



GEOLOGIC MAPPING

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

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

A TEAM OF UP TO: 2

APPROXIMATE TIME: 50 min

2. **EVENT PARAMETERS:** Each team may bring one three-ring binder (any size) containing information in any form from any source. The materials must be inserted into the rings (notebook sleeves are permitted). Each team **should** bring a **compass**, protractor, ruler, non-programmable calculator, colored pencils, and an equal-area projection stereonet with tracing paper and pin.
3. **THE COMPETITION:** The event may be composed of a test, stations, or a combination of both that will require the use of knowledge and relevant skills including observing, classifying, measuring, inferring, predicting and using relationships from the following topics:
 - a. Topographic and geologic maps
 - b. Plate tectonics, rock formation, Earth structure, Earth history, **lithologies, and geological principles;**
 - c. **Major structural elements**, fold geometries, fault types, erosional patterns, intrusion types, subsurface geometries, **and depositional and deformation sequences**
 - d. Cross-sections topographic profiles, projections of mapped features, and stereonet projections
 - e. Bed thicknesses, orientations of planes from points, and map projection **types**
 - f. **Geohazards types and methods to assess, monitor, and mitigate the associated risks**
 - g. **Aquifers, underground fluids, and methods of explorations and production**
4. **REPRESENTATIVE TASKS:**
 - a. Use a topographic map to construct a topographic profile
 - b. Use stratigraphic column, geologic map, topographic profile, strike and dip, and bed thickness measurement to construct a cross-section of sub-surface structures
 - c. Determine the order of events based on **geological principles**
 - d. Assess geohazard risks based on **interpretation of geologic and topographic maps, knowledge of lithologies, tectonic setting, and seismic history**
 - e. **Determine strike and dip and plunge and trend of planes and lines from direct measurements on samples of various geologic structures**
 - f. **Assess potential occurrence of underground fluids through interpretation of geologic map and cross sections**
5. **SCORING:** All questions will have been assigned a predetermined number of points. The highest score wins. Pre-identified questions will be used as tiebreakers.

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



GREEN GENERATION

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

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

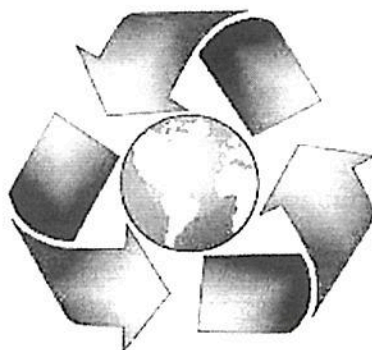
A TEAM OF UP TO: 2

IMPOUND: No

APPROXIMATE TIME: 50 minutes

2. **EVENT PARAMETERS:** Each team may bring one 8.5"x11" sheet of paper that may contain information on both sides in any form from any source. Each participant may bring any kind of non-graphing calculator, but no other resources.
3. **THE COMPETITION:** This event will be composed of three sections of approximately equal point value. This may include analysis, interpretation or use of charts, graphs and sample data. **Note:** Green Generation is designed for a two year rotation – the first year (2015) will cover aquatic issues, air quality issues and climate change while the second year (2016) will cover terrestrial issues and population growth issues.
 - a. Part 1: Review of the General Principles of Ecology
 - i. General Principles of Ecology – food webs and trophic pyramids, nutrient cycling, community interactions, population dynamics, species diversity and indicator species (2015 and 2016)
 - ii. Overview of Aquatic Environments – freshwater, estuaries, marine (2015)
 - b. Part 2: Problems resulting from human impacts on the quality of our environment
 - i. Aquatic Environmental Issues – Water Pollution, Ocean Dead Zones, Water Diversion, Overfishing (2015)
 - ii. Air Quality Issues – Acid rain, Air Pollution, Nuclear Pollution (2015)
 - iii. Climate Change – Effects on Plants, Animals, and Ecosystems, Greenhouse Effect, and Ozone Depletion (2015)
 - c. Part 3: Solutions to reversing/reducing human impacts that harm our environment
 - i. Legislation and Economic Opportunity for Solving Problems (Div. C) (2015 and 2016)
 - ii. Sustainability Strategies – Environmental Stewardship of Aquatic Ecosystems (2015)
 - iii. Bioremediation Strategies (2015)
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 **Green Generation CD (GGCD)** and the introductory **Bio/Earth CD (BECD)** are available on the Official Science Olympiad Store or Website at <http://www.soinc.org> and see the American Chemical Society (ACS) Climate Science Toolkit at <http://www.acs.org/content/acs/en/climatescience.html>



1. **DESCRIPTION:** Teams will answer questions related to time and they may construct and bring one non-electrical device to measure time intervals between 10 and 300 seconds.
A TEAM OF UP TO: 2 EYE PROTECTION: #2 IMPOUND: Yes APPROX. TIME: 50 minutes
2. **EVENT PARAMETERS:**
 - a. All reference materials to be used during all parts of the competition must be secured in a 3-ring binder, so that regardless of orientation nothing can fall out. Reference materials do not need to be impounded.
 - b. Competitors may bring calculators for use only during Part II of the competition. Items needed only for Part II of the competition do NOT need to be impounded.
 - c. Competitors must not bring watches, cell phones, or other time-keeping devices into the competition room (except for those used for the calibration step outlined below).
 - d. The event supervisor must hide from view any clocks present in the competition room.
 - e. Competitors must wear eye protection during device setup and testing. Teams without proper eye protection must be immediately informed and given an opportunity to obtain eye protection if time allows.
 - f. The device and all components needed to set up, calibrate, operate and clean up, including stopwatches, water, sand, tools, and clean-up supplies, must be impounded prior to the beginning of competition. Each team may impound only one device that will be used for all time trials.
 - g. The impounded device and any storage boxes must be clearly marked with the team's school name and competition number.
 - h. The device must be designed and operated in such a way to not damage or alter the floor.
3. **CONSTRUCTION:**
 - a. Examples of acceptable non-electrical devices include water or sand glasses, simple or torsional pendulums, or oscillating springs.
 - b. Commercial counters, timepieces or their parts are not allowed. Commercial balances, scales, test tubes, beakers, graduated cylinders, etc. are not considered counters and are allowed.
 - c. The device must NOT utilize any electrical components, physiological functions (e.g. pulse rate) or chemical reactions except for a battery-operated electronic balance or scale used solely to determine mass.
 - d. The device must be constructed to contain spillage.
 - e. At impound, the device and all components must be able to fit into an 80.0 cm x 80.0 cm x 80.0 cm cube (except for clean-up supplies, tools, stopwatch, etc.) and be moveable by the competing team members without outside assistance. The device may become larger once setup for Part I.
 - f. Devices must be constructed to minimize possible impacts on other teams when running (e.g., as quiet as possible, occupies a reasonable amount of space when set up, etc.).
 - g. Event supervisors must verify that devices meet event rules. Devices that do not meet event rules must not be impounded unless modified to meet event specifications by the team before the end of the impound period.
4. **THE COMPETITION:**

Part I:

 - a. The event supervisor must pre-select a different target time (as described under **SCORING**) for each of 5 time trials. The same times must be used for all teams. Teams must not be informed of the selected intervals. Time trials must run in the order listed in the **SCORING** section.
 - b. Teams must be given 5 minutes to setup and calibrate their device. All timing devices used for this calibration must then be impounded with the event supervisor prior to the start of the timing trials.
 - c. Prior to the start of each time trial the event supervisor must notify the teams that the trial is about to start.



IT'S ABOUT TIME (CONT.)

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

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

Part II:

- g. Teams must be given a set amount of time (20-30 minutes is suggested) to complete a written test.
 - h. Questions may be multiple choice, true-false, completion, or calculation problems.
 - i. When requested, answers must be provided in metric units with appropriate significant figures.
 - j. The competition must consist of at least one question from each of the following areas:
 - i. Time concepts (e.g., units, terminology)
 - ii. Time-related calculations (e.g., motion equations, astronomical principles)
 - iii. Time keeping devices and history (e.g., pendulums, Greenwich Observatory)
5. **SCORING:**
- a. Teams must start with 10 points per time trial (for a total of 50 possible points for Part I).
 - b. Points must be deducted from the initial 10 points as described below. The score for a trial must NOT be less than zero. There must not be any carry-over of penalty points between trials. The trial interval ranges and points deducted are:

<u>Time Trial #</u>	<u>Time Interval Range</u>	<u>Points Deducted / \pm 0.1 sec error</u>
Trial 1	10 to 30 sec	0.4 pts per 0.1 sec
Trial 2	30 to 90 sec	0.3 pts per 0.1 sec
Trial 3	90 to 180 sec	0.2 pts per 0.1 sec
Trial 4	180 to 300 sec	0.1 pts per 0.1 sec
Trial 5	any of the above	0.1 pts per 0.1 sec

- c. The Part II written test must be worth a total of 50 points.
- d. The total of the scores from Part I and Part II, minus any penalties, must determine the winner (which is the highest scoring team).
- e. Event supervisors may disqualify any device that is operated unsafely or a team that does not comply with the rules or bring a device, resulting in 0 points for Part I. Teams must still be allowed to compete in Part II.
- f. If any material or substance splashes, spills or falls on a table or floor the team may be assessed a penalty of up to 10 points.
- g. A penalty of 15 points may be deducted from the total score if a team does not completely clean up after the competition period. The event supervisor must make every effort to inform the team of a potential penalty and provide an opportunity to remedy the situation prior to assessing a penalty.
- h. Tiebreakers: 1st - best score from Time Trial 5, 2nd - designated question from the test.

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

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



MISSION POSSIBLE

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

1. **DESCRIPTION:** Prior to competition, teams must design, build, test, and document a "Rube Goldberg® like Device" that completes a required Final Task using a sequence of consecutive **Action or Energy Transfers**.
A TEAM OF UP TO: 2 **IMPOUND:** At State and National only **EYE PROTECTION: #2**
SET-UP TIME: 30 minutes for points **MAX. RUN TIME:** 3 minute limit
2. **SAFETY PARAMETERS:** All team members must properly wear safety spectacles with side shields at all times. Teams without proper eye protection must be immediately informed and given an opportunity to obtain eye protection if time allows, otherwise not be allowed to compete. Each device must pass a safety inspection before operation. Devices that demonstrate potential safety hazards must not be permitted to run unless those hazards are resolved to the satisfaction of the Event Supervisor; otherwise the team must receive only participation points.
3. **CONSTRUCTION PARAMETERS:**
 - a. All parts of the device must fit and stay within a 60.0 cm x 60.0 cm x 60.0 cm imaginary cube during operation.
 - b. The Device must begin with the Start Task and end with the Final Task as listed in Section 4.
 - c. After initiating the Starting Task, the device must be designed to operate autonomously. A team must be disqualified if the device is remotely timed or controlled.
 - d. The Five Energy Forms used in **Actions and Transfers** that will count for points are electrical (E), mechanical (M), thermal (T), chemical (C), and **visible light (VL)**. Batteries, candles, small rocket igniters, **matches**, etc., **used safely** may receive points determined by the way they cause the next action.
 - e. All scoreable **Actions and Transfers** must be visible.
 - f. Other non-scoreable **Actions and transfers** may be incorporated into the device, but must contribute to the **task sequence** and receive no points.
 - g. Electrical components may be used in the device, but no computers or integrated circuits are allowed.
 - h. All transfers take time, but any continuous action designed to take up time must not be electrical. In addition, at State and National competitions, adjusting a transfer that utilizes electricity in any way (either at the beginning, middle, or end of operation) intended to accomplish the ideal time is a Construction Violation.
 - i. Matches, candles, or small rocket igniters may be used. However, hazardous liquids and materials (e.g., rat traps, lead objects, **fuses, lasers**, etc.) and **unsafe chemical handling** will not be permitted.
 - j. All sources of energy and actions must be contained within the imaginary box before, during, and after the device's operation. The device must account for non-ideal ambient conditions. If the device is sensitive to light, air currents, etc., the team must provide necessary shielding.
 - k. **Voltage** 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.
 - l. Energy devices (e.g. batteries, mousetraps, candles), except motors, may be activated prior to the start of the device.
 - m. The top and at least one vertical wall must be open or transparent in order to view all actions and tasks.
 - n. **Students must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org**
4. **THE COMPETITION:** The Device Task is to raise one or more golf balls, collecting them in one or more scoring jugs, and activating a buzzer to signal the end of the Device's operation. Transfers receive points only if successful, are listed on the **Action Sequence List (ASL)**, and contribute toward the task sequence within the 3-minute time limit. A single Action or component must contribute to only one scoreable Transfer. **All scoring golf balls must be unaltered regulation golf balls but may be hand labeled for identification.**
 - a. **Start Task (100 points)** – Drop a golf ball into the device to initiate the first action. The golf ball must be dropped from a location higher than the entire device. Points are scored by lifting golf balls from a point below the bottom of the lowest scoring plastic beverage jug(s) and dropping them into a scoring jug(s). 1) Each scoring jug must remain at or above its starting level; 2) The top of a scoring jug may be cut to enlarge its opening, but the sides must be at least 10 cm higher than the bottom of the scoring jug; 3) The inside of the scoring jug must be unaltered with nothing attached, screwed, bolted, or hanging within the jug; 4) Other parts of the device may be taped or glued to the outside of the scoring jug(s); 5) Golf balls must be separated by the device so they are released into a scoring jug one at a time. Prior to entering a scoring jug each golf ball must cause an action(s) to release the next golf ball to enter a scoring jug.
 - b. **Bonus Energy Transfer Sequences (ETS) (optional)** – An ETS can receive points only if: 1) it is initiated by the process of a golf ball moving into a scoring jug (cannot be counted as an Energy Form); 2) it has a sequence of 2 or more transfers from one Energy Form to a different Energy Form; 3) the ETS is



MISSION POSSIBLE (CONT.)

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successful in its entirety as listed in the ASL; 4) it causes the next golf ball to move toward and into a scoring jug; 5) the device ceases to work when the ETS is not successful or the ETS is removed; and 6) both the initiating golf ball and next golf ball drop into a scoring jug. Possible bonus unique ETS include but are not limited to: M to C to M; M to C to VL to E; M to C to E; M to T to M; M to E to T to M; E to VL to E.

- c. **Final Task** (250 points) – The last golf ball to be counted must trigger a switch to activate a buzzer to signal the end of the Device’s operation. The buzzer must be clearly audible to the judges, so they can accurately measure the operation time. The last ball will count for points if it immediately drops into a jug.
 - d. An **Action Sequence List (ASL)** must be submitted to the Event Supervisor at **impound or check-in, whichever is first**. The ASL must be legible, neat, and an accurate documentation of each action and **Bonus ETS** of the device’s operation. See www.soinc.org for an example of the format required. Scoring will be based only **on the actions** and **Bonus ETS** listed in the ASL. Each **action and ETS** intended to earn points must be labeled in the device with a number matching the **ASL**. Unscored actions and transfers must be documented in the list in the **ASL**, but not be numbered.
 - e. The ideal operation time for maximum points is 60.0 seconds at Regionals, between 60.1 and 90.0 seconds at States, and 90.1 to 120.0 seconds at Nationals (time announced after impound). At State and Nationals, event supervisors will observe the adjustment of the device for timing to ensure that electricity is not used.
 - f. Timing and scoring for the device **begins** when a team member **releases a golf ball into the device**. **Timing of the device stops when the final buzzer is first audible to the judges**, or when 180.0 seconds elapse (whichever comes first).
 - g. 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.
 - h. If an action inadvertently starts a **transfer** out of sequence on the **ASL**, then all **transfers** skipped in the listed sequence must not earn points even if they are completed.
 - i. If a competitor completes a scoreable **transfer** or makes an adjustment that leads directly to completion of the **transfer or drop of a golf ball into a scoring jug** in the next action, **neither the transfer nor the golf ball will count for points** (even if it is part of the Final Task).
5. **SCORING POINTS:** High score wins.
- a. Teams that impound a device, but fail to compete, receive participation points.
 - b. 25 pts if the **ASL** is submitted as designated by the tournament director.
 - c. 25 pts if the **ASL** uses the format specified.
 - d. 25 pts if the **ASL** is 100% accurate of intended scoreable and unscored **Actions and ETS**.
 - e. 25 pts if the scoreable **Actions and ETS** within the device are correspondingly labeled **in the ASL**.
 - f. 50 pts if the team uses no more than 30 minutes to set up its device.
 - g. 0.1 pt for each 0.1 cm that the dimensions of the device are under 60.0 cm x 60.0 cm x 60.0 cm in each axis. Example: Device measures 40.0 cm x 38.9 cm x 52.4 cm. Pts. $20.0 + 21.1 + 7.6 = 48.7$ pts.
 - h. 100 pts for successfully completing the Start Task.
 - i. 2 pts for each full second of operation up to the ideal time.
 - j. **2 pts awarded for each golf ball properly dropped and staying in any approved scoring jug.**
 - k. 250 pts for successfully completing the Final Task.
 - l. **50 pts per each successful unique ETS. (max 6 x 50 = 300 pts)**
 - m. Points can be earned for **correctly completed ETS and/or golf balls dropped into a scoring jug** before 180.0 seconds elapse; **no points are awarded for Actions that occurs after the final buzzer sounds except for the last golf ball falling immediately into a scoring jug.**
6. **PENALTIES:**
- a. Minus 1 pt for each full second that the device operates beyond the ideal time until the final buzzer sounds or the 180.0 second time limit is reached (whichever occurs first).
 - b. Minus 15 pts each time the device is touched, adjusted, or restarted.
 - c. Minus 50 pts, one time, for any part or substance leaving the boundary of the device during the operation. Smoke, odors, light, radio waves, etc. may leave the device as long as not posing a hazard.
7. **TIERS:** Unsafe devices must not be allowed to run and teams must only receive participation points. Tier 1: Devices without any violations; Tier 2: Devices with construction or competition violations; Tier 3: Devices impounded after the deadline.
8. **TIES:** are broken by this sequence: 1. Fewest penalty points; 2. **Number of golf balls counted in the score;** 3. Smallest overall dimension (**L+W+H**) of device.

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

THIS EVENT IS SPONSORED BY: LOCKHEED MARTIN



PROTEIN MODELING

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

- DESCRIPTION:** Students will use computer visualization and online resources to guide the construction of physical models of proteins and to understand how protein structure determines function. For 2015, students will model proteins being used to edit the human genome. Currently these protein “tools” are designed by linking two specific parts (or domains) – one for DNA-targeting and another for DNA cleavage. Examples of DNA-targeting and DNA-cleaving protein domains will be featured in the Protein Modeling.
A TEAM OF UP TO: 3 **IMPOUND:** Yes **APPROXIMATE TIME:** 50 minutes for Part II & III
- EVENT PARAMETERS:** Pre-build models will be impounded.
 - Each team may bring up to five double-sided, 8.5”x11” pages of notes. Internet access is not permitted.
 - Students must bring a writing instrument.
 - Supervisors will provide all materials for on-site model construction.
- THE COMPETITION:** This event has three parts: a pre-build model, an on-site build model, & an exam.
 - Part I: The Pre-Build Model**
 - Students will use a computer program (Jmol/JSmol, see web-resources) to visualize a model of a specific protein based on atomic coordinate data, freely accessible from the RCSB Protein Data Bank (<http://www.rcsb.org>). For 2015, students will construct a model of the catalytic domain of the FokI endonuclease (amino acids 421-560 of PDB entry 2fok). Examples of endonuclease enzymes are described in the *Molecule of the Month* feature by David Goodsell titled “Restriction Endonuclease” (http://dx.doi.org/10.2210/rcsb_pdb/mom_2000_8). A constructed model of FokI endonuclease catalytic domain will be brought to all competitions; as the competition level increases, the scoring rubrics for the pre-build model will reflect higher expectations for model accuracy, detail and enhancements.
 - The final pre-build model must be based on the alpha carbon backbone display of the protein, using a scale of 2 cm per amino acid. Students may use Mini-Toobers®, or other comparable material (e.g., Kwik Twists, 12 gauge dimensional house wire, etc.), to construct their pre-build model. Students will use materials of their own choosing to add functionally relevant features to their model (e.g. selected amino acid sidechains, DNA or associated molecules). Additions to the model should highlight the significance of structure to the function of the protein. A significant portion of the score will be derived from these additional features. Students must provide a 3”x5” note card explaining the additions to their model and what they represent. Students must deliver their pre-build model and 3”x5” card to judges at the competition site for impounding. Students may pick up all models after the competition.
 - Part II: The On-Site Model**
 - During the on-site competition, students will build a physical model of a selected region of a specific protein using materials provided by the event supervisor. Web-based resources listed below will provide background information about the molecules for all levels of competitions.
 - Students will utilize a computer provided with the Jmol/JSmol application at the competition. Students must utilize only one of the identical computers provided at the competition with the appropriate coordinate files on it to guide their model construction. All construction materials for the model (Mini-Toobers®, amino acid sidechains, crosslinkers and plastic red and blue end caps) will be provided. Any model not handed to the judges by the end of the competition time will not be accepted for scoring.
 - Part III: The On-Site Exam** will be multiple choice/short answer questions addressing the principles of chemistry that drive protein folding and the structure/function relationship of the modeled proteins.
- SCORING:** 40% of the event score will be based on the pre-build protein model (Part I), 30% on the on-site build (Part II) and 30% on the written exam (Part III). The pre-build protein model will be scored based on the accuracy and scale of the secondary structures, as well as the additions to the model (e.g. sidechains, DNA or associated molecules). Additions that do not support the molecular story will not receive credit. The on-site build protein model will be scored based on accuracy of folding the model and positioning specific amino acid sidechains. The exam will be scored for accuracy. Ties will be broken using identified questions from the written exam.

Recommended Resources: Material for the students, coaches and judges will be available on the Science Olympiad Webpage at MSOE CBM (<http://cbm.msoe.edu/scienceOlympiad/index.php>) and RCSB PDB (<http://education.pdb.org/olympiad/>); RCSB PDB Homepage (www.rcsb.org) and PDB-101 resources (<http://www.rcsb.org/pdb-101>). ¹The Mini-Toobers® are a product of 3D Molecular Designs. Materials for the Pre-build can be obtained from <http://www.3dmoleculardesigns.com>.

THIS EVENT IS SPONSORED BY: The Milwaukee School of Engineering

1. **DESCRIPTION:** Competitors must design, build, and test a mechanical device, which uses the energy from a falling mass to transport an egg along a track as quickly as possible and stop as close to the center of a Terminal Barrier without breaking the egg.
A TEAM OF UP TO: 2 **IMPOUND:** Yes **EYE PROTECTION:** None **TIME:** 8 minutes
2. **CONSTRUCTION:**
 - a. The Scrambler must consist of an Egg Transport Vehicle (ETV) and an Energy Propulsion System. These may be separate or combined into a single unit. In its ready-to-run configuration, the entire Scrambler, including the egg, must not exceed 1.00 m in height and length and not exceed 0.75 m in width.
 - b. The ETV must be designed to travel a minimum of **8.5 m** and stay within a **2.00 m** track width before coming to a complete stop as close as possible to the center of the Terminal Barrier.
 - c. All energy used to propel the ETV must come from a falling mass not to exceed 2.00 kg. The mass must be part of the energy propulsion system and need not travel with the ETV. **The vehicle must not contribute to the falling mass.** Any part of the Scrambler whose gravitational potential energy decreases and provides energy to propel the ETV is considered to be part of the falling mass. To facilitate mass measurements, the **Scrambler must be impounded with the mass completely detached.**
 - d. The stopping mechanism must be contained completely within the ETV and work automatically. The ETV must not be remotely controlled or tethered.
 - e. The egg must rest on top of two $\frac{1}{4}$ " wooden dowels extending **perpendicularly** out a maximum of 4.0 cm from a rigid, unpadded and flat (**no holes**) backstop for the egg. The bottom of the wooden dowels must be between 5.0-10.0 cm above the track **and within 1.0 cm of the bottom of the backstop.** The backstop must be built of any rigid material and it must have a flat surface of 5.0 ± 0.5 cm wide by 5.0 ± 0.5 cm high by 1.27 cm (0.50 ") ± 0.5 cm thick, **be rigidly attached to the ETV, and be perpendicular to the track.** To facilitate timing, an additional vertical $\frac{1}{4}$ " wooden dowel must be attached vertically to the top of the rigid backstop. **This dowel must extend at least 20.0 cm from the track surface. A diagram of the backstop is available on www.soinc.org.**
 - f. The Event Supervisor (ES) must provide uncooked grade A large chicken eggs, one of which is selected by the team. **The ES must also provide tape** to secure the egg to the ETV. No tape may be placed on the front or rear **1.0 cm** of the egg. The rounded end of the egg must be **touching** the backstop and be visible to the ES after attachment. **The egg must be the foremost point of the ETV.**
 - g. Competitors must start the Scrambler by using any part of an unsharpened #2 pencil with an unused eraser **which must be provided by the ES. The pencil can either actuate a release mechanism or be incorporated into the Scrambler so that when removed the mass will begin to fall. In either case prior to any run, the team must be able to walk away from the Scrambler in its ready-to-run configuration and have the mass not fall.**
 - h. **The only parts of the Scrambler that are allowed to contact the floor are those that are already in contact with the floor in the ready-to-run position. All ETV wheels must be in contact with the floor at all times. The falling mass must not come in contact with the floor at any time. Piece(s) falling from the Scrambler result in a construction violation.**
 - i. **The Scrambler must not damage the venue at any time.**
 - j. No electrical or electronic devices may be used on the Scrambler, its alignment devices, or any tools (with the exception of any type of calculator).
 - k. **Students must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org**
3. **THE TRACK:** The track must be on a smooth, level, and hard surface with a Terminal Barrier extending across its end. Space is needed on each side of the track and beyond the Terminal Barrier to allow for error in the Scrambler's path.
 - a. **Approximately one-inch tape must be used to define the track's Start Line, the 0.50 m Line, the 8.50 m Line and Track Width Lines up to the Terminal Barrier.**
 - b. The center of the Start Line must be marked on the tape by the ES. The center of the Terminal Barrier must also be marked. A **mark** must also be placed on the Start Line 0.5 m from the left Track Width Line.
 - c. **The Terminal Barrier must be at least 25.0 cm tall and perpendicular to the track.**
 - d. The Terminal Barrier must be located at a chosen distance **9.00-12.00 m** from the Start Line in 1.00 m intervals for Regional, 0.50 m intervals for State and 0.10 m intervals for the National Tournaments. The distance must NOT be announced until all Scramblers have been impounded.
 - e. **Bonus: The center of a weighted #3 can (diameter $4 \frac{1}{4}$ ") will be placed 0.50 m from the left Track Width Line (when facing the Terminal Barrier) and halfway between the Start Line and the Terminal Barrier. The can will be in place on the track for all runs regardless of whether a team is going for the Bonus or not.**
 - f. If used, a photogate timing system must be installed at the **0.50 m Line** and the **8.50 m Line** at a height of 17.0 ± 2.0 cm.



SCRAMBLER (CONT.)

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

4. **THE COMPETITION:** The entire Scrambler system and any material needed to repair or to bring the Scrambler into compliance must be impounded before the start of the event. Tools for adjusting the Scrambler, test data, measuring and/or calculating devices to assist in making accurate adjustments to the Scrambler need not be impounded.
- Only competitors and the ES will be allowed in the impound and track areas while the teams are competing. Once competitors enter the event area, they must not leave the area or receive outside assistance, materials or communication.
 - Teams must be given a total of 8 minutes to complete up to 2 runs with their Scrambler. During this time teams may adjust their Scrambler, but they must not increase the falling mass once it has been measured. A run must be allowed to finish-if the mass begins to fall before the 8 minutes expires. Measurements by the ES must not be included in this time.
 - Teams may use their own measuring devices to verify the track dimensions during their allotted time. They must not roll the ETV on or near the track at any time prior to or during the competition.
 - Substances that may damage the floor or interfere with subsequent runs must not be applied to the wheels or floor. During their time, competitors may clean the track but the track must remain dry at all times.
 - All parts of the Scrambler must be behind and within 2.0 m of the Start Line and to the right of the 0.5 m marked line on the Start line when the mass begins to fall. This year the pointed tip of the egg does not have to start on the start line.
 - Sighting and/or aligning devices placed on the track are permitted but must be removed before the runs. Mounted sighting and aligning devices may be removed at the team's discretion prior to each run.
 - The energy propulsion system may be held in place during launch, but the ETV must be able to remain at its starting position in ready-to-run configuration without being touched.
 - If the ETV does not move upon actuation or the egg doesn't cross the Start Line, it does not count as a run and the team may request to set up for another run, but must not be given additional time.
 - Run Time starts when the dowel of the ETV reaches 0.50 m and ends when it either stops or it passes 8.50 m. The Run Time is recorded in seconds to the precision of the timing device used.
 - A Photogate timing system is highly recommended. Go to www.soinc.org for information.
 - Once the ETV starts a run, the competitors must wait until called by the ES to retrieve it. The 8 minute time resumes once competitors pick up their ETV or begin to make their own measurements.
 - Competition Violations would include competitors who follow the ETV down the track, any part of the ETV touches the Track Width Lines, the ETV passes the 0.5 m Line but stops before the 8.50 m Line, the ETV hits and moves the Bonus can, the egg is broken, or any part of the ETV touches the Terminal Barrier before the egg and other violation of the Competition section.
 - If the egg is broken as defined by "cracking the egg enough to leave a wet spot on a paper towel", the Distance Score must be from the point of impact to the center of the Terminal Barrier. If the egg breaks on the first run, a second run must not be permitted.
 - If the time and/or distance cannot be measured for a run (e.g., the ETV starts before the ES is ready, the competitors pick up the ETV before it is measured, or the ETV doesn't reach the 0.50 m line), or any part of the ETV passes the Terminal Barrier, it is a Failed Run.
 - Teams who wish to file an appeal must leave the Scrambler in impound with the ES.
5. **SCORING:** High score wins.
- Run Score = Distance Score + Time Score + Bonus Score + Penalties
 - Distance Score = A point-to-point measurement from the center of the Terminal Barrier to the pointed end of the egg measured to the nearest 0.1 cm.
 - Time Score = Run Time X 10
 - Bonus Score:** If the entire ETV successfully passes the #3 can on its left, remains within the track for the entire run, triggers both photogates, and has no violations, -100 pts will be added to their Run Score.
 - A Competition Violation must incur a Penalty of 1000 points per occurrence.
 - A Construction Violation must incur a Penalty of 3000 pts per occurrence, up to a max of 9000 pts.
 - A Vehicle which was not impounded during the impound period must incur a penalty of 4000 pts.
 - The Final Score = 5000 - the best Run Score.
 - If the competitors cannot start at least one run within the 8 min or those who have two Failed Runs must receive participation points only.
 - Ties are broken by this sequence: 1. Better non-scored Run Score; 2. Faster Run Time on the scored run.

Scoring Example: At a competition, a team's vehicle stopped with the pointed end of the egg 85.6 cm from the center of the Terminal Barrier, with a Run Time of 6.67 s, the egg broke so they incurred a Competition Penalty of 1000 pts.

Run Score: $(6.67 \times 10) + 85.6 + 1000 = 1152.3$

Final Score: $5000 - 1152.3 = 3847.7$

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

THIS EVENT IS SPONSORED BY: LOCKHEED MARTIN



TECHNICAL PROBLEM SOLVING

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

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

A TEAM OF UP TO: 2

EYE PROTECTION: #4

APPROXIMATE TIME: 50 minutes

2. **EVENT PARAMETERS:** Each student may bring and use any kind of calculator and must bring and use chemical/splash protection goggles where required. Each team may bring two 8.5" x 11" sheets of paper that may contain information on both sides in any form from any source (including a list of mathematical relationship, formulas or constants). Where a station requires a more advanced calculator, probes or other lab equipment, the event supervisor will provide them.
3. **THE COMPETITION:** The event will consist of two lab stations and up to 10 questions per station (limited to the two topic areas below).

Level	Probes	2015 Topics
All	Temperature, Dual Force, CBR2 (Motion Detector), and Colorimeter	Topics 1 & 2 will focus on the Forensic patterns of physical not chemical evidence associated with a crime scene. The teams will design, conduct and analyze experiments to solve a proposed crime based on physical evidence supplied.

Note: At the national level, Vernier probes and TI Nspire CX will be used at the two stations.

- a. Students will apply scientific theories and principles related to the current topics in the solution of the problems. Students will be asked to collect data, make measurements, and apply appropriate mathematics to determine specific values and defend solutions to a problem. Tasks may require the use of probeware that has been provided, set up, and demonstrated by the supervisor.
 - b. At the national tournament, supervisors will use calculators and probes for the topics above. State and Regionals are encouraged to use probes but may provide students with data sets collected by such sensors/probes following a data collection demonstration.
 - c. At state and national tournaments, supervisors will use calculators and probes for the topics above. Regionals are encouraged to use probes but may provide students with data sets collected by such sensors/probes following a data collection demonstration.
4. **SCORING:** Teams will be ranked based on the highest total points as determined by the sum of the scores of each individual station. Each of the two stations will be worth 100 points for a total of 200 points. In case of ties, a tiebreaker will be announced prior to the competition. At each of the two stations, the students will complete a required task (supported with data they have collected) and answer up to 10 questions. The 100 points will be awarded as follows:
 - a. 60 points on the correctness of their answer.
 - b. 20 points based on procedure and supporting data.
 - c. 20 points on content questions relating to the given topic.

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

<http://education.ti.com/en/tisciencespired/us/forensics/case-files>

http://www.atomiclearning.com/k12/ti_nspire

THIS EVENT IS SPONSORED BY TEXAS INSTRUMENTS



WRIGHT STUFF

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 test free flight rubber-powered monoplanes to achieve maximum time aloft.

A TEAM OF UP TO: 2

IMPOUND: None

TIME: 8 minutes

2. **EVENT PARAMETERS:**

- a. Teams **may** bring up to 2 airplanes, any tools, and their flight log.
- b. Event Supervisors must provide all measurement tools and timing devices.

3. **CONSTRUCTION PARAMETERS:**

- a. Airplanes may be constructed from published plan(s), commercial kits and/or a student's design. Kits must not contain any pre-glued joints or pre-covered surfaces.
- b. Any materials except Boron filaments may be used in construction of the airplane.
- c. Total mass of the airplane throughout the flight, excluding the rubber motor, must be 8.0 g or more.
- d. The airplane must be a monoplane (one wing) and the horizontally projected wingspan must not exceed 50.0 cm. The maximum wing chord (straight line distance from leading edge of wing to trailing edge, parallel to the fuselage) of the wing must be 8.0 cm or less. The maximum horizontally projected stabilizer span is 30.0 cm. The maximum allowable chord of the stabilizer is **6.0** cm.
- e. The propeller assembly **may be built by the competitor(s)** or purchased pre-assembled. It may include a propeller, a shaft, a hanger, and/or a thrust bearing. Bushings may be placed in the propeller or thrust bearing to reduce wobble or friction. The propeller must be a single two-bladed, propeller with a maximum diameter of 24.0 cm. **Variable-pitch propellers that include mechanisms to actively change the blade diameter or angle must not be used.**
- f. A rubber motor not to exceed a mass of 2.0 g (including any attachments such as O-rings) must power the airplanes and will be massed separately from the airplane. Motors may be lubricated before and/or after check-in.
- g. The airplane(s) must be labeled in such a way as to be easily identified by the event supervisor. At least one non-horizontal surface on the airplane (such as a fin or dihedral panel) must be covered in a non-transparent, non-white material so it can be identified at its maximum altitude.
- h. **Students must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org**

4. **THE COMPETITION:**

- a. The event must be held indoors. Tournament officials must announce the room dimensions (approximate length, width and ceiling height) in advance of the competition. Tournament officials and the Event Supervisor are urged to minimize the effects of environmental factors such as air currents. Rooms with minimal ceiling obstructions are preferred over very high ceilings.
- b. Once competitors enter the cordoned off competition area to trim, practice, or compete they must not receive outside assistance, materials, or communication. Teams violating this rule must be ranked below all other teams. Spectators must be in a separate area.
- c. During inspection each team must present a flight log of recorded data. Data must include 6 or more parameters (3 required and at least 3 additional) for 10 or more test flights prior to the competition. The required parameters are: 1) motor size before windup, 2) number of turns on the motor at launch, 3) flight time. The team must choose 3 additional data parameters beyond those required (e.g. turns remaining after landing, estimated/recorded peak flight height, the motor torque at launch, etc.).
- d. At the Event Supervisor's discretion:
 - i. Multiple official flights may occur simultaneously according to the Event Supervisor's direction.
 - ii. Test flights may occur throughout the contest but must yield to any official flight.
 - iii. No test flights will occur in the final half-hour of the event's last period, except for teams that declare a trim flight during their 8-minute flight period.
- e. A self-check inspection station may be made available to competitors for checking their airplanes prior to check-in with the Event Supervisor.

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

- f. Competitors may use any type of winder, but electricity may not be available.
 - g. Competitors must present their event materials (airplanes, motors, and logs) for inspection immediately prior to their 2 official flights. Timers must follow and observe teams as they are winding their motors. All motors that meet specifications will be collected at check-in and will be available to the team only for their official flights
 - h. Teams may make up to a total of 2 official flights using 1 or 2 airplanes.
 - i. After check-in teams must be given an 8-minute Flight Period, starting when their first flight (trim or official) begins. Any flight beginning within the 8-minute period will be permitted to fly to completion. Competitors may make adjustments/repairs/trim flights during their official 8-minute period. Before their launches, competitors must indicate to the Timers whether a flight is official or a trim flight. A flight is considered official if a team fails to notify Timer(s) of the flight's status. Teams must not be given extra time to recover or repair their airplanes.
 - j. Time Aloft for each flight starts when the airplane leaves the competitor's hand and stops when any part of the airplane touches the floor, the lifting surfaces no longer support the weight of the airplane (such as the airplane landing on a girder or basketball hoop) or the judges otherwise determine the flight to be over.
 - k. Event Supervisors are strongly encouraged to utilize 3 Timers on all flights. The median flight time in seconds to the precision of the device used, recorded by the 3 Timers, is the official time aloft.
 - l. Competitors must not steer the airplane during flight.
 - m. In the unlikely event of a collision with another airplane, a team may elect a re-flight. The decision to re-fly may be made after the airplane lands. Timers are allowed to delay a launch to avoid a possible collision. The eight-minute period does not apply to such a flight.
5. **SCORING:** The base score is the Team's longest single flight time. Ties will be broken by the longest non-scored **official** flight time.
- a. **10% of the flight time will be added to flight time of the airplane that has a colored panel on the wing that is at least the length of the wing chord and at least between 2 wing ribs.**
 - b. **At the state and national level, 10% of the flight time will be added to the total if the wing chord is 7.0cm or less.**
 - c. **At the national level, an additional 5% of the flight time will be added to the total if the wing chord is 6.5 cm or less.**
 - d. Teams with incomplete flight logs must have 10% of their flight time deducted from each flight.
 - e. Teams without flight logs must have 30% of their flight time deducted from each flight.
 - f. Teams that violate a rule under "CONSTRUCTION" or "THE COMPETITION" that does not have a specific penalty must be ranked after all teams that do not violate those rules.

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

THIS EVENT IS SPONSORED BY THE ACADEMY OF MODEL AERONAUTICS
<http://www.modelaircraft.org/>



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

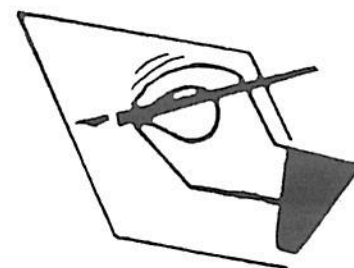
1. **DESCRIPTION:** One student will write a description of an object and how to build it, and then the other student will attempt to construct the object from this description.

A TEAM OF: 2

APPROXIMATE TIME: 55 Minutes

2. **THE COMPETITION:**

- a. A student is shown an object (which may be abstract, is the same for all teams and **ideally one per team**) built from, but not limited to, such items as science materials, inexpensive materials (e.g., straws, push pins, Styrofoam balls, paper cups, Popsicle sticks, etc.) or commercial sets (e.g., Googplex, K'nex, Tinker Toys, Lego, Lincoln Logs, etc.).
- b. The student has twenty-five (25) minutes to write a description of the object and how to build it. There will be no advantage to finishing early. Only numerals, words and single letters may be used. Symbols, drawings and diagrams are not allowed, with the exception of common punctuation and editing symbols. Printable punctuation marks/editing symbols that can be produced on a PC standard 101 key keyboard by pressing a single key or a single key in combination with the shift key may be used, however these must be used in their normal context and not as symbols to form a key/code. All abbreviations (not symbols) must be defined either at the beginning or when the abbreviation is first used. No prepared abbreviations on labels will be permitted. **Note: quotation marks or apostrophes may be used for inches or feet.**
- c. The supervisor of the event will pass the description to the remaining team member who will take the description and attempt to recreate (build) the original object in twenty (20) minutes.
- d. Supervisors will attempt to use different materials than the materials that were used last year.



3. **SCORING:**

- a. The team that builds the object nearest to the original and has properly written instructions is declared the winner.
- b. Points will be given for each piece of material placed in the proper connection and location compared to the model.
- c. Pieces that are connected correctly beyond the incorrect connection will be counted in the score. No penalty will be assessed for parts that were not used.
- d. Scoring Violations: Use of diagrams or drawings will result in disqualification. A one percent (1%) penalty of the total possible score will be assessed for each minor infraction (e.g., unlabeled abbreviations or improper use of editing symbols or codes). Scoring Example: If the total possible score is 50 and a team had seven infractions then 3.5 points [$7(50 \times .01) = 3.5$] would be deducted from their score.
- e. Time for the construction phase will be used as a tiebreaker.

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



GENERAL RULES

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

GENERAL RULES, CODE OF ETHICS AND SPIRIT OF THE PROBLEM

The goal of competition is to give one's best effort while displaying honesty, integrity, and good sportsmanship. Everyone is expected to display courtesy and respect (see Science Olympiad Pledges). Teams are expected to make an honest effort to follow the rules and the spirit of the problem (not interpret the rules so they have an unfair advantage). Failure by a participant, coach, or guest to abide by these codes, accepted safety procedures, or rules below, may result in an assessment of penalty points or, in rare cases, disqualification by the tournament director from the event, the tournament, or future tournaments.

1. Actions and items (e.g., tools, notes, resources, supplies, electronics, etc.) are permitted, unless they are explicitly excluded in the rules, are unsafe, or violate the spirit of the problem.
2. While competing in an event, students may not leave without the event supervisor's approval and must not receive any external assistance. All electronic devices capable of external communication (**including cell phones**) must be turned off, unless expressly permitted in the event rule and left in a designated spot if requested.
3. Students, coaches and other adults are responsible for ensuring that any applicable school or Science Olympiad policy, law, or regulation is not broken. All Science Olympiad content (e.g., policies, requirements, clarifications, FAQs, etc. on www.soinc.org) must be treated as if it were included in the printed rules.
4. All pre-built devices presented for judging must be constructed, impounded, and operated by one or more of the 15 current team members unless stated otherwise in the rules. If a device has been removed from the event area, appeals related to that device will not be considered.
5. **Officials are encouraged to apply the least restrictive penalty for rules infractions (see examples in the Scoring Guidelines). Event supervisors must provide prompt notification of any penalty, disqualification or tier ranking.**
6. State and regional tournament directors must notify teams of any site-dependent rule or other rule modification with as much notice as possible, ideally at least 30 days prior to the tournament.

Tentative Schedule for the 2015 National Tournament at the University of Nebraska, Lincoln, NE

Events	7:00 to 8:00 am	8:10 to 9:10 am	9:20 to 10:20 am	10:30 to 11:30 am	11:30 am Break 12:00 pm	12:00 to 1:00 pm	1:10 to 2:10 pm	2:20 to 3:20 pm
Air Trajectory	Impound	Walk in must report by 2:00 PM						
Anatomy & Physiology		1-10	11-20	21-30		31-40	41-50	51-60
Astronomy		11-20	21-30	31-40		41-50	51-60	1-10
Bridge Building		Walk in must report by 2:00 PM						
Bungee Drop	Impound	Walk in must report by 2:00 PM						
Cell Biology		21-30	31-40	41-50		51-60	1-10	11-20
Chemistry Lab		31-40	41-50	51-60		1-10	11-20	21-30
Compound Machines	Impound	41-50	51-60	1-10		11-20	21-30	31-40
Disease Detectives	All Teams							
Dynamic Planet		51-60	1-10	11-20		21-30	31-40	41-50
Entomology		1-10	11-20	21-30		31-40	41-50	51-60
Experimental Design		11-20	21-30	31-40		41-50	51-60	1-10
Forensics		21-30	31-40	41-50		51-60	1-10	11-20
Fossils		31-40	41-50	51-60		1-10	11-20	21-30
GeoLogic Mapping		41-50	51-60	1-10		11-20	21-30	31-40
Green Generation		51-60	1-10	11-20		21-30	31-40	41-50
It's About Time	Impound	1-10	11-20	21-30		31-40	41-50	51-60
Mission Possible	Impound	Walk in must report by 2:00 PM						
Protein Modeling	Impound	11-20	21-30	31-40		41-50	51-60	1-10
Scrambler	Impound	Walk in must report by 2:00 PM						
Technical Problem Solving		21-30	31-40	41-50		51-60	1-10	11-20
Wright Stuff		Walk in must report by 2:00 PM						
Write It Do It		31-40	41-50	51-60		1-10	11-20	21-30