ANATOMY

1. **DESCRIPTION:** This event encompasses the anatomy (structure and function) of the nervous and **integumentary** 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 of the **integumentary** and nervous systems and how aging and specific diseases affect them. Process skills may include data collection, making observations/inferences/predictions, performing calculations, analyses and conclusions. The test may include various formats (e.g., timed stations, written test, slides, etc.) limited to the following topics:

   a. **INTEGUMENTARY SYSTEM - All levels should know**:

      i. Functions of the integumentary system
      ii. Basic anatomy of the component parts of the skin
      iii. Anatomy of the four layers of the skin and skin receptors
      iv. Skin color and textures
      v. Components of hair and nails
      vi. Anatomy of integumentary glands
      vii. Effects of aging on the skin
      viii. 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:
      ix. Additional diseases: Psoriasis, human papilloma virus (HPV), **other types of dermatitis**
      x. Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)

   b. **NERVOUS SYSTEM - All levels should know:**

      i. The Brain - major regions of the brain and their functions
      ii. Sense Organs - regions of the sense organs and their functions
      iii. Disorders: Epilepsy, Alzheimer's Disease, Multiple Sclerosis and Parkinson's Disease, shingles (herpes zoster), cerebral palsy, glaucoma, pink eye (conjunctivitis)
      iv. Effects of the drugs: alcohol, caffeine, nicotine, and marijuana on the nervous system

      National Level Only:
      v. Central Nervous System - organization of the spinal cord
      vi. Neural Impulses - Cellular anatomy and types of neurons
      vii. Neural circuitry connecting the eye to the brain, tracing light detection from eye to brain
      viii. Treatment and prevention of **all of the conditions listed above.**

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)

Boomilever

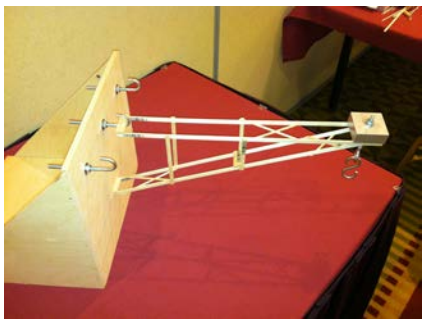
1. **DESCRIPTION:** A Boomilever is a cantilevered wood and **adhesive** structure, mounted to a vertical Testing Wall, carrying a load at a distance from the Wall. The objective of this event is to design and build the most efficient Boomilever meeting the requirements specified in these rules.

   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. **COMPETITION:**

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. **SCORING:**

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. **SCORING EXAMPLES:**

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)

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

CAN'T JUDGE A POWDER BY ITS COLOR

1. **DESCRIPTION**: The intent of this event is for students to make and record observations. Students will test and characterize one pure substance and then, based only on data they collect, answer a series of questions about that substance. Students WILL NOT be asked to identify the solid. Emphasis of this event is on the quality of data collected, answering questions about the substance and providing data to support their answers.

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

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

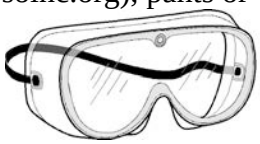
   a. **Students may bring** only these items:
      i. test tubes, brushes & racks, spot plates, well plates, reaction plates, beakers or similar small containers for mixing
      ii. something for scooping & stirring
      iii. pH or Hydrion paper
      iv. hand lens(es)
      v. Beral pipettes
      vi. 9-Volt Conductivity tester
      vii. paper towels

      Note: Students not bringing these items will be at a disadvantage. The event supervisor will not provide them. DO NOT BRING PENS OR PENCILS

   b. **Supervisor will provide**:
      i. 1 M NaOH
      ii. 1M HCl
      iii. 2 different writing instruments
      iv. waste container(s)
      v. wash bottle with distilled water (no more than 250 mL)

      The supervisor may provide:
      vi. Other equipment (such as a thermometer, balance, hot plate, probes, calculator, etc.)
      vii. If the supervisor feels instructions are needed in order to use something provided, instructions will be available.

   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:** Contestants will be given a sample of one pure substance. Equipment and test chemicals listed will be provided. The supervisor will make the selection of equipment and chemicals. Students and teachers ARE NOT to know what substance has been selected before the event. Students will be expected to perform relevant tests using the materials provided. Emphasis in scoring is placed on careful and organized observations.

a. Teams will use various tests to characterize the substance. These tests are to be determined by the students, not the supervisor. It is recommended that students be given 25-35 minutes to do these tests. Data is to be recorded on a data sheet with a pen provided by the event supervisor. It should be neat and organized.

b. During testing and observation of their substance, students must record their data. Any mistakes or changes should be crossed out. The data should be numbered sequentially as it is collected. The pens will be collected before the questions are given to the team.

c. Students will be given a different writing implement and a list of questions about the characteristics of their substance. The ability to answer these questions will depend on the quality and thoroughness of their investigations. Questions will have answers that derive from student observations. Questions will not be asked about melting point.

d. When the questions and writing implement are distributed, the Event Supervisor will collect all samples. If the team has sufficient data and/or observations to support the answer to a question, they are to simply place the data number(s) beside the question. Place a number for all data that supports your answer to the question. Students are never expected to actually answer the question, just put the numbers of the observation(s) that would be used to answer the question. So if the question was "Is dissolving the substance an endothermic or exothermic process?", the students would put the numbers of the observation of the temperature of the pure water and the temperature of the solution on dissolving as answers or if the students had taken it a step further and already subtracted the two temperatures, the student would put that number as the answer for more points. The student would not ever say endothermic or exothermic.

4. **Examples of Possible Substances**: baking soda ($NaHCO_3$), borax, Epsom salts, sugar, alum, chalk, non-iodized table salt (NaCl), sodium acetate ($NaC_2H_3O_2$), starch, talc, calcium carbonate, ammonium chloride, boric acid, copper (II) chloride, copper (II) sulfate, etc. Note: Colored and white salts are permissible.

5. **Sample Questions about the Substance:**

   a. Is the substance soluble in water?
   b. If soluble in water, is the solution capable of conducting a current?
   c. Does the substance react with an acid to produce a gas?
   d. If soluble in water, what is the approximate pH of the solution?
   e. If soluble in water, does the substance dissolve endothermically or exothermically?
   f. Using a hand lens, what is the shape of the individual particles or are they too small to see?

6. **SCORING:** Each question is worth up to 5 points. The number of points awarded will depend on the quality of the data and/or observations. If the team remembers an answer to a question but does NOT have the supporting data and/or observations, they may write the answer to the question with their pencil and receive a maximum of 2 points. Ties will be broken by using the most answers that received 5, then 4, then 3, etc. Time is not a tiebreaker!

Recommended Resources: 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

CRIME BUSTERS

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

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

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

   a. **Students may bring** only these items:
      i. test tubes (**brushes** & racks), spot plates, well plates, reaction plates or similar small containers for mixing
      ii. something for scooping & stirring
      iii. pH paper
      iv. magnet(s)
      v. hand lens(es)
      vi. microscope slides and cover slips
      vii. forceps or tweezers
      viii. writing instruments
      ix. paper towels
      x. one 8.5" x 11" two-sided page of notes per student containing information in any form from any source

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

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

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

   d. **Safety Requirements:** Students must wear the following or they will not be allowed to participate: closed-toed shoes, ANSI Z87 indirect vent chemical splash goggles (see www.soinc.org), pants or skirts that cover the legs to the ankles, and additionally a long sleeved lab coat that reaches the wrists and the knees or a long sleeved shirt that reaches the wrists with a chemical apron that reaches the knees. 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:** All competitions will consist of evidence from Parts 3. a-d and analysis of the evidence in Part 3.e. Analysis or questions can only be on the evidence topics included in the competition. The amount of evidence included will be according to the following table:

Level	Part 3a (i-iii)	Limit on Mixtures from Part 3.a.i. only	Part b	Part c	Part d	Part e
Regional	6 - 15	Up to 2 of 2 solids with *	5-7	1 type	1-2 topics	Required
State	10 - 18	2-4 of 2-3 solids with *	7-10	1-2 types	2-3 topics	Required
National	14 - 20	2-6 of 2-3 solids with *	10-15	1-3 types	2-4 topics	Required

a. **Qualitative Analysis**: The unknown common materials will be taken from the following lists.
   i. Solids: Anhydrous sodium acetate, yeast, vitamin C (Ascorbic Acid)**,** *calcium carbonate (powdered limestone), *table salt (NaCl), *sugar (crystal), *flour, *calcium sulfate $2H_2O$ (gypsum), *cornstarch, *baking soda, *powdered gelatin, *powdered Alka-Seltzer®, *sand (white).
   ii. Non-Powdered Metals: aluminum, iron, zinc, magnesium, copper, and tin.
   iii. Liquids: lemon juice, rubbing alcohol (isopropyl), household ammonia (3%), water, vinegar, hydrogen peroxide (3%). Every team gets the same set of unknowns (evidence). The unknowns will be identifiable by performing tests such as solubility, acidity, magnetic property, color, density, and odor. The scenario will identify which containers may hold the mixtures.

b. **Polymer Testing/Natural and Man-made Substances:** Students will demonstrate their skill in identifying and collecting evidence from a variety of sources such as:
   i. Hair (the difference between human, dog, cat, not specific kinds of hair),
   ii. Fibers (the difference between animal, vegetable, synthetic, not specific kinds of fibers), and
   iii. Recyclable plastics (PETE, HDPE, non-expanded PS, LDPE, PP, PVC). No burn test allowed but burn results may be provided.

c. **Paper Chromatography**: Students will analyze evidence from paper chromatography (ink pens, juices, Kool-Aid®, etc.). The paper chromatogram(s) will be collected with the score sheet. No calculations are expected to be performed.

d. **Crime Scene Physical Evidence:** Students will also demonstrate their skill in collecting and/or analyzing evidence from a variety of other sources such as:
   i. **Fingerprints**: Students may be asked to identify different patterns on fingerprint evidence such as the difference between whorls, loops, and arches.
   ii. **DNA evidence**: Students may be asked to compare DNA chromatograms/electropherograms from materials found at the scene to those of the suspects.
   iii. **Shoeprints & tire treads**: Students may be asked to compare prints and make conclusions such as direction and speed of travel. No calculations are expected to be performed.
   iv. **Soil**: Students may be given the composition of soil found at the scene or on the suspects and asked to determine if this implicates any of the suspects.
   v. **Spatters**: Analyze spatter patterns for speed and direction of impact. No calculations are expected to be performed.

e. **Analysis**: In addition to identifying each piece of evidence and answering basic questions within each topic, students will be expected to draw logical conclusions about the event as a whole. Questions may include but are not limited to who is/are the prime suspect(s), who is/are not suspect(s), and sequencing of events. It is expected that conclusions made will be supported by reference to specific evidence and/or testing.

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

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

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

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.

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

HELICOPTER

1. **DESCRIPTION**: Prior to the tournament teams design, construct, and test free flight rubber-powered helicopters to achieve maximum time aloft.

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

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

3. **CONSTRUCTION PARAMETERS:**
   a. Helicopters may be constructed from published plan(s), commercial kits and/or a student's design. Kits must not contain any pre-glued joints or pre-covered surfaces.
   b. A flat balsa wood disc, large enough to cover a dime, must be the upper most part of the helicopter, the part that would touch a flat ceiling first during the flight.
   c. Any materials except Boron filaments may be used in construction of the helicopter.
   d. Total mass of the helicopter throughout the flight, excluding the rubber motor, must be 3.0 g or more.
   e. The helicopter may use up to three fixed pitch rotors, not exceeding a maximum diameter of **25.0** cm. Rotors are defined as **one or more blades** that rotate on a common path around a vertical axis. There must not be any other lifting surfaces. There is no maximum limit on the number of blades per rotor or blade chord.
   f. **If a single-bladed rotor is used, the maximum radius from the center of rotation to the blade tip must be less than 15.0 cm. This does not include any non-lift generating counterweights. A blade is defined as a single surface designed to create lift force as it moves through the air.**
   g. Competitors must construct the rotors themselves. Commercially available rotors or propellers must not be used in whole or part. Commercial rotor thrust bearings may be used.
   h. The helicopter must be powered by rubber motor(s) of any mass. Motor(s) must be removable from the helicopter for check-in. Motors may be lubricated before and/or after check-in. Officials need not mass the motors.
   i. Each helicopter must be labeled so the Event Supervisor can easily identify to which team 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. Rooms with minimal ceiling obstructions are preferred over very high ceilings.
   b. Once competitors enter the cordoned off competition area to trim, practice, or compete they must not receive outside assistance, materials, or communication. Teams violating this rule must be ranked below all other teams. Spectators must be in a separate area.
   c. During inspection each team must present a flight log of recorded data. Data must include 6 or more parameters (3 required and at least 3 additional) for 10 or more test flights prior to the competition. The required parameters are: 1) motor size before windup, 2) number of turns on the motor at launch, 3) flight time. The team must choose 3 additional data parameters beyond those required (e.g. turns remaining after landing, estimated/recorded peak flight height, the motor torque at launch, etc.).
   d. At the Event Supervisor's discretion:
      i. Multiple official flights may occur simultaneously according to the Event Supervisor's direction.
      ii. Test flights may occur throughout the contest but must yield to any official flight.
      iii. No test flights will occur in the final half-hour of the event's last period, except for teams that declare a trim flight during their 8-minute flight period.

e. A self-check inspection station may be made available to competitors for checking their helicopters prior to being checked by the Event Supervisor.
f. Competitors may use any type of winder, but electricity may not be available.
g. Competitors must present their event materials (helicopter(s), motor(s), and log) for inspection immediately prior to their 2 official flights. Event supervisors are strongly urged to return flight logs after inspection. Timers must follow and observe teams as they are winding their motors.
h. Teams may make up to a total of 2 official flights using 1 or 2 helicopters.
i. After check-in teams must be given an 8-minute Flight Period, starting when their first flight (trim or official) begins. Any flight beginning within the 8-minute period will be permitted to fly to completion. Competitors may make adjustments/repairs/trim flights during their official 8-minute period. 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 helicopters.
j. Time Aloft for each flight starts when the helicopter leaves the competitor's hand and stops when any part of the helicopter touches the floor, the rotors no longer support the weight of the helicopter (such as the helicopter landing on a girder or basketball hoop) or the judges otherwise determine the flight to be over.
k. Event Supervisors are strongly encouraged to utilize 3 Timers on all flights. The 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.
l. Competitors must not steer the helicopter during flight.
m. In the unlikely event of a collision with another helicopter, a team may elect a re-flight. The decision to re-fly may be made after the helicopter lands. Timers are allowed to delay a launch to avoid a possible collision. The eight-minute period does not apply to such a flight.

5. **SCORING:** The base score is the Team's longest single flight time. Ties will be broken by the longest non-scored flight time.
   a. **For every single-bladed rotor assembly on the helicopter (up to 3) teams receive a 10% bonus added on their flight time (max 30%.)**
   b. Teams with incomplete flight logs must have 10% of their flight time deducted from each flight.
   c. Teams without flight logs must have 30% of their flight time deducted from each flight.
   d. Teams that violate a rule under "CONSTRUCTION" or "THE COMPETITION" that does not have a specific penalty must be ranked after all teams that do not violate those rules.

Recommended Resources: Reference and training resources including the **Helicopters DVD** 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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HEREDITY

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

   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 two non-programmable, non-graphing calculators.

3. **THE COMPETITION:** This event may be run at stations and may include process skills such as data analysis, predictions, calculations, inferences, and observations. Contestants will be given a combination of genetic problems to solve, pedigrees, karyotypes, or diagrams to analyze. Every attempt should be made to avoid over-emphasis on a particular area. Common genetic disorders will apply to all levels. At the various levels, possible areas to be tested are limited to the following topics**:**

Regional and State	Regional and State	National (all topics+Reg. & St.)
Monohybrid cross	Dihybrid cross	Pedigree construction and analysis
Dominant and recessive alleles	Sex-linked traits	Production of gametes with Abnormal #'s of chromosomes
Genotype vs. phenotype	Pedigree analysis	Trihybrid cross (probability analysis)
Human sex determination	Multiple alleles	Analysis of karyotypes for deletion, addition, translocation
Gene: protein relationship	DNA structure & replication	Transcription and translation
Mitosis	Meiosis and gamete formation	Multifactorial traits
Human karyotypes analysis for nondisjunction disorders	Co-dominance & incomplete dominance	Epistasis

4. **SAMPLE QUESTIONS:**
   a. In guinea pigs, short hair (S) is dominant over long hair (s). Two heterozygous dominant guinea pigs are crossed (Ss X Ss). What will be the genotype ratio of their offspring? What will be the phenotype ratio of their hair length?
   b. In mice, the gene for color coat (C) is dominant to the gene for albino (c), and the gene for straight whiskers (S) is dominant to the gene for bent whiskers (s). Two heterozygous dominant mice are crossed CcSs x CcSs. Show the Punnett Square of genotypes for this cross and determine the genotype and phenotype ratios for this cross.
   c. A man who is blood type AB marries a woman who is blood type O. What blood types might be present in their children?
   d. Examine a pedigree and answer the questions about sex of individuals, relationships, phenotype, and genotypes.
   e. Examine a karyotype and answer questions about sex of individual, number of chromosomes, monosomy, trisomy, and genetic disorders.
   f. Examine data and/or diagrams concerning mitosis, meiosis, or DNA structure/replication and answer questions about the processes.

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)

METEOROLOGY: SEVERE STORMS

1. **DESCRIPTION**: This event emphasizes the use of process skills within designated meteorological topics. Skills to be addressed and evaluated may include generating inferences, making predictions, problem solving, observing, formulating and evaluating hypotheses, and analyzing and interpreting data.

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

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

3. **THE COMPETITION**: Questions will be from the following **Severe Storm** Weather topics:

   a. Air masses, fronts, cyclones, and anticyclones, weather maps, weather stations, global circulation patterns, semi-permanent highs and lows, and scales of atmospheric motion.
   b. Thunderstorms, supercell thunderstorms; life cycles, characteristics, and structure and hazards
   c. Squall lines, mesoscale convective complexes, dry line thunderstorms
   d. Straight line winds, downdrafts, downbursts, gust fronts, microbursts, derechos, **dust storms**
   e. Electrification of clouds, lightning strokes, sprites and jets, lightning direction finders
   f. Tornados: life cycles, characteristics, structure, and hazards, Fujita & E-Fujita Scales
   g. **Observation technologies including aircraft, satellite imagery, Doppler Radar, Stationary Radar, interpretation of severe storms including bow front and TVS**
   h. Identify and interpret cloud types associated with severe storms
   i. Mid-latitude cyclones: life cycles, characteristics, structure, and hazards; surface weather maps
   j. Hurricanes: life cycles, characteristics, structure, hazards, origin/distribution, Saffir-Simpson Scale
   k. Weather **safety** (hail, flooding, winds, storm surges, etc.), NOAA warnings and watches
   l. **Precipitation from severe storms: snow, rain, hail, blizzard, etc.**
   m. **Severe Storm hazards: Flash flood, debris flow, mudslide, atmospheric river, winds, etc.**
   n. **Special Topics for 2014:** Hurricane Sandy 2012, East Coast Derecho 2012, Joplin Tornado 2011, 2012 Arizona Haboob

4. **REPRESENTATIVE ACTIVITIES**:

   a. Interpret surface weather stations, isobars, fronts, radar data, Doppler radar imagery, or satellite imagery relating to associated severe storms
   b. Demonstrate knowledge of the life cycle of different severe storms and be able to associate those conditions with radar and frontal data
   c. Relate specific hazardous conditions of severe storms and interpret their significance (e.g., Hurricanes and storm surges)
   d. Using Doppler radar and satellite images to interpret the three-dimensional structure of storms

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

Recommended Resources: All reference and training resources including the **Audubon Weather (Meteorology) Guide** and the **Bio/Earth CD** are available on the Official Science Olympiad Store or Website at www.soinc.org and see www.education.noaa.gov/Special_Topics/Science_Olympiad.html, www.ametsoc.org/dstreme/, www2010.atmos.uiuc.edu/(Gh)/home.rxml, www.education.noaa.gov

THIS EVENT IS SPONSORED BY: The National Oceanic and Atmospheric Administration (NOAA)

METRIC MASTERY

1. **DESCRIPTION**: Teams will estimate and then measure properties of identical objects including mass, area, volume, density, force, distance, time, and temperature. **Teams will also perform metric unit conversions.**

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

2. **EVENT PARAMETERS**: The event will be in one room (or two if needed).
   a. **The event will be divided into 3 Parts. Parts One & Two** will have 15-**25** stations.
   b. Competitors will rotate through the stations to make their estimations and then, using the same or identical objects, make their measurements. **Approximately two-thirds of the stations will be Direct Measurement and one-third of the stations will be Calculated.**
   c. Measuring devices must be kept out of sight during Part One - Estimation.
   d. The property to be estimated or measured and the units of measurement must be identified in the directions at each station. Prior to the competition supervisors **must** determine the acceptable measurement value with the same equipment that is to be used **at each station.**
   e. Competitors must not bring watches, writing implements, electronic devices, notes, or **use** any kind of measuring device (e.g., fingers, pieces of paper, pencils, clothing, etc.). Each competitor may bring a non-programmable calculator only for Part Two - Measurement.
   f. Supervisors must furnish pencils, paper, and all measuring devices needed for the event.
3. **THE COMPETITION**: For each part Competitors will be given an answer sheet to record their answers. Each answer sheet must be turned in prior to the next Part or the team will lose their score for that Part.
   a. **Part One - Estimation:**
      i. Recommended time at each station for the Estimation Part is 30 seconds.
      ii. Competitors must not touch **or** feel any of the objects, unless the station directions specifically state the object may be touched. **Competitors must be allowed to "heft" an object for estimated masses.**
   b. **Part Two - Measurement:**
      i. Recommended time at each station for the Measurement Part is 60 seconds.
      ii. Measurements must be made using the supervisor supplied instruments, **expressed to the instrument's resolution (the smallest division/markings/graduations on its scale) plus one estimated digit**.
      iii. To receive points, measurements must be expressed using the proper resolution, estimated digit appropriate for the instrument(s) provided, **and the proper unit of measurement. Example**: Correct answer = 9.0 cm. If the answer given by the team is 9 cm **or 9.0**, the answer will be marked wrong.
   c. **Part Three - Metric Unit Conversion**:
      i. **This part must be after the completion of Part One and Part Two.**
      ii. **Competitors will have 5 minutes to complete 5 Metric Unit Conversion problems.**
      iii. **Competitors will be asked to convert 5 metric numbers to a specific different metric unit and must not be required to convert from one measurement system to another (e.g., metric to standard).**
4. **SCORING**: Final high score wins. **Final Score = Estimation Score + Measurement Score + Metric Unit Conversion Score.**
   a. **Part One - Estimation**: Scores within 5% of the correct value, as determined by the event supervisor, will be awarded 5 points, within 10% will be awarded 3 points, and within 20% will be awarded 1 point.
   b. **Part Two - Measurement**:
      i. **Direct Measurements**: Measurements (**not involving calculations**) that are within **(+/-) 3** of the estimated digit as determined by the event supervisor, expressed to the instrument's resolution (**the smallest division/markings/graduations on its scale**) receive 5 pts. All others receive zero points.
      Example: The Supervisor measured the width of a page as 209.1 mm using a ruler whose smallest divisions are 1.0 mm, then any value from 208.8 mm - 209.4 mm would be accepted as correct.
      ii. **Calculated Measurements**: **Measurements that require formula calculations (e.g., calculating the density of an object, surface area, velocity, etc.) receive 5 points for answers within the range of the calculated value based on (+/-) 3 of the estimated digit of the direct measurements.** All other answers receive zero points. **Example**: Supervisor measured and calculated: 13.45 cm x 22.32 cm = 300.20 cm^2. Range: within -0.03: 13.42 cm x 22.29 cm = 299.13 cm^2, within +0.03: 13.48 cm x 22.35 cm = 301.28 cm^2. Thus any value from 299.13 cm^2 - 301.28 cm^2 would be accepted as correct.
   c. **Part Three - Metric Unit Conversions**: Answers must be with the correct unit written to receive 5 pts. All other answers receive zero points. **Example**: Convert 14.56 mm to hm. Correct answer = 0.0001456 hm.
   d. **Penalties**: A 10 point penalty will be given for each of the following team violations:
      i. Does not return measuring devices to their original location or does not clean up any spills.
      ii. Alters the equipment (e.g., such as un-zeroing a balance). Altering equipment may also result in DQ.
   e. Ties will be broken using tiebreaker stations **designated prior to the start of the event**.

Recommended Resources: The **Problem Solving/Technology CD** and resources are available at www.soinc.org

ROAD SCHOLAR

1. **DESCRIPTION**: Teams will answer interpretive questions that may use one or more state highway maps, USGS topographic maps, Internet-generated maps, a road atlas or satellite/aerial images.

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

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

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

   a. **Topographic Map Testing Areas**

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

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

   b. **Highway Map Testing Areas**

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

   c. **Student-Created Map Design**

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

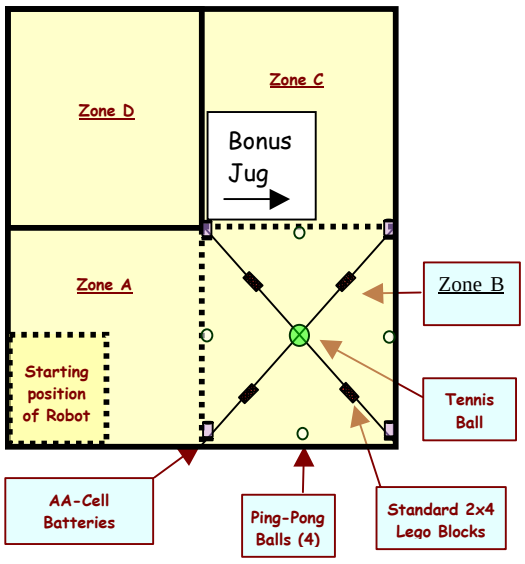
   * Items marked with an asterisk should be written at an introductory level for regional events.

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

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

Robo-Cross

1. **DESCRIPTION**: **Teams** design and build a robot capable of performing certain tasks on a prescribed Field.
   A TEAM OF UP TO: 2 **IMPOUND:** No **APPROXIMATE TIME**: 5 minutes
2. **CONSTRUCTION PARAMETERS**:
   a. Each team may enter only one Robot that must be built prior to the competition.
   b. The Robot may be controlled remotely by radio, infrared, or wired control boxes to the Robot. The Robot and Controller(s) are defined as the Device.
   c. A commercial kit must have at least one functional modification. A functional modification is defined as a modification such that the lack of it will result in the Robot not working or working differently.
   d. The Robot in the ready to run position must fit entirely inside an imaginary 30.0 cm x 30.0 cm x 30.0 cm cube. The Robot is not restricted to these dimensions during the run.
   e. The Robot may drop passive components, but must not separate into two or more active components.
   f. All Robot motion must be powered only by electrical, elastic, or gravitational energy. These forms of energy must not be converted to other forms such as hydraulics or pneumatics to power the Robot.
   g. Commercial batteries, not exceeding 14.4 volts as labeled, may be used to energize each of the electrical circuits in the Robot and its controller(s). Multiple batteries may be connected in series or parallel as long as the expected voltage output across any points does not exceed 14.4 volts as calculated using their labeled voltage. All power sources must be contained either in the Robot or as part of the controller(s).
   h. Competitors must go to www.soinc.org, Robo Cross to check legal and permitted frequencies for the radio controlled equipment for surface devices.
3. **TECHNICAL DOCUMENTATION:** In addition to the Device, teams must develop and submit at check-in (or as announced by the director) the following three technical documents-see samples at www.soinc.org.
   a. Illustration (any form, photo, drawings, etc.) of the basic structure of the Device with labels must show:
      i. All motors, numbered for reference in 3.b.i.
      ii. All energy sources
      iii. Controls **used** to interact with the Robot
   b. Operating Description: i. Robot reaction to each control input, ii. Tentative/proposed plan of movement (i.e., which items in the Competition Area will be moved; how the Robot plans to move each item)
   c. Written Practice Log: i. Record at least 10 runs, ii. Record at least 3 parameters. The parameters recorded must include score and time. Any additional data recorded will qualify as the third parameter.
4. **PLAYING FIELD:** See diagram of the Playing Field
   a. The Playing Field must be a smooth, rigid surface, 4' by 4' nominal outer dimension. Acceptable surfaces teams must be prepared for include, but are not limited to: hardboard, plywood, tile, hard foam board, etc.
   b. The perimeter of the playing field will have a border of commercial 1" x 2" (nominal, ¾" x 1½" actual) wood, attached to the top surface of the field with the 2" dimension placed vertical.
   c. The Playing Field will be equally divided into square zones labeled A, B, C, D counterclockwise. Zone D will have a border of commercial 5/8" to 11/16" quarter round molding separating it from the other zones attached on the inside of the Zone's borders. Rounded side must face Zone A & Zone C with the greater height placed vertical.
   d. The other interior boundaries must be designated by a line made with a fine tipped marker.
   e. Zone A will contain a marked 30.0 cm x 30.0 cm square in the outside corner as the Starting Position for the Robot.
   f. Zone B will contain all of the items listed in 4.i. at the start of the competition.
   g. Playing field may be designed to fold or separate along the zone boundaries. When in use they must not separate, and must not have more than 3 mm gap or step. One layer of tape, up to two inches wide, may be used to secure these seams.
   h. The Event Supervisor will supply the Playing Field, **Bonus Jug**, and items in 4.i.
   i. At the start of the competition, the Event Supervisor must place the following objects in Zone B: 4 Ping-Pong balls (approx. diameter 38 mm), 4 AA batteries on their sides, 1 tennis ball, and 4 Lego bricks (standard 2x4 size), as shown in the Playing Field diagram. To prevent premature movement of ping-pong balls, the Supervisor may put on the Playing Field a small dimple or paper reinforcement rings.



   j. **The Bonus Jug must be the bottom of a plastic gallon jug cut off to a height of 14.5 cm to 15.5 cm** placed in the **inside** corner of Zone **C with the opening facing away from Zone D.**

5. **COMPETITION**: At check in, the Event Supervisor inspects and measures the Device, selects 4 items from the Technical Documentation, and has the competitors point them out on their Device.
   a. Before starting the competition, competitors must place their Robot in the designated starting position in the outside corner of Zone A. The Robot must be in ready to run configuration.
   b. The competition must start by having the Event Supervisor verify that the Timers and competitors are ready. It is suggested that 3 Timers be used with the middle time recorded as the Run Time. The Event Supervisor will then count aloud "1, 2, 3, go". Teams will be allowed three minutes, starting with the word "Go", to complete the task of moving the items into scoring areas.
   c. The Robot may move the **Bonus Jug** (which must remain inside the playing field in any zone).
   d. If an item is moved by the control wires, it must be out of play and must not be used to attain any points.
   e. Miscellaneous Robot parts may end up in **or on** the **Bonus Jug** without penalty.
   f. The run must stop (and the time recorded to the precision of the instruments) when any of the following occurs (none of these actions will move the team to a lower tier):
      i. Three minutes have elapsed from the word "Go"
      ii. The team says "Stop"
      iii. Any part of the Robot or Bonus Jug that is Out of Bounds. Out of Bounds is defined as touching the floor outside of the Playing Field.
      iv. The team touches the Robot
      v. The Robot is physically moved by the wires connecting it to a control box
      vi. A team member steps on the playing field after the team has received a warning
   g. The Robot must stop within 2 seconds of the run completion.
   h. Any items moved/moving after the time has stopped must be scored where they were prior to that time.
   i. Teams who wish to file an appeal must leave their Documentation and Device with the Event Supervisor.
6. **SCORING**: At the end of the competition, points will be awarded based on the number and types of items that are in the specified scoring areas. Maximum score is **183**.
   a. If the Robot (parts touching the ground) is completely in:
      i. Zone A at the end of the competition, the team will receive 0 points
      ii. Zone B at the end of the competition, the team will receive 3 points
      iii. Zone C at the end of the competition, the team will receive 5 points
      iv. Zone D at the end of the competition, the team will receive 15 points
      v. If Robot parts (including dropped pieces) touch the ground in multiple zones, the lesser zone score will be awarded.
   b. Teams will receive the following points for each item moved into the following areas:

Item	Quantity	Points if in Zone C	Points if in Zone D
Lego blocks	**4**	**1**	**2**
Ping-Pong Balls	**4**	**2**	**4**
AA batteries	**4**	**3**	**6**
Tennis ball	**1**	**4**	**8**

      i. **Each item may earn points for a single zone.**
      ii. **A 2x** multiplier will apply to any item in or fully supported by the Bonus Jug while on **its side.**
      iii. **A 3x** bonus will apply to any item in or fully supported by the Bonus Jug if the opening is **facing up.**
      iv. An item that touches Out of Bounds, even if it is under the control of the Robot, is out of play and may not be used to attain points.
      v. If any part of the **Bonus Jug** is Out of Bounds, the items within will have no point value.
      vi. Any item on the line or straddling 2 zones will receive the lesser score.
   c. The score will be reduced one point for each incorrect identification in 5.a.
   d. Teams with no or incomplete Technical Documentation will have 5% deducted from their score.
   e. The team with the most points will be the winner.
   f. Tie Breakers: 1. Shortest run time; 2. Lowest mass of Device.
   g. Tiers:
      i. Tier 1: Devices that meet all requirements are ranked by highest score.
      ii. Tier 2: Devices with Competition violations are ranked by highest score.
      iii. Tier 3: Devices with Construction violations or both Construction and Competition violations are ranked by highest score.
      iv. Participation Points only: Devices that violate the frequency rules or are unable to compete.
      v. No Show Points only: Devices that have no capability by design to score points by moving objects.

Recommended Resource: The **Robo-Cross DVD** and training resources are available at www.soinc.org

ROCKS AND MINERALS

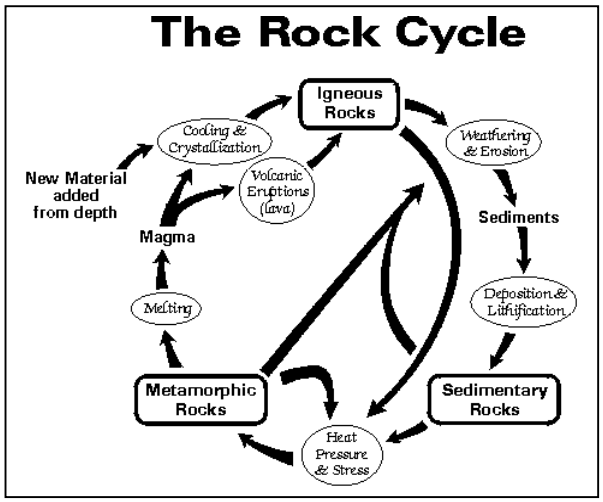
1. **DESCRIPTION**: Teams will demonstrate their knowledge of rocks and minerals.

   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.

ROTOR EGG DROP

1. **DESCRIPTION:** A team will construct an unpowered, autorotation helicopter device, which uses one or more helicopter rotor(s) to safely transport a raw chicken egg from a specified height to the floor.
   A TEAM OF UP TO: 2 **IMPOUND:** Yes **APPROXIMATE TIME:** 10 minutes
2. **EVENT PARAMETERS**:
   a. Students may bring only one prebuilt helicopter egg drop device. No other tools or equipment are allowed. The device may be in a protective storage container for impound.
   b. The supervisor will provide **scissors,** a raw, Grade A, large chicken egg, a plastic sandwich bag, a 3oz paper cup, and masking tape to attach the cup to the device and seal the bag (if needed).
3. **CONSTRUCTION PARAMETERS:**
   a. The device must use wings or blades that rotate around a central axis to slow the descent of the egg, using aerodynamic principles of a helicopter rotor in unpowered "autorotation" mode. No energy-producing mechanism of any type may be used to power the rotor(s) to slow the descent of the device. No commercial rotor assemblies may be used. The device must not be or contain an airplane, a balloon, or a parachute.
   b. Students must seal the egg in the provided plastic sandwich bag and place it in the provided cup.
   c. Students must mount or suspend the cup from the bottom of the helicopter device in such a position that the cup will be the first thing to contact the floor. Students may use the provided masking tape to attach the egg and cup to their device.
   d. No other shock absorbing or cushioning materials **can** be used either inside (including trapped air) or outside the bag or cup to protect the egg before the cup contacts the floor.
   e. The entire device, including the cup in **launch and** flying configuration, must fit into a 51 cm x 51 cm x 51 cm **cube in any orientation.**
4. **THE COMPETITION**:
   a. It is recommended that the event take place indoors, but if the event is held outdoors, teams must be notified of the location prior to the tournament date.
   b. The entire helicopter must be impounded and **weighed** before the start of the event. No modifications are allowed after impound other than to attach or extract the egg and cup from the helicopter.
   c. If competitors break the egg before the drop, they may request another egg, with a penalty of two seconds subtracted from their final time.
   d. Teams will have only one drop. All teams must drop their device from the same designated height. The drop height will be announced on the day of the tournament. It is recommended that the drop height be the maximum that the site will accommodate with a minimum height of five meters.
   e. Time starts when the device leaves the student's hand and stops **when the cup** or any part of the device touches the floor or the judges otherwise determine the flight is over. It is suggested that three separate timers be used and the final time be the median (middle) of the three times. Timing should be to the nearest 0.01 sec.
   f. After the drop the student is responsible for extracting the egg from the cup and sandwich bag and handing it to the event supervisor for inspection. Those helicopters whose egg did not survive will be ranked below those that survived.
   g. A broken egg is defined as a crack leaving a wet spot on a paper towel.
   h. Once the device is removed after testing there can be no further challenges for scoring or ranking.
5. **SCORING**:
   a. Teams will be ranked by the greatest descent time within each Tier, greatest time wins.
      i. Tier 1: Met construction/competition parameters and the egg survived.
      ii. Tier 2: Met construction/competition parameters and the egg did not survive.
      iii. Tier 3: Did not meet construction/competition parameters and the egg survived.
      iv. Tier 4: Did not meet construction/competition parameters and the egg did not survive.
   b. The tiebreaker is the mass of the **heaviest** helicopter (without the egg and cup).

Recommended Resources: All reference and training resources including the **Rotor Egg Drop DVD** (formerly Helicopter Egg Drop) are available on the Official Science Olympiad Store or Website at www.soinc.org

SHOCK VALUE

1. **DESCRIPTION**: Students will demonstrate their understanding of electricity, magnetism and simple electrical devices.

   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 electricity, magnetism and electrical devices such as light bulbs, batteries and motors. **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. Basic electrical DC circuit theory (e.g., concepts of voltage levels, current flow and direction, electrical pathways, volts, amperes, ohms, schematics, ohms law, **history**)
      ii. Basic electrical device concepts (e.g., battery polarity, parallel vs. series wiring of components, light bulb and motor connections, dry vs. wet cells). No semiconductors will be used
      iii. Basic electrical circuit construction/analysis (e.g., switches, power source, voltmeter measurements, light bulb/motor connections, 'kitchen' built batteries)
      iv. Basic magnetism concepts (e.g., North and South poles, Earth's magnetic field, electromagnet principles, magnetic vs. nonmagnetic materials, magnet shapes/types)
      v. Basic magnetic applications (e.g., use of a compass to determine directions/poles of a magnet, operation of an electromagnet, use of magnets in motors)
   d. **Historical items are limited to items related to named SI units (e.g., namesakes, related laws)**.
   e. Topics that must not be included in the competition are: semiconductors, AC circuit theory and devices, capacitors, inductors, **transformers, and non-linear devices**.
   f. **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 (CPCD)** are available on the Official Science Olympiad Store or Website at http://www.soinc.org

SIMPLE MACHINES

1. **DESCRIPTION**: This event includes activities and questions related to simple 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 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 and 1200.0g. The ratio of the large mass to the smaller mass must not exceed 5:1 for Regionals, 7:1 for States and 9:1 for Nationals. Competitors must not bring masses or include them in devices.

3. **CONSTRUCTION**:
   a. The device must be a class 1 lever with a single beam of length $\leq$ 1.00 m.
   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 machine concepts (e.g., types, terminology)
         2. Simple machine calculations (e.g., ideal / actual mechanical advantage, efficiency, load, effort)
         3. Simple 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 double pulleys)
         5. Wheel and Axle
      iv. Prohibited topics include: compound machines, dynamic calculations, strengths of materials, potential / kinetic energy, coefficient of friction, screw simple machine, 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 beam of the masses and fulcrum, 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 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

SOLAR SYSTEM: PLANETARY SCIENCE

1. **DESCRIPTION**: Students will demonstrate an understanding and knowledge of the properties and evolution of extraterrestrial ice and water in the solar system.

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

2. **EVENT PARAMETERS**: Each team may bring only two 8.5" x 11" two-sided pages of information in any form from any source.

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

   a. Part I: Participants may be asked to identify the planets, moons, and features included in the lists below as they appear on maps or imagery and must be knowledgeable about the history and processes involving ice and water for objects listed below.

      i. Mars: North Polar Ice Cap, South Polar Ice Cap, Equatorial Glaciers, Permafrost
      ii. Europa: Thrace Macula, Thera Macula, Conamara Chaos, Ridges, Cycloids, Plains, Ocean
      iii. Enceladus: Plumes, Jets, Tiger Stripes
      iv. Iapetus, Triton, Ceres, and Titan
      v. Comets, The Kuiper Belt, and The Oort Cloud

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

      i. History of and formation processes for specific formations above
      ii. Remote sensing, imagery, and satellite measurements of formations above
      iii. Physical, thermal, and chemical properties of potential habitats for life
      iv. Past, current, and planned future missions to explore these objects
      v. Phase diagrams and different crystalline forms of water ice

4. **SAMPLE PERFORMANCE TASKS**:

   a. Given a set of images of a particular feature, identify the planetary body on which that feature occurs and describe a hypothesis that explains how that feature was formed.
   b. Given a set of satellite measurements, compare the temperature and composition of different regions across a given planetary body.
   c. Use a phase diagram to determine what phase water should be in on different regions of a planet.

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

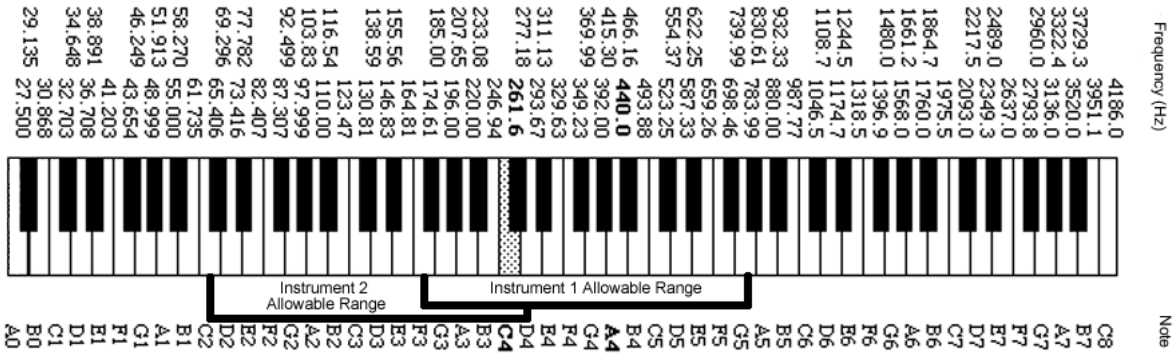
Recommended Resources: All reference and training resources including the **Bio/Earth CD (BECD)** are available on the Official Science Olympiad Store or Website at www.soinc.org or on following websites: solarsystem.nasa.gov/planets/, saturn.jpl.nasa.gov/ mars.jpl.nasa.gov/mro/, solarsystem.nasa.gov/galileo/, dawn.jpl.nasa.gov/, sci.esa.int/juice/, mars.jpl.nasa.gov/express, europa.seti.org

THIS EVENT IS SPONSORED BY: The University of Texas Institute for Geophysics (UTIG)

Sounds of Music

1. **DESCRIPTION**: Prior to the competition each team must build two instruments (of any **two of the following three types: percussion, strings, winds),** based on a 12 tone tempered scale, prepare to describe principles behind their operation and be able to perform a major scale, required & chosen melody with each.
   A TEAM OF: 2 **EYE PROTECTION**: None Required **APPROXIMATE TIME**: **28** minutes
2. **EVENT PARAMETERS:**
   a. Teams must provide a score of all music (both chosen and required) to be performed and submit it in notated form at the beginning of their presentation. Copies of this rules page must not be accepted.
   b. All music must be written in the appropriate clef for each of the instruments **(#1: Treble, #2: Bass)**.
   c. Each competitor must play at least one instrument.
   d. Notes, calculators, books, etc. must not be allowed during any **part**. Sheet music **and stands are** allowed.
   e. **The supervisor must provide a test** that contains age appropriate scientific questions concerning general principles of acoustics as well as on the design, function and construction of the instrument types (e.g., how it makes sound; what determines the pitch; how is volume changed; etc.).
3. **CONSTRUCTION**
   a. Each instrument must be capable of playing the required lines as written or as transposed into a key adapted to their instrument but within the allowable range. **Notes outside the allowable range are permitted but must not be scored.** Harmony for one instrument is required.
   b. No electric or electronic devices, toy or professional instruments or parts of such instruments are permitted (e.g., bells, whistles, mouthpieces, reeds or reed blocks, audio-oscillators, rosin, tuning pegs, etc.). The only exception is that strings (instrument or others) of any type are permitted.
   c. No electricity is allowed. All energy put into the instruments must originate from the competitors.
   d. Instruments must be able to go through a standard 75cm wide door.
4. **THE COMPETITION**:
   a. Once competitors enter the judging room, they will be given at least 30 seconds to setup before judging begins (there is a 5 point bonus if ready in <= 30 seconds).
   b. **Part 1: Instrument Evaluation (Accuracy, Range and Sound Quality)** (~ **4** minutes to judge)
      i. Instruments must be evaluated on **functionality, musicality, originality, varieties of instruments, and durability** through an interview process.
      ii. Competitors must play a supervisor specified note from the required scale, which must be judged for accuracy. The note must be able to be sustained for at least 3 seconds in order to be measured by an electronic or computer based tuner.
      iii. Each competitor must have at least 30 seconds to play the Mandatory scale as given in the following chart and must be evaluated on range, pitch, and sound quality.
      iv. Range will also be evaluated on range size. Instruments capable of playing above and/or below the mandatory scale but within the allowable range will receive more points. Corresponding frequencies for each note below have been rounded to the nearest whole number.

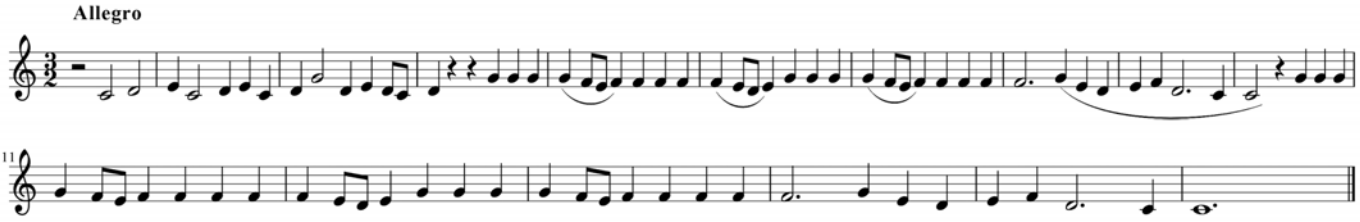
Scale	Instrument 1	Instrument 2
Mandatory Scale	**F major (F4-F5 [349-698 Hz])**	**C major (C3-C4 [131-262 Hz])**
Allowable Scoring Range	F3 to G5 [175-784 Hz]	C2 to D4 [65-294 Hz]
Music submitted in	Treble Clef	Bass Clef



c. **Part 2: Sound of the Ensemble** (~ 4 minutes to judge)
   i. The team must then perform, in any key within the musical ranges specified, the lines of music included below. The piece must be played as a duet including melody and harmony. Competitors must supply their own harmony. The performance is limited to a total of 90 seconds.
   ii. They must also play a duet of their choosing which best demonstrates their instruments' capabilities. The performance is limited to a total of 90 seconds.
   iii. Points for both songs must be based on harmony, blend, technique, timbre, suitability of tune for instruments, rhythm, interpretation of music, etc.
   iv. Competitors must be given a maximum of 4 minutes to play both the required duet and the chosen duet.

d. **Part 3**: **Knowledge** (~ **20** minutes to judge)
   i. This **is recommended to** be done with a written set of questions. **The test must contain at least three questions that relate to each of the three types of instruments used by the competitors. Competitors will be scored on the general acoustic questions and the questions that relate to the types of instruments brought by the competitors. Questions relating to the type of instrument not represented by the competitors will not be scored for that team.**
   ii. Competitors must be able to define or explain basic terminology regarding sound, sound production, and related science terms. These include the fundamental elements of wave theory, Bernoulli Effect, acoustics, musical sound perception, and harmonics.

5. **SCORING:** A complete scoring rubric is available on the Sounds of Music page on www.soinc.org
   a. All scoring must be done by the same set of judges (preferably 3). If more than one person is judging, each judge must score the same parts of the competition for all teams.
   b. All sections must be added for the total score (max possible score is **140** points).
   c. Judges must collectively have knowledge of both music and the physics of sound.
   d. **Part 1: Instrument Evaluation (Accuracy, Range and Sound Quality)** (Judge 1) (**30** points total max)
      i. Functionality, **musicality, originality, instrument varieties , durability** 5 points max
      ii. Accuracy of specified note 5 points max
      iii. Demonstrated range (for instrument #1) 5 points max
      iv. Sound quality (compared to standard instruments #1) 5 points max
      v. Demonstrated range (for instrument #2) 5 points max
      vi. Sound quality (compared to standard instruments #2) 5 points max
   e. **Part 2: Sound of the ensemble** (Judge 2) (**30** points total max)
      i. Group performance for the required song **15** points max
      ii. Group performance for the chosen song **15** points max
   f. **Part 3: Knowledge** (Judge 3) Includes participation of both team members. (**60** points total max)
   g. **Other scored items**: (20 points total max)
      i. Teams that furnish music for the judges with team name and number 5 points max
      ii. Teams that write their music in the correct clefs and correctly notated 5 points max
      iii. Teams that play all music in the correct range 5 points max
      iv. Teams that are ready to be judged within 30 seconds of entering the room 5 points max
   h. Teams that violate a rule in the Construction section must be ranked behind all other teams that do not.
   i. Tiebreaker: 1st, score on part 3: knowledge; 2nd, range of instruments
   j. Required Song: **"Hornpipe, Water Music, Handel",** shown below
   k. Competitors must transpose music into a suitable key to fit the assigned ranges of their instruments. Suggested tempo is **Allegro** ♩152.



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

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

WHEELED VEHICLE

1. **DESCRIPTION:** Competitors must design, build, and test one vehicle that uses a non-metallic, elastic material as its sole means of propulsion to travel a distance as quickly and accurately as possible.

   TEAM OF UP TO: 2 **IMPOUND:** Yes **EYE PROTECTION:** #5 **TIME:** 8 Minutes

2. **SAFETY PARAMETERS:** Competitors must wear eye protection during set-up and testing of their vehicle. 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.
3. **CONSTRUCTION PARAMETERS:**
   a. Vehicles must be designed as a single integral device to travel a distance between 7.00 m and 11.00 m and come to a complete stop without straying from the track's center. The exact distance (in 1.00 m intervals for regional, 0.50 m intervals for state and 0.10 m intervals for national tournaments) must be chosen by the Event Supervisor and announced after all vehicles have been impounded.
   b. All energy used to propel the vehicle must be stored in a non-metallic elastic device. It may be left unattached until just prior to the run. Pre-loaded energy storage devices may be used to operate other vehicle functions (e.g., braking system) as long as they do not provide energy to propel the vehicle.
   c. The distance between the center of rotation of the front-most and rear-most axles must not be > 70.0 cm.
   d. The entire vehicle width must not exceed 30.0 cm at any point.
   e. The vehicle must have attached to the front end a ¼ in wooden dowel approximately perpendicular to the floor so as to be the foremost part of the vehicle at all times during its run. Its purpose is twofold.
      i. The dowel must extend to at least 35.0 cm from the floor to interrupt the laser (if used-see 5.k.), which must be placed approximately 30.0 cm above the floor.
      ii. The dowel must also extend to within 1.0 cm of the track's surface so that its front bottom edge will be the vehicle's Measurement Point for distance measurements.
   f. No part of the vehicle can extend beyond the front of the ¼ in dowel either in ready to run mode or during its entire run.
   g. Competitors must start the vehicle by using any part of an unsharpened #2 pencil with an unused eraser (provided by the Event Supervisor) to actuate a trigger. The trigger must be designed so that its actuation is perpendicular (vertical) to the floor. A non-vertically actuated trigger is a construction violation. The vehicle must be able to remain at the starting position without being touched until triggered.
   h. Only the wheels and drive strings, if any, are allowed to contact the floor at any time. If any piece falls off the vehicle during the run, it is a construction violation.
   i. The vehicle must not be remotely controlled or tethered.
   j. No electrical or electronic devices may be used on the vehicle, its alignment devices or any tools (with the exception of any type of calculator). The stopping mechanism must work automatically.
4. **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. Space is needed on each side of the track's Center Line and beyond the Target Line to allow for error in the vehicle's path. It is recommended that at least 0.50 m is provided on both sides of the Center Line and beyond the Target Line. The laser or photogate system must be at a minimum of 0.50 m from either side of the Center Line. If less space is provided, teams must be notified 2 weeks in advance. See www.soinc.org for track setup.
   b. The Event Supervisor must use 1-inch tape to define the track's Center Line, the Starting Line, the 0.50 m Line, the 6.5 m Line, and Target Line. The edge of the tape must define each line. Each line should extend as far as practical on both sides of the track's Center Line.
5. **THE COMPETITION:** Teams who wish to file an appeal must leave their vehicle with the Supervisor.
   a. The vehicle, extra elastic devices and interchangeable parts needed to adjust the vehicle must be impounded before the start of the competition. Tools for adjusting the vehicle, test data, and measuring/calculating devices to assist in making accurate vehicle adjustments need not be impounded.
   b. Only competitors and the Event Supervisor will be allowed in the vehicle impound and track areas while teams are competing. Once competitors enter the event area, they must not leave the area or receive outside assistance, materials, or communication.
   c. Teams are given an Event Time of eight-minutes to load energy into their vehicle, and complete up to two runs. If the second run has started before the Event Time has elapsed, it must be allowed to run to completion. Time used by the Supervisor for run measurements must not count toward the Event Time.

d. Teams may adjust their vehicle before each run (e.g., change its elastic device, speed, distance, directional control, or make other changes from impounded parts).
e. Teams may use their own measuring devices to verify the track dimensions during their Event Time. They must not roll the vehicle on or adjacent to the track surface between the start and finish line at any time prior to or during the competition.
f. Substances that may damage the floor or interfere with subsequent runs must not be applied to the wheels or floor. During their Event Time, competitors may clean the track but it must remain dry at all times.
g. Teams must place the tip of the Vehicle's Measurement Point anywhere on the Start Line. Competitors may align their vehicle once it is on the Start Line. Sighting and/or aiming devices placed on the track are permitted but must be removed before the vehicle begins its run. Aligning and sighting devices mounted on the vehicle may be removed at the team's discretion prior to each run.
h. If a vehicle does not move upon actuation of the switch, the students may request to set up for another try at a run within their Event Time. Failure to move shall not count as a run. If the vehicle moves any distance after actuation of the switch, it must be considered a run.
i. Once the vehicle starts a run, the competitors must not follow it down the track and must wait until called by the Event Supervisor to retrieve it. Their Event Time resumes once the competitors pick up the vehicle or begin to make their own measurements.
j. Event Supervisors are encouraged to utilize a photogate timing system installed at the 0.50 m Line and the 6.50 m Line for the primary time. When 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, it is suggested that 3 timekeepers be used with the middle time used as the Run Time. It is recommended that lasers be placed across the track at 0.50 m and 6.50 m, which 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.
k. If the vehicle passes the 0.50 m Line but stops before the 6.50 m Line, the timekeepers record the stop time, the distance measurement is taken, and it is scored as a Tier 2 run.
l. If the vehicle travels in the wrong direction or if the time or distance cannot be measured for a vehicle (e.g., it starts before the Event Supervisor is ready, if it moves but does not go at least 0.50 m, or the competitors pick it up before it is measured), the run is a Failed Run.

6. **SCORING:** Low score wins. The Score for each run = Time Score + Distance Score + Center Line Bonus.
   a. Run Time starts when the dowel of the vehicle reaches 0.50 m and ends when it passes the 6.50 m mark. The Run Time must be recorded in seconds to the precision of the timing device used.
   b. Time Score = Run Time x 5.
   c. Distance Score: The Distance Score is the distance from the Measurement Point to the Target Line in centimeters measured to the nearest 0.1 cm. This is a point to line measurement.
   d. Center Line Bonus: A bonus of -20 points must be awarded if the center tape remains completely within the two wheels of the vehicle's widest axle while the vehicle travels between the Starting Line and the Target Line. This bonus must be awarded even if the vehicle veers off center line tape after the Measurement Point crosses the Target Line.
   e. The Final Score must be the run that gives the team the better rank.
   f. Ties must be broken by this sequence: 1. Better non-counted run; 2. Faster time on the counted run.
   g. Tiers:
      i. Tier 1: Any run with no violation
      ii. Tier 2: Any 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.
   h. Teams whose vehicle cannot complete a run within the Event Time or those who have two Failed Runs must be given participation points.

Scoring Example: At a competition, a vehicle stopped 67.6 cm from the Target Line with a measured Run Time of 6.67 s. The Center Line tape remained within the vehicle's track during the run.

Time Score:	33.35 (6.67 x 5)
Distance Score:	67.6
Center Line Bonus	- 20.0
Run Score:	80.95

Recommended Resources: The **Wheeled Vehicle DVD (WVD)** and the **Problem Solving/Technology CD (PTCD)** are available on the Official Science Olympiad Store or Website at http://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