SCIENCE OLYMPIAD
DIVISION B RULES MANUAL

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- Please read the **General Rules** on the back inside cover - they apply to all events. Note: all changes are in **bold**.
- Coaches: Please remember to register early for the Science Olympiad Summer Institute – sold out last year!
- Please visit the Science Olympiad web site: http://www.soinc.org for News, Clarifications, FAQs, Membership Information, Team Size Requirements, New Store Items and other valuable information, tips and resources.

The sites for the upcoming Science Olympiad National Tournament are:
University of Central Florida, Orlando, FL, May 18-19, 2012
Wright State University, Dayton, OH, May 17-18, 2013
University of Illinois, May 16-17, 2014
University of Nebraska, May 15-16, 2015

ANATOMY

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

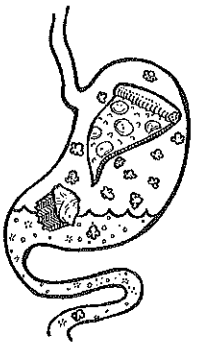
1. **DESCRIPTION:** This event encompasses the anatomy (structure and function) of the **digestive** and respiratory systems and the effects of aging and diseases on them.

   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 notes that contain 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 **digestive** and respiratory systems and how aging and specific diseases affect them. Process skills expected may include data collection, making observations, inferences, predictions, calculations, analyses and conclusions. The test may include various formats (e.g., timed stations, written test, slides, etc.) for the following topics:

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

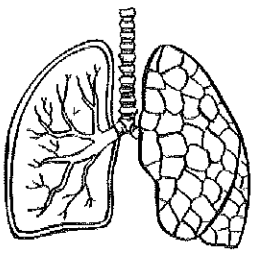


      i. Functions of the digestive system
      ii. Basic anatomy of the component parts of the alimentary canal and accessory organs of digestion
      iii. Anatomy of the four layers of the wall of the alimentary canal
      iv. Comparison of the lining of the esophagus, stomach, small intestine and large intestine
      v. Compare and contrast mechanical and chemical digestion
      vi. The effects of exercise on the digestive system
      vii. The diseases on each level from the cell to the whole person as listed: stomach & duodenal ulcers, cancers of the digestive system, diarrhea, lactose intolerance, hepatitis, appendicitis
      viii. Treatment and prevention of all described diseases

      National Level Only:

      ix. Specific functions of the liver and pancreas in the digestive system
      x. Additional diseases: Crohn's disease, GERD, diverticular disease

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



      i. Anatomy of the Respiratory System – Principal organs, their structure and function
      ii. Functions of the Respiratory System
      iii. Mechanisms of Pulmonary Ventilation
      iv. Patterns of Breathing
      v. Measures of Pulmonary Ventilation
      vi. How exercise and high altitude affect the respiratory system
      vii. Understand disorders: COPD, asthma, emphysema, pneumonia, sleep apnea, **Cystic Fibrosis**

      National Level Only:

      viii. Additional diseases/disorders to know: tuberculosis, pulmonary edema, **bronchitis**, **lung cancer**
      ix. Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.)
      x. Regulation of the Respiratory System

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 **Bio/Earth CD** are available on the Official Science Olympiad Store and Website at http://www.soinc.org

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

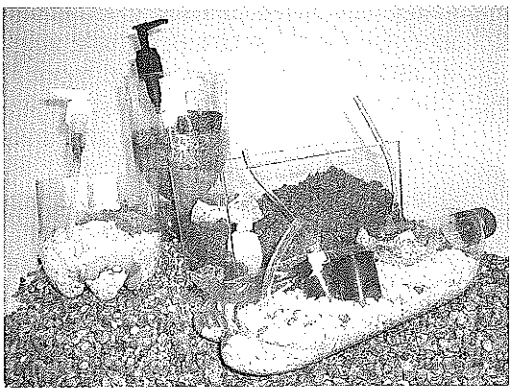
AWESOME AQUIFERS

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

1. **DESCRIPTION:** Students will construct an aquifer and answer questions about groundwater concepts.

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

2. **EVENT PARAMETERS:** The supervisor will supply score sheets, water, Station 2 resources, and Station 3 building objectives. Students are required to bring any materials needed to assemble an aquifer on-site. The entire aquifer is to be housed in one transparent container not exceeding a total volume of 3.1 liters. This container can be cut or punctured in advance but must be brought to the competition empty. Electric pumps/tools and commercial flow models are not allowed. Students cannot bring notes, texts, or references. Students are responsible for taking and/or properly disposing of all materials used in assembling their aquifer. An extended list of suggested materials (**hazardous and harmful chemicals are NOT allowed**) and possible concepts are available at www.soinc.org and http://www.groundwater.org/pe/so_aa.html and may include but not limited to material such as:

   a. Sand and gravel (such as pea-sized or aquarium gravel)
   b. Modeling clay or plumber's putty
   c. Materials for wells and pumps, such as soap bottle pumps or aquarium tubing and plastic syringes. No electric or commercial pumps permitted.
   d. Well screening materials, e.g., nylon hose, cotton, coffee filters, etc.
   e. Sponge
   f. Aluminum foil and/or plastic wrap or sheeting
   g. Empty 35 mm plastic film canisters or equivalent
   h. Material to represent contaminants, such as food coloring or powdered drink mix
   i. Materials that could be used for remediation such as coffee filters, fabric squares, charcoal, etc.
   j. Items useful in creating or demonstrating the aquifer but that will not be part of the aquifer, such as scissors, tacks, tape, containers to hold water and/or contaminants, blank paper, pen or pencil, etc.

3. **THE COMPETITION:** Students will be given 10 minutes to complete each station.
   a. Station 1: Students take a written test on groundwater concepts and vocabulary. Questions can be multiple choice, true/false, fill in the blank, or short answer.
   b. Station 2: Students take a written test utilizing provided resources such as maps, charts, graphs, models, and scientific publications. Questions can be multiple choice, true/false, fill in the blank, or short answer.
   c. Station 3: Students build an aquifer that will explain and demonstrate concepts chosen by the event supervisor. Students may create notes at Station 3 to use at Station 4. Possible concepts include but are not limited to: recharge, discharge, connection between surface and groundwater, water table, porosity, permeability, well location and abandonment, groundwater contamination, remediation, and safe yield from an aquifer. See list of presentation concepts for regional, state, and national tournaments at Awesome Aquifer event page at www.soinc.org.
   d. Station 4: Students use the aquifer built at Station 3 to explain and demonstrate the required concepts to a judge(s). Information may be presented in any way or order students choose and the same demonstration may be used to explain more than one concept. Judge(s) may ask clarifying questions but only if a team has finished its demonstration and there is time remaining.

4. **SCORING:** Highest score wins. Station 1-25%, Station 2-25%, and Station 4-50%. First tiebreaker: highest score at station 4. Second tiebreaker: highest score on pre-selected questions at station 1 and 2. Answers must include units where appropriate.

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

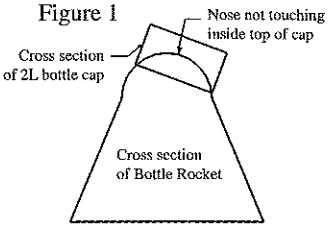
THIS EVENT IS SPONSORED BY THE GROUNDWATER FOUNDATION
(http://www.groundwater.org/pe/so_aa.html)

BOTTLE ROCKET

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

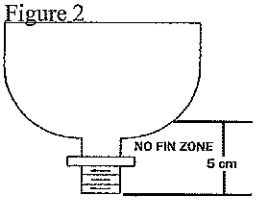
1. **DESCRIPTION:** Prior to the tournament, teams construct **two** rockets designed to stay aloft for the greatest amount of time.
2. **TEAM OF UP TO:** 2 **IMPOUND:** No **EYE PROTECTION:** #5 **APPROXIMATE TIME:** 10 min.
3. **EVENT PARAMETERS:**
   a. Teams must design, build, and bring **up to two** rockets to the tournament **(only 1 launch per rocket). Parts from one rocket must not be used on another rocket.**
   b. **Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows, otherwise they will not be allowed to compete and scored as a no-show.**
   c. Event supervisors must provide the launcher and water.
4. **CONSTRUCTION PARAMETERS:**
   a. Rocket pressure vessels must be made out of a single **1 liter or less** plastic carbonated beverage bottle with a neck/nozzle opening internal diameter of approximately 2.2 cm (a 1/2 inch Schedule 40 PVC pipe must fit tightly inside the nozzle opening). Labels may be removed from the bottle but must be presented at the safety inspection.
   b. **Only** tape **must** be used to attach fins and other components to the pressure vessel. **No glues of any type may be used on the pressure vessel. Glue may be used in other parts of the rocket assembly.** Metal **of any type** and commercial model rocket parts are prohibited **anywhere on the rocket.**
   c. The structural integrity of the pressure vessel **must** not be altered. This includes, but is not limited to: physical, thermal or chemical damage (e.g., cutting, sanding, using hot or super glues, **spray painting**).
   d. Alteration to the structural integrity of the pressure vessel results in a **safety** violation **of the rocket** and **it must** not be launched. Event supervisors assess structural integrity by looking through the nozzle and sides of the bottle for discoloration, bubbles, thinning or cuts in the walls.
   e. The nose of the rocket must be rounded or blunt at the tip and designed such that when a standard 2 liter bottle cap **(~3.1 cm diameter x 1.25 cm tall)** is placed on top of the nose, no portion of the nose touches the inside top of the bottle cap (see Figure 1). Teams must not use a nose that is sharp, pointed, or consisting of a rigid spike regardless of the material used.

Figure 1



   f. Explosives, gases other than air, chemical reactions, pyrotechnics, electric or electronic devices, elastic powered flight assists, throwing devices, remote controls, and tethers are prohibited at any time. All energy imparted to the rocket at launch must originate from the water/air pressure combination.
   g. All rockets **must** be launched using the launcher provided by the supervisor. Fins and other parts added to the bottle must be 5 cm or higher above the level of the bottle's opening, to ensure rockets fit on the launcher (see Figure 2).
   h. Rockets must not change shape or deploy any type of recovery system.

Figure 2



5. **THE COMPETITION:**
   a. Teams must arrive at the competition site ready to launch. Following the safety inspection of **the** rockets, teams may add any amount of water to the inspected rocket(s). When called to launch, the teams have a total of 10 minutes to launch **the** rockets (only 1 launch per rocket). Any rocket launched before the time expires must be scored.
   b. Rockets must be launched at **60 psi**. Once pressurized, teams must not touch or approach the rocket.
   c. Parts of the rocket must not fall off or become separated during launch or flight.
   d. Time aloft is recorded in hundredths of a second. Timing begins when the rocket separates from the launcher and stops when any part of the rocket touches the ground, goes out of sight, or comes to rest on an obstruction (e.g. a tree or building).
   e. **Event supervisors are strongly encouraged to use three independent timers on all launches. The middle value of the three timers must be the officially recorded time.**
6. **SCORING**: Rockets with construction or safety **violations will not** be launched due to safety. **Teams that are unable to launch a rocket because of construction violations will receive participation points only.**
   a. Ranking within each tier is determined by the **combined** greatest time aloft **of both rocket flights. If a team only launches one rocket then that team will receive only the flight time for that launch.**
   b. **Tiers**: Teams with a Tier 1 rocket and a rocket with a violation **are scored** as if they had only **one** rocket.
      i. Tier 1: **Rockets** launched without construction or competition violations.
      ii. Tier 2: **Any Launch with** competition violations.
   c. Ties are broken by the greatest time aloft by a single rocket.

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

COMPUTE THIS

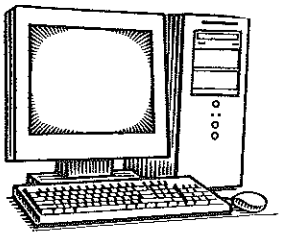
Read the General Rules in the manuals and on www.soinc.org as they apply to every event.

1. **DESCRIPTION**: This event integrates Personal Computing (PC) technology, the Internet, and quantitative data analysis. Teams are presented with a problem that requires quantitative data capture from the public Internet and the organization and presentation of data in a graphical format. Short answer questions related to the problem are also included.

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

2. **EVENT PARAMETERS**: No resource materials or calculators may be used during the competition. Blank tablet paper and writing instruments may be used to assist teams in organizing their thoughts, if desired. Prior to the event, teams may construct their own publicly accessible (non-password protected) websites to organize URL links and reference information for use during the competition. Teams may also freely access any publicly accessible www site or search engine (e.g., Google or others) to locate information within the **http://www.cdc.gov/** domain. However, during the event, no external communication is permitted with other individuals via e-mail, chat rooms, or other forms of collaborative computing; the penalty for an infraction of this nature will be immediate disqualification.

3. **THE COMPETITION**:



   a. Each team will be provided with one personal computer with a WWW browser (e.g., Internet Explorer and/or Firefox), MS Word, MS Excel, and broadband Internet access. **Event supervisors shall announce the software products and versions to be provided at the tournament site at least 30 days prior to the competition, in coordination with their tournament director.**

   b. Teams will be given a problem in the area of **epidemiology**, and all required information will be located on web sites within the **http://www.cdc.gov/** domain.

   c. The problem statement will require the capture of quantitative information from the Internet followed by spreadsheet data entry and graphical presentation. A specific chart format (e.g., line chart, pie chart, column chart, etc.) will be defined in the problem statement. All charts must include labeling for each axis (including units of measure) and legends to properly label data within the chart (i.e., elements within a pie chart, multiple lines in a line graph, etc.). No URLs are required in the data table or the chart to identify the source of information, but all data must come from the **http://www.cdc.gov/** domain.

   d. The problem statement will also include up to five (5) short answer questions. Questions may involve analysis of data previously collected or require additional facts to be gathered via Internet search. Where additional searches are required, teams **must** list the specific source URL associated with each answer. The URL must be complete and must point to information within the **http://www.cdc.gov/** domain.

   e. Teams will construct a **MS Excel** file that contains the data tables and graphics associated with the problem and a **MS Word** file that contains the answers and URLs associated with the short answer questions. The event supervisor will specify how these files are to be submitted at the conclusion of the event. Teams should include their school name and team number (as appropriate) within both files to ensure proper identification by the event supervisor.

4. **SCORING**: High score wins based on a-c.

   a. Completeness and Accuracy of Quantitative Data Collected-20 Points
   b. Completeness, Accuracy, and Format of Graphical Data Presentation-30 Points
   c. Answers and URLs Associated with Short Answer Questions-50 Points
   d. The tiebreakers shall be:
      i. The number of short answer questions correctly answered
      ii. The completeness and accuracy of quantitative data collected
      iii. The overall quality of graphical data presentation

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

CRIME BUSTERS

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

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

   A TEAM OF UP TO: 2 **EYE PROTECTION**: #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.

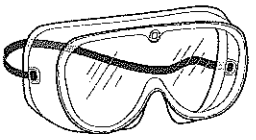
   a. **Students may bring** only these items:
      i. test tubes & racks, spot plates, well plates, reaction plates or similar small containers for mixing
      ii. something for scooping & **stirring**
      iii. pH paper
      iv. magnet(s)
      v. hand lens(es)
      vi. microscope slides and cover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

      The supervisor may provide:
      vi. other equipment (such as a microscope, probes, calculator…), or
      vii. candle & matches if fibers given, or
      viii. differential density solutions or other method of determining density of polymers if plastics given or
      ix. reagents to perform additional tests.

   c. **Safety Requirements:** Students must wear the following or they will not be allowed to participate: closed-toed shoes, ANSI Z87 indirect vent chemical splash goggles (see http://soinc.org), pants or skirts that cover the legs to the ankles, and **additionally** a long sleeved lab coat that reaches the wrists and the knees **or** a long sleeved shirt that reaches the wrists **with** a chemical apron that reaches the knees. Chemical gloves are optional. 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 disqualified from the event.



3. **THE COMPETITION:** All competitions will consist of evidence from Parts 3a and 3b, and Part 3e (Analysis). Additional evidence will be included according to the following table:

Level	*Part a*	*Part a Mixtures*	*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

Questions can only be asked on the evidence topics included in the competition.

   a. **Qualitative Analysis**: The unknown common materials will be taken from the following lists.
      i. Solids: Anhydrous sodium acetate, *sand (white), *calcium carbonate (powdered limestone), vitamin C (Ascorbic Acid), *table salt (NaCl), *sugar (crystal), *flour, *calcium sulfate $2H_2O$ (gypsum), *cornstarch, *baking soda, *powdered gelatin, *powdered Alka-Seltzer®, yeast.
      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. Question 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 3e. Second tiebreaker is Part 3a. Third tiebreaker is Part 3b.
   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

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

1. **DESCRIPTION:** Students will use their investigative skills in the scientific study of disease, injury, health, and disability in populations or groups of people with a focus on food borne illness.

   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 notes that contain information in any form from any source and up to 2 non-programmable, non-graphing calculators.

3. **THE COMPETITION: Sample Problems and Resources** may be found at http://www.soinc.org
   a. This event combines a basic understanding of biological and physical agents that cause disease with an ability to analyze, interpret, evaluate and draw conclusions from simple data and communicate results to peers. Students should be able to distinguish between infectious and non-infectious health burdens.
   b. A broad definition of health will be used for this event. Potential topics include health as well as illness (mental, physical, infectious, chronic, environmental, societal, genetic, injuries and health behaviors).
   c. This event will include questions based on:
      i. Data collection
      ii. Creating graphic displays of data
      iii. Interpreting trends and patterns of epidemiologic data
      iv. Communicating results

      
   d. Students will be presented with one or more descriptions of public health problems such as an outbreak of food poisoning, a cluster of cases of West Nile encephalitis or state data on bicycle injuries.
   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 Div. 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. They 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 between 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 Division B and Division C competitions should reflect the age-appropriateness for the two groups.
   j. The event format may be exam-based, station-based or a combination of both.

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

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

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

DYNAMIC PLANET

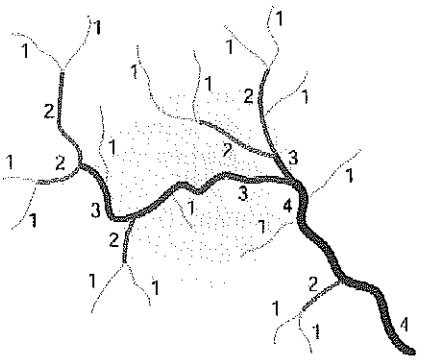
Read the General Rules in the manuals and on www.soinc.org as they apply to every event.

1. **DESCRIPTION:** Students will use process skills to complete tasks related to **Earth's fresh waters**.

   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 (i.e., observing, classifying, measuring, inferring, predicting, communicating, and using number relationships) from the following topics:
   a. Interpretation of fresh water features shown on USGS topographic maps
   b. Stream drainage systems: **stream order**, drainage patterns, main channel, tributaries and watersheds
   c. Channel types: braided, meandering, straight **and calculations of sinuosity**
   d. Sediment: weathering, erosion, forms and sizes, transportation, deposition
   e. River valley forms and processes: geology, gradient, base level, floodplain features, dynamic equilibrium, nick points, waterfalls, stream capture, deltas and fans



   f. Perennial and intermittent stream flow, stream gauging and monitoring, stream flow calculations, discharge, load, floods, recurrence intervals, (Division C only: Chezy and Manning equations)
   g. Groundwater: zone of aeration, zone of saturation, water table, porosity, permeability, aquifers, confining beds, hydraulic gradient, water table contour lines, flow lines, capillarity, recharge and discharge **and interactions between surface and groundwater**
   h. Karst features: sinkholes, solution valleys, springs, disappearing streams, caves
   i. Lake formation and types: faulting, rifting, volcanic action, glaciation, damming of rivers, changes over time
   j. Lake features: inflow and outflow, physical and chemical properties, stratification, shorelines, waves
   k. Wetlands: interactions between surface and groundwater **in the evolution of** bogs and marshes
   l. Destruction/Effects of land use changes, dams and levees: sedimentation, down-cutting, diversion of water, flooding, ecological changes
   m. Hydrologic cycle and water budgets: precipitation, runoff, evaporation
   n. Pollution: types, sources, transport

4. **REPRESENTATIVE TASKS:**
   a. Analyze and interpret features and actions of a stream or river appearing on a topographic map including watershed boundaries, elevation, gradient, direction of flow, drainage pattern, valley shapes, erosional landscapes, and depositional features
   b. Construct a water table contour map and indicate the direction of groundwater movement
   c. Analyze data on the thermal structure of a lake and determine how the stratification changes seasonally

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

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

EXPERIMENTAL DESIGN

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

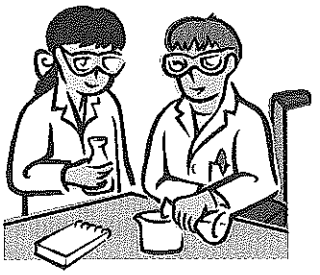
1. **DESCRIPTION**: This event will determine a team's ability to design, conduct, and report the findings of an experiment actually conducted on site.

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

2. **EVENT PARAMETERS**: Students must bring ANSI Z87 indirect vent chemical splash goggles and a writing instrument(s). Students may also bring a timepiece, a ruler, and a non-programmable calculator. Chemicals that require other safety clothing will not be used.

3. **THE COMPETITION:**
   a. Supervisors must provide teams with identical sets of materials at a distribution center or in a container. The materials will be listed on the board or placed on a card for each team. If provided, both the card and the container will be considered part of the materials. The identity of the materials is to remain unknown until the start of this event and will be the same for each team. The students must use at least two of the provided materials to design and conduct an experiment.
   b. The supervisor must assign a question/topic area that determines the nature of the experiment. The assigned question/topic area should be the same for all teams and allow students to conduct experiments involving relationships between independent and dependent variables (like height vs. distance).
   c. 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 team not following proper safety procedures will be asked to leave the room and will be disqualified from the event. Any student 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 (2 Points)
b. Hypothesis: Including prior knowledge that contributed to hypothesis (4 Points)
c. Variables:
   i. Constants: (Controlled Variables) Factors that are purposefully kept the same (4 Points)
   ii. Independent Variable: Factor being manipulated (3 Points)
   iii. Dependent Variable: Factor being measured which responds (3 Points)
d. Experimental Control (**where applicable**): (Standard of Comparison) (2 Points)
e. Materials (3 Points)
f. Procedure: Including Diagrams (6 Points)
g. Qualitative Observations During Experiment & Summary of Results: (4 Points)
h. Data Table: Including Use of Significant Figures for Division C (6 Points)
i. Graph(s): (6 Points)
j. Statistics: **Div. B**: Average (mean), median, mode, range, or drawn in line of best-fit (2 Points)
   Div. C all of B: + standard deviation and any other relevant statistics that teams choose (4 Points)
k. Analysis of Results: Interpretation (4 Points)
l. Possible Experimental Errors including identified human errors (3 Points)
m. Conclusion: Include why your results did or did not support the hypothesis: (4 Points)
n. Recommendations for Further Experimentation Based on Your Data & Practical Applications: (4 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

FOOD SCIENCE

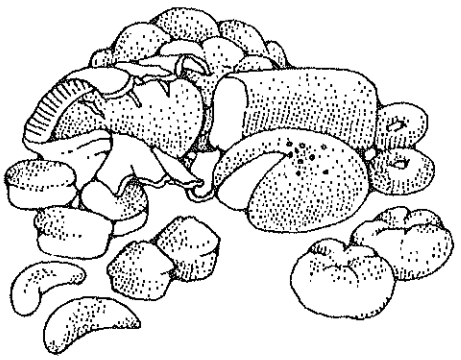
Read the General Rules in the manuals and on www.soinc.org as they apply to every event.

1. **DESCRIPTION:** Using their understanding of the chemistry and physical properties of baking ingredients, teams will answer questions at a series of stations.

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

2. **EVENT PARAMETERS:**
   a. Prior to the event, teams must make and bring a viscosity-testing device (only one is needed but back-ups are permitted) and prepare standard curve graph(s) using their homemade viscosity-testing device.
   b. Teams must bring something to write with and may bring: non-programmable calculators and one 3-ring binder, any size, containing information in any form from any source including results and analysis of their prior experimentation (i.e., teams are encouraged to bake goods, observe and record the differences caused by adjusting the ingredients from the Approved List of Ingredients).
   c. Event Supervisors must provide: Ingredients to be tested from the Approved List of Ingredients, reagents, and lab equipment for all labs and activities.
   d. **Safety Requirements**: Students must wear the following or they will not be allowed to participate: closed-toed shoes, ANSI Z87 indirect vent chemical splash goggles (see http://soinc.org), pants or skirts that cover the legs to the ankles, and **additionally** a long sleeved lab coat that reaches the wrists and the knees **or** a long sleeved shirt that reaches the wrists **with** a chemical apron that reaches the knees. Chemical gloves are optional. 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 disqualified from the event.

3. **THE COMPETITION:**
   a. All ingredients in the activities or lab stations are limited to the following **Approved List of Ingredients**:
      i. Liquids: water, milk (whole/reduced, cow, goat, almond, buttermilk, soy, coconut), eggs, egg substitute
      ii. Lipids: vegetable oil, shortening, butter, margarines, chocolate
      iii. Leavening Agents: baking powder, baking soda, yeast, cream of tartar
      iv. Flavoring: Salt and vanilla (essential oils and extracts- Nationals only)
      v. Flours: all purpose white, cake, whole wheat, almond, coconut, corn, rice
      vi. Sweeteners: sugar, brown sugar, honey, molasses, sucralose, aspartame, fructose



   b. There must be **one** activity/lab station and related questions where teams will determine the viscosity, in centipoise (cP), of any one individual ingredient (Regional & State) or one combination of ingredients (Nationals) from the Approved List of Ingredients using their **homemade viscosity-testing device** and standard curve graph.
   c. There must be at least seven **other** activities/lab stations with questions related to the Approved List of Ingredients or baked goods made from those ingredients. The activities or stations must be related to this list of topics or tasks:

      i. Lipids
      ii. Proteins
      iii. Carbohydrates
      iv. Starches
      v. Liquids
      vi. Leavening agents
      vii. Sweeteners
      viii. Density
      ix. Nutritional value of a sample label
      x. Other measurable properties of baked goods

4. **SCORING**:
   a. The team with the highest score wins.
   b. Time will not be used for scoring.
   c. Ties are broken by the accuracy of the viscosity testing device activity/station. If teams do not bring a viscosity-testing device, ties are broken by an essay question designated by the event supervisor.
   d. Penalties: A penalty of up to 10% if the team's area is not cleaned up as instructed by the event supervisor. Teams without a homemade viscosity-testing device receive zero points for the viscosity testing activity/station.

5. **Sample Activities, Lab Stations, and Relevant Questions:**
   a. Teams may answer questions concerning chemical properties of approved ingredients and their use in baking, including understanding of chemical test reactions using Benedict's, Biuret, Iodine, brown bags, etc.
   b. Teams may answer questions about how different ingredients and different amounts of ingredients used during the baking process affect the final product. For example, what is the difference in using corn oil or butter and how does this affect the final product?
   c. Teams may answer questions about how baking powder differs from baking soda or yeast as leavening agents (e.g., explain the affect altitude has on baking and what adjustments are necessary in baking procedures due to altitude.)
   d. When given data, teams may calculate the nutritional value of a sample and answer questions concerning computation of nutrition and energy stored in foods.
   e. Teams may be required to measure the density of a baked good.
   f. When given only a recipe from the Approved List of Ingredients, teams may be required to produce a list of ingredients (found on a sample nutritional label) in order by the greatest mass.
   g. Given only a recipe, students may be required to identify which ingredients are the sources of starch, protein, etc.
   h. Given information about taste and texture of a baked good, teams may identify possible mistakes or substitutions made in a recipe. For instance if told a baked good is dry and crumbly but has no overcooked starch, students could identify the problem as the ingredients were not mixed properly or insufficient liquid was put into the batter, but not a result of baking too long. Students will use the results of their testing to answer these questions.

Homemade Viscosity Testing Device: The viscosity-testing device can be made from an 8 oz. Styrofoam cup by heating the end of a 16 penny nail (hold it with an insulated glove or a pliers) over a candle approximately one minute and then punching a hole from INSIDE the cup into the center bottom of the cup. Place tape over the hole. For each test, fill the testing device with the same amount of each liquid to be tested. After removing the tape, time how long it takes for the liquid to break the flow as it leaves the cup. Record your data to create your standard curve graph(s).

Standard Curve Graph: Create a graph of time to break flow vs. viscosity in *centipoise* (cP) using the homemade viscosity-testing device and the following liquids:

i. Water	1 cP	iv. Karo® Corn Syrup	2000 cP
ii. Mazola® Canola Oil	60 cP	v. Molasses	3000 cP
iii. Hershey® Chocolate Syrup	1000 cP	vi. Pure Honey	7000 cP

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

FORESTRY

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

1. **DESCRIPTION:** This event will test student knowledge of North American trees that are on the Official National Tree List.

   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 notes that contain information in any form from any source, up to 2 commercially published field guides, and one copy of the Official National Tree List (teams may tab {limit 3 words} the guides and write on any of these).

3. **THE COMPETITION:**

   a. All questions will be restricted to specimens on the Official National Tree List.

   b. This event may be held either indoors or in a wood lot or both. Specimens (or pictures/slides if necessary) will be lettered or numbered at stations. Each team will be given one answer sheet to record the Genus and species name and the answers to the correlated questions.

   c. Leaf specimens may be live or preserved depending on availability and may be accompanied by twigs, cones, seeds, or other parts of the tree. Identification will be based on an examination of living or preserved leaf specimens (compound leaves should be intact). For each specimen, students will be asked a correlated question that pertains to the tree's structure, ecology, or economic characteristics. Structural characteristics may include leaf types, leaf shapes, leaf margins, leaf venation, leaf arrangement on the stem, twigs, bark, flowers, cones, fruits, seeds, and tree shapes.

   d. Ecological characteristics may include habitats, adaptations to the environment, biomes, succession, and relationships (e.g., symbiosis and competition) with animals or other plants. Economic characteristics may include beneficial or detrimental aspects of trees such as sources of food, medicine, building materials, chemicals, fuel, fiber, and trees as nuisance species.

   e. It is recommended that state and regional contests be limited to local or regional trees (e.g., trees east or west of the Rockies). State and regional directors should prepare a list, which includes the trees students are expected to master. State directors should send the state tree lists to competing teams as soon as possible so teams may gather specimens. The Official National Tree List will include specimens from the **National Audubon Society Field Guide(s) to Trees** (Eastern and Western regions).

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

Recommended Resources: All specimens listed on the Official Science Olympiad **National Tree List** are represented in the **National Audubon Society Field Guide(s) to Trees** (Eastern and Western regions), which is available on the Official Science Olympiad Store/Website at http://www.soinc.org as are all reference and training resources.

KEEP THE HEAT

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

1. **DESCRIPTION:** Teams must construct an insulated device prior to the tournament that is designed to retain heat. Students must also complete a written test on thermodynamic concepts.

   A TEAM OF UP TO: 2 **EYE PROTECTION**: #4 **IMPOUND:** Yes **APPROX. TIME:** 50 Minutes

2. **EVENT PARAMETERS:**
   a. Competitors must bring their insulating device, 2 identical 250 mL Pyrex beakers, eye protection, plots and writing utensils and may bring any notes, parts/supplies, or type of calculators for use during any part of the competition. Notes of any kind must be 3-hole punched and secured in a 3-ring binder of any size, so that regardless of orientation nothing falls out.
   b. Event supervisors must supply the hot water, devices for transferring measured volumes from the water source to the team's beakers, and thermometers or probes (recommended).
   c. Prior to the day of the competition, the team must calibrate their devices by preparing up to 4 plots (either on separate graphs or overlaid on the same graph) showing the relationship between elapsed cooling time and ending water temperature for various quantities of water and starting water temperatures. If hand drawn, they must be on graph paper. All plots must be properly labeled and marked to identify the team.
      i. Teams may be required to submit their plots prior to the tournament as requested by the supervisor.
      ii. Teams must have a duplicate set to use during competition, as those submitted may not be returned.
      iii. Students must be prepared to answer questions about the data collection and how the plots are used.
      iv. Example plots are available on the Keep the Heat page on soinc.org
   d. The team's device, parts and any supplies (beakers, tools, notes, plots, etc.) must be impounded before the event starts. Eye protection does not need to be impounded. Appeals by teams will not be processed after they remove their device from the competition area unless the appeals committee has released it.
   e. Competitors must wear splash rated eye protection during set-up and while loading their devices with water. They may remove it for Part 2 of the competition. Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows, otherwise they will not be allowed to compete in Part 1.

3. **CONSTRUCTION:** The device must fit within a 30.0 cm x 30.0 cm x 30.0 cm cube.
   a. The only materials permitted in the device are: wood, paper, cardboard, natural fibers, organic granular material, aluminum foil and fastening materials (tape, glue, screws, bolts, nuts, nails, string, etc.). Fastening materials may only be utilized to secure the device components together, not to contribute to the insulating properties of the device.
   b. Examples of prohibited materials: any type of foam (plastic, metal, expandable glue, etc.), plastic (except for as part of the fastening materials listed above), bubblewrap, glass, commercial insulation, etc.
   c. Within the device, students must be able to easily insert and remove a 250 mL standard, unaltered, empty Pyrex (or similar brand name) beaker that they supply (height ~1.4 times the diameter).
   d. The device must also easily accommodate the insertion and removal of a thermometer/probe into the beaker via a hole at least 1.5 cm in diameter directly above the beaker. The top surface of the hole must be less than 5 cm above the top lip of the beaker. The hole must remain open during the competition.
   e. Devices must be inspected to ensure that there are no energy sources (e.g., no electrical components, small battery powered heaters, chemical reactions, etc.) to help keep the water warm. At the event supervisor's discretion, teams must disassemble their devices at the end of the testing period in order to verify the materials used in construction.
   f. All parts of the device must not be significantly different from room temperature at impound.

4. **THE COMPETITION:**
   a. **Part 1: Device Testing**
      i. After all devices are impounded, the event supervisors must announce the temperature of the source water bath (60 to 90°C), the volume of water to be used (100 to 200 mL, in 25 mL increments at Regional competitions, 10 mL at State competitions, 1 mL at the National competition) and the amount of cooling time allowed (20 to 40 mins.). These variables must be the same for all teams.

ii. The event supervisor must also announce the current room temperature.
iii. Teams must have a maximum of 5 minutes to set up their devices at the start of the competition.
iv. Each team, in a staggered sequence, must have the set amount of water poured into their 2 beakers, one of which they must then insert into their device, the other must be placed on an open surface next to the device. Teams may secure and/or close access panels with fastening materials after inserting the beaker. Event supervisors must record the time each team receives their water.
v. Teams must use their plots to calculate the temperature of the water in their beaker at the end of the cooling time. They must provide the event supervisors with their estimate at the end of this period, prior to the supervisor measuring the actual temperature.
vi. At the end of the cooling period, the event supervisor must record the temperature in each beaker to the best precision of the available instrument. Supervisors may leave thermometers/probes in the devices and the un-insulated beakers for the entire cooling period, but must announce if they will do so before impound. Otherwise they must first insert a thermometer/probe into the un-insulated beaker, wait at least 10 seconds, and record the resulting temperature. The event supervisor must then wipe any residual water off the thermometer/probe and repeat the same process with the beaker inside of the students' device. Multiple thermometers/probes may be used at the supervisor's discretion.

b. **Part 2: Written Test**
i. Students must take a test on thermodynamic concepts for the remaining time after all devices have been loaded with water. All teams must have the same amount of time to take the test.
ii. The test must be worth 50 points
iii. Topics may include, but are not limited to: temperature conversions, definitions of heat units, thermal conductivity, heat capacity, specific heat, the laws of thermodynamics, the history of thermodynamics, and thermodynamic processes.

5. **SCORING**: High score wins.
a. All scoring calculations are to be done in degrees Celsius.
b. Teams must be tiered as follows:
i. Tier 1: Teams with no violations of any of the rules above.
ii. Tier 2: Teams with violations of any of the rules above.
c. One of the submitted plots, selected by the event supervisor, must be scored as follows:
i. Partial credit may be given. The max Plot Score possible is 10 points.
ii. 2 points if labeled with school and student's names.
iii. 2 points for appropriate title of plot and X and Y-axis labels.
iv. 2 points for appropriate units and axis increments.
v. 1 point for each data plot on a graph or graphs turned in (up to 4 total).
d. The final score is the sum of four components (a scoring calculation spreadsheet is available at soinc.org)
i. Test Score = max of 50 points
ii. Plot Score = max of 10 points
iii. Heat Retention Score = ((internal beaker water temp / external beaker water temp) - 1) x 50 points
iv. Prediction Score = (1-(abs (final internal beaker water temp - predicted internal beaker water temp) / final internal beaker water temp)) x 25 points
e. Scoring Example: A team gets 22 out of 25 questions on the test correct, submits 4 accurately labeled plots, and predicts the final internal beaker water temp will be 35.0 degrees C. The actual final internal beaker water temp was 32.1 degrees C and the external beaker had a final temp of 27.0 degrees C.

Test Score = (22 / 25) x 50 = 44; Heat Retention Score = ((32.1 / 27.0)-1) x 50 = 9.4;
Plot Score = 10; Prediction Score = (1-(abs (32.1-35)/32.1)) x 25 = 22.7;
Total Score = 44 + 10 + 9.4 + 22.7 = 86.1.

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

METEOROLOGY

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

1. **DESCRIPTION:** Participants will demonstrate a multidisciplinary understanding of the earth and planetary systems that influence climate on planet Earth. This event will place emphasis on understanding how these systems are impacting climate change past and present on our planet.

   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 notes containing information in any form from any source. Each **participant** may bring any kind of (non-graphing) calculator, but no other resources.

3. **THE COMPETITION**: **Questions will be from the following topics**:
   a. Composition and evolution of Earth's atmosphere with emphasis on how composition can affect climate (greenhouse gasses, volcanic particulates, atmospheric carbon variability, etc.).
   b. Weather vs. Climate
   c. Solar radiation/Earth's energy balance:
      i. Albedo, long and shortwave radiation (in context of Daisy World Model)
      ii. Solar weather, insolation, solar output, sunspots, solar maximums and minimums
      iii. Daily and annual maximum and minimum temperatures
   d. Climatic zones: The Köppen climate classification system with emphasis on how it can be used to understand climate change
      i. Understand the difference between the Köppen and Thornwaite systems
      ii. Understand and be able to interpret climographs
   e. Natural climatic variability: with emphasis on how it might affect climate change:
      i. Effects of land masses and water bodies on climate
      ii. Effects of latitude and longitude and elevation (topography)
      iii. Effects of Earth's mean temperature: with emphasis on how changes might impact Earth's cryosphere, hydrosphere, biosphere, and atmosphere systems
      iv. Effects of plate tectonics on climate
   f. Oceanic and atmospheric circulation: their impact on climate and climate change:
      i. Semi-permanent pressure cells and the three-cell model of atmospheric circulation
      ii. El Niño, La Niña, Southern Oscillation/Walker circulation
      iii. Thermohaline circulation and wind-driven oceanic currents
      iv. Oceanic circulation
   g. Earth's celestial cycles: their impact on long-term climate change
      i. Seasons
      ii. Milankovich Cycles: eccentricity, axial tilt, and precession
      iii. Solar maximums and minimums
   h. Paleoclimates of Earth's geologic history
   i. Pleistocene Ice Age, Younger Dryas Cold Period, Medieval Warm Period, Little Ice age
   j. Paleoproxies: Such as, ice cores, ocean sediments, lacustrine sediments, dendrochronology, coral bleaching, and what information they are able to provide about ancient climates
   k. Human impact: global warming, greenhouse gases, ozone depletion, deforestation, desertification and urban heat island effect

4. **SCORING**: Points will be awarded according to the quality and accuracy of responses, the quality of supporting reasoning, and correct use of scientific technique. Highest score wins. Several pre-identified questions will be used as tiebreakers.

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

MICROBE MISSION

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

1. **DESCRIPTION**: Teams will answer questions, solve problems, and analyze data pertaining to microbes.

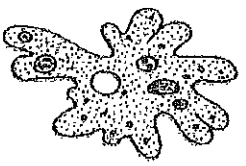
   A TEAM OF UP TO: 2 **EYE PROTECTION**: #4 **APPROXIMATE TIME**: 50 Minutes

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

3. **THE COMPETITION**: The event may be run as timed stations. Students will be given questions pertaining to different types of microbes. Some questions/stations may involve the actual use of a microscope. If no microscopes are available, high quality photographs with appropriate scales may be used instead. Most questions should emphasize age/division appropriate process skills such as: data interpretation from graphs and tables, use of a dichotomous key, drawing conclusions, calculations, metric conversions, determining actual size of the organism, inferences, and making observations. Students may be asked to perform simple laboratory procedures as measurements or using probes (sufficient information will be provided at the station). Possible live specimens may include only baker's yeast, ciliates, amoebae, lichens, and algae. Pictures & prepared slides are appropriate for all microbial types. The content areas may include:

   Regional and State Tournaments (B & C): The **competition should cover all of the topics and not emphasize just one area such as microbial disease.**

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



   Division C (only)

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

   National Tournament (B & C)

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

4. **SAMPLE QUESTIONS**: **Note: Disease questions must be restricted to the 2012 Microbial Diseases on www.soinc.org**
   a. Provide two differences among bacteria, viruses, and fungi.
   b. Using the following key, determine (from pictures) which cell, A, B, or C is considered an alga.
   c. Based on the following graph, determine which organism is best suited for growth in acid environment.
   d. A cell is observed through a light microscope at 4x magnification. The cell takes up abut half of the visual field. What is the approximate length of this organism?
   e. Students observe a picture of a plate with different colonies on it. Based on the color of the colony, how many different kinds of organisms do you detect? Which type of organism appears to be the most prevalent?
   f. From this picture identify the organelle, its function, and state which type of microbe it is unique to.
   g. What type of microbe is involved in the production of most breads?
   h. What type of microbe is responsible for polio?
   i. Based on the following graph, what will be the microbial population/ml after 3.5 hours of growth?
   j. Match the disease with the type of organism that causes it.

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

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

MISSION POSSIBLE B

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

1. **DESCRIPTION**: Prior to the competition, teams must design, build, test, and document one "Rube Goldberg®-like Device" that completes a required Final Task using a sequence of consecutive tasks.
   TEAM: 1-3 **IMPOUND:** Yes **EYE PROTECTION**: #2 **Set-up**: 30 min **Run:** 3 min
2. **SAFETY PARAMETERS:**
   a. All team members must properly wear safety spectacles with side shields at all times. Teams without proper eye protection must be immediately informed of that and given a chance to obtain eye protection if time allows, otherwise not be allowed to compete and scored as a no-show.
   b. Each device must pass a safety inspection before operation. Devices with potential hazards or safety concerns must not be permitted to run unless safety concerns are resolved to the satisfaction of the event supervisor. Devices that cannot be made to operate safely must only receive participation points.
3. **CONSTRUCTION PARAMETERS:**
   a. All parts of the device (with exception of the string for task 4.a) must fit within an imaginary box (50.0 cm x 50.0 cm x 80.0 cm) in any orientation.
   b. The device must be designed and constructed to consecutively execute a sequence of tasks selected by the team from the list in section 4.
      i. The Starting Task must be designed as Task 4.a. and the Final Task must be designed as Task 4.m.
      ii. No more than 8 additional Tasks (from 4.b. - 4.k.) plus the "special task" are counted for points between the Starting Task and the Final Task and these may occur in any order.
      iii. After the Starting Task, the device must be designed to operate autonomously.
      iv. Each task in the device must be designed to contribute to the completion of the Final Task except the use of switches to turn off previously used motors. Parallel and/or dead end tasks are not allowed.
      v. Other non-scoreable tasks may be incorporated into the device, and must contribute to the completion of the Final Task. These tasks receive no points.
   c. Electric components are limited to batteries, wires, mechanical switches, and/or up to three motors. No computers, integrated circuits, or any other unlisted electric components are permitted in the device.
   d. Hazardous spills, flames, liquids, and hazardous materials (e.g., rat traps >6cmx12cm, flammable substances) are not permitted.
   e. Power to any single electrical circuit must not exceed 10.0 volts. All batteries must be factory-sealed and voltage labeled by the manufacturer. Lead-acid batteries are not permitted.
   f. Energy devices such as batteries and mousetraps may be set or activated prior to starting the device, but not the motors.
   g. A team must be disqualified if the device is remotely timed or controlled.
4. **THE TASKS:** Tasks receive points only if successful, listed on the task sequence list, and contribute towards Final Task completion within the 3-minute time limit. A single action must contribute to only one scoreable task.
   a. (100 points) Starting Task- Initiate an action by pulling a string that extends out of the boundaries of the device.
   b. (20 points) Push a wedge between two objects so that they are separated to cause the next action.
   c. (20 points) Use a lever with an IMA greater than 1 in a manner that requires an IMA greater than 1 to cause the next action (e.g., lift a heavier mass with a lighter mass).
   d. (20 points) Turn a screw such that it moves an object at least 2.0 cm in the direction parallel to the screw's axis of rotation before causing the next action.
   e. (20 points) Use a pulley system with an IMA greater than 1 to lift an object at least 5.0 cm before causing the next action.
   f. (30 points) Combine two levers of different class into a system with an IMA greater than 5 and utilize the IMA greater than 5 to cause the next action.
   g. (30 points) Release the energy stored in a spring (not a mousetrap) such that it causes the next action.
   h. (30 points) Use a rack and pinion gear system to move an object at least 5.0 cm before causing the next action.
   i. (40 points) Move an object with a third class lever at least 15.0 cm away from where it starts. The lever must not be in contact with the object at the beginning or end of this task. The final placement of the object must cause the next action.
   j. (50 points) Move and pour granular material from one container to another higher in the device. The presence of the granular material in the higher container must cause the next action.
   k. (50 points) Drop a bouncy ball such that at least the final 10 cm (measured vertically) of the downward motion is unguided and the upward bounce of at least 5 cm (vertical) causes the next action.
   l. (20 points + bonus) Special Task: Pull a mass up a ramp at least 10 cm (vertical), causing the next action. Bonus points will be awarded based on both the mass raised and the height travelled.

m. (250 points + bonus) Final Task - Use a paddle wheel to lift a mass. All 5 conditions must be met. (1) Granular material must pour from a container onto a paddle style wheel. The weight of the granular material must be the only force turning the paddle wheel; (2) The paddle wheel must be directly attached to an axle (i.e., no gearing, pulleys, counterweights, etc.); (3) The turning axle must wrap a string around itself lifting a mass displaying the team's name at least 10 cm at regional tournaments, 20 cm at State, 30 cm at Nationals; (4) Teams must mark a line on the device, and timing must stop when the bottom of the mass passes the pre-marked the line on the device; (5) The mass must be easily removed from the string wrapping around the axle.

5. **TASK SEQUENCE LIST (TSL)**: Details the scoreable sequence of tasks to occur during device operation.
   a. Tasks in section 4, intended to earn points, must be sequentially numbered and identified by letter in both the TSL and device.
   b. Non-scoreable actions or tasks must be listed in the TSL but not be numbered.
   c. The TSL must be submitted at check in, impound, or as announced by the tournament director.
   d. A sample and template TSL are posted on www.soinc.org.
6. **OPERATION OF DEVICE:**
   a. Timing of the device begins when a team member pulls the starting string.
   b. Timing of the device stops when the final task is completed or when 180.0 seconds elapses (whichever comes first). The ideal operation time is 60.0 seconds at Regionals, between 60.0 and 90.0 seconds at States, and between 90.0 and 120.0 seconds at Nationals (time announced after impound).
   c. Event supervisors are strongly encouraged to utilize 3 independent timers on all runs. The middle value of the 3 timers must be the officially recorded time. Times must be recorded in hundredths.
   d. If the device stops, jams or fails, the team must be allowed to "adjust" it to continue operation. Any obvious stalling to gain a time advantage must result in disqualification.
   e. If an action inadvertently starts a task out of sequence on the TSL then all tasks skipped in the listed sequence must not earn points even if they are completed.
   f. If the team completes a task themselves or makes an adjustment that leads directly to completion of the task in the next action, that task must not receive points (even if it is the final task).
7. **SCORING POINTS:**
   a. Teams that impound a device but fail to compete receive participation points.
   b. Points can only be earned for tasks successfully completed before 180.0 seconds elapses.
   c. 2 points for each full second of operation up to the ideal time.
   d. 10 points each time any of the tasks requiring movement of a certain distance are self-measured (i.e. the movement is along a permanently installed ruler).
   e. 10 points each time any of the tasks requiring an IMA are self-measured.
   f. 75 points, if the TSL is submitted properly and uses the format specified and the tasks within the device are correspondingly labeled.
   g. 25 points, if the TSL is 100% accurate in documentation of intended scoreable and non-scoreable tasks.
   h. 50 points, if the team uses no more than 30 minutes to set up their device.
   i. Point value listed within tasks for the first time each lettered task is successfully completed as indicated in section 4.
   j. 1 point for every 100 grams of mass lifted up the ramp in Special Task 1. Max 100 pts. (10 kg)
   k. 1 point for every whole vertical cm the mass is raised in Special Task 1.
   l. 1 point for every 10 grams of mass lifted in the final task (only if final task is successfully completed). Max 100 pts. (Masses>1 kg factor into tiebreakers)
8. **PENALTIES:**
   a. -1 point for each full second that the device operates beyond the ideal time until final task completion, or the 180.0 second time limit is reached (whichever occurs first).
   b. -15 points each time the device is touched, adjusted, or restarted.
   c. -50 points, one time, for any substance that leaves the boundary of the device during operation.
9. **TIERS:** Teams with an unsafe device must not be allowed to run their device, and receive only participation points.
   a. Tier 1: Devices without any violations
   b. Tier 2: Devices with construction violations or parallel or "dead end" paths
   c. Tier 3: Devices impounded after the deadline
10. **TIES** are broken by this sequence: 1. Fewest penalty points, 2. Greatest mass of the weight lifted in the final task (only if the final task is completed), 3. Closest to ideal time.

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

MOUSETRAP VEHICLE

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

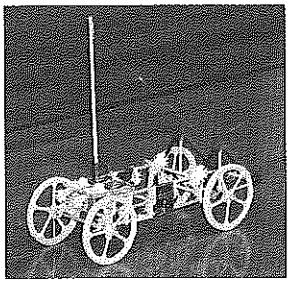
1. **DESCRIPTION**: Teams design, build, and test one vehicle using one mousetrap as its sole means of propulsion to reach a target as quickly, accurately and close to their predicted time as possible.
   A TEAM OF UP TO: 2 **IMPOUND: Yes** **EYE PROTECTION:** #5 **APPROX. TIME: 10** minutes
2. **SAFETY PARAMETERS**: Competitors must bring and correctly wear eye protection, ANSI Z87+ spectacles with side shields, while preparing and running their vehicle. **Teams without proper eye protection must be immediately informed of that and given a chance to obtain eye protection if time allows, otherwise not be allowed to compete and scored as a no-show.**
3. **CONSTRUCTION PARAMETERS**:
   a. **Vehicles must be designed to travel a specified distance,** come to a complete stop without straying from the center of the track, **and be as close as possible to their predicted time. The exact distance for Regional is 10.00 m; for State between 8.00 and 12.00 m (1.00 m intervals); and for Nationals between 8.00 and 12.00 m (0.50 m intervals). At State and Nationals, the distance is chosen by the Event Supervisor and not announced until all vehicles have been impounded.**
   b. Only one unmodified snap mousetrap (with a base less than 6.0 cm x 12.0 cm) must be used as an energy source. An unmodified mousetrap is one that still retains all of its original parts and structural integrity to function as intended. Altering the structural integrity of the mousetrap includes, but is not limited to, welding, bending, and cutting. Items, **other than an extension bar attached to the snap portion,** may not be added to the mousetrap. **Soldering, taping, tying, gluing, and/or clamping the extension bar to the snap portion is allowed. Up to four (4) holes may be drilled in the mousetrap for attachment to the chassis only.**
   c. All of the vehicle's kinetic energy must originate from the unmodified mousetrap (spring). Items must not be added to the mousetrap to increase the potential energy of the unmodified mousetrap. Conversion of the mechanical energy of the mousetrap spring is permissible, but any additional sources of kinetic energy must be at their lowest states at the beginning of the run.
   d. The vehicle must have **the point of a bent paper clip that serves as a** 'Measurement **point' attached to the front of its chassis,** that extends down to within 1.0 cm of the track's surface. The point of the paper clip nearest the track surface is used as the reference point for distance measurements **and must be easily accessible to the Event Supervisor.**
   e. **In the ready-to-start mode, the vehicle must be no more than 1.00 m long and 0.35 m wide. The width dimension must be parallel to the Starting Line. After it starts its run, it does not have to remain within these dimensions.** There is no restriction on the height of the vehicle.
   f. Competitors must start the vehicle by actuating a trigger using **an unsharpened #2 pencil, with an unused eraser (supplied by the Event Supervisor).** The **trigger** must be **designed** so that its actuation is perpendicular **(vertical)** to the floor. A **non-vertically** activated trigger is a construction violation.
   g. The wheels **and drive string(s)** are the only vehicle parts permitted to contact the floor at any time.
   h. Stopping mechanisms must work automatically. The vehicle must not be tethered or remotely controlled.
   i. **Electrical components must not be used on the vehicle or its alignment devices.**
4. **THE TRACK**:
   a. The competition must be on a straight and level lane with a relatively smooth, hard, low-friction surface. **Space is needed on each side of the track's center and beyond the finish line to allow for error in the vehicle's path.**
   b. **One-inch tape must be used to define the track's center (Center Line Bonus), the Starting Line, and Target Line (finish line). The inside edge of the tape must define the Starting Line and the Target Line. The Starting Line must be 1.0 m in length. The Finish Line must be a minimum of 1.0 m in length but may be extended to facilitate measurement.**
   c. **The track centerline must connect the center points of the start and finish lines. The center of the start and finish line must be marked.**
   d. **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. All runs by a team must be made on the same track.**
5. **THE COMPETITION**:
   a. **The vehicle must be impounded before the start of the competition. Tools, data, and calculating devices need not be impounded.**
   b. **For States and Nationals,** the Target Distance must not be announced until all vehicles have been impounded.
   c. Only competitors being judged are allowed in the vehicle impound and track areas while teams are competing.

d. **Teams may not verify the distance by rolling the vehicle on the track surface (floor) between the start and finish line at any time prior to or during the competition.**
e. All parts of the vehicle must move as a whole; no anchors, tie downs, launching ramps, or other separate pieces are allowed. The competitors must not hold, constrain, or give a push to the vehicle. If any piece falls off during the run, it is considered a construction violation. The vehicle must be able to remain at the starting position without being touched until triggered.
f. **Before the first run, the competitors must predict their vehicle's Run Time. They are not allowed to change the prediction for the second run, but they may adjust the vehicle.**
g. Teams have 10 minutes of Event Time to set up, make any adjustments **(including adjusting the Measurement point)**, take measurements, and start two runs. If the second run has started before the 10-minute period has elapsed, it must be allowed to run to completion. Time used by the Event Supervisor for **run** measurements must not count toward the 10 minute Event Time.
h. **Teams must place the tip of the vehicle's Measurement point anywhere directly above the Starting Line and align the vehicle prior to the run.**
i. **Sighting and/or aiming devices placed on the track are permitted but must be removed before the vehicle runs. Aligning and sighting devices mounted on the vehicle may be removed at the team's discretion prior to each run.**
j. Run Time starts when the vehicle begins forward motion and ends when the vehicle comes to a complete stop. If a vehicle does not move upon actuation of the switch it does not count as a run and the team may request to set up for another a run, but must not receive extra time.
k. **If the vehicle moves any distance after actuation of the switch, it must be considered a run.**
l. Once the vehicle starts a run the competitors must move outside the lane, not follow their vehicle, and wait until called by the Event Supervisor to retrieve their vehicle following measurement.
m. Run Time is in seconds, recorded to 0.01 seconds.
n. **Event supervisors are strongly encouraged to utilize 3 independent timers on all runs. The middle value of the 3 timers must be the officially recorded time.**
o. **If the time and/or distance cannot be measured for a vehicle (e.g., the vehicle starts before the Event Supervisor is ready or the competitors picks up the vehicle before it is measured), or the vehicle travels in the wrong direction, it is a failed run, which counts as a run with no score.**
p. Teams who wish to file an appeal must leave their vehicle with the Event Supervisor.

6. SCORING: Low score wins.
   a. The Run Score = Distance Score + Time Score + **Center Line Bonus + Predicted Time Score.**
   b. **The Distance Score is the distance from the Measurement point to the Target Line in millimeters. This is a point to line measurement.**
   c. **The Time Score = 10 * (Run Time).**
   d. **A Center Line Bonus of -20.0 points is awarded if the center tape remains completely within the vehicle's track, i.e. the Center Tape is not visible outside of either wheel of the vehicle's widest axle, while the vehicle travels between the start and finish line as determined by the Measurement point.**
   e. **The Predicted Time Score = 10 * |(Predicted Time - Travel Time)|.**
   f. **The Final Score for the event is the run, which gives the team the better rank.**
   g. Tiers: Teams are ranked using the single run that gives them the best overall rank.
      i. 1st Tier: A run with no violations.
      ii. 2nd Tier: A run with competition violations.
      iii. 3rd Tier: A run with construction violations or both competition and construction violations.
      iv. **4th Tier: A vehicle that cannot complete any runs. (Participation points only)**
   h. **Ties** must be broken by this sequence **1. Better non-scored run; 2. Better Predicted Time Score of better run; 3. Better distance score on better run.**

SCORING EXAMPLE: At a competition, a team's vehicle stopped 103 mm from the Target Line. It made the run in 7.86 seconds, kept the Center Line within the vehicle's track, and their predicted time was 6.79 sec.

Distance Score	**103.0 points**	
Time Score	**78.6 points**	**(10* 7.86 s)**
Center Line Bonus	**-20.0 points**	
Predicted Time Score	**10.7 points**	**(10 * |(6.79 s – 7.86 s)|)**
Run Score	**172.3 points**	



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

OPTICS B

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

1. **DESCRIPTION**: **This event includes** activities and questions related to geometric and physical optics.
   A TEAM OF UP TO: 2 **EYE PROTECTION**: None Required **APPROX. TIME**: 50 Minutes
2. **EVENT PARAMETERS**:
   a. Competitors may bring **any measuring tool, premade templates, writing utensils** and use any type of **calculators** for use during any part of the competition.
   b. All reference materials to be used during **all parts of** the competition must be secured in a 3-ring binder, must be 3-hole punched and inserted in the binder so that regardless of orientation nothing can fall out.
   c. **Event Supervisors provide the Laser Shoot Surface (LSS), laser, mirrors and barriers. Multiple LSS's may be used to facilitate all teams being able to compete in a timely manner.**
3. **THE COMPETITION**:
   a. The competition consists of three parts that include experimental tasks and questions related to geometric optics and physical optics. All answers are to be provided in SI units with proper significant figures.
   b. Part 1: Geometric Optics, which may include the following topics:
      i. Law of reflection (**Specular** / Diffuse)
      ii. Refraction (measurement of index of refraction)
      iii. Prism (Deviation and Dispersion)
      iv. Convex, concave, and plain mirrors: ray tracing, focal length, real object, images (real/virtual, erect/inverted, magnification)
      v. Convex and concave lens: ray tracing, focal length, real object, and images (real/virtual, erect/inverted, magnification)
      vi. **Operating principles of optical equipment (microscopes, telescopes, cameras, glasses)**
   c. Part 2: Physical Optics, which may include the following topics:
      i. Visible Spectrum (primary/secondary colors, additive/subtractive, absorption/reflection)
      ii. Structure and function of the parts of the **human** eye
      iii. Wavelengths, frequencies, velocities, and nomenclature of the various portions of the EM spectrum
      iv. Doppler shift
      v. Bright Line and Absorption Spectra
   d. Part 3: Laser Shoot - The objective is to reflect a laser beam with **mirrors around barriers** to a target.
      i. The maximum set-up time is **4** minutes. **Timing must stop when the competitors remove the material covering the face of one mirror. Competitors must not make any additional adjustments to the mirrors at that point other than to remove the other mirror coverings.**
      ii. The Laser Shoot Surface (LSS) is a horizontal flat surface enclosed by a 2 ± 0.5 cm thick wall; the surface may be a table top.
      iii. The size of the enclosed horizontal surface is 56 ± 1 cm x 35 ± 1 cm.
      iv. The height of the wall above the laser shoot surface is **9 ± 1.5 cm**.
      v. The **5 flat** mirrors must have a width of **5 - 8** cm. **Each** mirror is mounted so that it stands vertically (at a 90 degree angle to the LSS), **does not have excess mounting material on its side edges, has its approximate center at the level of the laser beam** and can be easily relocated **anywhere** on the LSS by the students. **The mirror faces must initially be covered with a cardboard sleeve or other easily removable non-reflecting, opaque material.**
      vi. A laser (provided by the Event Supervisor) is mounted in a horizontal plane through the approximate center of one of the 35 cm long walls at a height of **1.5 - 6.0** cm above the LSS.
      vii. Class 2 Lasers (1mW or less) are to be used. Green lasers are preferred but not required.
      viii. The laser must be securely mounted through the wall such that it cannot be moved and the laser beam is perpendicular to the wall through which it is mounted.
      ix. **A line is drawn on the LSS from a point directly below the emitting tip of the laser to a point directly below the center of the laser beam where it strikes the opposite wall.** The event supervisor must test the beam's alignment before the next team is permitted to see the LSS.
      x. Competitors are not permitted to touch the laser or change its orientation and/or position. The laser must remain fixed throughout the entire event.

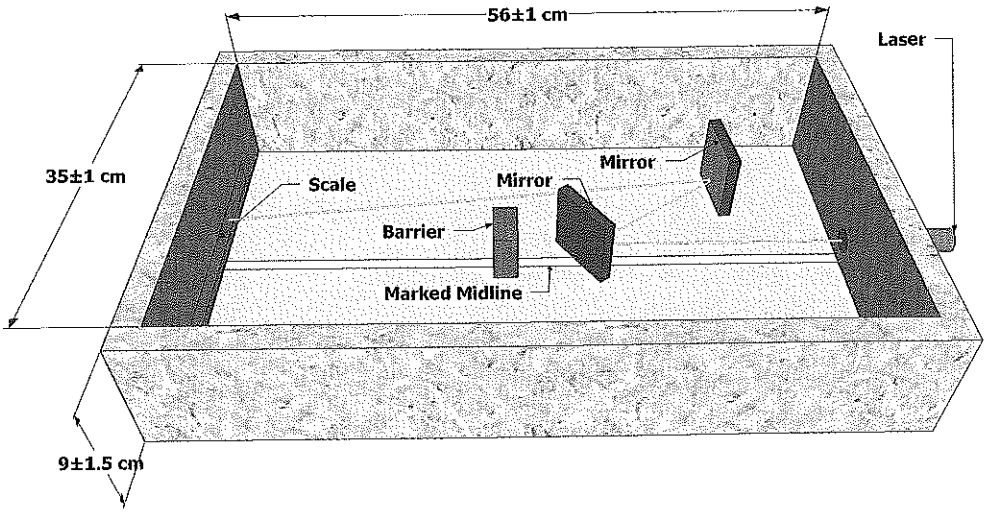
xi. A metric scale with a resolution of at least 1 mm must be attached horizontally to the **far** target wall at the level at which the laser strikes. One of the marks on the scale **is the Target Point.**

xii. **A barrier is placed somewhere along the line between the emitting tip of the laser and the Target Point. The barrier must have a width of 2 to 4 cm and be tall enough to block the laser beam. The barrier must be in the same position and orientation in respect to the LSS for all competitors.**

xiii. Competitors must make all measurements, calculations, and mirror placement/alignment within the **4-**minute time allowed. The laser must not be turned on until the competitor(s) complete the mirror placement /alignment. **Competitors may choose to use between 1 and 5 mirrors.**

xiv. **All mirrors** must be placed in a home position designated by the event supervisor before the next competitors are permitted to see the laser shoot station.

xv. Competitors must not mark on or modify the LSS.



4. **SCORING:**

a. The highest total points wins. Points are awarded for correct answers, measurements, calculations, analysis of data, **number of mirrors used** and laser shoot accuracy. Supervisors are encouraged to provide a standardized form on which students can show all ray tracings, measurements and calculations.

b. Points are distributed in the following manner:

i. Part 1: Geometric Optics — % correct answers x 30 points
ii. Part 2: Physical Optics — % correct answers x 30 points
iii. **Part 3: Laser Shoot Mirrors — # mirrors the laser reflects off of x 4 points**
iv. Part 3: Laser Shoot Accuracy — **(20 – (accuracy (in mm)/10))**

(Note: **Accuracy is the horizontal distance from the Target Point to the center of where the laser strikes a wall;** if the distance is > **200** mm **or the laser does not strike a wall**, set the result to 0 for 4.b.iv., **but still calculate the # mirrors score; If the laser strikes another wall instead of the wall the Target Point is on, the distance shall be the sum of the straight line measurements from the target to the corner along one wall and from the corner to the laser dot along the other wall.)**

c. **Scoring example: A team correctly answers 7 out of 10 questions on Part 1 and 65 out of 100 on Part 2. They use 3 mirrors on the laser shoot and the laser beam ends up 21 mm away from the Target Point: Part 1 score: 7/10 = 0.7 x 30 = 21 points, Part 2 score: 65/100 = 0.65 x 30 = 19.5 points, Part 3 mirrors score: 3 x 4 = 12 points, Part 3 accuracy score: 20 - (21 / 10) = 17.9 points. Total score: 21 + 19.5 + 12 + 17.9 = 70.4 points.**

d. Ties are broken using a designated task(s) or question(s). The supervisor must identify the tiebreaker on the answer form provided to the students at the beginning of the competition period.

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

REACH FOR THE STARS

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

1. **DESCRIPTION**: Students will demonstrate an understanding and basic knowledge of the properties and evolution of stars, open clusters and globular clusters, and normal and star-forming galaxies.

   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 notes containing information in any form from any source and must provide their own clipboards and red-filtered flashlights.

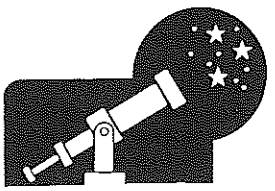
3. **THE COMPETITION:** This event is divided into two parts. Notes may be used during both parts.

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

   Andromeda: *M31 Andromeda Galaxy*
   Aquila: **Altair**
   Auriga: **Capella**
   Bootes: **Arcturus**
   Cancer: *M44 Beehive Cluster*
   Canes Venatica: *M51 Whirlpool Galaxy*
   Canis Major: **Sirius**
   Canis Minor: **Procyon**
   Centaurus: **Proxima Centauri**
   Cetus: **Mira**
   Cassiopeia: *Cas A & Tycho's Star*
   Cygnus: **Deneb**
   Dorado: *LMC*
   Gemini: **Castor** & **Pollux**
   Libra: **Gliese 581**
   Hercules: *M13 Globular Cluster*
   Leo: **Regulus**
   Lyra: **Vega** & *M57 Ring Nebula*
   Mensa: *LMC*
   Orion: **Betelgeuse**, **Rigel** & *M42 Orion Nebula*
   Perseus: **Algol**
   Sagittarius: *Sgr A*
   Scorpius: **Antares**
   Taurus: **Aldebaran**, *Hyades Star Cluster*, *M1 Crab Nebula* & *M45 Pleiades*
   Tucana: *SMC*
   Ursa Minor: **Polaris**
   Ursa Major: **Mizar** & **Alcor**
   Virgo: **Spica**
   Also the Milky Way Galaxy

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

      i. Spectral classification of stars
      ii. Stellar evolution
      iii. Open and globular clusters
      iv. Galactic types and structure



4. **SAMPLE PERFORMANCE TASKS**:
   a. Given the properties and/or spectra of stars and deep sky objects, participants will identify their proper placement on an H-R Diagram.
   b. Given a sequence of evolutionary stages for sun-sized and massive stars - red giant, red supergiant, planetary nebula, white dwarf, type Ia and type II supernovae, neutron stars and black holes - participants will match a set of images in the correct sequence.

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

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

ROAD SCHOLAR

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

1. **DESCRIPTION**: Participants will respond to 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, 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.

3. **THE COMPETITION**: The highway and quad 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 one square mile (1-mile x 1-mile) section using the correct features listed in 3.c. This square will be included on the answer sheet. Participants may not write on the maps.

   a. **Topographic Map Testing Areas**

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

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

4. **SCORING**: Teams will be ranked according to their point total. Values of questions may be weigbted. 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** are available on the Official Science Olympiad Store or Website at http://www.soinc.org

ROCKS AND MINERALS

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

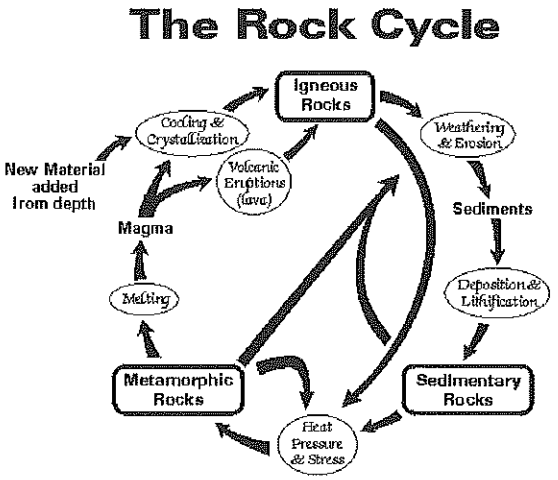
1. **DESCRIPTION**: Teams will demonstrate their knowledge of rocks and minerals.

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

2. **EVENT PARAMETERS**: Each **team** may bring only one magnifying glass; one published field guide that they may tab and write in and one 3-ring binder (any size) containing information in any form from any source. The materials must be 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 Science Olympiad Rock and Mineral 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.

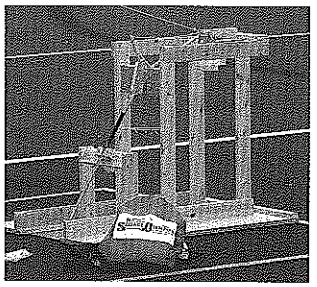
STORM THE CASTLE

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

1. **DESCRIPTION**: Prior to the tournament, teams design, construct, and calibrate a device that uses only the energy of a falling counterweight to launch a projectile as far and accurately as possible.
   A TEAM OF UP TO: 2 **EYE PROTECTION**: #5 **IMPOUND:** Yes **APPROX. TIME:** 15 Minutes
2. **EVENT PARAMETERS**: Supervisors may disqualify any apparatus that is operated in an unsafe manner.
   a. Prior to the day of the competition, the team must calibrate their devices by preparing up to 5 **plots (either on separate graphs or overlaid on the same graph)** showing the mass of various projectiles or counterweights vs. distance. If they are hand drawn, they must be on graph paper. All **plots** must be properly labeled and marked to identify the team submitting them.
      i. Teams may be required to submit their **plots** prior to the tournament as requested by the supervisor.
      ii. Teams must have a duplicate set to use during competition, as those submitted may not be returned.
      iii. Students must be prepared to answer questions about the data collection and how the **plots** are used.
      iv. **Example plots and calculation pages are available on the Storm the Castle page on soinc.org**
   b. Teams may also submit an example calculation page showing how to use the **plots** to position the target for a hypothetical counterweight and projectile.
   c. The team's device, **parts** and any supplies (tools, notes, copies of graphs, etc.) must be impounded before the start of the event. **Eye protection does not need to be impounded.** Appeals by teams will not be processed after they remove their device from the competition area.
   d. All teams must use the same projectiles, **counterweights**, and target (**all** provided by the supervisor). The mass of the **counterweights** and projectiles must not be announced until all of the devices are impounded.
   e. Competitors must wear eye protection rated ANSI Z87+ during set-up, testing, and launching. Teams without proper eye protection must **be immediately informed and given a chance to obtain eye protection if time allows, otherwise they will not** be allowed to compete and are scored as a no-show.
3. **CONSTRUCTION**: The entire device, including the projectiles and **counterweights** must fit in a **65.0 cm x 65.0 cm x 65.0 cm** cube when in the ready-to-fire position. **The cube must be square to the floor and launch area.**
   a. The triggering device is not considered part of the device. It must extend out of the launch area and does not need to return to the launch area after launch. Battery triggered devices are allowed; radio controlled devices are not. The triggering device must not pose a danger to anyone due to flying parts or excessive movement outside of launch area.
   b. The device must be constructed to accommodate the **counterweights** and the projectiles. Neither the **counterweights** nor the projectiles may be modified.
   c. The **2 separate counterweights** must consist of a **0.5-1.5 kg and** a **1.5-2.5 kg** mass with a hook on top. **Each** hook and counterweight together must fit inside a 15 cm cube. If the hook is used to attach the counterweight **to the device, the device must be able to accept a standard 1" open hook bolt.**
   d. Projectiles must have a mass of **20-40 g (for the lighter counterweight) and 40-60 g (for the heavier counterweight)** and must be approximately spherical with a diameter not exceeding 6 cm. Dangerous projectiles must be avoided. If multiple projectiles are used, they must be similar in size, shape, and mass.
   e. The device, without the counterweight and projectile, must not contribute energy to the launch. Example violations, **allowable types, and mechanisms for testing for added energy are available on soinc.org.**
4. **THE COMPETITION:** Only competitors, the Event Supervisor, and officials are allowed in the impound and competition areas while teams are competing. Once teams enter the event area to compete, they must not leave or receive outside assistance, materials, or communication until they are finished competing.
   a. When instructed by the event supervisors, teams must place their device anywhere within a marked perimeter of a **1.0** m by **1.0** m square designated "the Launch Area" and must not anchor it to the ground.
   b. The use of AC powered electrical equipment to set up and operate the device is not allowed.
   c. Except for the triggering mechanism, no part of the device and counterweight may extend out of the Launch Area before it is triggered or after the launch motion is complete. Any part of the device or counterweight that extends out of the launch area during the launch must return to rest within the Launch Area without assistance.
   d. The target must be an open-topped container with a minimum dimension of 20 cm x 20 cm x 20 cm.
      i. Before the first launch **with each counterweight**, the team must announce the position of the target (Target Distance) in **0.5 m increments**. The event supervisors must set the target so that two sides of the target are parallel with a straight line from the center of the Launch Area to the center of the target.
      ii. If they hit the target, the team may request it moved to a new Target Distance (in **0.5 m increments**).
      iii. Event supervisors must indicate each projectile's first point of impact. After each launch the event supervisor must indicate when the competitors may approach the target to make measurements to calibrate their device, which is included in the team's 5 minutes. Competitors may not touch the target.

e. The device may be moved anywhere within the Launch Area between launches.
f. During the launch, competitors may not touch or hold the device, or be in the launch area or the area in front of the line that marks the front edge of the launch area. They may touch only the part of the triggering device that extends outside of the launch area.
g. Teams have 5 minutes to make 4 launches **(2 with each counterweight)**. No practice shots may be made. They must give ample warning to the event supervisor prior to each launch. It must not count as a launch if the competitors attempt to initiate a launch and the device does not go through a launch motion.
h. Time the event supervisors spend moving the target or measuring the distances to the projectiles does not count against the team's 5 minutes.
i. Event supervisors must be responsible for retrieving projectiles and returning them to the team between each launch if less than **2 projectiles of each type** are initially provided to the team.
j. In the event of a rule violation or penalty, the event supervisor must stop the timer and explain the reason for the violation or penalty. The team may continue to compete after the clock has been restarted.
k. Devices may be modified **in any way** in accordance with all rules while the clock is running in order to make successful launches. Only the tools, **parts** and supplies impounded may be used during competition.
l. If a part of the device does not return to within the Launch Area on its own, the device may be repaired or repositioned and subsequent launches scored normally.

5. **SCORING**: All measurements must be made and recorded in meters to the nearest 0.01 meter.
   a. The Launch Score (LS) for each launch must be: **LS = TD – 3A + B**
      i. The Target Distance (TD) is the distance requested by the competitors and is measured from the center of the front of the launch area to the center of the target.
      ii. The Accuracy Score (A) **is the straight-line** distance from the projectile's point of first impact to the target center. **If it hits the far wall initially, judges must estimate the height of the impact and add that to the distance from the target center to the wall.**
      iii. The Bonus (B) is **0.15 x TD if the projectile hits the target at first impact or 0.30 x TD** if at first impact lands in and stays in the target.
      iv. If the projectile hits the target on first impact the Accuracy Score must be 0.
      v. If any part of the device leaves the Launch Area and does not return, the LS must be 0.
      vi. If the LS is calculated to be less than 0, it must be set to 0 for final scoring purposes.
      vii. **If a shot hits a side wall or ceiling, the LS must be zero. If all shots are zero due to this, the last shot must be scored from where the projectile first impacts the floor, target, or far wall.**
   b. One of the submitted **plots**, selected by the event supervisor, must be scored as follows:
      i. Partial credit may be given. The max Graph Score (GS) possible is 12 points.
      ii. 2 points if labeled with school and student's names.
      iii. 2 points for appropriate title of **plot** and X and Y-axis labels.
      iv. 2 points for appropriate units and axis increments.
      v. 1 point for each **data plot on a graph or graphs** turned in (up to 5 total).
      vi. 1 point for an example calculation page turned in.



   c. Penalties: A 3 point penalty each time any of the following occurs:
      i. A competitor is warned for not correctly wearing proper eye protection.
      ii. A competitor is in the Launch Area when the launch is triggered.
      iii. The device goes through an unintentional launch motion.
      iv. No warning is given prior to a launch.
      v. **Violating any other rule listed above in part 4, Competition.**
   d. The Final Score must be: FINAL SCORE = **Best LS 1st counterweight + Best LS 2nd counterweight +** GS – Penalties. **High score wins.**
   e. Teams must be ranked by score in tiers based upon:
      i. Tier 1: Teams with no violations **(5.c. Penalties do not eliminate teams from this tier).**
      ii. Tier 2: Teams with **Construction** violations **or missed impound**.
   f. Tie breakers: 1st : Best Launch Score; 2nd : Second best Launch Score; 3rd : Third best Launch Score.
   g. Scoring Example: Graph Score (GS) = 10.5 pts; Penalties = 3 pts
      Launch 1 **(CW1)**: TD = 14.00 m; A = 1.43 m; => LS1 = 14.00 – **3x1.43 = 9.71**
      Launch 2 **(CW1)**: TD = 14.00 m; A = **landed in target;** => LS2 = 14.00 – 0.00 + **(0.3 x 14.00) = 18.20**
      Launch 3 **(CW2)**: TD = 20.00 m; A = 2.78 m; => LS3 = 20.00 – **3x2.78 = 11.66**
      Launch 4 (CW2): TD= 20.00 m; A=hit ceiling; => LS4 = 0
      FINAL SCORE = LS2 + LS3 + GS – P = **18.20 + 11.66 + 10.5 - 3 = 37.36 points**

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

TOWERS

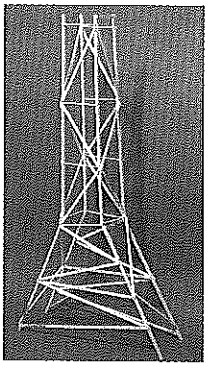
Read the General Rules in the mannals and on www.soinc.org as they apply to every event.

1. **DESCRIPTION:** The objective of this event is to design and build the most efficient Tower meeting the requirements specified in these rules.
   A TEAM OF UP TO: 2 **IMPOUND:** NO **EYE PROTECTION:** #2 **MAXIMUM TIME:** 10 minutes
2. **EVENT PARAMETERS:**
   a. Each team **is allowed to** enter only one tower, built prior to the competition.
   b. Team members **must** wear eye protection during the set-up and testing of the tower. **Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows, otherwise they must not be allowed to compete and scored as a no-show.**
   c. The Event Supervisor **must** provide all assessment devices, testing apparatus, hardware, and clean, dry sand or similar dry, free-flowing material (referred to subsequently as "sand").
3. **CONSTRUCTION PARAMETERS:**
   a. The Tower **must** span a 20.0 cm x 20.0 cm opening on a Test Base (see 4.b.) **and may be placed on the Test Base surface in any configuration such that** the loading chain is suspended within 2.5 cm of the center of the opening in the Test Base.
   b. The Tower **must** not be braced against any edge of the Test Base for lateral support at any time. No portion of the Tower is allowed to extend below the top surface of the Test Base prior to testing.
   c. The Tower **must** support a Loading Block (see 4.a.) a **minimum of 40.0 cm** above the Test Base. **Tower heights between 40.0 cm and 70.0 cm are scored as described under Scoring (See 6.b and 6.c).** There is no maximum Tower height.
   d. The portion of the Tower more than 30.0 cm above the Test Base for Division B, or more than 15.0 cm above the Test Base for Division C, must fit through an 8.0 cm diameter circular opening or hole.
   e. The loading point on the Tower **must** be constructed to permit placement of a chain and Loading Block on and through the Tower (see 4.c.), to support the bucket (see 4.d.).
   f. **The tower must be constructed such that only the loading block supports the chain and bucket.**
   g. The Tower **must** be a single structure, with no separate or detachable pieces.
   h. The Tower **must** be constructed of wood and bonded by glue. No other materials are permitted (e.g. no particleboard, wood composites, bamboo, paper, or commercially laminated wood).
   i. There are no limits on the cross section sizes of individual pieces of wood. Wood may be laminated without restriction by the team.
   j. Any type of commercially available bonding material (glue) may be used. **Adhesive putty is not permitted.**
4. **TESTING APPARATUS:**
   a. The Loading Block **must** be 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 1/4" or 5/16" threaded eyebolt.
   b. The Test Base **must** be a solid, level surface as follows:
      i. The Test Base **must** be at least 32.0 cm long x 32.0 cm wide.
      ii. The Test Base **must** have a 20.0 cm x 20.0 cm square opening at its center.
      iii. The Test Base **must** have a smooth, hard, low-friction surface (e.g. metal, high-pressure plastic laminate (Formica), Melamine, etc.) and **must** not bend noticeably when loaded.
   c. **A chain and 1/4" or 5/16" threaded eyebolt must be suspended from the Loading Block through the Tower. Clearance within the Tower must accommodate these dimensions for the testing apparatus:**
      i. **The end of the eyebolt must be at least 5.0 cm and no more than 12.0 cm below the loading block.**
      ii. **The head of the eyebolt and the chain must fit through a 3.0 cm diameter hole.**
   d. An ordinary five-gallon plastic bucket **must** be suspended from the chain by means of one or more S-hooks, with enough clearance above the floor to allow for Tower deflection.
   e. The Event Supervisor **must** provide sand for loading the Towers, and **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 15.200 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 Tower after check-in for competition. Once teams enter the event area to compete, they **must** not leave or receive outside assistance, materials, or communication until they are finished competing.
   b. All Towers **must** be assessed prior to testing for compliance with construction parameters.
   c. The Event Supervisor **must** measure the Tower height in cm to the nearest 0.1 cm.
   d. Team members **must** place their Towers on the scale for the Event Supervisor to determine the Tower mass, in grams to the nearest 0.01 g.
   e. Team members **must** place the Tower on the Test Base and assemble the Loading Block, eyebolt and chain, and hang the bucket from the chain, as required to load the Tower. **Team members may disassemble the block and eyebolt if necessary.**
   f. Team members **must** be allowed to adjust the Tower until they start loading sand. Once loading of sand has begun, the Tower must not be further adjusted.
   g. **The Event Supervisor must allow team members to safely and effectively stabilize the bucket from movement caused by loading of the sand.**
   h. Team members **must** have a maximum of ten minutes to set up and test their Towers either to the maximum load or failure.
   i. Towers that fail before supporting 15.000 kg **must** be scored according to the actual weight supported at time of failure (see 6.a.), **measured to the nearest gram or best precision available**. Loading **must** stop immediately when a failure occurs. The Event Supervisor may remove any sand added after failure.
   j. **Failure is defined as: the inability of the Tower to carry any additional load, any part of the load is supported by anything other than the Tower, or deflection such that any portion of the Tower gains lateral support from any edge of the Test Base.**
   k. Pending no arbitrations, teams may take their Towers with them after testing. If a Tower is removed there can be no further challenges for scoring or ranking.

6. **SCORING:**
   a. The load scored **must** not exceed **15.000 Kg,** and includes the mass of all testing apparatus supported by the Tower. The least amount of load to be scored **must** be the mass of the Loading Block.
   b. **Tower heights greater than 70.0 cm must be scored as 70.0 cm.**
   c. **Towers must be scored and ranked within each tier by the following equations:**
      i. **Score for Regional Tournaments = (Load supported/Mass of Tower)*(Height of Tower-5)**
      ii. **Score for State Tournaments = (Load supported/Mass of Tower)*(Height of Tower-15)**
      iii. **Score for National Tournament = (Load supported/Mass of Tower)*(Height of Tower-25)**
   d. **Tiers:**
      i. Tier 1: Towers meeting all the Construction Parameters are ranked by highest score.
      ii. Tier 2: Towers not meeting one or more Construction Parameters are ranked by highest score.
      iii. Tier 3: **Towers not meeting one or more Competition Parameters are ranked by highest score.**
      iv. Tier 4: Towers unable to be loaded for any reason (e.g. cannot accommodate loading block, chain, etc., or failure to wear eye protection) are ranked by lowest mass.
   e. **Ties: are broken by this sequence: 1. Lowest Tower mass, 2. Tallest Tower Height**
   f. **Example score calculations:**
      i. **Tower 1: mass = 15.12 g, height = 40.3 cm, load supported = 12.134 Kg**
         Regional Score = 28.329 ***State Score = 20.304*** ***National Score = 12.278***
      ii. **Tower 2: mass = 12.32 g, height = 56.0 cm, load supported = 13.213 Kg**
         Regional Score = 54.697 ***State Score = 43.972*** ***National Score = 33.247***
      iii. **Tower 3: mass = 10.62 g, height = 64.2 cm, load supported = 13.971 Kg**
         Regional Score = 77.880 ***State Score = 64.724*** ***National Score = 51.569***



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

WATER QUALITY

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

1. **DESCRIPTION**: The event will focus on evaluating aquatic environments.

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

2. **EVENT PARAMETERS:** Each team may bring only one 8.5" x 11" two-sided page of notes that contain information in any form from any source and up to 2 non-programmable, non-graphing calculators. 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 freshwater "lakes, ponds, or rivers" scenarios and have students analyze and evaluate comparative macroinvertebrates, and water quality data. In subsequent years this event will cover estuarine and ocean ecology. Process skills may include equipment use, collecting and interpreting data, measuring, calculating, classifying, 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, the water cycle, nutrient cycling, aquatic chemistry (and its implications for life), potable water treatment, waste water treatment, aquatic food chains and webs, community interactions, population dynamics, watershed resource management issues, sedimentation pollution and harmful species.

   b. Macro-flora and fauna Section will include the identification (common name only) of immature and adult macroinvertebrates & aquatic nuisance organisms, their importance as indicators of water & wetland quality. In addition Division C will also be expected to know the general ecology, life cycles, and feeding habits of all listed organisms.

Class 1-pollution sensitive	Class 2-moderately sen.	Class 3-moderately tolerant	Class 4-pollution tolerant	Class 5 Air Breathing
Mayfly	Aquatic Sowbug	Water Mite	Air Breathing Snail	Whirligig Beetle
Caddisfly	Damselfly	Midge	Deer/Horse Fly	Water Strider
Stonefly	Dragonfly	Blackfly	Tubifex	Mosquito
Dobsonfly	Scuds	Flatworm	Blood Midge	Giant Water Bug
Gilled Snails	Crane Fly	Leeches		Back Swimmer
Water Penny				Water Boatman
Riffle Beetle				Predacious Diving Beetle
Water Scorpion				

Aquatic Nuisance Plants: Purple Loosestrife, Eurasian Water Milfoil and Water Hyacinth.
Aquatic Nuisance Animals: Zebra Mussel, Spiny Water Flea, Asian Tiger Mosquito and Carp

   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, alkalinity, total solids and biochemical oxygen demand and their relationship to one another. Actual testing will be limited to salinity. Teams must build, calibrate, bring and demonstrate a salinometer/hydrometer capable of measuring saltwater concentrations between 1-10%.

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 & Bio/Earth CDs** are available on the Official Science Olympiad Store or Website at http://www.soinc.org.

WRITE IT/DO IT

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

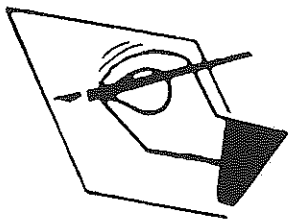
1. **DESCRIPTION**: One student will write a description of an object and how to build it, and then the other student will attempt to construct the object from this description.

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

2. **THE COMPETITION:**

   a. A student is shown an object (which may be abstract 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. 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.



   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 will be assessed for each minor infraction (e.g., unlabeled abbreviations or improper use of editing symbols or codes). Scoring Example: If a team has seven infractions and the total possible score is 50, then the team score would be 46.5 = 50-[7(50x.01)].

   e. Time for the construction phase will be used as a tiebreaker.

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

National Science Education Standard: Content Standard G: Science as a human endeavor "Some scientists work in teams and some work alone, but all communicate extensively with others." Please see the Website at http://www.soinc.org for references to all other event content standards from the **National Science Education Standards.**