ANATOMY AND PHYSIOLOGY

1. **DESCRIPTION**: Understand the anatomy and physiology of the nervous, **integumentary** and **immune** systems.

   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**: Students should know the basic anatomy and physiology of the nervous, **integumentary** and **immune** systems. The test is **limited** to the following topics:

   a. **INTEGUMENTARY SYSTEM - All levels should know and understand:**
      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), other types of dermatitis
      viii. Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)

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

      National Level Only:
      viii. The Brain - anatomy and physiology of brain function including function and role of specific nuclei clusters and tracts, theories of dreaming, purpose and principles of MRIs and EEGs, Neural Impulses - Retrograde signaling
      ix. 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

1. **DESCRIPTION:** Students will demonstrate an understanding of the basic concepts of mathematics and physics relating to stellar evolution and **variable stars**.

   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 3-hole punched and inserted into the rings (notebook sleeves are allowable). 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, radio), charts, graphs, animations and DS9 imaging analysis software, participants will complete activities and answer questions related to:

   a. Stellar evolution, including spectral features and chemical composition, luminosity, blackbody radiation, color index (B-V), and H-R diagram transitions, proto-stars, **T Tauri variables**, Cepheid variables, semiregular variables, red supergiants, **Mira variables**, **RR Lyrae variables**, neutron stars**,** magnetars**,** pulsars**,** x-ray binary systems**, dwarf & recurrent novas, S Doradus variables,** Type II and **Type Ia supernovas**.

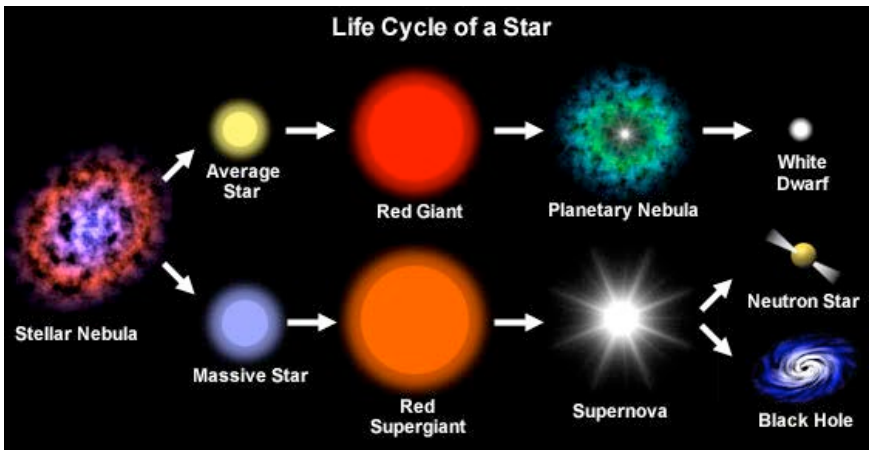
   b. Use Kepler's laws, rotation and circular motion to determine answers relating to the orbital motions of binary and multiple star systems; use parallax, spectroscopic parallax, and the distance modulus to calculate distances to Cepheids, **RR Lyraes** and **Type Ia supernovas**.

   c. Identify, know the location and answer questions relating to the content areas outlined above for the following Objects: **Mira**, **W49B**, **Tycho's SNR**, **Vela SNR**, **G1.9+0.3**, **Eta Carinae**, **SS Cygni**, **T Tauri**, **GRS 1915+105**, **47 Tucanae**, **The Trapezium**, **T Pyxidis**, **Abell 30**, **RX J0806.3+1527**, **V1647 Ori**, **V1**, **NGC 1846**, **NGC 3132**

4. **SCORING:** All questions will have been assigned a predetermined number of points. The highest score wins. Selected questions having differentiated weights 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



Boomilever

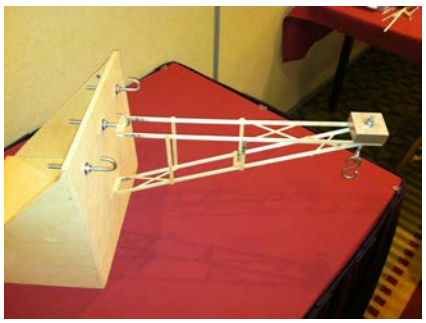
1. **DESCRIPTION:** A Boomilever is a cantilevered wood and **adhesive** structure, mounted to a vertical Testing Wall, carrying a load at a distance from the Wall. The objective of this event is to design and build the most efficient Boomilever meeting the requirements specified in these rules.

   A TEAM OF UP TO: 2 **IMPOUND:** None **EYE PROTECTION:** #2 **MAXIMUM TIME:** 10 Minutes

2. **EVENT PARAMETERS:**
   a. Each team is allowed to enter only one Boomilever built prior to the competition.
   b. Team members must wear proper eye protection during the set-up and testing of the Boomilever. 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, hardware, **level, two bucket stabilization sticks (refer to www.soinc.org),** and clean, dry sand or similar dry, free-flowing material (hereafter "sand").

3. **CONSTRUCTION PARAMETERS:**
   a. The Boomilever must be a single structure designed to attach to **one mounting hook (Div. C); one, two or three (Div. B) mounting hook(s)** in the Testing Wall (4.b.), support a Loading Block (4.a.) **with** a load up to 15.0 kg at a distance from the Wall **as specified (3.c.).**
   b. **The Contact Depth of the Boomilever is the lowest distance that the Boomilever touches the Testing Wall, measured below the center of the holes for the hook(s). The Contact Depth must not be more than 20.0 cm (Div. B) or 15.0 cm (Div. C) prior to loading.**
   c. The center of the Loading Block measured horizontally from the face of the Testing Wall must be between **45.0 cm - 50.0 cm (Div. B/C) and approximately centered horizontally on the Testing Wall.**
   d. **The Loading Block must be supported at a height higher than 5.0 cm below the Contact Depth.**
   e. **The Boomilever must be attached by means of the mounting hook(s) in the Testing Wall (4.b.iii.). The Boomilever must be able to be set up for testing without adjusting the mounting hook(s).**
   f. The Boomilever must not be attached or hooked to any edge of the Testing Wall. All tensile and shear connection to the Testing Wall must be through the mounting **hook(s).**
   g. All parts of the Boomilever 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 shall be 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.**

4. **TESTING APPARATUS:**
   a. The Loading Block **Assembly must consist of**:
      i. A square block measuring 5.0 cm x 5.0 cm x approximately 2.0 cm with a hole in the center of the square faces for a ¼" threaded eyebolt.
      ii. **¼" threaded eyebolt no longer than 4" long** and a **¼" wing nut**



   b. The Testing Wall must be as follows:
      i. It must be a vertical, solid, rigid surface with dimensions minimum of 40.0 cm wide x 30.0 cm high. It must a minimum of ¾" high grade plywood or other suitable material, with a smooth, hard, low-friction surface, and must not bend when loaded.
      ii. **Mounting hook(s) shall be 4" steel J-bolts made of ¼" nominal round stock, have a 5/8" nominal inside hook diameter with a threaded ¼" mounting end.** National Hardware bar code stock number N232-892 (UPC 038613228917), ¼" by 4" **or exact equivalent shall be used.**
      iii. **Mounting hook(s)** must be attached to the Testing Wall by the Supervisor with the "opening" up and installed to allow 2.5 cm +/- 0.1 cm clearance between the wall and the closest edge of the hook. The hook(s) must be secured in place with a hex nut and flat washer on the front side and a wing nut and flat washer on the back side of the Testing Wall. Division C must have one hook, horizontally aligned, and centered between the sides of the Testing Wall 5.0 cm below its top. Division B must have three hooks horizontally aligned and centered 5.0 cm below the top of the Testing Wall. The middle hole must be centered between the sides of the Testing Wall, with the other holes centered 10.0 cm on each

side of the middle hole. Supervisors must insure that the hook(s) remain securely in position during the competition. The centerlines of the holes must be visible on the face of the Testing Wall.

iv. **A horizontal Contact Depth line** must be clearly visible below the centerline of the holes **for the mounting hooks at** 20.0 cm (Div. B) or 15.0 cm (Div. C).

c. A chain and hook must be suspended from the Loading Block **assembly.**

d. An approximately five gallon plastic bucket with a handle must be suspended from the chain or hook with enough clearance above the floor to allow for Boomilever deflection.

e. The Event Supervisor must verify that the combined mass of the Loading Block, chain, bucket, sand, and attaching hardware is at least 15.000 kg and no more than 15.**5**00 kg prior to testing.

f. At the Event Supervisor's discretion, more than one testing apparatus may be used to ensure all teams can compete in a timely manner.

5. **<u>COMPETITION</u>:**

a. No alterations, substitutions, or repairs may be made to the Boomilever after check-in. Once teams enter the event area to compete, they must not leave or receive outside assistance, materials, or communication.

b. All Boomilevers must be assessed prior to testing for compliance with construction parameters.

c. Team members must place their Boomilever 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 ten minutes to set up and test their Boomilever either to the maximum load or **to** failure.

e. Team members must attach their Boomilever to the Testing Wall using the mounting **hook(s)**. **Teams must not adjust the mounting hook(s).** Teams must assemble the Loading Block **assembly,** eyebolt, chain and/or S-hooks, and hang the bucket as required to load the Boomilever. Team members may disassemble the block and eyebolt if necessary to set up the test.

f. Teams must set the Loading Block on the Boomilever within the **specified range** from the Testing Wall.

g. **The Event Supervisor must measure and record the Boomilever's Contact Depth and verify that it does not exceed the limit before loading sand**.

h. Team members must be allowed to adjust the Boomilever until they start loading sand. No adjustment may be made after loading of sand has begun.

i. Team members must be allowed to safely and effectively stabilize the bucket from movement caused by loading of the sand. **Direct contact of 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. Boomilevers 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 Boomilever to carry any additional load, or any part of the load supported by anything other than the Boomilever. **Incidental contact between the chain and the device is not failure.** Loading must stop immediately when a failure occurs or when time expires. The Event Supervisor must remove any **parts of the Boomilever that fell into the bucket and** sand added after failure.

k. **Teams who wish to file an appeal must leave their Boomilever with the Event Supervisor.**

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

a. The Load Scored must be the **measured** load supported, but must **not** exceed 15.000 kg. This includes the mass of all the testing apparatus supported by the Boomilever. The least possible load scored must be the mass of the Loading Block. Boomilevers that cannot support the Loading Block must be ranked in Tier 4.

b. Boomilevers must be scored and ranked in the first 3 tiers by the highest **Score**:

Score = Load Scored (g)/Mass of Boomilever (g)

c. Boomilevers must be scored in four tiers as follows:

i. Tier 1: Boomilevers meeting all the Construction Parameters and no Competition Violations.

ii. Tier 2: Boomilevers with one or more **Competition** Violations.

iii. Tier 3: Boomilevers with **Construction** Violations or both Competition and Construction Violations.

iv. Tier 4: Boomilevers unable to be loaded for any reason (e.g., cannot be mounted on testing Wall, 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** Boomilever Mass; 2. **Least** Contact Depth prior to loading.

7. **<u>SCORING EXAMPLES</u>:**

a. Mass = 14.27 g, load scored = 13,235 g → **Score = 927.47**

b. Mass = 16.92 g, load scored = 15,000 g → **Score = 886.52**

c. Mass = 10.30 g, load scored = 15,000 g, **Contact Depth = 21.4 cm → Score = 1456.31** (Tier 2)

<u>Recommended Resource:</u> The **Boomilever DVD** and training resources are available at www.soinc.org

BUNGEE DROP

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 and is the same 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 multiple spotters or digital video cameras. 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 National 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 approximately 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 **Problem Solving and Technology CD** are available on the Official Science Olympiad Store or Website at www.soinc.org

CHEMISTRY LAB

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 equilibrium and **chemical reactions/stoichiometry**.

   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 may bring a non-programmable, non-graphing calculator, and one 8.5" by 11" two sided page of notes containing information in any form from any source.
   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. Chemical gloves are optional, **but recommended**. 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**: 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. 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. 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. Equilibrium: Students should be able to write equilibrium reactions, predict the direction of a reaction using Le Châtelier's Principle, calculate an equilibrium constant and use equilibrium constants to determine concentrations. Tasks will be chosen from the following 1) Use a titration/data of a weak acid/base with a strong acid/base to calculate an equilibrium constant. 2) Investigate an equilibrium reaction and determine what happens when it is stressed. 3) Construct/use a standard absorption curve to determine an equilibrium constant. 4) Use a calorimeter to predict a curve. **5) Verify gas laws**. 6) At state & national levels, knowledge/application of equilibrium to separate chemicals may be included.
   b. **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.

5. **SCORING**: Equilibrium: 50% & **Chemical Reactions/Stoichiometry**: 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

CIRCUIT LAB

1. **DESCRIPTION**: Students will demonstrate their understanding of direct current (DC) electrical circuits.

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

2. **EVENT PARAMETERS**:

   a. Students are allowed to use any notes and/or calculators. Notes must be secured in a 3-ring binder of any size, so that regardless of orientation nothing falls out. Calculators must not have external probes or sensors of any type attached to them.
   b. The event supervisor must provide any needed measurement equipment such as multimeters or probes. Students may bring their own basic multimeters for use in place of event supervisor provided ones.

3. **THE COMPETITION**:

   a. The competition must consist of both hands-on tasks and questions related to DC electrical circuits. **25-**50% of the score must be from the practical portion (hands-on tasks), and 50-**75**% must be from the theoretical portion (written questions). **No single question may count for more than 10% of the score.**
   b. Supervisors are encouraged to use measurement equipment (e.g., computer or calculator sensors/probes, multimeters, etc.) wherever possible or provide students with data sets collected by equipment following demonstration of the data collection. If used, data must be presented in a tabular and/or graphic format and students will be expected to interpret the data.
   c. The event supervisor may provide some mathematical relationships, but the students are expected to know and understand the concepts outlined below. The competition must consist of at least one task/question from each of the following areas:
      i. DC circuits concepts, definitions and principles (e.g., voltage and current sources, EMF, resistance, applications of series and parallel circuits, voltage dividers, impedance matching, **history**)
      ii. DC circuit analysis theory (e.g., Ohm's Law, parallel and series resistors, Kirchhoff's Laws, node and mesh analysis, Norton and Thevenin equivalents)
      iii. DC circuit analysis practice (e.g., the use of voltmeters, ammeters, ohmmeters and multimeters, resistor color codes and their uses in series and parallel circuits, **Wheatstone** bridges)
      iv. Intermediate DC circuits concepts, definitions and principles (e.g., electrical SI base and derived units, capacitance, ideal diodes, electron current, RC circuits, **digital logic**)
   d. **Digital logic may be included only in the theoretical portion and is limited to: ideal basic two-state logic gates (AND, OR, NOT, NAND, NOR), Boolean algebra, truth tables, logic formula minimization, and Venn diagrams. Three-state logic gates, latch circuits, flip flops, sequential logic, and other digital logic concepts are prohibited**.
   e. **Historical items are limited to items related to named SI units (e.g. namesakes, related laws)**.
   f. Topics that must not be included in the competition are: semiconductors, AC circuit theory and devices, inductors, **transformers, and non-linear devices**.
   g. **Light Emitting Diodes (LEDs) may be used in the practical portion as a light bulb equivalent only**.

4. **SCORING**:

   a. Points will be awarded for correct answers and/or proper technique.
   b. Ties will be broken using a designated task or question(s)**, which will be the same for all teams and will be identified before all periods**.

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

COMPOUND MACHINES

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 cm x 100 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.
   e. Event Supervisors provide all masses. Masses must have a flexible loop of fishing line or similar material on top, large enough to slide a standard golf ball through. The masses, including the fully stretched out flexible loop, must be able to fit inside of a 15.0 cm x 15.0 cm x 15.0 cm cube.
   f. Allowed masses may be between 50.0-1200.0g. The ratio of the large mass to the smaller mass must not exceed 12:1 for Regionals, 16:1 for States and 20:1 for Nationals. Competitors must not bring masses or include them in devices.

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 $\leq$ 50.0 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.

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. Where appropriate, answers must be provided in SI units with appropriate 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)
         3. Simple / compound machine history (e.g., Greek/Renaissance discoveries)
      iii. Questions are limited to the following static equilibrium simple machines:
         1. Lever (all three classes)
         2. Inclined Plane
         3. Wedge
         4. Pulley (up to two triple pulleys)
         5. Wheel and Axle
         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 an unknown mass using a known mass and a lever.
   ii. While all teams are working on Part 1, the supervisor will individually call each team up to a station. Multiple identical stations may be used, but all teams must have the same values of masses.
   iii. Supervisors must verify that devices meet construction specs. Devices that do not meet construction specs must not be tested until brought into spec via modification with the tools and supplies brought by the team. Competitors may use their Part 1 time for this, but must not interfere with the device testing of other teams
   iv. Part 2 timing begins when the supervisor provides a known and unknown mass to the competitors and reveals the value of the known mass. The supervisor must ensure that value is not revealed to other teams who have not yet competed in Part 2.
   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 value of the unknown mass. Teams may use their resources, calculators and tools to produce their calculation.
   vi. Competitors must not mark on, attach anything to, or modify the masses.
   vii. Part 2 timing must stop when the competitors provide the supervisor with a calculated value of the unknown mass or 4 minutes has elapsed. Supervisors must record the elapsed time to the nearest whole second. No changes are allowed to be made to the calculated value 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 20 points.
   c. Mass Score (MS) = (1-(abs (AM - CV) / AM)) x 30 points. The smallest possible MS is 0. AM is the actual mass of the unknown mass (measured to the best precision of the equipment available to the event supervisor) and CV is the calculated value of the unknown mass.
   d. Teams with no device or mass estimate, or that do not make an honest attempt to utilize a compound lever to determine the unknown mass value receive MS & TS of 0.
   e. Final Score (FS) = ES + MS + TS. The maximum possible FS is 100 points. High score wins.
   f. Tie Breakers: 1st - Best MS; 2nd - Best ES; 3rd - Best TS; 4th - 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

DESIGNER GENES

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

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

2. **EVENT PARAMETERS:** Each team may bring only one 8.5" x 11" two-sided page of notes that contain information in any form from any source and up to 2 non-programmable, non-graphing calculators

3. **THE COMPETITION:** This event may be run at stations and may include observations, inferences, predictions, data analysis, and calculations. Every attempt should be made to avoid over-emphasis on a particular area. At the various levels, possible areas to be tested are limited to the basic principles of genetics (see Heredity-B event training on SO website) plus the following topics:

Regional and State	**Regional and State**	**National (all topics-Regional, State, and National)**
DNA structure & function	**Sanger** DNA Sequencing	Restriction mapping
DNA Replication **including roles of enzymes**	DNA fingerprinting	**Phylogenetics**
Gene expression **including roles of enzymes**	RFLP	RNA processing
Promoters	PCR	**RNA-Seq**
Mutations	**DNA microarrays**	DNA Repair
Organelle DNA	**Molecular cloning**	Epigenetics
Plasmid selection and isolation	Gene Therapy	**Next Gen Sequencing Platforms (comparison)**

4. **EXAMPLES:**

   a. Gel electrophoresis set up and running. Photographs showing results of a gel with the lanes labeled: mother, child, male 1 and male 2.
      i. Identify the apparatus or process (gel electrophoresis).
      ii. According to the results, who is the possible father of the child?
      iii. Why do the bands of DNA in the photograph end up at different locations within their lanes?
      iv. What is the size of fragment 3 in Lane 3?
   b. Given a sequence of coding strand DNA,
      i. What is the sequence of the corresponding RNA?
      ii. Using the genetic code, what would be the sequence of amino acids made from this RNA?
   c. What would be the consequence of mutating the -10 region of a prokaryotic promoter?

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

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

THIS EVENT IS SPONSORED BY: The American Society for Biochemistry and Molecular Biology (ASBMB)

DISEASE DETECTIVES

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 **Environmental Quality**.

   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 **scientific** 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 as well as illness (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**
      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

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

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

2. **EVENT PARAMETERS:** Each team may bring four 8.5" x 11" double-sided pages of notes containing information in any form from any source and bring up to two non-graphing calculators.

3. **THE COMPETITION:** Participants will be presented with one or more tasks, many requiring the use of process skills (e.g., observing, classifying, measuring, inferring, predicting, communicating, and using number relationships) from the following topics:

   a. Glacial formation, mass-balance, and flow
   b. Glacier and ice sheet types and forms (alpine and continental)
   c. Glacial erosion, erosional landforms, and sediment transport
   d. Glacial depositional landforms and sediments
   e. Interpretation of glaciers and glacially altered landscape features shown on USGS topographic maps
   f. Periglacial environment processes and landforms
   g. Glaciers in the hydrologic cycle: impacts on climate, streams, lakes, and oceans, sub-glacial hydrology, isostatic effects on Earth's crust
   h. Pleistocene and pre-Pleistocene glacial history: evidence and chronology
   i. Theories explaining glacial and ice sheet advance and retreat (e.g., Milankovich cycles)
   j. Glaciers as indicators of modern global climate change

4. **REPRESENTATIVE TASKS:**
   a. Analyze and interpret features and actions of a mountain glacier appearing on a topographic map including elevation, gradient, ablation and accumulation zones, direction of flow, medial moraines, crevasses, valley shapes, erosional landscapes, and depositional features
   b. Analyze a geologic map of glacial deposits to determine the sequence of events over the course of several episodes of advance and melt-back
   c. Interpret oxygen isotope data from a sediment core to identify changes in sea level caused by glacial advance and melting

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

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

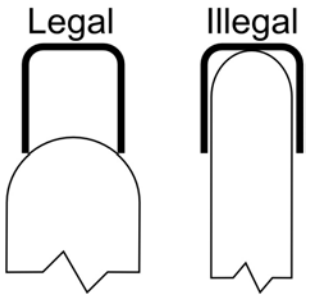
ELASTIC LAUNCH GLIDER

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

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

2. **EVENT PARAMETERS:**
   a. Teams bring up to 2 gliders and flight log(s). Teams may bring any tools and their flight log.
   b. Competitors must wear eye protection rated ANSI Z87+ **at all times** while in the cordoned area of the competition. Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows, otherwise they must not be allowed to compete.
   c. Event Supervisors must provide all measurement tools and timing devices.

3. **CONSTRUCTION PARAMETERS:**
   a. Gliders may be constructed from published plan(s), commercial kits and/or student designs.
   b. **Competitors must not use any components with** pre-glued joints or pre-covered surfaces.
   c. The glider must be constructed only from any types of the following materials: wood, foam, paper, plastic film, carbon fiber, **tape**, and/or glue. Ballast may be any malleable non-metallic substance. The functional components may be attached to each other using tape, thread or glue.
   d. The mass of the glider throughout the flight must be **more than 3.0 g** and less than **10**.0 g.
   e. Wingspan must not exceed **28.0** cm at any time.
   f. The blunt nose of the fuselage, when inserted into a lip balm cap with inside dimensions of ~1.57 cm deep and ~1.37 cm wide must not touch the end.
   g. Launch handle(s)**, excluding elastic, must be less than 1 m long in any orientation** and be of a safe configuration. **The elastic used in the launch handle must be non-metallic and must be in contact with the glider throughout the launch.**



   h. Each glider must be labeled so the Event Supervisor can easily identify the team to which it belongs.

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.
   b. Once competitors enter the cordoned off competition area to trim, practice, or compete they must wear **eye protection at all times** and not receive outside assistance, materials, or communication. Teams violating these rules must be ranked below all other teams. Spectators must be in a separate area.
   c. During inspection each team must present a flight log of recorded data. Data must include 4 or more parameters (3 required and at least 1 additional) for 10 or more test flights prior to the competition. The required parameters are: 1) estimated/recorded peak flight height after launch, 2) approximate length of elastic (relaxed), and 3) Flight Time. The team must choose an additional parameter beyond those required (e.g., orbit diameter, cross section of elastic launch loop, height at transition to glide pattern, launch angle, 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 5-minute flight period.
   e. A self-check inspection station may be made available to competitors for checking their glider and launch handle dimensions prior to being measured by the officials.

f. Competitors must present their glider(s), **launch handle(s)**, and flight log for inspection immediately prior to their 5 official flights. Event Supervisors are strongly urged to return flight logs after inspection. Timers will follow teams as they prepare and launch their gliders.
g. **Gliders must be launched from a launch handle by a single competitor who must be at floor level**.
h. Teams may make up to a total of **5** official flights using 1 or 2 gliders.
i. After check-in teams must be given a **5**-minute Flight Period, starting when their first flight (trim or official) begins. Any flight beginning within the **5**-minute period must be permitted to fly to completion. Competitors may make any adjustments/repairs/trim flights and may switch gliders or launch handles during their **5**-minute Flight Period.
j. Competitors must declare to the Timers before any launches during their Flight Period whether it is an official flight or trim flight. If teams do not indicate the flight type before the launch, it must be considered official. Teams must not be given extra time to recover or repair their gliders.

k. Time Aloft for each flight starts when the glider leaves the **launch handle** and stops when any part of the glider touches the floor, stops moving due to an obstruction (such as a glider landing on a girder or basketball hoop), or the judges otherwise determine the flight to be over.
l. Event Supervisors are strongly encouraged to utilize 3 Timers on all flights. The middle value of the 3 Timers must be the official Time Aloft for that flight, recorded in seconds to the precision of the device used.
m. Gliders must only be launched while aimed at any point on the ceiling. Competitors must not aim for the walls, spectators, low obstructions, etc.
n. Competitors must not steer their gliders during the flight.
o. In the unlikely event of a collision with another glider, a team may elect a re-flight. The decision to re-fly may be made after the glider lands. Timers are allowed to delay a launch to avoid a possible collision. The 5-minute period does not apply to such situations.

5. **SCORING**:
   a. A Team's Score is the sum of their **three** longest Times Aloft. High Score wins.
   b. **At State and National Tournaments only a glider in a canard configuration must receive a 30% bonus added to its Time Aloft.**
   c. Teams with incomplete flight logs must have 10% deducted from their Score.
   d. Teams without flight logs must have 30% deducted from their Score.
   e. Teams with Construction or Competition must be ranked after all teams that do not violate those rules.
   f. Ties must be broken by the longest non-scored Time Aloft.

Recommended Resources: Reference and training resources including the **Elastic Launched Glider 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 THE ACADEMY OF MODEL AERONAUTICS
http://www.modelaircraft.org/

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ENTOMOLOGY

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" two-sided page of information in any form from any source (e.g., notes, insect lists, etc.) 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 or common name and answer a related question(s). Questions are **limited** to Questions are **limited** to topics below and Insects are **limited** to those listed **limited** to those listed on the Official Insect List, which is based on the 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

2014 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 questions will defer to this resource as the correct answer.**

EXPERIMENTAL DESIGN

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 Division C (12 Points)
i. Graph(s): (12 Points)
j. Statistics: **Div. B**: Average (mean), median, mode, range, or drawn in line of best-fit (4 Points)
   Div. C all of B: + standard deviation and any 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 or CD** are available on the Official Science Olympiad Store or Website at http://www.soinc.org

FORENSICS

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 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 **student** may bring one 8.5" x 11" two-sided page of notes containing information in any form from any source
      xvi. a non-programmable 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 http://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. Chemical gloves are optional, **but recommended**. 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 R_fs.

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

GEOLOGIC MAPPING

1. **DESCRIPTION**: Students will demonstrate their understanding of the construction of topographic maps, geologic maps and cross sections, and their use in forming interpretations regarding floods, landslides, earthquakes, and subsurface structure.

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

2. **EVENT PARAMETERS**: Each team is permitted to bring one three-ring binder (any size) containing information in any form from any source. The material must be 3-hole punched and inserted into the rings (notebook sleeves are allowable). Each team is allowed to bring accessories such as a protractor, ruler, non-programmable calculator, colored pencils, and an equal-area projection stereonet with tracing paper and pin.

3. **THE COMPETITION**: Participants will be presented with questions and tasks, many requiring the use of knowledge and relevant skills including observing, classifying, measuring, inferring, predicting and using relationships from the following topics:

   a. Basic features of topographic and geologic maps
   b. Basics of plate tectonics, rock formation, Earth structure, and Earth history
   c. Fold geometries, fault types, erosional patterns, map signatures of intrusions, subsurface geometries, deformation sequences, and sub-surface depositional features
   d. Major structural elements including synforms, antiforms, synclines, anticlines, basins, monoclines, unconformities, domes, and saddles
   e. Cross-sections (faults, folds, strata, etc.), topographic profiles, projections of mapped features, and stereonet projections of measured features
   f. Bed thicknesses, map projections, true dip, and the orientations of planes from points

4. **REPRESENTATIVE TASKS**:

   a. Use a topographic map to determine flooding risk and construct a topographic profile.
   b. Use stratigraphic column, geologic map, and topographic profile to construct a cross-section of sub-surface structure.
   c. Use strike and dip and bed thickness data to determine subsurface folds and the vertical distance of a well drilled through rock strata.
   d. Determine the order of events based on deformation history and cross-cutting relationships.
   e. Assess geohazard risks based on tectonic setting, seismic history, potential for floods, or slope instability.

5. **SCORING**: All questions will have been assigned a predetermined number of points. 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.

MagLev

1. **DESCRIPTION**: Competitors may construct up to two self-propelled magnetically-levitated vehicles **each** with **one** battery-powered motor that turns **one** propeller to move the vehicle down a magnetic track. Competitors must also be tested on their knowledge of magnetism and related topics.

   A TEAM OF UP TO: 2 **EYE PROTECTION:** #1 **IMPOUND**: Yes **APPROXIMATE TIME**: 50 minutes

2. **EVENT PARAMETERS**:
   a. The event has two parts: Part 1 - **written test on magnetism concepts**, and Part 2 - **vehicle testing**.
   b. For Part 2, the vehicle(s) and any material needed to adjust the vehicle(s) (e.g., extra magnets, shims, masses, batteries, etc.) must be impounded prior to the start of competition. Competitors may bring their own maglev track to use during their run. Teams may share tracks, but must have different vehicles. Supervisors must check the track specifications before use. Tools and the track need not be impounded.
   c. For both parts, all reference materials must be secured in a 3-ring binder so that regardless of orientation, none can fall out. **Calculators of any type are allowed and need not be impounded.**
   d. Competitors must wear eye protection during set-up and testing of their vehicle(s). Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows. If not, teams are not allowed to compete in Part 2.

3. **CONSTRUCTION**:
   a. Vehicles may be made of any material, but must meet all specifications and cannot **modify** the track.
   b. The length of the vehicle must be between 15.0 and 22.0 cm (**excluding an optional tether system, see 3.l.)** and cannot vary during the run. Vehicles, excluding dowel (see 3.f), must be less than 20.0 cm tall with the propeller in motion when non-levitated.
   c. The mass of the vehicle (including batteries and dowel) must be **between** 250.0 **and 2000.0** grams.
   d. If a team does not provide a track, their vehicle(s) must fit a standard track (2 9/16" wide). It is recommended that the vehicle(s) be adjustable to accommodate variations in track width, track height and track polarity.
   e. The entire vehicle, except for the propeller **and any propeller shielding (see 3.h.)**, must not extend outside of the vertical planes defined by the inside edge of the side rails of the track.
   f. The vehicle must have a **1/4**" dowel vertically attached within 5.0 cm of its front edge **such that the top end is between 30.0 and 35.0 cm above the lowest vehicle surface. The dowel must have a rigid flag (sized at least 5.0 x 5.0 cm) at the top such that one of the 5 cm sides is parallel to the track and another is parallel to the dowel, with the flag pointed to the rear of the vehicle.**
   g. Commercial batteries, not exceeding 9.0 V as labeled, may be used to energize the motor on the vehicle. Multiple batteries may be connected together as long as the expected voltage across any points does not exceed 9.0 V as calculated by their labels. The vehicle must not have any other energy sources.
   h. Vehicles **must have one motor rotating one propeller**. **Propellers must have a diameter of ≤ 14.0 cm and must be shielded from direct contact such that the event supervisor is not able to make contact with the propeller with a standard ¼" dowel. The supervisor must be able to verify these diameters.**
   i. Brushless motors and integrated circuits are not permitted.
   j. Rare earth magnets **must not** be used on the vehicle **or track**. **Vehicles must be able (or modifiable during the testing time) to travel in either track direction. Teams are permitted to rotate the track.**
   k. The vehicle must be levitated as it moves down the track (inadvertent contact is permitted). Competitors must demonstrate **levitation** by pushing the vehicle slightly down. **If it then rises it is levitated.**
   l. **Vehicles must have an electric switch to permit safe starting. A stopping system must be integrated into either the vehicle or the track that will either stop the motion of the vehicle or shut the motor off. A tethering system is permitted only if it is designed to stop the vehicle. Remote control is not permitted.**

4. **THE TRACK**: More information is provided on the event page on www.soinc.org
   a. The track must be a non-electrified track ≥ **119.0 cm** long and have an inside width between 2.0" and 3.0". On longer tracks, a **119.0 cm** segment must be marked for the competition.
   b. Event supervisors must provide at least one track for teams who do not bring a track or whose track does not meet specifications. This track must be a standard width track (2 9/16" between inner faces of rails) **Modification of the supervisor track is not permitted. Event supervisors must announce the specifications of their provided track at least two weeks prior to the competition.**
   c. The height of the inside edge of the side rails measured from the top of the magnets **on the base of the track** to the top of the railing must be between 2.00 and 5.00 cm. **Side rail magnets are allowed.**

d. Both commercially produced tracks and hand-made tracks are allowed. Instructions for making various tracks are available on the event page on www.soinc.org.
e. The track must be placed on a flat level surface with enough room to allow a cushioned barrier **or metal plate** to be placed at the end of the track and 25 cm beyond to prevent the vehicle from being damaged.

5. **THE COMPETITION**:
   a. **Part 1: Written Test**
      i. All answers must be provided in SI units with appropriate significant figures.
      ii. Teams must be given a set amount of time (20 – 30 minutes is suggested) to complete a written test.
      iii. **The competition must consist of at least one task/question from each of the following areas:**
         1. **Maglev transportation history.**
         2. **Magnetic fields / forces of current conductors, plates and loops; magnetic domains.**
         3. **Magnetic field energy; motion of charged particles in a magnetic field (Nationals only).**
         4. **Personal security and medical applications of magnetism (Nationals only).**
   b. **Part 2: Vehicle Testing**
      i. The length of the timed portion of the track is **95.0 cm**. Supervisors must mark the distance on all tracks with both start and finish lines. **The target time is between 5.0 and 15.0 s.** The event supervisor must announce the exact **time** after impound, which must be the same for all teams.
      ii. Competitors must have a total of 8 minutes to orient, adjust and repair their vehicle(s), and make two successful **or five failed** runs. Vehicles that do not meet the construction specs must not run until brought into spec, **and must be assessed the construction penalty**.
      iii. Competitors must place their vehicle on the track directly before the start line. They must place **an object** in front of their vehicle to keep it from moving. **Prior to starting a run, and without actually turning on the motor, teams must demonstrate a safe starting and ending process**.
      iv. When ready, competitors may turn on their motor and indicate that their vehicle is ready.
      v. Competitors must not touch their vehicle after they have turned on their motor.
      vi. The judge must give a countdown of "3, 2, 1, launch". The competitors must then release their vehicle by removing the **object** and stepping away from the track. **Timing must start when the dowel crosses the start line and stop when it crosses the finish line**.
      vii. **Supervisors are encouraged to use photogates for more precise timing and use at least one back-up manual timer. If only manual timers are utilized, 3 timers are recommended on all runs. The middle value of the 3 timers must be the officially recorded time. Time is recorded in seconds to the precision of the device**.
      viii. Runs may be done with one vehicle or competitors may use different vehicles for each of the runs. A run must count as long as it is started before the 8-minute period elapsed.
      ix. If a vehicle fails to move after 3 seconds, or moves only part of the way down the track, competitors must be allowed to restart their vehicle without penalty **up to four times** within the 8-minute window **or** until two successful runs have been completed. Additional successful runs are not allowed.
      x. If during a run any part of the vehicle falls off, the run must be counted **as a failed run** and the team will be allowed to repair and restart their vehicle or replace it with another impounded vehicle.
      xi. Teams filing an appeal regarding Part 2 must leave their vehicle(s) and track in the competition area.

6. **SCORING:** A scoring rubric is available on the event page on www.soinc.org
   a. **Mass Score (MS) = (mass of vehicle / mass of heaviest successful vehicle) x 25 points.**
   b. Teams whose vehicle(s) only move partially down the track get a **MS** = 0. Teams whose vehicle(s) do not move past the start line or attempt any runs get a **MS = -5**. Teams that fail to impound get a **MS = -10**.
   c. Time Score (TS) = (1-(abs (**run time** – **target** time)/**run time**)) x **25** points. The smallest possible TS is 0. Teams with no successful runs receive a TS and **MS** of 0.
   d. Exam Score (ES): The test used for Part **1** of this event must be worth 50 points.
   e. Penalties: 2 points - each Competition violation; **20 points - Construction violation (only once total).**
   f. Final Score (FS) = **MS** + TS + ES - Penalties. The maximum possible FS is **100** points. High score wins.
   g. Tie Breakers: 1st - Best **ES**; 2nd - Best **MS**; 3rd - Best TS; 4th - Best 2nd **TS**; 5th - specific test questions

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

Materials Science

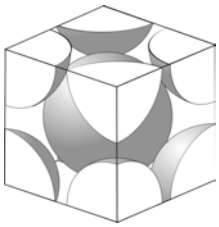
1. **DESCRIPTION**: Teams will answer a series of questions or complete tasks involving the science processes of chemistry focused in the areas of Materials Science.

   A TEAM OF UP TO: 2 **EYE PROTECTION**: #4 **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS**:
   a. **Teams** may bring: a handheld nonprogrammable calculator, a writing utensil and one 3-ring binder (any size) containing pages of information in any form from any source that must be 3-hole punched and inserted into the rings (sheet protectors are allowed).
   b. **Event Supervisors** will provide: any materials needed for **lab stations**.
   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 http://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. Chemical gloves are optional, **but recommended**. 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 focus on students evaluating the properties of materials and answering questions related to the materials' chemistry: 1) Evaluating the mechanical performance of materials; 2) Evaluating the intermolecular forces of materials.
   b. The event will consist of an activity or activities with supporting questions. The questions will be scaffolded such that students are guided from the observed bulk properties to principal chemical properties; "macro" to "micro" scale. Supervisors are encouraged to use computers or calculators with sensors/probes wherever possible. **Students may be asked to collect data using probeware that has been set-up and demonstrated by the Supervisor.** The supervisor may provide students with data sets collected by such sensors and probes following demonstration of the data collection. Digital microscopes and cameras connected to computers are encouraged.
   c. Cleanup should occur after all materials have been returned or a penalty may be given.
   d. Students will be expected to interpret data by preparing data tables and/or construction of graphs of the data. Completeness, accuracy and quality of data tables and graphs will be taken into account.
   e. All measurements must be recorded with correct significant figures and units. All calculations must also include correct significant figures and units.

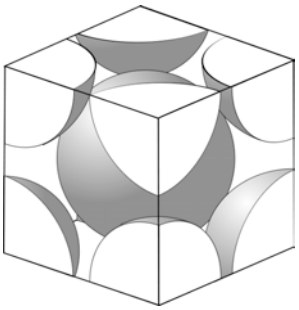
4. **LAB STATIONS**: Material Performance & Atomic/Molecular Structure Topics are limited to:
   a. **General properties and characteristics of material classes** (metals, ceramics, polymers, composites)
      i. Physical characteristics (Density, strength, thermal properties, etc.)
      ii. Manufacturing techniques and natural occurrences
      iii. Chemical Composition (elements, bonds, etc.)

   b. **Material characterization techniques**
      i. Visual (Optical and electron microscopy)
      ii. Physical tests
         1) Stiffness of material - Young's Modulus
         2) Breaking strength of a material - Yield Strength
         3) Surface Area/Volume ratio
         4) Permanent deformation of material under constant load - Creep Rate
         5) Resistance to flow - Viscosity
         6) Resistance to fracture - Fracture toughness (State and National tournaments)
         7) Resistance to repetitive strain - Fatigue Limit (State and National tournaments)
         8) Stiffness under shear load - Shear Modulus (State and National tournaments)
         9) Transverse, inherent strain - Poisson's Ratio (State and National tournaments)

iii. Material selection for specific applications - Choosing the best material for an application based off of a list of materials and their properties

c. **Intermolecular Forces and Surface Chemistry**
   i. Chemical tests
      1) Surface Chemistry, surface tension, contact angle
      2) Thickness of a molecule
   ii. Crystal Structures
      3) Ionic, Covalent, Crystalline, Semi-Crystalline, Amorphous
      4) Common atomic packing (FCC, BCC, HCP, Simple Cubic)
      5) Atomic packing factor (Geometry only)



5. **SAMPLE QUESTIONS**:

   a. **Material Performance Relationships**:
      i. Using an apparatus provided by the event supervisor: generate a stress vs. strain curve, and calculate Young's modulus, identify the yield strength and offset yield strength.
      ii. For a ceramic material, what types of bonds are generally formed, and how does this contribute to properties such as density, hardness, and brittleness.
      iii. Students may be asked to perform mechanical tests to identify an ideal material for a given application.

   b. **Intermolecular Forces and Surface Chemistry:**
      i. Based on droplet characteristics, characterize the hydrophobicity or hydrophilicity of the provided surfaces. For example, students may be asked to identify unknown surfaces or rank the hydrophobicity of the provided surfaces.
      ii. Using the Wilhelmy plate apparatus and the provided equation, determine the surface tension of a liquid. Evaluate changes in surface tension with the application of surfactants or other liquids.
      iii. Students may be provided images to measure contact angles, evaluate boiling point of liquids, perform polymer melt tests for crosslinking, and will answer question related to these measurements.
      iv. Students may be expected to answer questions or complete labs and activities such as: Using materials supplied by the event supervisor to model packing for cubic or hexagonal crystal structures. Answer questions related to unit cell characteristics and properties such as formula, density, and dimensions, packing factor, etc.
      v. Students may be asked to create a droplet/surface to meet the contact angle designated by the Event Supervisor. Students may be asked to perform tests at surfaces (liquid or solid) and identify the ideal material for a given application.

6. **SCORING**: **Intermolecular Forces section (lab and written exam) 50% and Material Performance section (lab and written exam) 50%.** All ties will be broken by pre-selected questions chosen by the supervisor. These questions may or may not be identified to the students. Any graphs that are generated will be evaluated on these basic parameters (partial credit may be given): Points should be given for a correct title, and X and Y-axis labels including appropriate units and axis increments. Additionally, students may be required to create a best-fit line for the data points, identify specific points on the graph such as yield strength, and/or others designated by the event supervisor that relate directly to the property being measured. Any calculations relating to generated graphs should have work clearly shown on a provided page with proper units.

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

MISSION POSSIBLE

1. **DESCRIPTION**: Prior to the competition, teams must design, build, test, and document a "Rube Goldberg® like Device" that completes a required Final Task using a sequence of consecutive **Energy Transfers**.

   TEAM: **1-2** students **IMPOUND**: At state and national only **EYE PROTECTION**: #2

   SET-UP TIME: 30 minutes for points **MAX. RUN TIME:** 3 minute limit

2. **SAFETY PARAMETERS:** All team members must properly wear safety spectacles with side shields at all times. Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows, otherwise not be allowed to compete. Each device must pass a safety inspection before operation. Devices with potential hazards or safety concerns must not be permitted to run unless safety concerns are resolved to the satisfaction of the event supervisor; otherwise they must receive only participation points.

3. **CONSTRUCTION PARAMETERS:**
   a. All parts of the device must fit and stay within a 60.0 x 60.0 x 60.0 cm imaginary cube during operation.
   b. The device must be designed and constructed to use forms of energy, listed in **3.e.**, to complete a sequence of **transfers** that all contribute to completion of the Final Task.
   c. **The Device must begin with the Start Task and end with the Final Task as listed in Section 4.**
   d. After the Starting Task, the device must be designed to operate autonomously. A team must be disqualified if the device is remotely timed or controlled.
   e. The **Five Basic Energy Forms used in transfers** that will count for points are electrical, mechanical, thermal, chemical, and electromagnetic spectrum (radio, infrared, and visible light only). Batteries, candles, small rocket igniters, etc., may receive points determined by the way they cause the next action.
   f. Each **transfer** in the device must be designed to contribute to the completion of the Final Task except the use of switches to turn off previously used motors and transfers for the Bonus Task. Parallel and/or dead end tasks are not allowed **with the exception of switching off motors or for the Bonus Task.**
   g. **All scoreable actions and transfers must be visible with the exception of radio & infrared electromagnetic spectrum transfers.**
   h. Other non-scoreable **transfers** may be incorporated into the device, but must contribute to the completion of the Final Task, receive no points, and be listed on the **Energy Transfer List (ETL)**.
   i. Only wires, batteries, photo cells, homemade solenoids, switches, and up to three motors may be used in the device. No computers, integrated circuits or other electric components are allowed.
   j. **All transfers take time, but any continuous action designed to take up time must not be electrical. In addition, at State & National adjusting a transfer that utilizes electricity in any way (either at the beginning, middle, or end of operation) intended to accomplish the ideal time is a violation.**
   k. Matches, candles, or small rocket igniters may be used. However, hazardous liquids and materials (e.g., rat traps, **lead objects, etc.**) are not permitted.
   l. All sources of energy and actions must be contained within the imaginary box before, during, and after the device's operation. The device must account for non-ideal ambient conditions. If the device is sensitive to light, air currents, radio waves, etc., the team must provide all necessary shielding.
   m. Power to any single electrical circuit must not exceed 10.0 volts. All batteries must be factory-sealed and voltage labeled by the manufacturer. Lead-acid batteries are not permitted.
   n. Energy devices (e.g., batteries, mousetraps, candles), except motors, may be activated prior to starting the device.
   o. The top and at least one vertical wall must be open or transparent for viewing all actions and tasks.

4. **THE COMPETITION:** Transfers receive points only if successful, are listed on the ETL, and contribute toward Final Task completion within the 3-minute time limit. A single action must contribute to only one scoreable **transfer**.
   a. **Start Task** (100 points) - (1) In a 1 pint container, randomized by shaking, is a mixture of up to 10 golf tees (4-10 cm long), 10 #1 metal paperclips, and 10 non-metallic 1-2 cm diameter marbles, (2) which are quickly poured into the device (3) from above the entire device, so that the mixture falls into the device and (4) triggers the first action, which (5) begins the chain of events. All materials in the mixture must be un-altered. If any part of 4.a. is violated, no points will be awarded for the Start Task or the Bonus Task.
   b. **An Energy Transfer can receive points when it directly transfers from one Basic Energy Form to a different Basic Energy Form, but only if it is successful and is listed in the ETL. Each of the five Basic Energy Forms may be used for scoreable transfers up to three times, but must transfer to a different Basic Energy Form than previously scored. All scoreable Energy Transfers must contribute toward the completion of the Final Task to earn points.**

c. An Energy Transfer List **(ETL)** must be submitted to the Event Supervisor by a specified time/date prior to or at the tournament. This list will detail each Energy Transfer in the sequence in which it will occur during operation of the device. See www.soinc.org for an example of the format required.
d. Scoring will be based only on the Energy Transfers listed in the ETL. The ETL must be legible, neat and an accurate documentation of the device's operation. If the device includes extra Transfers that do not count for points, they must be documented in the list, but they must not be numbered.
e. Each Energy Transfer intended to earn points must be labeled in the device with a number matching the ETL list for the Energy Transfer.
f. **Bonus Task** – Sort the mixture of golf tees, paperclips, and marbles into three different one-pint plastic containers similar to the original container. Each container must be labeled, by material, to score points. Sorting does not have to lead to the Final Task, but only items sorted before the time stops will receive points.
g. **Final Task** (250 points) – Switch on a light to signal the end of the action. It must be clearly visible to the judges, so they can accurately measure the operation time for the device.
h. **The ideal operation time** for maximum points is 60.0 seconds at Regionals, between 60.1 and 90.0 seconds at States, and 90.1 to 120.0 seconds at Nationals (time announced after impound). **At State and Nationals, event supervisors will observe the adjustment of the device for timing to ensure that electricity is not used per rule 3.j.**
i. Timing and scoring for the device **begins** when a team member **pours the last of the objects from the pint container into the device**. **Timing of the device stops when the final light is first visible to the judges**, or when 180.0 seconds elapse (whichever comes first).
j. If the device **stops**, jams or fails, the team must be allowed to "adjust" it to continue operation. Any obvious stalling to gain a time advantage must result in disqualification.
k. If an action inadvertently starts a **transfer** out of sequence on the ETL then all **transfers** skipped in the listed sequence must not earn points even if they are completed.
l. If a competitor completes a scoreable **transfer** or makes an adjustment that leads directly to completion of the **transfer** in the next action, that **transfer** must not receive points (even if it is the Final Task).

5. **SCORING POINTS:** High score wins.
   a. Teams that impound a device, but fail to compete, receive participation points.
   b. Points can only be earned for **transfers** successfully completed before 180.0 seconds elapse and **no points will be awarded for anything that occurs after the final light shines.**
   c. **0.1 pt for each .1 cm that the dimensions of the device are under 60.0 cm x 60.0 cm x 60.0 cm in each axis. Example: Device measures 40.0 cm x 38.9 cm x 52.4 cm. Pts. 20.0 + 21.1 + 7.6 = 48.7 pts.**
   d. 2 pts for each full second of operation up to the ideal time.
   e. 5 pts **awarded for each object successfully sorted in its correct final container** (**max=150 pts.)**.
   f. **25** pts if the ETL is submitted **as designated by the tournament director.**
   g. **25 pts if the ETL** uses the format specified.
   h. **25 pts if** the scoreable **transfers in the ETL and** within the device are correspondingly labeled.
   i. 25 pts if the ETL is 100% accurate in documentation of intended scoreable and non-scoreable **transfers**.
   j. 50 pts if the team uses no more than 30 minutes to set up their device.
   k. **30 pts for the first time an Energy Form is transferred per rule 4.b. (max=150 pts)**
   l. **20 pts for the second time an Energy Form is transferred per rule 4.b. (max=100 pts)**
   m. **10 pts for the third time an Energy Form is transferred per rule 4.b. (max=50 pts)**
   Total Energy Form max points = 300 pts.
6. **PENALTIES:**
   a. Minus 1 pt for each full second that the device operates beyond the ideal time until the final light shines or the 180.0 second time limit is reached (whichever occurs first).
   b. Minus **5 pts for each original object sorted into a wrong final container.**
   c. Minus 15 pts each time the device is touched, adjusted, or restarted.
   d. Minus 50 pts, one time, for any part or substance leaving the boundary of the device during the operation. Smoke, odors, light, radio waves, etc. may leave the device as long as none of these pose a hazard.
7. **TIERS:** Unsafe devices must not be allowed to run and **teams must** only receive participation points. Tier 1: Devices without any violations; Tier 2: Devices with construction violations; Tier 3: Devices with parallel path or "dead end" paths **(other than in the Bonus Task)**; Tier 4: Devices impounded after the deadline.
8. **TIES:** are broken by this sequence: 1. Fewest penalty points; 2. **Closest to perfect for objects in the three final containers**; 3. **Smallest overall dimension of device**.

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

ROCKS AND MINERALS

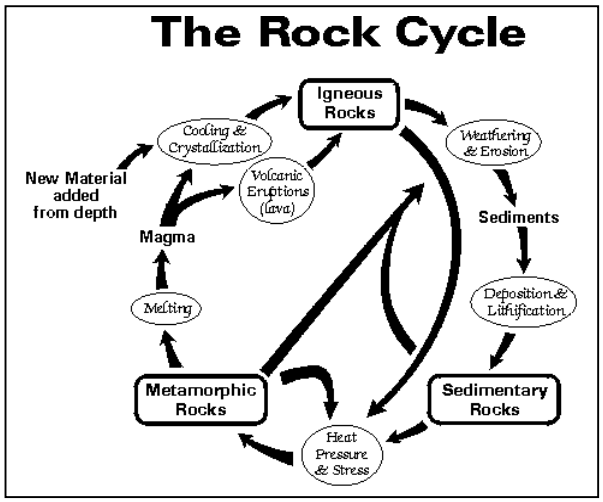
1. **DESCRIPTION**: Teams will demonstrate their knowledge of rocks and minerals.

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

2. **EVENT PARAMETERS**: Each **team** may bring only one magnifying glass; one commercially published resource that may be tabbed and written in and one 3-ring binder (any size) containing pages of information in any form from any source. The pages must be 3-hole punched and inserted into the rings (sheet protectors are allowed).

3. **THE COMPETITION**:
   a. Equal time intervals, as determined by the supervisor, will be allotted for each station. When the start signal is given, participants will begin work at their initial station.
   b. Participants may not move to the next station until prompted to do so, may not skip stations, or return to any previously visited station.
   c. Specimens and other materials placed at the various stations may not be taken to other stations.
   d. HCl will not be provided, nor may it be brought to or be used during the competition. Written descriptions as to how a specimen might react were it to be tested with HCl may be provided.
   e. Only those specimens appearing on the **Official NSO list (see www.soinc.org)** will be used in the competition with the following exception: Tournament Directors may include up to five additional specimens important to their own state. If additional specimens are to be included, all teams must be notified **no later than three weeks prior to the competition.**

4. **Topics may include, but are not limited to**:
   a. Specimen identification
   b. Rock cycle
   c. Properties of minerals
   d. Mineral groups
   e. Economic importance
   f. Formation and properties of igneous, sedimentary, and metamorphic rocks
   g. Clues to past environments
   h. Composition and structure of minerals
   i. Bowen's reaction series



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

6. **SCORING**: Total scores will determine rankings in this event. Ties will be broken by the accuracy or quality of answers to selected questions.

Recommended Resources: All reference and training resources including the **Science Olympiad Rock & Mineral Teaching Guide,** the **Bio/Earth CD** and the **National Audubon Society Field Guide to North American Rocks and Minerals** are available on the Official Science Olympiad Store or Website at http://www.soinc.org Also, **Rocks and Minerals kits** (*excluding only silver, gold, and diamond) may be purchased by check or School Purchase Order from ESES, P.O. Box 503, Lee's Summit, MO 64063 (No Credit Cards or Phone Orders-PH 816-524-5635; FAX 816-525-4263) item OLY01 at $85.00. Price quoted includes shipping and handling.

SCRAMBLER

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

   A TEAM OF UP TO: 2 **IMPOUND**: Yes **EYE PROTECTION**: None **TIME**: 10 Minutes

2. **CONSTRUCTION**:
   a. The Scrambler must consist of an egg transport and an energy propulsion system. These may be separate or combined into a single unit. In the ready-to-launch configuration, the entire Scrambler, including the egg, must not exceed 1.00 m in height and depth and not exceed 0.75 m in width.
   b. The egg transport must be designed to travel a minimum of 8.20 m and stay within a 1.50 m track width before coming to a complete stop as close as possible to the center of the Terminal Barrier.
   c. All energy used to propel the egg transport must come from a falling mass not to exceed 2.00 kg. The mass must be part of the energy propulsion system and need not travel with the egg transport. Any part of the Scrambler whose potential gravitational energy decreases and provides energy to propel the egg transport after the falling mass is released is considered to be part of the falling mass. To facilitate mass measurements, the Scrambler must be impounded with the mass detached.
   d. The stopping mechanism must be contained completely within the egg transport and work automatically. The egg transport must not be remotely controlled or tethered.
   e. The egg must rest on top of two ¼" wooden dowels which extend out a maximum of 4.0 cm from a rigid, unpadded and flat backstop for the egg. The bottom of the wooden dowels must be between 5.0-10.0 cm above the track. The backstop must be built of any rigid material and it must have a flat surface of 5.0±0.2 cm wide by 5.0±0.2 cm high by 1.27 cm (0.50") thick. To facilitate timing, an additional vertical ¼" wooden dowel must be permanently attached from the top center of the rigid backstop such that it will cross the laser path of the photogate system which must be placed approximately 20.0 cm from the floor. A picture of a sample backstop will be available on www.soinc.org.
   f. The Event Supervisor must provide an uncooked grade A large chicken egg (one per team and selected by the competitors) with the rounded end of the egg to be placed against the backstop. The rounded end of the egg must be visible to the Event Supervisor after attachment. Tape must be provided to secure the egg to the transport with no tape placed on the front or rear 2.0 cm of the egg.
   g. Competitors must start the Scrambler by using any part of an unsharpened #2 pencil with an unused eraser (provided by the Event Supervisor) to actuate a release mechanism.
   h. Only the wheels of the Scrambler are allowed to contact the floor. If any piece falls off the Scrambler during the run, it is a construction violation.
   i. No electrical or electronic devices may be used on the Scrambler, its alignment devices, or any tools (with the exception of any type of calculator).

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 with a Terminal Barrier extending across its end. Space is needed on each side of the track and beyond the Terminal Barrier to allow for error in the Scrambler's path.
   b. One-inch tape must be used to define the track's Start Line, the 0.20 m Line, the 8.20 m Line and Track Width Lines up to the Terminal Barrier.
   c. The center of the Start Line must be marked on the tape by the Event Supervisor. The center of the Terminal Barrier must also be marked.
   d. The Terminal Barrier must be located at a chosen distance 8.70-11.70 m from the Starting Line in 1.00 m intervals for Regional, 0.50 m intervals for State and 0.10 m intervals for the National Tournaments. The distance must NOT be announced until all Scramblers have been impounded.
   e. If used, a photogate timing system must be installed at the 0.20 m Line and the 8.20 m Line at a height of approximately 20.0 cm.

4. **THE COMPETITION**:
   a. The entire Scrambler system must be impounded before the start of the event. Tools for adjusting the Scrambler, test data, and measuring/calculating devices to assist in making accurate adjustments to the Scrambler need not be impounded.
   b. Only competitors and the Event Supervisors will be allowed in the impound and track areas while the teams are competing. Once competitors enter the event area, they must not leave the area or receive outside assistance, materials or communication.
   c. Teams must be given a total of 10 minutes to make up to 2 runs with their Scrambler. During this time teams may adjust their Scrambler, but they must not increase the falling mass once it has been measured.

A run is completed if the release mechanism is actuated before the 10 minutes expires. Measurements by the Event Supervisor must not be included in this time.

d. Teams may use their own measuring devices to verify the track dimensions during their allotted time. They must not roll the egg transport on or near the track at any time prior to or during the competition.
e. Substances that may damage the floor or interfere with subsequent runs must not be applied to the wheels or floor. During their time, competitors may clean the track but the track must remain dry at all times.
f. The pointed tip of the egg must be placed even with the Starting Line anywhere along its length prior to the beginning of each run. All parts of the Scrambler must be behind the Starting Line when the release mechanism is actuated.
g. Sighting and/or aligning devices placed on the track are permitted but must be removed before the runs. Mounted sighting and aligning devices may be removed at the team's discretion prior to each run.
h. The Scrambler must be able to remain at the starting position in ready-to-launch configuration without being touched until triggered by the #2 pencil.
i. If a Scrambler 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. If the Scrambler moves any distance after actuation, it must be considered a run.
j. Run Time starts when the dowel of the egg transport reaches 0.20 m and ends when it either stops or it passes 8.20 m. The Run Time is recorded in seconds to the precision of the timing device used.
k. Event supervisors are encouraged to utilize a photogate timing system for the primary time. If used, a backup handheld timer must also be used in case the systems fails or the device does not trigger the photogates. If a photogate system is not available, lasers placed across the track at 0.20 m and 8.20 m would help the timekeepers be more accurate because all they have to watch for is the flash of light as the dowel cuts through the laser beam. If photogates are not being used, three timekeepers should be utilized with the middle time used as the official Run Time.
l. Once the egg transport starts a run, the competitors must not follow it down the track and must wait until called by the Event Supervisor to retrieve it. The 10-minute time resumes once competitors pick up their egg transport or begin to make their own measurements.
m. If any part of the Scrambler leaves the 1.50 m track the run must be placed in Tier 2. If any part of the Scrambler comes to a stop beyond the plane of the Terminal Barrier, the run must be placed in Tier 2 with a Run Score of 5000.
n. If the Scrambler passes the 0.20 m Line but stops before the 8.20 m Line, the timekeepers record the stop time, take run measurements and score the run in Tier 2.
o. If the egg is broken (as defined by cracking the egg enough to leave a wet spot on a paper towel) the run is scored as Tier 2. The Distance Score must be from the point of impact to the center of the Terminal Barrier. If the egg breaks on the first run, a second run must not be permitted.
p. If any part of the egg transport (besides the egg) touches the Terminal Barrier it is scored as a Tier 2 run.
q. If the time and/or distance cannot be measured for a Scrambler (e.g., the Scrambler starts before the Event Supervisor is ready, the competitors pick up the vehicle before it is measured, or it doesn't reach the 0.20 m line), it is a Failed Run.
r. Teams who wish to file an appeal must leave the Scrambler with the Event Supervisor.

5. **SCORING**: Best low score wins. The Run Score = Distance Score + Time Score
   a. The Distance Score is a point-to-point measurement from the center of the Terminal Barrier to the pointed end of the egg measured to the nearest 0.1 cm.
   b. Time Score = Run Time X 5
   c. Tiers: Teams are ranked using the single run that gives them the best overall rank.
      i. Tier 1: A run with no violations.
      ii. Tier 2: A run with competition violations.
      iii. Tier 3: Any runs with construction violations or both competition and construction violations.
      iv. Tier 4: Any teams with vehicles not impounded during the impound period.
   d. If the competitors cannot start at least one run within the 10 minutes or those who have two Failed Runs must receive participation points only.
   e. Ties are broken by this sequence: 1. Better non-scored Run Score; 2. Faster Run Time on the scored run.

Scoring Example: At a competition, a team's vehicle stopped with the pointed end of the egg 85.3 cm from the center of the Terminal Barrier with a Run Time of 6.67 s.

Distance Score:	85.3	
Time Score:	33.35	(6.67 x 5)
Run Score:	118.65	

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

TECHNICAL PROBLEM SOLVING

1. **DESCRIPTION**: Teams will gather and process data to solve problems.

   A TEAM OF UP TO: 2 **EYE PROTECTION**: #4 **APPROXIMATE TIME**: 50 minutes

2. **EVENT PARAMETERS:** Each **student** may bring **and use any kind of** calculator and **one 8.5" X 11" two-sided page of information in any form from any source (including a list of mathematical relationship, formulas or constants)** and must bring and use chemical/splash protection goggles where required. Where a station requires a more advanced calculator, probes or other lab equipment, the event supervisor will provide them.

3. **THE COMPETITION**: The event will consist of two lab stations and up to 10 questions **per station** (limited to the two topic areas below).

Level	Probes	2014 Topics
All	**Voltage, amps and Temperature**	Topic 1 will focus on electrochemistry under standard and non-standard conditions. This topic can include basics of oxidation/reduction reactions, half-cells, electroplating, and Galvanic Cells. The event supervisor will supply appropriate half-cell reduction potentials.
All	**Temperature**	Topic 2 will focus on heat and thermodynamics in an open or closed system. The topic can include the basics of heat transfer, specific heat capacity, latent Heat, and Newton's Law of Cooling. The event supervisor will supply either specific heat values of appropriate material, or the materials necessary for the student to determine the required values.

- **Note: At the national level, Vernier probes and TI handhelds will be used at the two stations.**

a. Students will apply scientific theories and principles related to the current topics in the solution of the problems. Students will be asked to collect data, make measurements and determine specific values to solve a problem using probeware that has been provided, set up, and demonstrated by the supervisor. Intermediate measurements and calculations may be required.

b. At state and national tournaments, supervisors will use calculators and **probes for the topics above.** Regionals are encouraged to use probes but may provide students with data sets collected by such sensors/probes following a data collection demonstration.

4. **SCORING**: Teams will be ranked based on the highest total points as determined by the sum of the scores of each individual station. **Each of the two stations will be worth 100 points for a total of 200 points for the event.** In case of ties, a tiebreaker will be announced prior to the competition. **At each of the two stations the students will complete a required task (supported with data they have collected) and answer up to 10 questions. The 100 points will be awarded as follows:**

   1) **50 points on the correctness of the required answer.**
   2) **30 points based on procedure and supporting data.**
   3) **20 points on content questions relating to the given topic.**

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

THIS EVENT IS SPONSORED BY TEXAS INSTRUMENTS

WATER QUALITY

1. **DESCRIPTION**: The event will focus on the evaluation and understanding of aquatic environments.

   A TEAM OF UP TO: 2 **EYE PROTECTION**: #4 **APPROXIMATE TIME**: 50 Minutes

2. **EVENT PARAMETERS:** Each team may bring one 8.5" x 11" two-sided page of notes that may contain information in any form from any source, **one student built salinometer/hydrometer for testing** and up to 2 non-programmable, non-graphing calculators. Each participant must bring Z87 chemical splash goggles.

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. Supervisors are expected to utilize estuary and **marine** scenarios and have students analyze and evaluate comparative macroinvertebrates and water quality data. Process skills may include equipment use, collecting and interpreting data, measuring, analyzing data, and making inferences.
   a. This section will use multiple choice, matching, fill-in-the-blank and/or short answers in areas such as: aquatic ecology, water cycle, nutrient cycling, aquatic chemistry and its implications for life, potable water treatment, waste water treatment, aquatic food chains/webs, community interactions, population dynamics, watershed resource management issues, sedimentation pollution and harmful species.
   b. This section will examine **coral reefs** and **the ecological factors that have harmful effects on reef ecosystems. It will also include the identification (common name only) of Coral Reef organisms and their importance as indicators of reef health. In addition teams are expected to know the general ecology, life cycles, and feeding habits of all listed organisms:**

Global	Global	Indo-Pacific region only
Banded coral shrimp (***Stenopus hispidus***)	Long-spined black sea urchins (***Diadema* spp.*)***	Barramundi cod (***Cromileptes altiverlis***)
Butterfly fish (***Chaetodon* spp.)**	Parrotfish (>20 cm) (Scaridae or Scarinae)	Bumphead parrotfish (***Bolbometopon muricatum***)
Crown of thorns starfish (***Acanthaster planci***)	Pencil urchin	Humphead wrasse ***(Cheilinus undulatus)***
Fleshy algae	Recently killed coral	Giant clams (***Tridacna* spp.)**
Grouper >30 cm (Serranidae, Epinephelinae)	Snapper (Lutjanidae)	Sea Cucumber
Hard coral	Sponge	**Atlantic region only**
Lobster	Sweetlips - (Haemulidae ***Plectorhinchus* spp.**)	Flamingo Tongue Snail ***(Cyphoma gibbosum***)
Morey eel (Muraenidae)	Triton ***(Charonia* spp.)**	Nassau grouper ***(Epinephelus striatus)***
Note: spp.is abbr for multiple species		Gorgonia

   c. Water Monitoring and Analysis Section - Students are expected to understand and interpret data related to testing procedures and purposes for collecting data related to salinity, pH, phosphates, turbidity dissolved oxygen, temperature, nitrates, fecal coliform, total solids, biochemical oxygen demand **and aragonite saturation** and their relationship to one another. **The water quality index used for freshwater ecosystems does not apply to estuaries and marine ecosystems.** Actual testing will be limited to salinity. Teams must build, calibrate, bring and demonstrate a salinometer/hydrometer capable of measuring saltwater (most likely NaCl) concentrations between 1-10% (mass/volume). There are no restrictions except that the team must build the device. Teams should be able to estimate percent to the nearest tenth. Full credit will most likely be given ±1 at Regionals and ±0.5 at State/Nationals. Points for salinity testing should be approximately 5% of the total score. The presence of calibration solutions is up to the event supervisor.

4. **SCORING:** Questions will be assigned point values. Students will be ranked from highest to lowest score. Ties will be broken by pre-determined tiebreaker questions.

   Recommended Resources: All reference and training resources including the **Water Quality/Marine and Estuary CD (WQCD)** and the **Bio/Earth CD (BECD)** are available on the Official Science Olympiad Store or Website at www.soinc.org

WRITE IT/DO IT

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

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

2. **THE COMPETITION**:

   a. A student is shown an object (which may be abstract and is the same for all teams) built from, but not limited to, such items as science materials, inexpensive materials (e.g., straws, push pins, Styrofoam balls, paper cups, Popsicle sticks, etc.) or commercial sets (e.g., Googoplex, K'nex, Tinker Toys, Lego, Lincoln Logs, etc.).

   b. The 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. Only numerals, words and single letters may be used. Symbols, drawings and diagrams are not allowed, with the exception of common punctuation and editing symbols. Printable punctuation marks/editing symbols that can be produced on a PC standard 101 key keyboard by pressing a single key or a single key in combination with the shift key may be used, however these must be used in their normal context and not as symbols to form a key/code. All abbreviations (not symbols) must be defined either at the beginning or when the abbreviation is first used. No prepared abbreviations on labels will be permitted. **Note: quotation marks or apostrophes may not be used for inches or feet.**

   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 properly written instructions is declared the winner.

   b. Points will be given for each piece of material placed in the proper connection and location compared to the model.

   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. Scoring Violations: Use of diagrams or drawings will result in disqualification. A one percent (1%) penalty **of the total possible score** will be assessed for each minor infraction (e.g., unlabeled abbreviations or improper use of editing symbols or codes). Scoring Example: **If the total possible score is 50 and a team had seven infractions then 3.5 points [7(50x.01)=3.5] would be deducted from their score.**

   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