs.org/content/acs/en/climatescience.html>

THIS EVENT IS SPONSORED BY DUPONT PIONEER





HYDROGEOLOGY

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

1. **DESCRIPTION:** Students will manipulate a groundwater computer model, answer questions about groundwater concepts, and evaluate solutions, based on hydrogeological evidence, to reduce anthropogenic effects on groundwater.

A TEAM OF UP TO: 2

APPROXIMATE TIME: 50 Minutes

2. **EVENT PARAMETERS:**

- The supervisor will supply answer sheets and modeling resources.
- Students may bring a calculator, writing utensils, protractor, and an 8.5" x 11" note sheet.
- Supervisors and students should refer to www.groundwater.org/so.html for event guides, sample tests, event set-up recommendations, stated online resources, and more.

3. **THE COMPETITION:**

- The competition will take place in three parts (Parts 1 - 3).
- Students will be given a total of 50 minutes to complete Parts 1 - 3.
- Students will be given Parts 1 - 3 at the beginning of the event and may complete Parts 1 - 3 in any order.
- Students will complete Parts 2 & 3 using a scenario selected by the supervisor from the Groundwater Foundation's Hydrogeology Challenge (practice scenarios available at <http://groundwater.beehere.net>).
- Part 1: Students take a written test. The competition must consist of at least one question from each of the following areas: the fundamentals of groundwater and hydrogeology, surface-groundwater interactions, the relation of groundwater flow to geologic structure, and the management of contaminated groundwater. Questions can be multiple choice, true/false, fill in the blank, or short answer.
- Part 2: Students will use and manipulate a scenario selected by the supervisor from the Hydrogeology Challenge under static pumping conditions to answer questions.
 - Supervisors will provide the Hydrogeology Challenge scenario URL to students.
 - Students must fully complete the scenario for three wells in static conditions. The three wells will be provided by the supervisor (For example: Wells A, B, and C).
 - Students will submit model results online.
- Part 3: The supervisor will provide a set of circumstances for which the students will: 1) evaluate the risk of contamination to wells in the Hydrogeology Challenge scenario, 2) be able to explain any and all assumptions that were made in their analysis, and 3) complete a Remediation Techniques Table.
 - The set of circumstances must include the following: non-static conditions (at least one well must be pumping water), a pollutant (from the Contaminant Table found online), and a pollution source to be located at one well. The set of circumstances may include well types, well uses, and/or any other information the supervisor deems relevant.
 - Students will manipulate the Hydrogeology Challenge scenario to determine which wells are at risk of contamination by the pollutant and approximately how long until the contamination may occur.
 - Students will fill out a Remediation Techniques Table for the given set of circumstances (see example table online). The supervisor will provide the remediation techniques in the Remediation Techniques Table. The student will have to fill out the remediation technique definition, whether the technique is in-situ or ex-situ, the type of technique (chemical, biological, etc.), the average cost of the technique (low, medium, or high), and whether the technique is applicable to the pollutant given in the set of circumstances. Students and supervisors may use the Remediation Table for Hydrogeology (located online) as a guide, but are not limited to the techniques listed in this resource.
 - Students will use their results from the Hydrogeology Challenge and Remediation Techniques Table to answer questions about the scenario. Questions can be multiple choice, true/false, fill in the blank, or short answer.

4. **SCORING:** Highest total score wins. (Part 1 = 25%, Part 2 = 25%, Part 3 = 50%.) First tiebreaker: highest score on Part 3. Second tiebreaker: highest score on pre-selected questions from Part 1. Answers must include units where appropriate.

Recommended Resources: All reference and training resources including the **Hydrogeology DVD (HGD)** and the **Problem Solving and Technology CD (PTCD)** are available on the Official Science Olympiad Store or Website at www.soinc.org For questions or help visit FAQs and for more information on the Hydrogeology Challenge and Event Guide visit www.groundwater.org/so.html.

THIS EVENT IS SPONSORED BY THE GROUNDWATER FOUNDATION



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. The pages must be punched and inserted into the rings (sheet protectors are allowed). *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 *Agilus* 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



IT'S ABOUT TIME

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

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

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

2. **EVENT PARAMETERS:**

- a. The event supervisor must hide from view any clocks present in the competition room.
- b. All reference materials to be used during all parts of the competition must be secured in a 3-ring binder, so that regardless of orientation nothing can fall out.
- c. Competitors may bring calculators for use only during Part II of the competition.
- d. Each team may impound only one device and all components that are **integral to its operation (e.g. water, sand, etc.)**. **Components needed to set up, calibrate, and clean up (e.g., tools, clean-up supplies, reference materials, other time keeping devices) need not be impounded.** Each team may impound only one device that will be used for all time trials.
- e. The impounded device and any storage boxes must be clearly marked with the team's school name and competition number. At impound, the device and all **impounded** components must be able to fit into an 80.0 cm x 80.0 cm x 80.0 cm cube and be moveable by the competing team members without outside assistance. The device may become larger once setup for Part I.
- f. Event supervisors must verify that **the device meets** event rules. **A device that does not meet** event rules must not be impounded unless modified to meet event specifications by the team before the end of the impound period.
- g. The device must be designed and operated in such a way **that it does not** damage or alter the **competition area**.

3. **CONSTRUCTION:**

- a. Examples of acceptable non-electrical devices include water or sand glasses, simple or torsional pendulums, or oscillating springs.
- b. Commercial counters, **tally devices**, timepieces or their parts are not allowed. Commercial balances, scales, test tubes, beakers, graduated cylinders, **and burets** are not considered counters and are allowed.
- c. The device must NOT utilize any electrical components, physiological functions (e.g., pulse rate) or chemical reactions except for a battery-operated electronic balance or scale used solely to determine mass. **Competitors must not be an integral part of the device, but may interact with it during operation (e.g., they can make adjustments, move containers, count specific actions, etc.)**.
- d. The device must be constructed to contain spillage.
- e. The device must be constructed to minimize possible impacts on other teams when running (e.g., as quiet as possible, occupies a reasonable amount of space when set up, etc.).

4. **THE COMPETITION:**

Part I: Device Testing

- a. Teams must be allowed to interact with their device before, during, between and after the time trials.
- b. The event supervisor must pre-select a different target time (as described under **SCORING**) for each of 3 time trials. The same times must be used for all teams. Teams must not be informed of the selected intervals. Time trials must run in the order listed in the **SCORING** section.
- c. Teams must be given 5 minutes to setup and calibrate their device. **All other time keeping devices (e.g., watches, cell phones, etc.) must then be collected** by the event supervisor prior to the start of the time trials.
- d. **Prior to the start of the scored time trials, event supervisors must conduct a short example non-scored time trial to familiarize teams with the process and sounds involved.**
- e. Prior to the start of each time trial the event supervisor must notify the teams that the trial is about to start.



IT'S ABOUT TIME (CONT.)

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

- f. To mitigate human error, the event supervisor must use a timing device that produces a tone or sound indicating the interval start and stop. A stopwatch is not acceptable for this task. A computer with a program that can produce a series of beeps at the start and end of a time interval, or a prerecorded audio file that contains such beeps with a given time interval and is played to the teams is suggested. Event supervisors who do not utilize the audio files available on the National Science Olympiad website must provide teams with an example in advance of the competition.
- g. Teams must then have at least one minute to determine, calculate, and record the time from their device (to the nearest 0.1 second) and prepare for the next time trial.

Part II: Written Test

- g. Teams must be given a set amount of time (20-30 minutes is suggested) to complete a written test.
- h. Questions may be multiple choice, true-false, completion, or calculation problems.
- i. Unless otherwise requested, answers must be provided in metric units with appropriate significant figures.
- j. The test must consist of at least five questions from each of the five following areas:
 - i. Physics of modern timekeeping devices (e.g., atomic clocks, quartz clocks, electronic oscillations)
 - ii. Dynamical systems (e.g., motion equations, planetary motion, gravity, relativity, half-life)
 - iii. Waves and frequencies (e.g., electromagnetic waves, frequency analysis, harmonics, normal modes, resonance)
 - iv. Historical time keeping devices (e.g. pendulum clocks, water clocks, sun dials, early clocks and watches, primary mechanisms for keeping time)
 - v. Time standards (e.g., UDT, sidereal time, leap years/seconds, major calendars)

5. SCORING:

- a. Teams must start with the points listed below per time trial (for a total of 50 possible points for Part I).
- b. Points must be deducted from the initial points as described below. The score for a trial must NOT be less than zero. There must not be any carry-over of penalty points between trials. The trial interval ranges and points deducted are:

Time Trial #	Time Interval Range	Points Deducted / \pm 0.1 sec error	Initial Points
Trial 1	10 to 90 sec	0.3 pts. per 0.1 sec	15
Trial 2	90 to 300 sec	0.2 pts. per 0.1 sec	15
Trial 3	10 to 300 sec	0.1 pts. per 0.1 sec	20

- c. The Part II written test must be worth a total of 50 points.
- d. The total of the scores from Part I and Part II, minus any penalties, must determine the winner (which is the highest scoring team).
- e. Teams that operate their device unsafely or bring no device must receive a score of zero for Part 1. Teams must still be allowed to compete in Part II.
- f. If any material or substance splashes, spills or falls on a table or floor, or the team violates any other event rule (e.g., doesn't meet the event or construction parameters, misses impound), the team may be assessed a penalty of up to 10 points.
- g. A penalty of 15 points may be deducted from the total score if a team does not completely clean up before leaving the competition area. The event supervisor must make every effort to inform the team of this potential penalty and provide an opportunity to remedy the situation prior to assessing this penalty.
- h. Tiebreakers: 1st - best score from Time Trial 3, 2nd - designated question from the test.

Recommended Resources: All reference and training resources including the **It's About Time DVD (TIMD)** and the **Chem/Phy Sci CD** are available on the Official Science Olympiad Store or Website at <http://www.soinc.org>

THIS EVENT IS SPONSORED BY THE NATIONAL ASSOCIATION OF WATCH AND CLOCK COLLECTORS (NAWCC)



PROTEIN MODELING

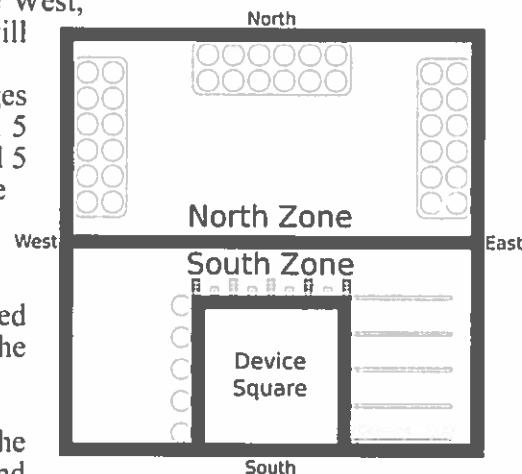
See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

- DESCRIPTION:** Students will use computer visualization and online resources to construct physical models of proteins. For 2016, students will model proteins involved in the biosynthesis of the neurotransmitters dopamine and serotonin, and in the subsequent signaling by these neurotransmitters as they bind to receptor proteins on post-synaptic cells.
A TEAM OF UP TO: 3 IMPOUND: Yes APPROXIMATE TIME: 50 minutes for Parts II & III
- EVENT PARAMETERS:** Pre-build models will be impounded.
 - Each team may bring up to five double-sided, 8.5"x11" pages of notes (**sleeve protectors are permitted**).
 - Students must bring writing instruments (**pencil/pen for the exam and marker for marking the toobers**) and a **metric ruler with cm marks**.
 - Supervisors will provide all **other** materials for on-site model construction and test. (Internet access not permitted)
- THE COMPETITION:** This event has three parts: a pre-build model, an on-site build model, & an exam.
 - Part I: The Pre-Build Model.** Students will use the program Jmol/JSmol, (see web-resources) to visualize a model of a specific protein based on atomic coordinate data, freely accessible from the RCSB Protein Data Bank (<http://www.rcsb.org>). For 2016, students will construct a model of a fragment of sepiapterin reductase (residues 93-261 of PDB entry 1SEP.pdb), an enzyme responsible for making the cofactor tetrahydrobiopterin. The role of this protein in neurotransmitter biosynthesis will be described in the Molecule of the Month feature by David Goodsell. A constructed model of this protein will be brought to all competitions; as the competition level increases, the scoring rubrics for the pre-build model will reflect higher expectations for model accuracy, detail and enhancements.
 - The final pre-build model must be based on the alpha carbon backbone display of the protein, using a scale of 2 cm per amino acid. Students may use Mini-Toobers®, or other comparable material (e.g., Kwik Twists, 12 gauge dimensional house wire, etc.), to construct their pre-build model. Students will use materials of their own choosing to add functionally relevant features to their model (e.g. selected amino acid sidechains, DNA or associated molecules). **Additions to the model should highlight the significance of structure to function of the protein. Students must explain additions to their model and what they represent in 500 words or less (single space, 10 point font size).** A significant portion of the score will be derived from these additional features. Students must deliver their pre-build model and explanations for impounding. They may pick up all models after the competition.
 - Part II: The On-Site Model.** During the on-site competition, students will build a physical model of a selected region of a specific protein using materials provided by the event supervisor. Web-based resources listed below will provide background information about the molecules for all levels of competitions.
 - Students will utilize a computer provided with the Jmol/JSmol application at the competition. Students must utilize only one of the identical computers provided at the competition with the appropriate coordinate files on it to guide their model construction. All construction materials for the model (Mini-Toobers®, amino acid sidechains, crosslinkers and plastic red and blue end caps) will be provided. Any model not handed to the judges by the end of the competition time will not be accepted for scoring.
 - Part III: The On-Site Written Exam** will be multiple choice/short answer questions addressing principles of chemistry that drive protein folding and the structure/function relationship of the modeled proteins.
- SCORING:** 40% of the event score will be based on the pre-build protein model (Part I), 30% on the on-site build (Part II) and 30% on the written exam (Part III). The pre-build protein model will be scored based on the accuracy and scale of the secondary structures, as well as the additions to the model (e.g. sidechains, DNA or associated molecules). Additions that do not support the molecular story will not receive credit. The on-site build protein model will be scored based on accuracy of folding the model and positioning specific amino acid sidechains. The exam will be scored for accuracy. Ties will be broken using identified questions from the written exam.

Recommended Resources: Material for the students, coaches and judges will be available on the Science Olympiad Webpage - at MSOE CBM (<http://cbm.msoc.edu/scienceOlympiad/index.php>) and RCSB PDB (<http://education.pdb.org/olympiad/>); RCSB PDB Homepage (www.rcsb.org) and PDB-101 resources (<http://www.rcsb.org/pdb-101>). The Mini-Toobers® are a product of 3D Molecular Designs. Materials for the Pre-build can be obtained from <http://www.3dmoleculardesigns.com>

THIS EVENT IS SPONSORED BY: The Milwaukee School of Engineering

1. **DESCRIPTION:** Prior to the competition, teams must design, build, document, and test one robotic device to move Scoreable Items.
A TEAM OF UP TO: 2 **IMPOUND:** No **EYE PROTECTION:** B **APPROX. TIME:** 10 min.
2. **EVENT PARAMETERS:** Teams must provide one Device. Teams without proper eye protection must be immediately informed of that and given a chance to obtain eye protection if time allows, otherwise not be allowed to compete and are scored as a no-show. The Supervisor provides the Competition Area and Items.
3. **CONSTRUCTION PARAMETERS:** The Device includes the Arm(s), an optional permanently attached Base, optional detachable passive Arm end effectors (parts that interact with the Items on the Competition Area), remote control box(es) (e.g. radio control; infrared; connections wires, tubes, hoses, etc.), and optional separate power supply.
 - a. The Arm(s) may be attached to a Base. All parts (except the control box(es), separate power supplies, and their connections) must fit inside an imaginary 30.0 cm x 30.0 cm x 100.0 cm high rectangular prism (only during the start). The Device must be attached to the floor only by the force of gravity.
 - b. Multiple commercial kits may be used, but each must have at least one functional modification, defined as a modification such that the lack of it will result in the Device working differently or not working.
 - c. While pneumatics are permitted, storage devices must not start with positive gauge pressure.
 - d. Commercial batteries, not exceeding 14.4 volts as labeled, may be used to energize each of the Device's electrical circuits. Multiple batteries may be connected in series or parallel as long as the expected voltage output across any points does not exceed 14.4 volts as calculated using their labeled voltage. Teams must be able to show the Event Supervisors (ES) the labeled voltage. All energy storage devices must be contained in the Device, power supply, or controller(s). Lead-acid batteries are not allowed.
 - e. Competitors must go to www.soinc.org to check legal and permitted frequencies for the radio-controlled equipment for surface devices.
 - f. Students must be able to answer questions regarding the design, construction, and operation of the Device per the Building Policy and **Technical Documentation** in 4.a.-c. See www.soinc.org
4. **TECHNICAL DOCUMENTATION** (must be submitted with the Device at check-in and include):
 - a. **Illustration (photos, drawings, etc.) of the basic structure of the Device with labels that must show:**
 - i. All actuators, numbered for reference in 3.b.i; ii. All energy sources; iii. Controls used to interact with the Device
 - b. **Operating Description:** i. Robot reaction to each control input, ii. Tentative/proposed plan of movement (i.e., which Items will be moved, how the Device plans to move each Item)
 - c. **Written Practice Log:** i. Record at least 10 runs, ii. Record at least 3 parameters. The parameters recorded must include score and time and any additional parameter as the third parameter.
5. **COMPETITION AREA:** The Competition Area is a 75.0 cm x 75.0 cm square marked using the inside edge of tape approx. 2.5 cm wide. The Supervisor must designate each of the 4 sides as North, East, South, and West. See www.soinc.org for an expanded view of Competition Area.
 - a. The inside edge of tape is used to mark a 30.0 cm x 30.0 cm square (the "Device Square") inside of, centered on, and sharing the South edge of the Competition Area.
 - b. The Competition Area is divided into equally sized North and South Zones defined by a piece of tape connecting the midpoints of the East and West edges of the Competition Area.
 - c. The Goal Cartons are 3 egg cartons (2 x 6 egg slots) with all covers and flaps removed. The unsecured Goals are placed facing up, centered, and lengthwise along the West, North, and East inside edges of the North Zone. Each carton will have 2 egg slots randomly and clearly labeled with a "B".
 - d. Scoreable items will be evenly spaced, touching the outside edges of the Device Square tape: 5 ping pong balls on the west side, 5 Lego bricks (standard 2 stud x 4 stud size) on the north side, and 5 unsharpened #2 pencils on the east side. A 2 stud end of the Lego bricks and the eraser end of each pencil will be pointing perpendicularly away from the edges of the Device Square tape.
 - e. 4 standard 16mm dice with the "1" dot facing up are centered between the Lego bricks touching the north outer edge of the Device Square.
6. **COMPETITION:**
 - a. At check-in, the Event Supervisor will inspect and measure the Device, select 6 items from the Technical Documentation, and have the competitors point them out on their Device.





ROBOT ARM (CONT.)

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

- b. Teams will have 3 minutes of Preparation Time to set up and test their Device in the Competition Area.
 - c. Before starting the competition, the Device must be in the Device Square in the ready to run configuration.
 - d. Prior to the run, the Event Supervisor must verify that the timekeepers and competitors are ready. It is suggested that 3 Timers be used with the middle time recorded as the Run Time. The Event Supervisor will then count aloud "1, 2, 3, Go". Teams will be given up to 3 minutes, starting from the word "Go", to complete the task of moving the Scoreable Items.
 - e. **The Device may move Goal Cartons anywhere inside or outside the Competition Area after Competition Time begins.**
 - f. Scoreable Items and Goal Cartons must not be damaged and must remain usable for other teams (e.g. Ping pong ball cannot be physically changed, mass remains the same, structural integrity remains intact, surface texture remains the same, etc.)
 - g. The run must stop (and the time recorded to the precision of the Timers) when any of the following occur (none of these actions will move the team to a lower tier):
 - i. 3 minutes has elapsed from the word "Go"
 - ii. The competitors say "Science"
 - iii. The competitors contact the Competition Area a second time after being warned once
 - iv. The competitors impart energy directly into the arm, base, Goal Cartons, or Scoreable Items.
 - v. Any end effectors are moved by anything besides stored energy in the Device
 - vi. Any part of the Device (except for end effectors and connections to control boxes) touching the Device Square surface in the ready to run configuration exits the Device Square
 - vii. The Arm(s) become detached from the optional Base (not including optionally detachable passive end effectors).
 - h. All objects must be scored based on where they were at the end of the run when time is stopped.
 - i. Teams who wish to file an appeal must leave their Technical Documentation and Device with the ES.
7. **SCORING: At the end of the competition, points will be awarded based on the number and types of objects that are in the specified scoring areas. High score wins.**
- a. If an Item is moved by the control box(es) connections or touches the surface outside of the Competition Area, even if it is under the control of the Device, that Item is out of play and will not attain any points. The Goal Cartons may touch the surface outside the Competition Area.
 - b. Teams must receive the following points for each Item completely supported by Goal Cartons at the end of the Competition Time. Any Item supported by multiple Goal Cartons will not receive any points. The Goal Cartons containing the Items may be anywhere (even outside the Competition Area) as long as they are upright as when the Competition Time started.

	<u>West Goal Carton</u>	<u>North Goal Carton</u>	<u>East Goal Carton</u>
Pencil	4	3	3
Lego	3	4	3
Ping Pong	3	3	4

- c. 2 additional points for each Goal Carton slot labeled "B" containing a Ping-Pong ball.
- d. At the end of the run, 1 point is awarded for every Item and dice completely within the area defined by vertically extending the lines defining the North Zone.
- e. 6 points for each die sitting flat completely within the Competition Area that has an even number facing upwards at the end of the Competition Time.
- f. The maximum number of points possible is 103.
- g. For each item incorrectly identified in 6.a., the final score will be multiplied by 0.98.
- h. Teams with incomplete Technical Documentation will have their final score multiplied by 0.95. Teams with no Technical Documentation will have their final score multiplied by 0.80.
- i. Ties are broken by 1) Greatest number of dice with the number six facing up; 2) Greatest number of Items fully supported by Goal Cartons; 3) Shortest Competition Time.
- j. Tiers:
 - i. Tier 1: Devices that meet all requirements.
 - ii. Tier 2: Devices with Competition violations.
 - iii. Tier 3: Devices that fail to meet a spec. under "Construction Parameters".
 - iv. Participation Points only: Devices that violate the frequency rules; that have no capability, by design or construction, to score points via moving objects; or are unable to compete.

Recommended Resources: All resources including the **Robot Arm DVD (RAD)** are available on the Official Science Olympiad Store or Website at <http://www.soinc.org>

THIS EVENT IS SPONSORED BY LOCKHEED MARTIN

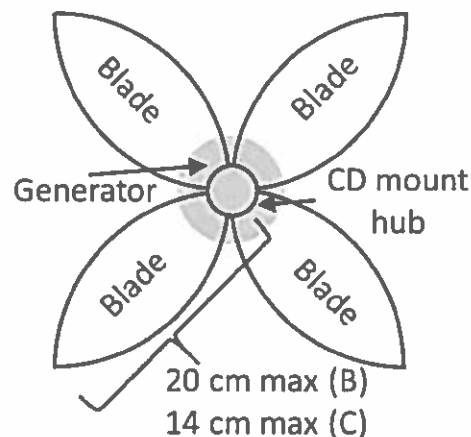
1. **DESCRIPTION:** Teams will build a blade assembly that consists of any kind of propeller/pinwheel/rotor attached to a compact disc (CD), which will be used to capture wind power. Students will also be tested on their knowledge regarding alternative energy.

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

2. **EVENT PARAMETERS:**

- All reference materials to be used during Part II of the competition must be secured in a 3-ring binder so that regardless of orientation none can fall out. Materials such as pencils, pens, protractors, rulers, nonprogrammable calculators, and any other similar tools may also be used during the set up and activity.
- 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.
- 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.
- The supervisor must provide the testing materials listed below (see the event page on www.soinc.org for a sample setup), which must be the same for all teams:
 - One or two 20" multispeed box fan(s) to be used as the wind source
 - Support stand(s) that allow for vertical and horizontal adjustments of the blade assembly
 - Motor/generator(s) mounted to the support stand(s)
 - Load resistor(s) between 5 and 7.5 ohms wired in parallel with the motor/generator that must have the same value for all teams
 - Device(s) to measure voltage across the load resistor
- 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 a support stand. Note: adjacent diagrams do not show CD to scale.

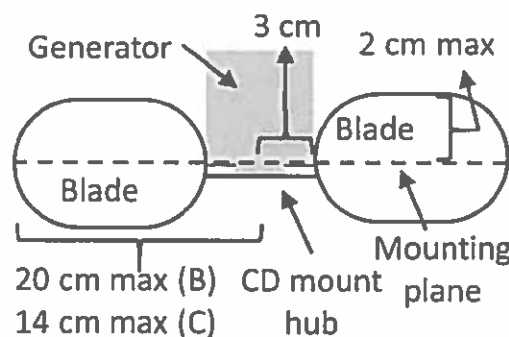
Example Assembly Front View



3. **CONSTRUCTION:**

- Each team may bring one pre-constructed blade assembly attached to a 12.0 cm CD.
- 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).
- 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).
- The blade assembly must be made of only nonmetallic substance(s).
- 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.
- When mounted, no part of the blade assembly may extend behind the mounting plane of the CD for a radial distance of 3 cm. Beyond a radial distance of 3 cm the blade assembly must not extend more than 2 cm 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.
- 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 Side View



4. **THE COMPETITION:**

Part I: Device Testing

- 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 verify that the blade assembly meets event rules before a team's testing period begins. This verification may take place during impound. Teams must be notified as soon as possible if a blade assembly does not meet specifications.
 - d. Teams may modify the blade assembly during the impound period, their Part I testing periods, or their Part II written test period, if time is available. 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.
 - f. Once the 3-minute testing period begins, teams must attach their blade assembly to the motor/generator mount and position it. The final position of the blade assembly must be no closer than 5 cm from the front grill of the fan. 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 during setup. Teams are allowed to adjust, modify, start and stop the blade assembly rotation during the testing period.
 - g. No later than 2.5 minutes into the testing period, with the fan already on and the blade assembly rotating, the students must tell the event supervisor to begin a 30 second measurement period. The team must not touch the blade assembly during the measurement period.
 - h. The event supervisor must record the maximum voltage that occurs during the 30-second measurement period. Voltage measurement devices that have 'peak hold' or 'max hold' functions are recommended.

Part II: Written Test

- i. Teams must be given a set amount of time (20-30 minutes is suggested) to complete a written test.
- j. Questions may be multiple choice, true-false, completion, or calculation problems.
- k. Unless otherwise requested, answers must be provided in metric units with appropriate significant figures.
- l. The test must consist of at least 25 questions (five each from the following five 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. SCORING:

- a. The Power Score of the blade assembly is calculated using the equation below:

$$\text{Power Score} = (\text{Max Voltage})^2 / \text{load resistance}$$
- b. The Part I Score is the sum of the low speed Power Score + high speed Power Score.
- c. If the blade assembly stops turning for a period of 10 or more seconds during the 30 second measurement period, has any pieces that detach from the assembly, or the team exceeds the 3 minute time limit, the Power Score at that fan speed must be multiplied by 0.8 when calculating the Part I Score.
- d. The Part II written test must be worth a total of 50 points.
- e. A team's Final Score must be determined as follows (with highest score winning):

$$\text{Final Score} = 50 \times (\text{Part I Score} / \text{Highest Part I Score of all teams}) + \text{Part II Score} - \text{Penalties}$$
- f. A 15-point penalty must be applied to the final score for any construction violation or if the team misses impound.
- g. The Part I Score 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.
- h. Ties must be broken by: 1st the highest high-speed voltage; 2nd the highest low speed voltage.

Recommended Resources: 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 dimes, 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 7.0 g or more.
- d. The airplane must be a monoplane (one wing) and the horizontally projected wingspan must not exceed 40.0 cm. The maximum wing chord (straight line distance from leading edge of wing to trailing edge, parallel to the fuselage) of the wing must be 6.0 cm or less. The maximum horizontally projected stabilizer span is 25.0 cm. The maximum allowable chord of the stabilizer is 5.0 cm.
- e. The propeller assembly may be built by the competitor(s) or purchased pre-assembled. 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 20.0 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.
5. **SCORING:** The base score is the Team's longest single flight time. Ties will be broken by the longest non-scored official flight time.
- a. 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.
 - b. At the state and national level, immediately after inspection, competitors **may attach up to 3 USD dimes** to their airplane, which will be available for inspection before competing. Flights receive a **50% bonus** to their flight time for each dime carried by the airplane during the flight (i.e., **1.5x flight time for one dime, 2.0x for two, 2.5x for three.**) The coins must be removable (not permanently glued) and readily visible to officials for inspection. The airplane must still comply with all other construction and competition rules, in particular 4.j (flight time will stop if the coins fall off the airplane and hit the ground) and 3.c (the airplane must still have a mass greater than 7.0g without the coins).
 - 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

<http://www.modelaircraft.org/>



1. DESCRIPTION:

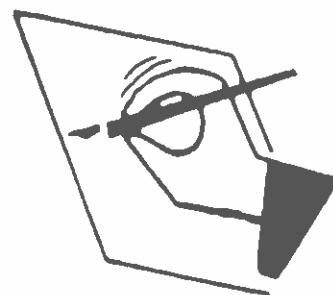
One student will write a description of an object and how to build it, and then the other student will attempt to construct the object from this description.

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 are not 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 the 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 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 2016 National Tournament at the University of Wisconsin-Stout, Menomonie, WI

COMPETITIVE EVENTS	7:00 - 8:00	8:15-9:15	9:30-10:30	10:45-11:45	11:45 12:15	12:15-1:15	1:30-2:30	2:45-3:45	
Anatomy & Physiology		21-30	31-40	41-50	LUNCH BREAK	51-60	1-10	11-20	
Astronomy		51-60	1-10	11-20		21-30	31-40	41-50	
Cell Biology		31-40	41-50	51-60		1-10	11-20	21-30	
Chemistry Lab		1-10	11-20	21-30		31-40	41-50	51-60	
Disease Detective	1-60								
Dynamic Planet		41-50	51-60	1-10		11-20	21-30	31-40	
Experimental Design		51-60	1-10	11-20		21-30	31-40	41-50	
Forensics		31-40	41-50	51-60		1-10	11-20	21-30	
Fossils		21-30	31-40	41-50		51-60	1-10	11-20	
Game-On		31-40	41-50	51-60		1-10	11-20	21-30	
GeoLogic Mapping		11-20	21-30	31-40		41-50	51-60	1-10	
Green Generation		41-50	51-60	1-10		11-20	21-30	31-40	
Hydrogeology		51-60	1-10	11-20		21-30	31-40	41-50	
Invasive Species		1-10	11-20	21-30		31-40	41-50	51-60	
Its About Time	IMPOUND	1-10	11-20	21-30		31-40	41-50	51-60	
Protein Modeling	IMPOUND	11-20	21-30	31-40		41-50	51-60	1-10	
Wind Power	IMPOUND	41-50	51-60	1-10		11-20	21-30	31-40	
Write It, Do It		21-30	31-40	41-50		51-60	1-10	11-20	
Air Trajectory	IMPOUND	Self-Schedule Online							
Bridge Building		Self-Schedule Online							
Electric Vehicle	IMPOUND	Self-Schedule Online							
Robot Arm		Self-Schedule Online							
Wright Stuff		Self-Schedule Online							



Exploring the World of Science

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

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