AIR TRAJECTORY

Read the General Rules in the manuals and 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 into a target and collect data regarding device parameters and performance.
   A TEAM OF UP TO: 2 **EYE PROTECTION** #5 **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.
   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 device part whose potential energy decreases and provides launch energy is considered part of the mass. The mass may consist of multiple discrete parts, which together count as the total mass. The device must be impounded with the mass detached.
   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.
   d. The launching device, including the projectile and all components, must fit within a 75.0 cm x 75.0 cm x 1.00 m (Div C), 80.0 cm x 1.00 m x 1.00 m (Div B) box in ready-to-launch configuration, in any orientation chosen by the team. Weights used to stabilize the device must be within the box.
   e. The triggering device is not considered part of the device and must not contribute energy to the launch. It must extend out of the launch area, allow for the competitors to remain at least 1.00 m 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 plastic practice 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 rectangular launch area 1.00 m x 1.50 m (parallel to the launch direction), designated by tape on the floor. Tape must also be placed 1.00 m away from the sides and back of the launch area.
   b. Competitors must not be within 1.00 m 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 1.00 m 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 and centered on an imaginary line parallel to the launch direction that bisects 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. Target distances must not be announced until after impound is over and must be the same for all teams. 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 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 between 2.00 m and 8.00 m in front of the launch area and up to 2.00 m to the right or left of the center line. 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 100 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:
   a. A competitor is warned by the supervisor for not correctly wearing the eye protection.
   b. A competitor is within 1.00 m 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 1.50 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.
      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).
   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

Read the General Rules in the manuals and on www.soinc.org as they apply to every event.

1. **DESCRIPTION**: Students will demonstrate an understanding of the basic anatomy and physiology of the Cardiovascular, Integumentary and Immune systems.
   A TEAM OF UP TO: 2 **APPROXIMATE TIME**: 50 minutes
2. **EVENT PARAMETERS:** Each team may bring one 8.5" x 11" sheet of paper that may contain information on both sides in any form from any source and up to two non-programmable, non-graphing calculators.
3. **THE COMPETITION**: The test is **limited** to the following topics:
   a. **INTEGUMENTARY SYSTEM:**
      i. Functions of the Integumentary System
      ii. Basic anatomy of the component parts of the skin
      iii. Anatomy of the layers of the skin and sensory receptors
      iv. Skin Color and Texture, Hair and Nails, Integumentary Glands
      v. Effects of aging on the skin
      vi. 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, athletes foot, impetigo) and skin cancer

      National Level Only:
      vii. Additional disorders: psoriasis, human papilloma virus (HPV) and **scabies**
      viii. Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)

   b. **IMMUNE SYSTEM:**
      i. Basic Functions of the Immune System
      ii. Anatomy and physiology of nonspecific defense system
      iii. Anatomy and physiology of specific defense system
      iv. The physiology of the immune response and allergic reactions
      v. Role of the Lymph System in immunity
      vi. Disorders: immunodeficiencies (i.e., AIDS), autoimmune diseases (i.e., multiple sclerosis, rheumatoid arthritis & systemic lupus erythematosus), and hypersensitivities (i.e., contact dermatitis)

      National Level Only:
      vii. Types of Organ Transplants and Prevention of Rejection
      viii. Additional disorder: Grave's Disease
      ix. Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)

   c. **CARDIOVASCULAR SYSTEM:**
      i. The Heart - chambers and valves of the heart, electrical stimulation of myocardial tissue, pacemaker tissue, interpreting ECG (EKG) readings
      ii. Blood Vessels - arteries, arterioles, veins, venules, capillaries
      iii. Blood - plasma, hematocrit, red blood cells, oxygen transport, hemoglobin, platelets and blood clotting, regulation of blood plasma volume and acidity, blood typing & basic genetics of ABO, Rh, and MN blood types including paternity mysteries
      iv. Measurement of the pulse rate and blood pressure
      v. Relevant calculations include systolic and diastolic pressure, mean arterial pressure, stroke volume and cardiac output
      vi. Disorders: Congestive Heart Failure, Atrial Fibrillation, Myocardial Infarction, Atherosclerosis, Bradycardia and Tachycardia
      vii. Effects of exercise, smoking, alcohol, caffeine and drugs on the cardiovascular system

      National Level Only:
      viii. Blood Vessels- continuous vs. fenestrated capillaries, blood brain barrier
      ix. Lymphatic System- white blood cells, lymph nodes, lymph ducts, lymphatic capillaries, lymphoid organs (spleen, thymus), tissue fluid
      x. Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)
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)

ASTRONOMY

Read the General Rules in the manuals and on www.soinc.org as they apply to every event.

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

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

2. **EVENT PARAMETERS:** Each team may bring either two laptop computers or two 3-ring binders (any size) containing information in any form from any source, or one binder and one laptop. 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, 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 I/II regions, molecular clouds, and exoplanets including but not limited to: gas giants, terrestrial planets, super-Earths, mini-Neptunes, and hot Jupiters**.

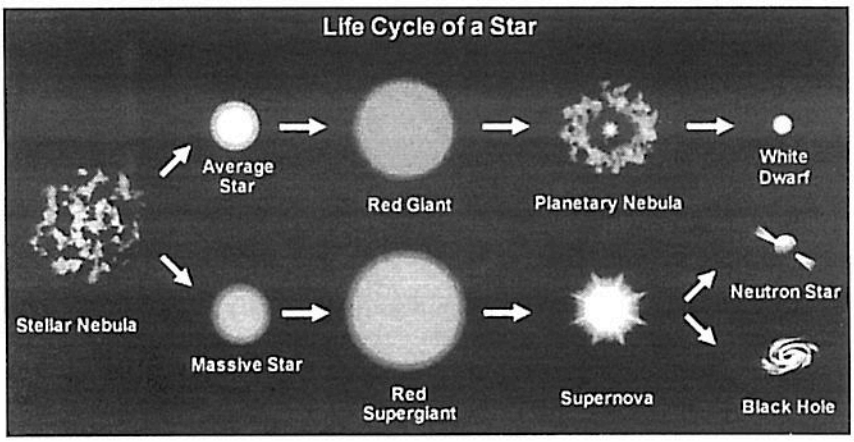
   b. Use Kepler's laws, rotation and circular motion to answer questions relating to the orbital motions of **planets and planetary systems**; use parallax, spectroscopic parallax, and the distance modulus to calculate distances to **planetary systems; use radial velocity and transit timing methods to 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: **FU Orionis, TW Hya, 2M1207, CoRoT-2, HD 209458b, HD 189733b, Kepler-7b, GJ 1214b, Beta Pictoris, Fomalhaut, HR 8799, WISE 1049-5319, Gliese 229B, LP 944-20, N159, M20.**

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: http://www.aavso.org/ ; http://chandra.harvard.edu/photo/index.html ; http://antwrp.gsfc.nasa.gov/apod/astropix.html

THIS EVENT IS SPONSORED BY: Chandra Education and Public Outreach Office for the Chandra X-Ray Observatory



BRIDGE BUILDING

Read the General Rules in the manuals and on www.soinc.org as they apply to every event.

1. **DESCRIPTION**: The objectives of this event are for the team to design and build the lightest bridge with the highest structural efficiency that can span a given opening meeting the requirement specifications.
   A TEAM OF UP TO: 2 **IMPOUND**: No **EYE PROTECTION**: #2 **MAXIMUM TIME**: **8** Minutes
2. **EVENT PARAMETERS**:
   a. Each team is allowed to enter only one Bridge built prior to the competition.
   b. Team members must wear proper eye protection during the set-up and testing of the bridge. Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows. Teams without eye protection must not test and must be ranked in Tier 4.
   c. The Event Supervisor must provide all assessment devices, testing apparatus, two bucket stabilization sticks, and clean, dry sand or similar dry, free-flowing material (hereafter "sand").
3. **CONSTRUCTION PARAMETERS**:
   a. All construction must be completed prior to check-in.
   b. The Bridge must be a single structure designed and built by the team to sit upon two Test Supports (4.b.) at either end of the bridge and support a Loading Block (4.c.).
   c. The bridge must span an opening of 35.0 cm (Division B) or 45.0 cm (Division C).
   d. There is no maximum length or height.
   e. The outside width of the Bridge must be at least 5.0 cm at any height along its span. No portion of the bridge may extend below the top surface of the Test Supports (4.b) prior to testing.
   f. The bridge must accommodate a Loading Block Assembly placed in the center of the bridge span.
   g. All parts of the Bridge must be constructed 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).
   h. There are no limits on the cross section sizes or lengths of individual pieces of wood. Wood may be laminated by the team without restriction.
   i. 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, hot melt, polyurethane and super glues. Adhesive tapes are not allowed.
   j. **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**:
   a. The Test Base **must** be a solid, level surface as follows:
      i. **Must** be at least 55.0 cm long x 32.0 cm wide.
      ii. **Must** have a smooth, hard surface (e.g., hardwood, metal, or high-pressure plastic laminate). The Test Base **must** be stiff enough so it does not bend noticeably when loaded.
      iii. **Must** have an opening at its center approximately 20.0 cm x 20.0 cm, for bucket suspension.
      iv. **Parallel lines must be marked across the width of the surface of the Test Base to indicate the Clear Span. A centerline dividing the Test Base in half must be marked on the Test Base; lines at 17.5 cm for Division B, or 22.5 cm for Division C, on each side of the centerline will indicate the Clear Span. The Bearing Zones are the test base surfaces wider than the Clear Span lines. Refer to example on www.soinc.org**
   b. The Test Supports supplied by the Event Supervisor **must** meet the following requirements:
      i. Two identical supports at least 3.0 cm x 3.0 cm x 15.0 cm.
      ii. Made of a material that does not noticeably compress when loaded
      iii. Have smooth, hard surfaces (e.g., hardwood, metal, or high-pressure plastic laminate)
   c. The Loading Block Assembly must consist of:
      i. A square block measuring 5.0 cm x 5.0 cm x approximately 2.0 cm high with a hole in the center of the 5.0 cm x 5.0 cm faces for a ¼" threaded eyebolt.
      ii. ¼" threaded eyebolt **(1" nominal eye outside diameter),** no longer than 4" and a ¼" wing nut.
   d. A chain and S-hooks that are suspended from the Loading Block assembly.
   e. An approximately five gallon plastic bucket with a handle to be suspended from the chain and hook

f. The Event Supervisor must verify the combined mass of the Loading Block assembly, chain, hooks, bucket, and sand is at least 15.000 kg and no more than 15.500 kg prior to testing.
g. At the Event Supervisor's discretion, more than one testing apparatus may be used.

5. **THE COMPETITION**:
   a. No alterations, substitutions, 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. All bridges must be assessed prior to testing for compliance with construction parameters.
   c. Team members must place their Bridge on the scale for the Event Supervisor to determine its mass in grams to the nearest 0.01 g.
   d. Team members must have a maximum of **8** minutes to setup and test their Bridge to the maximum load, to failure, or the 8 minutes elapses.
   e. The students will place the bridge on the Test Supports (4.b) that are set by the students in the Bearing Zones (4.a.iv). The Test Supports must sit on one of the 15 cm long faces.
   f. Team members will place the loading block approximately at the center of the test base opening.
   g. Teams 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.
   h. Team members must be allowed to adjust the Bridge until they start loading sand. No adjustment may be made after sand loading has begun.
   i. 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.
   j. 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 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.
   k. 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 failure. Sand added after failure will be removed by the event supervisor.
   l. The Load Supported includes the loading block, chain, hooks, eyebolt, wing nut, bucket, and sand.
   m. Teams who wish to file an appeal must leave their Bridge with the Event Supervisor.

6. **SCORING**:
   a. The Load Scored is the measured load supported, but must not exceed 15.000 kg. This includes the mass of all the testing apparatus supported by the Bridge. The least possible load scored must be the mass of the Loading Block. Bridges that cannot support the Loading Block must be ranked in Tier 4.
   b. Bridges must be scored and ranked in the first 3 tiers by the highest Score.
   c. Score = Load Scored (g)/Mass of bridge (g)
   d. 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.
   e. Ties are broken by this sequence: 1. Lowest Bridge Mass; 2. Shortest bridge height prior to loading.

7. **SCORING EXAMPLES**:
   a. Load scored = 13,235 g, Bridge Mass = 14.27 g, Score = 927.47
   b. Load scored = 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

BUNGEE DROP

Read the General Rules in the manuals and on www.soinc.org as they apply to every event.

1. **DESCRIPTION**: Each team will design one "elastic" cord to conduct two separate "drops" at a given height(s) and attempt to get a drop mass placed in a bottle as close as possible to, but without touching, a landing surface (plane).
   A TEAM OF UP TO: 2 **IMPOUND:** Yes **TIME**: approximately 15 minutes
2. **EVENT PARAMETERS**:
   a. Teams must provide one "elastic" cord to be used for both drops that terminates with a closed metal ring approximately 1/2 to 1 inch in diameter (e.g., a key ring) that will not open and may bring their own measuring devices, to confirm heights, length or mass during the time given for preparing their two drops.
   b. Supervisors will supply a drop mass (50-300 grams) that will be placed in a 500-591 mL plastic bottle. **Total weight of the bottle shall include the bottle, attachments and mass. The same weight shall be used for both drops**. An attachment mechanism (hook, clasp, carabiner, etc.) that will connect the team's bottom cord ring to the bottle and a top anchoring system/extended platform with a release mechanism (e.g., a clamp) to attach the top end of the elastic cord, which all teams must use. At Regionals, the mass will be in multiples of 25 grams, at State the mass will be in multiples of 10 grams, and at Nationals it may be any mass. The bottle's total mass value and length, including the attachment mechanism, will be posted immediately after impound.
   c. Supervisors must provide an accurate system for determining how close a team's device came to the landing surface (plane), and whether or not it touched. Some successful methods for determining the closeness of a drop to the landing surface (plane) include the use of digital video cameras **and in all cases, use multiple spotters as backup**. Possible methods for determining whether the device touched or broke the landing surface (plane) include a carbon paper drop area or a very fine powder landing area.
3. **THE COMPETITION:**
   a. The Drop: Teams will be given a total of 5 minutes to prepare their device in the holding area, followed immediately by 5 minutes to complete both drops.
   b. The drop heights: both "drop heights" will be between 2-5 meters (at Nationals the drop heights will be between 5-10 m). At Regionals and State the 2nd drop height may be the same or different. At Nationals the drop heights will be different. The exact height from which the drop must occur will be verified by at least two separate measurements by the supervisor. The drop height values and drop instructions will be posted immediately after impound.
   c. Elastic cords must be impounded prior to posting the bottle's length and total drop mass value and drop height(s). No physical alterations may be made to the elastic cord once it has been impounded (with the exception of marking drop locations on the cord before the drops). Any team that fails the "elasticity test" will be allowed to compete, but will be ranked behind all teams which pass the test. The cord may consist of more than one material (contest rubber, nylon, latex tubing, thread, sewing elastic, metal springs, etc.) and more than one strand as long as it meets the elasticity test. The operational definition of elasticity for this event is: while being suspended vertically, the bottom meter of the cord must stretch to at least 1.25 meters when a single 500g mass is attached to this section and return to **within 5cm of** its original length after the mass is removed. "Self-limiting-brake" mechanisms such as a separate, parallel, non-elastic strand that "brakes" the fall of the mass with little to no rebound are not permitted.
4. **SCORING**:
   a. The final score will be the sum of the distances between the lowest point of the bottle and the surface (plane) for each drop. The team with the lowest total distance for the two drops will be the winner.
   b. Teams with one drop that touches the landing surface (plane) will be ranked below those that have no touches. Teams with two touches will be ranked below those teams with one touch. Teams that failed the elasticity test will rank below all those that passed the elasticity test.
   c. If there is a tie, the team with the single best drop overall (closest to the landing surface (plane) on either drop) will win. Second tiebreaker is the cord with the greatest stretch in the elasticity test.

Recommended Resources: All reference and training resources including the **Bungee Drop DVD** and the **Prob.Sol./Tech CD** are available on the Official Science Olympiad Store or Website at www.soinc.org

CELL BIOLOGY

Read the General Rules in the manuals and on www.soinc.org as they apply to every event.

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**: #4 **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:** Students will bring and wear Z87 chemical splash 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:
1) Biological monomers and polymers, including LDL and HDL 2) **Cellular homeostasis (pH, osmolarity, etc.)** 3) Enzymes 4) Cell organelles/structures and their functions 5) Differences between eukaryotic and prokaryotic cells 6) Qualitative aspects of photosynthesis & respiration 7) Membrane structure and function 8) Movement across membranes 9) Importance of ATP 10) Structure of viruses 11) Cell cycle and mitosis 12) Chromosome structure 13) Fermentation products and uses	1) All topics from state and regional plus: 2) Cell communication and membrane receptors 3) Apoptosis 4) Enzyme inhibition 5) Stem cell concepts and uses 6) Viral replication 7) C_3 vs. C_4 vs. CAM plants 8) Consequences of changes in protein shape 9) Cancerous vs. normal cells 10) Genomics 11) 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

Read the General Rules in the manuals and 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 chemical reactions/stoichiometry and **kinetics**.

   A TEAM OFUP TO: 2 **EYE PROTECTION:** #4 **APPROX. TIME:** 50 min.

2. **EVENT PARAMETERS**:
   a. **Students: Each student** must bring safety equipment and a writing implement and **each team** may bring a **non-camera capability** calculator and one three-ring binder (any size) containing information in any form from any source that is inserted into the rings (notebook sleeves are permitted).
   b. **Supervisors:** must provide reagents/glassware/references that are needed for the tasks (e.g., Periodic Table, table of standard reduction potentials, any constants needed, etc.).
   c. **Safety Requirements:** Students must wear the following or they will not be allowed to participate: closed-toed shoes, ANSI Z87 indirect vent chemical splash goggles (see www.soinc.org), pants or skirts that cover the legs to the ankles, and additionally a long sleeved lab coat that reaches the wrists and the knees or a long sleeved shirt that reaches the wrists with a chemical apron that reaches the knees. **Long hair, shoulder length or longer, must be tied back**. Gloves are optional. Students who unsafely remove their safety clothing/goggles or are observed handling any of the material or equipment in a hazardous/unsafe manner (e.g., tasting or touching chemicals or flushing solids down a drain and not rinsing them into a designated waste container provided by the supervisor) will be penalized or disqualified from the event.

3. **THE COMPETITION**:
   a. 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.
   b. Supervisors are encouraged to use computers or calculators with sensors/probes. Students may be asked to collect data using probe ware that has been set up & demonstrated by the Supervisor. Or the supervisor 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.
   c. 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**:
   a. Chemical Reactions/Stoichiometry: Students will complete experimental tasks and answer questions related to classification of reaction type, balancing reactions (including predicting products of double replacement reactions, solubility, oxidation-reduction, total ionic and net ionic equations), and reaction prediction.
   b. **Kinetics:** Students will demonstrate an understanding of the principals 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.

5. **SCORING**: Chemical Reactions/Stoichiometry: 50% and **Kinetics** 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

COMPOUND MACHINES

Read the General Rules in the manuals and on www.soinc.org as they apply to every event.

1. **DESCRIPTION**: This event includes activities and questions related to simple and compound machines.

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

2. **EVENT PARAMETERS**:
   a. The event has two parts: Part 1 - written test on simple/compound machines, and Part 2 - device testing.
   b. Competitors may bring a single pre-made device, tools, supplies, reference materials, writing utensils and any type of calculators for use during both competition parts. Calculators do not need to be impounded.
   c. The device and any tools and/or supplies must fit inside a box no larger than 100.0 cm x 100.0 cm x 50.0 cm (at impound) and must be impounded prior to the start of competition.
   d. 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. **Reference materials do not need to be impounded.**
   e. Event supervisors provide **three** masses **labeled A, B, and C. A flexible loop, large enough to pass a standard golf ball through, must be tied to the top of each mass. The loops may be made from fishing line, zip ties, string, etc**. The masses, including the fully stretched out flexible loop, must be able to fit inside a 15.0 cm x 15.0 cm x **20**.0 cm **box**.
   Masses A, B, and C must be between **20**.0 and **800**.0g. The ratio of the **largest** mass to the **smallest** mass must not exceed **8:1** for Regionals, **10:1** for States and **12:1** for Nationals.
3. **CONSTRUCTION**:
   a. The device must be a class 1 lever connected directly in series to a class 2 lever, each with a single beam of length less than or equal to **40**.0 cm.
   b. The device may be made out of any materials. Electric or electronic components are prohibited.
   c. The device must be constructed to accommodate the masses.
   d. **The device must not include springs.**
   e. **Competitors must not bring masses or include them in devices except when fixed in place prior to impound to obtain static equilibrium.**

4. **THE COMPETITION**: All teams must be given the same total amount of time to complete both parts of the competition.
   a. Part 1: Written Test:
      i. **Questions must utilize only metric units. When requested**, answers must be provided in **metric** units with the appropriate number of significant figures.
      ii. The competition must consist of at least one question from each of the following areas:
         1. Simple/compound machine concepts (e.g., types, terminology)
         2. Simple/compound machine calculations (e.g., ideal/actual mechanical advantage, efficiency, load, effort, potential / kinetic energy, coefficient of friction)
      iii. Questions are limited to the following static equilibrium simple machines **and must include at least five of the following**:
         1. Lever (all three classes)
         2. Inclined Plane
         3. Wedge
         4. Pulley (up to two triple pulleys **in a single system, also including belts**)
         5. Wheel and Axle **(including gears)**
         6. Screw
      iv. Prohibited topics include: dynamic calculations, strengths of materials, and angle of repose

b. Part 2: Device Testing
   i. The objective is to quickly determine **the ratios of three** unknown masses using a **compound** lever.
   ii. While all teams are working on Part 1, the event supervisor will individually call each team to a station. Multiple identical stations may be used, but all teams must use identical masses.
   iii. Supervisors must verify that devices meet construction specifications. Devices that do not meet construction specifications must not be tested until the devices comply with event specifications via modification with the tools and supplies brought by the team. Teams may use time allotted to Part 1 for this, but must not interfere with the device testing of other teams
   iv. Part 2 timing **(not to exceed 4 minutes)** begins when the event supervisor provides **the masses** to the competitors. The supervisor must ensure that **the mass values are** not revealed to **any** teams. **Teams must not touch the masses until time begins.**
   v. Using the basic mathematical principles of a lever and adjusting only the relative positions along the lever beams of the masses and fulcrums, competitors must calculate the **ratios** of the masses. **Teams may work with either two or three masses at a time.** Teams may use their resources, calculators and tools to determine mass ratios.
   vi. Competitors must not mark on, attach anything to, or modify the masses.
   vii. Part 2 timing stops when the competitors provide the supervisor with the calculated **mass ratios A/B and B/C** or 4 minutes has elapsed. Event supervisors must record the elapsed time to the nearest whole second. No changes are allowed to the calculated values once timing stops.

5. **SCORING**:
   a. Exam Score (ES): The test used for Part 1 of this event must be worth **50** points.
   b. Time Score (TS) = ((240 - team's part 2 time) / 240) x **10** points.
   c. **Ratio** Scores (**R1 and R2**) = (1-(abs (**AR** – CV) / **AR**)) x **20** points. The smallest possible **R1** and **R2** is 0. **AR** is the actual **ratio** of **two of the** masses (measured to the best precision of the equipment available to the event supervisor) and CV is the calculated value of the **ratio**. **R1 uses ratio A/B, R2 uses ratio B/C.**
   d. Teams with no device or **ratio** estimates, those **that miss impound,** or those that do not make an honest attempt to utilize a compound lever to determine the mass **ratios** receive **R1 & R2 &** TS of 0.
   e. Final Score (FS) = ES + **R1** + **R2** + TS. The maximum possible FS is 100 points. High score wins.
   f. Tie Breakers: **1st - Best ES; 2nd - Best TS; 3rd - specific test questions.**

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

DISEASE DETECTIVES

Read the General Rules in the manuals and 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
      ii. Creating graphic displays of data
      iii. Interpreting trends and patterns of epidemiologic data
      iv. **C Division only:** Recognizing and accounting for potential sources of error, rate adjustment (direct and indirect) and stratified analysis (e.g., Mantel-Haenszel test). Using basic statistical methods to describe data and test hypothesis involving qualitative and quantitative data **(<10% of test)**
      v. Communicating results
   d. Students will be presented with one or more descriptions of public health problems.
   e. Based on these descriptions, they will be expected to do the following:
      i. Generate hypotheses and recognize various fundamental study designs.
      ii. Evaluate the data by calculating and comparing simple rates and proportions.
      iii. Identify patterns, trends and possible modes of transmission, sources or risk factors.
      iv. Recognize factors such as study design/biases that influence results (more for Div. C-less for B).
      v. Propose interventions based on promoting positive health behaviors, eliminating or reducing risks of environmental exposures, or disrupting clearly identifiable chains of transmission.
      vi. Translate results/findings into a public health/prevention message for identified populations at risk.
   f. Students will also be expected to:
      i. Define basic epidemiological and public health terms (e.g., outbreak, epidemic, pandemic, surveillance, risk, vector, fomite, zoonosis, etc.).
      ii. Recognize various categories of disease causing agents & give examples of illnesses caused by each.
      iii. Recognize and understand differences among the major groups of infectious agents (e.g., viruses, bacteria, protistans, fungi and animals).
      iv. Recognize examples of various epidemiologic and public health phenomena such as types of outbreaks and modes of transmission.
   g. Calculations and mathematical manipulations should be part of the competition. Data may be contrived or modified to make it more appropriate for this age group as long as it does not radically alter results or interpretation.
   h. Process skills may include hypothesis, observations, inferences, predictions, variable analysis, data analysis, calculations, and conclusions.
   i. The level of questioning for B/C competitions should reflect the age-appropriateness for the two groups.
   j. The event format may be exam-based, station-based or a combination of both.

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

Recommended Resources: All reference and training resources including the **Disease Detective CD** are available at http://www.soinc.org

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

DYNAMIC PLANET

Read the General Rules in the manuals and on www.soinc.org as they apply to every event.

1. **DESCRIPTION**: Teams will complete tasks related to **physical and geological oceanography**.

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

2. **EVENT PARAMETERS**: Each team may bring four 8.5" x 11" sheets of paper that may contain information on both sides in any form from any source. Each student may bring any kind of calculator.

3. **THE COMPETITION**: Teams will be presented with one or more tasks, in a timed station-to-station format with the possible use of probe ware at stations. The emphasis will be on the **NGSS Science and Engineering Practices below** rather than vocabulary, identification, or questions based solely on the recall of facts. Topics are limited to the following:

   a. Seawater: composition, density, variations in salinity, and sources of salts
   b. Energy inputs, outputs, transfers and conversions
   c. Water temperature, pressure, and three-layer structure of ocean water
   d. Topographic features found on continental margins, ocean basins, and mid-ocean ridges
   e. Processes and features of tectonic plate motion in ocean basins, and patterns of age of the ocean floor
   f. Formation of fringing reefs, barrier reefs, and atolls
   g. Waves: Motion, height, wavelength, period, fetch, swell, surf, and tsunamis
   h. Surface currents: Warm and cold currents; Coriolis effect, and gyres
   i. Coastal currents: longshore currents, rip currents, and upwelling
   j. High and low tides, spring and neap tides, and tidal currents
   k. Coastal features and processes, uplift and subsidence
   l. Oceanic tools used to collect water samples, sediments, cores, track water movement, etc.
   m. Buoyancy of ships and submarines in water of varying density

4. **REPRESENTATIVE ACTIVITIES**:

   a. Given the water temperatures at various depths in a column of seawater, teams will construct graphs and identify and label the thermocline.
   b. Identify topographic features of ocean regions using seafloor maps.
   c. Write a hypothesis to explain changes in water salinity in high latitude ocean regions.
   d. Analyze and interpret data related to water pH in selected regions that may explain changes in barrier reef formation.
   e. Calculate the buoyancy of a given watercraft in water samples of varying diversity.

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

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

Next Generation Science Standards (NGSS) Science and Engineering Practices: asking questions and defining problems, developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational thinking, constructing explanations and designing solutions, and engaging in argument from evidence and obtaining, evaluating, and communicating information. Be sure to see how all forty-six of the Science Olympiad events are aligned to NGSS at http://soinc.org/align_natl_stand

ENTOMOLOGY

Read the General Rules in the manuals and on www.soinc.org as they apply to every event.

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

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

2. **EVENT PARAMETERS**: Each team may bring one 8.5" x 11" sheet of paper that may contain information on both sides in any form from any source and one commercially published resource that may be annotated, and tabbed (limit 3 words on tabs), and a hand lens or magnifying glass. The Supervisor will provide an answer sheet and if needed, dissecting microscopes.

3. **THE COMPETITION**:

   a. Teams will be asked to identify an insect's Order, Family or common name and answer a related question(s). Questions are **limited** to topics below and insects are **limited** to those listed on the Official Insect List, which is based on the Audubon Insect and Spider Field Guide.

   b. Insect specimens or images (nymph or larva for selected orders and families) will be exhibited so that students will be able to see pertinent features with the unaided eye or a hand lens.

   c. For any individual specimens, questions may also be asked concerning the economic or health impact of the specimen upon the human race.

   d. Topics may include structure and function of internal and external anatomy, ecology, behavior, and history.

   e. One of the stations may involve students using or formulating a simple dichotomous key to identify insects.

4. **SCORING**: The team with the highest number of correct answers will determine the winner. Selected questions may be used as tiebreakers.

Recommended Resources: All reference and training resources including the **Audubon Insect and Spider Guide,** the **Taxonomy CD (TXCD)** and the **Bio/Earth Sci CD (BECD)** are available on the Official Science Olympiad Store or Website at www.soinc.org

This Official Insect List is available at www.soinc.org under B/C Events/Entomology

2015 Entomology (B/C) – Official Insect List

Specimens will be **limited to those on the** Official list of **30** insect orders and **100** families. Orders or Families marked by an "*" require that the contestant be able to recognize larvae or nymph forms. **The taxonomic scheme is based upon the Audubon Insect and Spider Field Guide. Any arbitrations or questions will defer to this resource for the correct answer.**

EXPERIMENTAL DESIGN

Read the General Rules in the manuals and on www.soinc.org as they apply to every event.

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

   A TEAM OF UP TO: 3 **EYE PROTECTION**: #4 **APPROXIMATE TIME**: 50 minutes

2. **EVENT PARAMETERS:** Students must bring ANSI Z87 indirect vent chemical splash goggles and a writing instrument(s). Students may also 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 a Reporting Form based on the Rubric below and 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. The students will be given an outline (patterned after the scoring rubric) to follow when recording/reporting 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 scoring rubric at the bottom of this page. Zero points will be given for an inappropriate or no response. Points will be awarded dependent upon the completeness of the response. 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 RUBRIC/REPORTING FORM

a. Statement of Problem: Experimental Question (4 Points)
b. Hypothesis: Including prior knowledge that contributed to hypothesis (8 Points)
c. Variables:
   i. Constants: (Controlled Variables) Factors that are purposefully kept the same (8 Points)
   ii. Independent Variable: Factor being manipulated (6 Points)
   iii. Dependent Variable: Factor being measured which responds (6 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: Including drawn in line of best-fit (12 Points)
j. Statistics: **Div. B&C**: Average (mean), median, mode **or** range or standard deviation 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: a. Statement of problem should not have a yes or no answer. It should be specific to the experiment being conducted and is not the same as the assigned topic area. b. Experiments should consist of repeated trials. c. Variables should be operationally defined. d. Experiments should be simple and have only one independent and one dependent variable.

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

Read the General Rules in the manuals and 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**: #4 **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 (notebook sleeves are permitted)
      xvi. **A non-camera** calculator

      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.) or
      ii. candle & matches if fibers given, or
      iii. differential density solutions or other method of determining density of polymers if plastics given or
      iv. reagents to perform other tests

   d. **Safety Requirements:** Students must wear the following or they will not be allowed to participate: closed-toed shoes, ANSI Z87 indirect vent chemical splash goggles (see www.soinc.org), pants or skirts that cover the legs to the ankles, and additionally a long sleeved lab coat that reaches the wrists and the knees or a long sleeved shirt that reaches the wrists with a chemical apron that reaches the knees. **Long hair, shoulder length or longer, must be tied back.** Gloves are optional. Students who unsafely remove their safety clothing/goggles or are observed handling any of the material or equipment in a hazardous/unsafe manner (e.g., tasting or touching chemicals or flushing solids down a drain and not rinsing them into a designated waste container provided by the supervisor) 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	8-12	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.

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 Rfs.

d. **Crime Scene Physical Evidence**:
   i. **Fingerprint Analysis:** Students may be expected to know the 8 NCIC classifications (arch, tented arch, radial loop, ulnar loop, plain whorl, central pocket whorl, accidental, and double loop). 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

FOSSILS

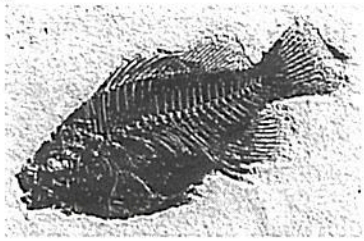
Read the General Rules in the manuals and on www.soinc.org as they apply to every event.

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:
   a. Identification of all fossil specimens on the official Fossil List posted at http://www.soinc.org
   b. Conditions required for a plant or an animal to become fossilized.
   c. Common modes of preservation: permineralization, petrifaction/petrification/silicification, mineral replacement, cast/mold, imprint, actual remains. Uncommon modes of preservation: encasement in amber/copal, mummification, freezing, entrapment in tar/asphalt.
   d. Relative dating: law of superposition, original horizontality, cross cutting relationships, unconformities (buried erosion surfaces).
   e. Absolute dating: radiometric dating, half-life, carbon dating, volcanic ash layers.
   f. Geologic Time Scale
   g. Index Fossils
   h. Fossil bearing sedimentary rocks: limestone, shale, sandstone, mudstone, coquina, etc.
   i. Modes of life: filter feeder, predator, scavenger, deposit feeder, benthic, pelagic, etc.
   j. Environments: marine, terrestrial, fresh water, etc.
   k. Mineral and organic components of skeletons, shells, etc: (calcite, aragonite, silica, chitin)
   l. Taxonomic hierarchy: kingdom, phylum, class, order, family, genus, species
   m. Adaptations and morphologic features of major fossils groups
   n. Important paleontological events and discoveries and their significance (e.g., Burgess Shale Permian Extinction, feathered dinosaurs from China)



4. **REPRESENTATIVE STATION TASKS:** Possible questions, tasks, stations and/or examples:
   a. Identify each fossil and record its mode of preservation.
   b. **Identify each of the fossils and list them in order from oldest to most recent.**
   c. Identify each index fossil and record the geologic period(s) **in its stratigraphic range.**
   d. Based on the fossil and rock associations, determine the environment in which the organism lived.
   e. Construct a range chart and determine the age of the fossil assemblage.
   f. **Identify the Genus of a sample trilobite and the type of rock in which the creature is embedded.**
   g. 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.