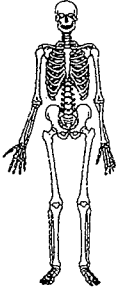


1. **DESCRIPTION:** This event encompasses the anatomy and physiology of selected body systems.  
**A TEAM OF UP TO:** 2 **APPROXIMATE TIME:** 50 Minutes
2. **EVENT PARAMETERS:** Each team member may bring a non-programmable calculator. **Each team may bring one 8.5" x 11" two-sided page of notes that contain information in any form from any source.**
3. **THE COMPETITION:** Students should know the basic anatomy and physiology of the skeletal, **muscular** and **endocrine** 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, PowerPoint slides, anatomical specimens, etc.) for the following topics:

a. **SKELETAL SYSTEM** All competition levels should know:

- i. Bones of the axial and appendicular skeleton; label the basic surface anatomy of a bone as shown on a diagram and/or normal X-ray, **CT and MRI.**
- ii. Name, structure and function of types of joints and the muscle and ligament attachments that surround the joints and the ranges of motion allowed by each type (e.g., ball and socket).
- iii. Structures of bones in cross-section.
- iv. Cellular composition, structure and function of bones, bone marrow and cartilage.  
**(Development and maturation of bones at the cellular and gross anatomical levels)**
- v. How to distinguish between types of vertebrae (e.g., cervical, thoracic and lumbar).
- vi. **Characteristics** and radiological features of bone diseases/disorders from the cell level to the whole person as listed: osteoarthritis, osteoporosis, fractures, disc herniation, scoliosis, anterior cruciate ligament tears, medial collateral ligament damage.
- vii. The effects of exercise on the skeletal system and the diseases mentioned.



**National Level Only:**

- viii. Additional diseases/disorders to know: spinal stenosis, achondroplasia, juvenile rheumatoid arthritis, spinal fractures, and ankylosing spondylitis, osteosarcoma.
  - ix. Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.).
  - x. Label the bones of the skull.
  - xi. Salter-Harris fracture classification system.
  - xii. **Know the foramina of the skull and what passes through each.**
- b. **MUSCULAR SYSTEM - All levels should know:**
- i. The interaction of the skeletal and muscular systems to allow movement.
  - ii. Muscle fibers -the cellular and gross anatomy of skeletal muscle, cardiac muscle & smooth muscle.
  - iii. Physiology of the skeletal muscle contraction system and the neuromuscular junction.
  - iv. How the skeletal muscles move bone, maintain posture, and produce heat.
  - v. Skeletal muscle actions – origin, insertion, interactions of different muscles.
  - vi. Location and identification of the major skeletal muscles of the body including origin, insertion, and function. See [www.soinc.org](http://www.soinc.org) for a list of the Major Skeletal Muscles.
  - vii. The effects of exercise on the cellular and gross anatomical structure of the muscular system.
  - viii. Muscle and tendon injuries and their prevention (i.e., strains and sprains).
  - ix. The diseases on each level from the cell to the whole person as listed:
  - x. Poliomyelitis, Muscular Dystrophies, Myasthenia gravis, Torricellis.

**National Level Only:** Kinds of muscle contraction, Classes of muscle fibers and their functions, Understand cardiac and smooth muscle roles in the body, Understand muscle sensory systems (e.g. spindles and Golgi tendon organs). Additional diseases: Carpal Tunnel Syndrome, Fibromyalgia, and Chronic fatigue syndrome, Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.), Role of the nervous system in muscle function.

c. **ENDOCRINE SYSTEM - All competition levels should know:**

- i. The three classes of hormones – steroids, peptides, and amines
- ii. Mechanisms of hormone action – water soluble vs. fat soluble
- iii. Endocrine related problems – hypersecretion, hyposecretion
- iv. Hormone producing glands, their hormones and the function of each
- v. Understand disorders: diabetes mellitus, hypoglycemia, Graves disease, goiter

**National Level Only:** Endocrine cycles and negative feedback, Autonomic nervous system control of endocrine function, Additional Disorders: Cushing's Syndrome, Addison's Disease, and Myxedema, Treatments and/or prevention for all conditions listed above (drugs, surgery, etc.).

4. **SCORING:** Points are awarded for correct answers. Selected questions/quality of free-response will break ties.

1. **DESCRIPTION:** Students will demonstrate an understanding of the basic concepts of mathematics and physics relating to **galaxies**.

**A TEAM OF UP TO:** 2

**APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:** Each team **member** is permitted to bring a programmable calculator and either a laptop computer or 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 (notebook sleeves are allowable). **No Internet access allowed.**

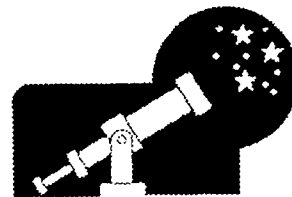
3. **THE COMPETITION:** Using information which may include H-R diagrams, spectra, light curves, motions, distance equations and relationships, stellar magnitudes and classification, multi-wavelength images, charts, graphs, and animations, participants will be asked to complete activities for the following topics:

- Use all available information to determine answers relating to **normal galaxies and starburst galaxies**, including **star formation, mid-sized and massive black holes, galactic structure, globular clusters, population I & II stars**, Type Ia & Type II supernovae, eclipsing binaries and X-ray binaries.
- Use all available information, including Kepler's laws, to determine answers relating to the orbital motions of binaries, cosmological distance equations **and the period-luminosity relationship (Cepheids and RR Lyrae) to answer questions related to characteristics and distances of galaxies; Hubble's Law to answer questions about Hubble's constant, and the recessional velocities and distances of galaxies.**
- Students will be asked to identify, be knowledgeable about, and answer questions relating to the content areas outlined above for the following Deep Sky Objects (DSOs): \*Epsilon Aurigae, **Milky Way Galaxy (MWG), Sagittarius A\*, Andromeda Galaxy (M31), The Cartwheel Galaxy, M84, M33, NGC 604, M33 X-7, M101, C153, M82, SN1994D, Sn1993J, M15 and G1.**  
\*Epsilon Aurigae is part of a nationwide observing campaign for the International Year of Astronomy (2009) and will be included in the Astronomy Event for 2010 and 2011.
- The competition may include one or more tasks at stations such as: **sequencing images of galaxies by the degree of star formation; placing images of different types of objects in the correct locations within galaxies; matching images of light curves with the appropriate objects; using charts, data tables and/or graphs to determine distances and calculate Hubble's constant; using graphing calculators to plot observational data and calculate periodicity or distance.**

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

### **RECOMMENDED RESOURCES:**

- Science Olympiad Astronomy CD:** Available at [www.soinc.org](http://www.soinc.org) store
- <http://www.aavso.org/>
- [http://chandra.harvard.edu/edu/formal/stellar\\_ev/](http://chandra.harvard.edu/edu/formal/stellar_ev/)
- [http://www.tufts.edu/as/wright\\_center/products/sci\\_olympiad/sci\\_olympiad\\_astro.html](http://www.tufts.edu/as/wright_center/products/sci_olympiad/sci_olympiad_astro.html)
- <http://chandra.harvard.edu/photo/index.html>
- <http://antwrp.gsfc.nasa.gov/apod/astropix.html>



**NATIONAL SCIENCE EDUCATION STANDARDS:** Science as Inquiry, Content Standard A: Use Technology and Mathematics to Improve Investigations and Communications; Formulate and Revise Scientific Explanation and Models using Logic and Evidence; Earth and Space Science, Content Standard D: The Origin and Evolution of the Universe (Grades 9-12).

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

1. **DESCRIPTION:** This event integrates content knowledge and process skills in the areas of cell biology and **cellular** biochemistry.

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

2. **EVENT PARAMETERS:** Students will bring and wear Z87 chemical splash goggles where needed and non-programmable calculators. **Each team may bring one 8.5" x 11" two-sided page of notes that contain information in any form from any source.**

3. **THE COMPETITION:**

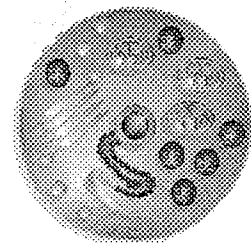
- a. The competition may be administered at a series of lab-practical stations **such as** demonstrations, experiments, scientific apparatus, models, illustrations, specimens, data collection and analysis, and problems for students to solve. Content topics will include:

<i>At the regional and state level:</i>	<i>At the national level:</i>
1) Biological monomers and polymers, <b>including LDL and HDL</b> 2) pH 3) Enzymes 4) Cell organelles/structures and their functions 5) Differences between eukaryotic and prokaryotic cells 6) Qualitative aspects of photosynthesis & respiration 7) Membrane structure and function 8) Movement across membranes 9) Importance of ATP 10) Structure of viruses 11) Cell cycle and mitosis 12) <b>Chromosome structure</b> 13) <b>Fermentation products and uses</b>	1) All topics from state and regional plus: 2) Cell communication and membrane receptors 3) Apoptosis 4) Enzyme inhibition 5) <b>Stem cell concepts and uses</b> 6) Viral replication 7) C <sub>3</sub> vs. C <sub>4</sub> vs. CAM plants 8) Consequences of changes in protein shape 9) <b>Cancerous vs normal cells</b> 10) <b>Genomics</b> 11) <b>Bioethics relating to above topics</b>

- b. Process skills may include writing hypotheses, determining independent and dependent variables, controlling variables, graphing, analyzing data, interpreting results as well as using and applying technologies.
- c. Questions pertaining to the *exact amount of ATP* produced during cellular respiration **must not** be used (note: this is because the amount of ATP produced varies within a cell).

4. **SAMPLE QUESTIONS:**

- a. Using models, photographs, or illustrations of structures such as organic molecules and cell organelles, identify the structure and describe its function or role in life processes.
- b. Using a light microscope, estimate cell size and determine the 3-dimensional shape of cells. Relate the size and shape of a cell to its function.
- c. Make measurements to calculate surface area to volume relationships. Relate surface area to volume relationships to cell structure and function.
- d. Contrast viruses and cells.
- e. Using the results of gel electrophoresis, identify and compare the different proteins.
- f. Identify substances such as protein, carbohydrates, lipids and vitamin C using reagent tests or data provided.
- g. Calculate the energy content of food from data either given or obtained from calorimeters.



5. **SCORING:** Each correct response will be assigned a point value. The highest score wins. Selected questions may be used as tiebreakers.

1. **DESCRIPTION:** Teams will answer a series of questions or complete a task involving the science processes of chemistry focused in the areas of **kinetics and aqueous solutions**.

**TEAM OF UP TO:** 2

**EYE PROTECTION:** #4

**APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**

- Students** must bring: a non-programmable, non-graphing calculator, a pencil, **no reference material**.
- Event Supervisors** must provide: Whatever other reagents/glassware are appropriate for the tasks students are asked to do, Periodic Table, any constants needed.
- 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 a **chemical apron** with a **sleeved shirt or lab coat** that reaches below the knees. 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:** The competition will consist of a series of stations that include activities similar to those in first year high school courses. These stations could include hands-on activities, questions about each topic, interpretation of experimental data (graphs, diagrams, etc.), and/or observation of an experiment set up and running. Supervisors are encouraged to use computer or calculators with sensors/probes wherever possible. Students may be asked to collect data using probeware that has been set-up and demonstrated by the Supervisor. Or the supervisor may provide students with data sets collected by such sensors/probes following demonstration of the data collection. Data will be presented in a tabular and/or graphic format and students will be expected to interpret the data. Students should be aware that nomenclature, formula writing, and stoichiometry are essential tools of chemistry and may be included in the event at any time. Stoichiometry includes, for example, such abilities as mole conversions and percentage yield. For purposes of nomenclature and formula writing, students are expected to know the symbols and charges for the following ions by memory: nitrate, carbonate, phosphate, acetate, sulfate, ammonium, bicarbonate, and hydroxide. Students should also know how to use the "ite" form of an ion, which is one less oxygen than the "ate" form. Students should be able to use the periodic table to obtain the charge for monatomic ions (e.g.,  $\text{Na}^+$ ,  $\text{S}^{2-}$ , etc.).

4. **SAMPLE QUESTIONS**

- Kinetics:** Students will demonstrate an understanding of the principals of kinetics. They must be able to measure reaction rates and identify how and why reaction conditions (temperature, concentration, particle size, and catalysts) affect reaction rates. At the regional level, teams will NOT be asked to determine rate laws experimentally or from data provided. At the state and national levels, teams will be asked to determine rate laws from actual experimentation or data provided, and teams should also be able to determine rate constants with correct units.
- Aqueous Solutions:** Students will demonstrate an understanding of the principals and properties of aqueous solutions. They must be able to calculate solution concentrations given quantities of solute and solvent, and to calculate quantities of material required to produce a solution of specified concentration. Molarity, molality, mass percentage, and parts per million may be required. At state and national levels, conversions between concentration units may be required. Tasks will be chosen from the following:
  - Use the concept of density to experimentally determine the concentration of a solution.
  - Determine solution concentration using a series of standard absorbencies and Beer's Law.
  - Use freezing point depression to determine the molar mass of a solute.
  - Use titration to determine an unknown concentration.
  - Identify and explain factors that effect solution formation.
  - Construct a solubility curve
  - Determine whether a solution is saturated, unsaturated or supersaturated.



5. **SCORING: Kinetics: 50% and Aqueous Solutions: 50%.** Time may be limited at each station, but time will not be used as a tiebreaker or for scoring. All ties will be broken by selected questions chosen by the supervisor. These questions may or may not be identified to the students.

**RECOMMENDED RESOURCES:** See [www.soinc.org](http://www.soinc.org)

# DISEASE DETECTIVES

1. **DESCRIPTION:** Students will use their investigative skills in the scientific study of disease, injury, health, and disability in populations or groups of people with a focus on the effects of population growth on public health outcomes.

**A TEAM OF UP TO:** 2

**APPROXIMATE TIME:** 50 minutes.

2. **EVENT PARAMETERS:** Non-programmable calculators are permitted. **Each team may bring one 8.5" x 11" two-sided page of notes that contain information in any form from any source.**

3. **THE COMPETITION:** (Sample Problems and Resources may be found at <http://www.soinc.org>)
- 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.
  - 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).
  - This event will include questions based on:
    - Data collection
    - Creating graphic displays of data
    - Interpreting trends and patterns of epidemiologic data
    - Communicating results
  - 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.
  - Based on these descriptions, they will be expected to do the following:
    - Generate hypotheses and recognize various fundamental study designs.
    - Evaluate the data by calculating and comparing simple rates and proportions.
    - Identify patterns, trends and possible modes of transmission, sources or risk factors.
    - Recognize factors such as study design or biases that influence results (especially for Division C - less for Division B).
    - Propose interventions based on promoting positive health behaviors, eliminating or reducing risks of environmental exposures, or disrupting clearly identifiable chains of transmission.
    - Translate results/findings into a public health/prevention message for identified populations at risk.
  - They will also be expected to:
    - Define basic epidemiological and public health terms (e.g., outbreak, epidemic, pandemic, surveillance, risk, vector, fomite, zoonosis, etc.).
    - Recognize various categories of disease causing agents & give examples of illnesses caused by each.
    - Recognize and understand differences between the major groups of infectious agents (e.g., viruses, bacteria, protists, fungi and animals).
    - Recognize examples of various epidemiologic and public health phenomena such as types of outbreaks and modes of transmission.
  - 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.
  - Process skills may include hypothesis, observations, inferences, predictions, variable analysis, data analysis, calculations, and conclusions.
  - The level of questioning for Division B and Division C competitions should reflect the age-appropriateness for two groups.
  - The event format may be exam-based, station-based or a combination of both.



4. **SCORING:**
- 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.
  - 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.
  - Points should be awarded for both quality and accuracy of answers, the quality of supporting reasoning, and the use of proper scientific methods.
  - Highest number of points will determine the winner. Selected questions may be used as tiebreakers.

1. **DESCRIPTION:** Students will use process skills to complete tasks related to earthquakes & volcanoes.

**A TEAM OF UP TO:** 2

**APPROXIMATE TIME:** 50 minutes

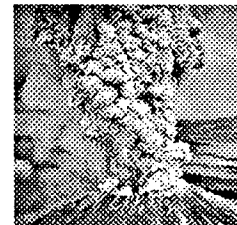
2. **EVENT PARAMETERS:** Each team may bring one 8.5" x 11" two-sided page of notes containing information in any form from any source and up to two "non-graphing" calculators.

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. Worldwide distribution patterns of earthquakes and volcanoes
- b. Types of volcanoes: shield, stratovolcanoes (composite), cinder cones; active, dormant, extinct
- c. Volcanic hazards: primary hazards including pyroclastic flows, lahars, tephra and gases, lava flows, flood basalts; secondary hazards including flooding and famine
- d. Types of earthquakes: spreading center, subduction zone, transform fault, intraplate
- e. Earthquake hazards: primary hazards including rapid ground shaking causing structural damage, buckled roads and rail tracks; secondary hazards including landslides and avalanches, alterations to water courses, flooding and fire
- f. Volcanic monitoring: geologic history, associated earthquake activity, magma movement, satellite data, hazard maps
- g. Earthquake monitoring: geologic history, identification of faultlines, remote seismograph positioning, changes in groundwater levels, observations of strange behaviors in animals
- h. Volcanism: at plate boundaries, over hot spots (oceanic and continental); hydrothermal vents
- i. Plate boundaries: ocean-ocean convergence, ocean-continent convergence, divergent plate boundaries at ocean ridge spreading centers and continental rift valleys, transform plate boundaries at mid-ocean ridges; rifting of continental plates
- j. Plate tectonics: seafloor spreading, features formed at plate boundaries, evidence of sea floor spreading including magnetic reversals, age of seafloor as opposed to continents, fossil evidence, density differences between continental and oceanic plates
- k. Faults: dip-slip, both normal and reverse; strike-slip, or transform
- l. Climatic effects of volcanic ejecta, both solid particles and gases, released into the atmosphere
- m. Tsunamis: origin, wave characteristics, warning system, "life" stages
- n. Seismic waves: primary (P)/secondary (S), surface; measurement: magnitude/intensity/focal depth

4. **REPRESENTATIVE TASKS:**

- a. Given a map of selected islands and seamounts of the Hawaiian chain accompanied by the approximate age and distance from the Island of Hawaii for each, participants will plot the movement of the Pacific Plate on a graph. They will then respond to a number of interpretative questions, including calculations, related to the information plotted on the graph.
- b. Given pre and post May 18, 1980 Topographic Profiles of the eruption of Mt. St. Helens, participants will respond to a series of questions identifying where no changes were made, where material has been removed, and where material has been added (deposited). They will then be given a series of questions to determine their ability to interpret observations and draw conclusions about that eruption.
- c. Calculate the location of an epicenter of an earthquake by triangulation using travel time of P and S waves.



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.

**SUGGESTED RESOURCES:** <http://pubs.usgs.gov/gip/dynamic/dynamic.html>;  
 Tarbuck, Edward J. and Frederick K. Lutgens, *Earth Science*. Prentice Hall, 2006. ISBN-10: 0131258524;  
 Spaulding, Nancy E. and Samuel N. Namowitz. *Earth Science*. McDougal Littell. 2005. ISBN 0-618-49938-5;  
 Decker, Robert and Barbara Decker, *Volcanoes*, W. H. Freeman. 1997. ISBN 0716724405; Bolt, Bruce A. *Earthquakes*. W. H. Freeman. 1992, ISBN 0716722364; Chester, Roy. *Furnace of Creation; Cradle of Destruction*. Amacom. 2008 ISBN 13:978-0-8144-0920-6 <http://earthquake.usgs.gov/learning/>;  
<http://nemo.sciencecourseware.org/VirtualEarthquake/>; <http://www.earth2class.org/>; <http://vulcan.wr.usgs.gov/>

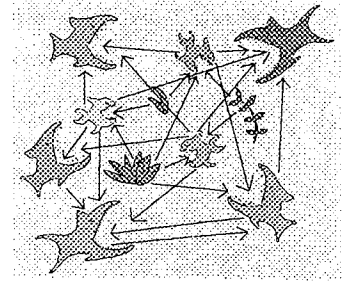
**NATIONAL SCIENCE EDUCATION STANDARDS:** Content Standard D. Structure of the Earth System; Earth's history.

1. **DESCRIPTION:** Students will answer questions involving content knowledge and process skills in the area of ecology and adaptations in featured North American biomes.

**A TEAM OF UP TO:** 2

**APPROXIMATE TIME:** 50 Minutes

2. **EVENT PARAMETERS:** Students may bring a non-programmable calculator. **Each team may bring one 8.5" x 11" two-sided page of notes that contain information in any form from any source.** References and training resources are available on the Official Science Olympiad Web Page at <http://www.soinc.org>.



3. **THE COMPETITION:**

- a. The event will emphasize these process skills as they apply to ecology: defining variables; analyzing data from graphs and tables; presenting data in graphs and tables; forming hypotheses; making calculations and predictions.
- b. All questions **will** deal with the following ecological principles: Energy flow through food webs and trophic pyramids including quantitative analysis of data; nutrient cycling, community interactions; population dynamics including density dependent/independent limiting factors, carrying capacity, doubling time, exponential/logistical growth and how to calculate population growth; extinction, selection and migration; human impact upon ecosystems (climate change, invasive species, acid rain, erosion, pollution). In addition, students should be familiar with the pros and cons of using alternative energy and its effect on the environment. If stations are used, students must spend the same amount of time at each station. **Division C: State and Nationals only:** life history strategies (e.g., age structure, survival curves, life tables, R and K strategies).
- c. Approximately 50% of the questions should specifically address grassland ecology and **taiga** ecology. The remainder of the questions will cover general ecological principles. In each subsequent year, one biome will remain and one replaced by the next biome on the list: freshwater lakes and streams, marine (including estuaries), forests, deserts, grasslands, taiga, tundra.

4. **SAMPLE QUESTIONS:**

**Division B:**

- a. From the description of community interactions, create a food web. Then predict what would happen to the food web if the primary producers were greatly reduced in number by a disease.
- b. Given a description of the interaction between two species, identify the type of community interaction.
- c. Provide three reasons why a grassland is easier to sustain over a number of years than a suburban lawn.
- d. Compare a grassland with a **taiga**. What kinds of adaptations may be common in both environments? How are the organisms in each environment adapted for the rates of nutrient recycling that you would expect to find?

**Division C:**

- e. Given a complex food web, create a trophic pyramid and determine the amount of energy in each level when given a quantity of energy entering the producer level.
  - f. Students are given a graph depicting the changes in two interacting populations of different species in a habitat. Predict which population is the predator and which is the prey. Give reasons for your choices.
  - g. Determine the population growth rate for an area given  $r$  (rate of increase) and  $N$  (number of individuals).
  - h. Students are given three age structures and asked to determine which population has the highest birth rate, death rate, doubling time, and mean age.
5. **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.

1. **DESCRIPTION:** Prior to the tournament, teams will construct rockets designed to stay aloft the greatest amount of time while carrying an Egg-O-Naut (a raw Grade A large chicken egg) that survives (doesn't break) impact.

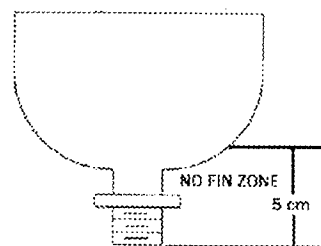
**TEAM OF UP TO:** 2 **IMPOUND:** No **EYE PROTECTION:** #5 **APPROX. TIME:** 10 minutes

2. **EVENT PARAMETERS:**

- Teams will build and bring up to two rockets to the tournament.
- Participants must wear eye protection rated ANSI Z87+ (Eye Protection #5 on [www.soinc.org](http://www.soinc.org)) during the loading, launching, and retrieving of their rockets and Egg-O-Nauts.**
- Event supervisors will provide the launcher, water, and Grade A large chicken eggs.** The supervisor will place an identifying mark (using a Sharpie or ink stamp) on the eggs to ensure that teams are using provided eggs.

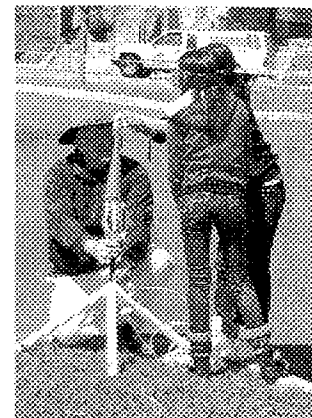
3. **CONSTRUCTION PARAMETERS:**

- Each rocket's pressure vessel must be made out of a single **2-liter plastic** carbonated beverage bottle with a neck/nozzle opening approximately 2.2 cm internal diameter (1/2 inch Schedule 40 PVC pipe should just fit inside the nozzle opening). Labels may be removed from the bottle but labels must be presented at the safety inspection.
- The structural integrity of the pressure vessel (carbonated beverage bottle) cannot be altered. Examples of altering structural integrity include but are not limited to physical, thermal or chemical damage (e.g. cutting, sanding, using hot glues, or super glues). **Tape and select glues may be used to attach fins and other components to the pressure vessel.** Glues must be silicone or polyurethane-based. Damage to the structural integrity of the pressure vessel will result in disqualification and the rocket will not be allowed to launch. Damage will be assessed by looking into the bottle through the nozzle for discoloration, bubbles, or thinning of the walls of the bottle.
- Metal may be used, but may not be attached to or have direct contact with the pressure vessel and any time. For safety, rockets **and separated components** may not use leading surfaces that are sharp, pointed, or consisting of a rigid spike.
- Commercial model rocket parts may not be used.
- All rockets will be launched using the launcher provided by the supervisor. To ensure rockets will fit on the launcher, fins and other parts added to the bottle must be **5 cm or higher above the level of the bottle's opening. Nothing, including tethers, may break this plane.**
- All energy imparted to the rocket **at launch** must originate from the water/air pressure combination (both provided by the event supervisor). No explosives, electric, elastic powered flight, throwing, remote controls, or pyrotechnics may be used.
- Any recovery system is allowed. **Potential or kinetic sources of energy may be used in the recovery system; however, objects (such as springs, rubber bands, etc.) must be in their lowest energy state at launch.**
- The rocket(s) must be built so that the egg **provided by the event supervisor** is easily removed. Nothing (e.g., glue or tape) may be adhered to the egg.
- The part of the rocket containing the Egg-O-Naut should be **differently** colored if it is to detach from the rocket.



## 4. THE COMPETITION:

- a. Egg-O-Naut is a walk-up event; teams should arrive at the competition site ready to launch. Following the safety inspection of each rocket, teams will receive 1 egg per rocket, add any amount of water and load their egg in each rocket. When called to launch, the teams will have a total of **10 minutes** to launch 1 or 2 rockets brought to the competition (only 1 launch per rocket). Any rocket launched before the time expires will be scored. The second rocket may be launched prior to retrieval of the Egg-O-Naut.
- b. All rockets will be launched at **75 psi**. Once the rocket is pressurized, no contestant may touch or approach the rocket.
- c. Time aloft will be recorded **in** hundredths of a second. Timing begins when the rocket separates from the launcher and stops when the Egg-O-Naut or portion of the rocket containing the egg touches the ground or comes to rest on a tree, building, or other obstruction or goes out of sight. Preferably three timers should be used and the middle recorded time will be used for scoring.
- d. The teams will retrieve their rockets and immediately show the rocket or capsule with the Egg-O-Naut to an event inspector. Any Egg-O-Naut capsule or wrapping must be opened in the presence of an event official.



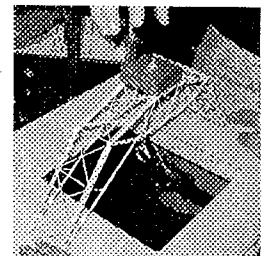
## 5. SCORING:

- a. Any Egg-O-Naut (or portion of the rocket containing the egg) that completely detaches from the pressure vessel will receive a 3 second bonus. Rockets whose parts (e.g. fins) do not remain linked while aloft will not be disqualified or penalized.
- b. Egg-O-Nauts that can be retrieved and survive will receive a 15 second bonus. Egg-O-Naut's survival is defined as not cracking the egg enough to leave a wet spot on a paper towel. An Egg-O-Naut that cannot be retrieved will not receive the 15 second bonus.
- c. The score for each rocket will be equal to its time aloft plus bonus seconds for Egg-O-Naut capsule separation plus bonus seconds for Egg-O-Naut survival. A team's final score for the event will be the score for their individual rocket with the highest score.
- d. Teams whose final score is for a rocket with construction violations will be scored as follows:
  - i. Rockets that violate a safety related construction rule will not be launched and will receive only participation points (this includes competitors not wearing proper eye protection).
  - ii. Teams having other construction violations will be ranked **in a tier** below other teams.
- e. **Ties will be broken** by the better score of **each tied team's** other rocket.

THIS EVENT IS SPONSORED BY THE AMERICAN EGG BOARD (AEB)  
([www.eatincredible.com](http://www.eatincredible.com))

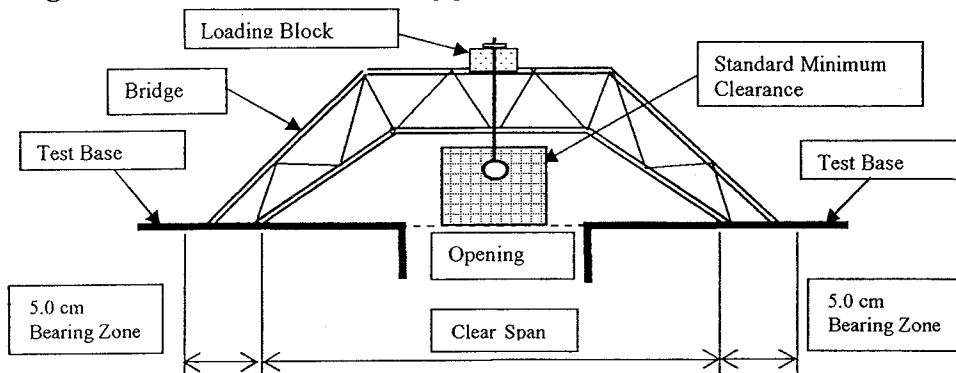


1. **DESCRIPTION:** The objective of this event is to design and build the most efficient bridge.  
**A TEAM OF UP TO: 2** **IMPOUND:** No **EYE PROTECTION: #2** **MAXIMUM TIME:** 10 minutes
2. **EVENT PARAMETERS:** (See Eye Protection #2 on [www.soinc.org](http://www.soinc.org))
  - a. Each team may enter only one bridge, which must be built prior to the competition.
  - b. Team members must bring and wear Safety Spectacles with Side Shields during the set-up and testing of the bridge or they will not be allowed to compete.
  - c. The **assessment** devices, testing apparatus, hardware, and **clean, dry sand or similar dry, free-flowing material (referred to subsequently as "sand")** will be provided by the Event Supervisor. No other items or materials may be used for **assessment** or testing.
3. **CONSTRUCTION PARAMETERS:**
  - a. The bridge must have a Clear Span of 35.0 cm in Division B, or 45.0 cm in Division C, on a Test Base.
  - b. The bridge may only touch the surface of the Test Base within the Bearing Zone before loading. The Bearing Zone will be 5.0 cm beyond either side of the Clear Span. The bridge may not be braced at any time against any edge of the Test Base for lateral support.
  - c. The center portion of the bridge must be raised above the level of the Test Base, so that a Standard Minimum Clearance of **15.0 cm long x 15.0 cm high in Div. B**, or **30.0 cm long x 12.5 cm high in Div. C**, exists between the top surface of the Test Base and the underside of the bridge (see 4.c. below).
  - d. The maximum bridge height for both Division B and Division C will be **20.0 cm**.
  - e. The bridge must support a Loading Block (see 4.a. below) above the center of the Test Base, above the Standard Minimum Clearance. **Teams** may place the Loading Block on or within the bridge structure.
  - f. The loading point on the bridge must be constructed to permit placement of a chain or threaded eyebolt through the bridge and Loading Block, to support the bucket. The load applied to the Loading Block shall consist of a bucket, suspending hardware, and sand provided by the Event Supervisor (see 4.f. below).
  - g. There is no minimum or maximum width for the bridge.
  - h. The bridge must be a single structure, with no separate or detachable pieces.
  - i. The bridge is to be constructed of wood and bonded by glue. No other materials may be used (e.g. no particleboard, wood products, bamboo, paper, or commercially laminated wood). **There are no limits on the cross section sizes of individual pieces of wood (the ¼" x ¼" limitation has been removed).**
  - j. Any type of commercially available bonding material (glue) may be used.
  - k. Wood may be laminated without restriction by the team.
  - l. **Bridges that fail to meet one or more of the requirements of the Construction Parameters will be ranked after those that meet all Construction Parameter requirements.**
4. **TESTING APPARATUS:**
  - a. The Loading Block shall be a square block measuring precisely 5.0 cm x 5.0 cm x approximately 2.0 cm high with a hole in the center of the square faces for a ¼" threaded rod or eyebolt.
  - b. The Test Base shall be a solid, level surface as follows:
    - i. The Test Base shall be least 55.0 cm long x 32.0 cm wide.
    - ii. The Test Base shall have an opening at its center approximately 20.0 cm x 20.0 cm, for suspension of the bucket. The opening may be any shape.
    - iii. Parallel lines shall be marked across the width of the surface of the Test Base: a centerline dividing the Test Base in half; lines at 17.5 cm and 22.5 cm in Division B, or 22.5 cm and 27.5 cm in Division C, on each side of the centerline, to indicate the Bearing Zones.
    - iv. The Test Base shall have a smooth, hard surface (e.g. metal, high-pressure plastic laminate (Formica, Melamine, etc.)). The Test Base shall be stiff enough that it does not bend noticeably when loaded.
  - c. The Standard Minimum Clearance between the underside of the bridge and the Test Base shall be verified by sliding or placing a Clearance Block under and completely through the bridge, centered on the opening, without touching the bridge. The Clearance Block shall be **15.0 cm long x 15.0 cm high in**



Division B, or 30.0 cm long x 12.5 cm high in Division C. The Clearance Block may be made of any material and any convenient thickness. It is removed for testing since it is only for **assessment** purposes.

- d. A chain or S-hooks shall be suspended from the Loading Block through the bridge by means of a ¼" threaded eyebolt or short threaded rod.
- e. An ordinary five-gallon plastic bucket shall be suspended from the chain by means of one or more hooks, with enough clearance above the floor to allow for bridge deflection.
- f. Sand shall be provided for loading the bridges, which shall be added to the bucket by the team members. **The Event Supervisor** shall verify that the combined mass of the Loading Block, chain, bucket, sand, and attaching hardware is at least 15.000 kg prior to testing.



## 5. COMPETITION:

- a. No alterations or repairs may be made to the bridge after check-in for competition.
- b. All bridges will be assessed prior to testing for compliance with design and construction parameters.
- c. **Team members shall place their bridges on the scale for the Event Supervisor to determine the bridge mass, to the best available precision (0.1 g or better), for scoring purposes at the time of testing.**
- d. **The Clearance Block will be given to the team members to pass under their bridge so that the Event Supervisor can confirm the Standard Minimum Clearance.**
- e. **Team members shall place the bridge on the Test Base and assemble the Loading Block, eyebolt, chain, etc, and hang the bucket from the chain, as required to load the bridge. The center of the Loading Block must be over the center of the opening in the Test Base. The bridge may only touch the Test Base in the appropriate Bearing Zone prior to loading. Team members shall be allowed to adjust the bridge until they start loading sand.**
- f. Team members shall add sand to the bucket, until the bridge fails or the maximum load is reached (**teams are allowed to steady, not support, the bucket with their fingertips**). The maximum load scored is 15.000 kg (which includes sand, bucket, Loading Block and attached hardware).
- g. Bridges that fail before supporting 15.000 kg will be scored by Structural Efficiency according to the actual weight supported at time of failure. **Loading shall stop immediately when a failure occurs.**
- h. Failure is defined as complete bridge breakage, deflection so that the bridge or Loading Block touches or extends below the top surface of the Test Base within the Clear Span, or the bucket rests on the floor.
- i. Bridges may be released and taken away by the competitors after testing, assuming there is no pending arbitration. If a bridge is removed there can be no further challenges for scoring or ranking.

## 6. SCORING:

- a. Bridges will be scored and ranked by Structural Efficiency, as defined by the following equation:  
Structural Efficiency = Load supported/Mass of bridge. All masses are expressed in grams.
- b. Load scored cannot exceed 15,000 grams (15.000 kg).
- c. Bridges which meet all the **Construction Parameters** are ranked in the first tier by Structural Efficiency.
- d. Bridges which do not meet one or more **Construction Parameters** shall be ranked in the second tier by Structural Efficiency.
- e. Bridges which cannot be loaded will be ranked by **the lower** mass in the third tier.
- f. In the event of ties for Structural Efficiency, the bridges shall be ranked favoring the lighter bridge. Bridges, which are still tied, shall be ranked favoring the lowest overall bridge height.

1. **DESCRIPTION:** This event will focus on Soil Chemistry related to Environmental Chemistry.

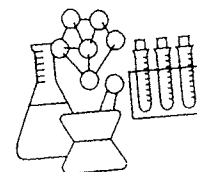
**A TEAM OF UP TO:** 2

**EYE PROTECTION:** #4

**APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS/CONSTRUCTION:**

- Each team may bring one 8.5" x 11" two-sided page of notes containing information in any form from any source and each student may bring a pencil and a non-programmable calculator.
- Supervisors will provide:
  - Instrumentation to analyze environmental chemicals.
  - Chemicals.
  - Whatever other laboratory ware may be necessary.
  - Standardized curves to interpret the results from the analysis.
  - Event supervisors will be expected to instruct students in the use of the provided instrumentation.
- 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, a chemical apron with a sleeved shirt or a lab coat that reaches the knees. 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:** This event will consist of a series of experiments and questions at stations or a single bench on these Environmental Chemistry topics:

- This year the students will be expected to use the instruments and/or chemicals the event supervisor provides to analyze soil and/or "digested" soil samples. Actual hazardous materials may not be used, but experiments to simulate the presence of hazardous materials are permitted.
- Students will be expected to analyze soils for the nutrient content and distinguish between "Absolutely necessary" (primary) compounds using NPK tests, "vital" (secondary) compounds containing Ca, Mg, and S, and "trace minerals" (micronutrients) necessary for plant growth such as Fe, Mn, Zn, B, Cu, Mo, Cl, Si, Ni, and Co.
- Students will also need to be able to distinguish between sand, silt, and clay and determine the porosity of the soil, its permeability, pH, and water retention.
- Students may be asked questions about soil pollutants, types of pollutants, to determine if a pollutant is from a point or non-point source, and possible types of remediation.
- What are the impacts of improper fertilization on the surrounding environment (including adjacent soil, water, or air)?
- What is the best course of remediation?
- Students will be expected to interpret retention times of a gas chromatograph or a mass spectrogram to analyze an organic contaminant of a soil sample.
- Students will be expected to know how to do dilution calculations, unit conversions (ppm, micro liters, etc.), and Stoichiometric calculations related to remediation.

4. **SAMPLE QUESTIONS:** Students may be given several different soil or "digested" soil samples with probes and/or chemicals and asked to determine what fertilizer/chemicals should be added to give the highest yield of various vegetables. Or students might be asked to analyze the samples for presence/absence of trace minerals or contaminants. Students may be given a mass spec or chromatogram of a pure substance and the main components of a pesticide and asked if the pesticide is present. Students may be asked to identify laboratory equipment or describe a procedure to analyze soil for a required test.

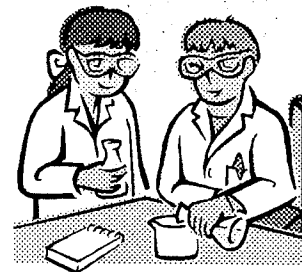
5. **SCORING:** Points will be awarded for correct answers and/or proper technique. Time may be limited at each station, but time will not be used as a tiebreaker or for scoring. All ties will be broken by a predetermined event supervisor selected question.

**RECOMMENDED RESOURCE:** Science Olympiad Website and CPCD at [www.soinc.org](http://www.soinc.org)

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.
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 will 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 related to the question 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: (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 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: plus 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. The variables should be operationally defined. d. Experiments should be simple and have only one independent and one dependent variable.



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

**A TEAM OF UP TO:** 2

**APPROXIMATE TIME:** 50 minutes



2. **EVENT PARAMETERS:** **EYE PROTECTION:** #4

a. **Students** may bring only these items:

i. Test tubes and test tube holders or any devices in which they can perform the tests, droppers, funnel(s), filter paper, pH or litmus paper, spatulas, plastic spoons or stirring rods, 9 volt conductivity tester (no testers will be allowed that run on AC current), thermometer, flame test equipment (nichrome wire, cobalt blue glass, etc.), slides, ruler, hand lens, writing instruments, a pencil (for chromatograms), paper towels, and metal tongs. (Students not bringing these items will be at a disadvantage. The event supervisor will not provide them.)

ii. **Each team may bring one 8.5" x 11" two-sided page of notes containing information in any form from any source**, and a non-programmable calculator.

b. **Supervisor** will provide: Iodine reagent (Iodine dissolved in KI solution), 2M HCl, 2M NaOH, Benedict's solution, (no more than 50 mL of each of the solutions) a hot water bath, a Bunsen burner or equivalent BTU heat source to perform flame tests, **a calculator and probes or other appropriate instrumentation to analyze water samples**, a waste container, chromatography materials, and a wash bottle with distilled water (no more than 250 mL). The supervisor may provide other equipment (such as a microscope) or 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, a **chemical** apron with a **sleeved shirt** or a lab coat that reaches the knees. 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:** There will be 4 parts and then the Analysis of the Crime. The event will consist of evidence from the first three parts and up to 2 parts from Crime Scene Physical Evidence at Regional, 3 parts from Crime Scene Physical Evidence at State & 4 parts of Crime Scene Physical Evidence at National.

a. **Qualitative Analysis:** Substances to identify: sodium acetate, sodium chloride, sodium hydrogen carbonate, sodium carbonate, lithium chloride, potassium chloride, calcium nitrate, calcium sulfate, calcium carbonate, cornstarch, glucose, sucrose, magnesium sulfate, boric acid, and ammonium chloride (there will be no mixtures). The team will be provided with 3-5 powders at Regional (4-8 at State and 6-8 at National) of the 15 substances listed above. All teams will have the same set of solids to identify. No more than 15 g of each substance will be given to the team.

b. **Water Testing:** **Students will also demonstrate their skill in testing water samples** for some combination of temperature, pH, hardness, DO, BOD, COD, turbidity, conductivity (Total Dissolved Solids), common anions (such as  $\text{Cl}^-$ ,  $\text{NO}_3^-$ ,  $\text{PO}_4^{3-}$ , etc.), and common cations (such as  $\text{NH}_4^+$ ,  $\text{Pb}^{2+}$ ,  $\text{Cr}^{3+}$ , etc.). Students may be asked to perform the tests on samples of water taken from different areas of a body of water or they may be asked to compare water samples from different bodies of water, or they may be asked to perform all tests on just one water sample. Each time a test is required counts as one test. Students will have 5-7 tests at Regional, 7-10 at State, and 10-13 at Nationals.

c. **Chromatography/Spectroscopy:** Students may be expected to separate components using chromatography and/or analyze mass spectra. Students may be expected to do paper or thin layer chromatography and measure  $R_f$ s (rate of flow). Students will be expected to do chromatograms on 1 type of material at Regional, 1-2 at State, and 2-3 at National.

- d. **Crime Scene Physical Evidence:**
- i. **Fingerprint Analysis:** Students will be expected to know the 8 NCIC classifications (arch, tented arch, radial loop, ulnar loop, plain whorl, central pocket whorl, accidental, and double loop). Students should also be familiar with the common fingerprint development techniques of dusting, iodine fuming, ninhydrin, and cyanoacrylate fuming. Students should understand terminology such as bifurcation, ridges, island, enclosure, loop, whorl, and arch. Students should be able to answer questions about skin layers and how fingerprints are formed. Students may be asked questions on the different methods of detecting fingerprints and the chemistry behind each of these methods.
  - ii. **DNA:** Students may be asked to compare DNA chromatograms/electropherograms from materials found at the scene to those of the suspects. Students will be expected to know how DNA is copied. See [http://nobelprize.org/educational\\_games/chemistry/pcr/index.html](http://nobelprize.org/educational_games/chemistry/pcr/index.html)
  - iii. **Glass analysis.** Students may be asked to use index of refraction to determine the type of a glass found broken at a crime scene. They may be asked to analyze which hole or fractures occurred before others based on a piece of glass available for examination or a picture of a piece of glass.
  - iv. **Entomology.** Students may be asked to identify how long an animal has been dead based on the type of insects found on the body at the scene.
  - v. **Spatters.** Students may be asked to analyze actual spatters or photographs of spatters to determine the angle and velocity with which the liquid approached the solid object bearing the spatter.
  - vi. **Seeds and Pollen.** Students may be asked to compare pictures of seeds or pollen found at the scene with either seeds or pollen found on the suspects or seeds or pollen from different regions of the country.
  - vii. **Tracks and Soil.** Students may be asked to match tire tracks or footprints found at the scene to tires or shoes of the suspects. Students may be given the composition of soil found at the scene or on the suspects and asked to determine if this implicates any of the suspects.
  - viii. **Blood.** Students may be asked to identify the ABO blood type using artificial blood (event supervisor required to provide instructions on how the typing system works) or students may be asked to identify if blood sample, either prepared microscope slide or pictures of microscope slide is human, avian, mammalian, or reptilian/amphibian.
  - ix. **Bullet striations.** Students may be asked to match the striations on bullets or casings found at the crime scene and fired from a given gun.
- e. **Analysis of the Crime:** Students will be asked to write an analysis of the crime scene explaining not only which pieces of evidence implicate which suspect and why the suspect(s) was (were) chosen as the culprit(s), but also why the other suspects were not chosen. They will also answer any other crime scene analysis questions posed by the event supervisor.
4. **SAMPLE QUESTIONS:** The collected evidence and other data given could be used in a mock crime scene analysis to solve a crime problem. A scenario will be developed such as the following: a bank robber enters the bank and hands the teller a note, which says, "Give me all your money." The robber escapes with the money, but a white powder remains. Later, suspects are brought in. Chromatographic analysis of the ink from their pens is performed in order to identify the robber. Each suspect's white powder is then compared with the powder found at the scene of the crime and so on.
5. **SCORING:** Team with the highest score wins. Time will not be used for scoring. The score will be composed of the following elements (percentages given are approximate):
- a. Part 3a 20%, Part 3b 20%, Part 3c 15%, Part 3d 15%, and 3e Analysis of the Crime 30%.
  - b. Tiebreaker: Ties will be broken by the highest score on the analysis of the crime scene, which includes the reasons why certain suspects have been eliminated or others remain in the pool of possible criminals.
  - c. A 10% penalty may be given if the area is not cleaned up as designated by the event supervisor.



1. **DESCRIPTION:** Teams will demonstrate their knowledge of ancient life by completing selected tasks at a series of stations. Emphasis will be on fossil identification and ability to answer questions about classification, habitat, ecologic relationships, behaviors and the use of fossils to date and correlate rock units.

**A TEAM OF UP TO:** 2

**APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:** Each **team** may bring only one magnifying glass; one published field guide that they may tab, write in or attach Post-It or other notes; 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:** Emphasis will be placed upon task-oriented activities. Participants will move from station to station, with the length of time at each station predetermined and announced by the event supervisor. Participants are not permitted to return to stations, but may change or add information to their original responses while at other stations. **Identification will be limited to species on the list, but other species may be used to illustrate key concepts. The questions will be from the following topics:**

- Conditions required for a plant or an animal to become fossilized
- Common modes of preservation: permineralization, petrification/petrification/silicification, mineral replacement, cast/mold, imprint, actual remains
- Uncommon modes of preservation: encased in amber, mummification, freezing, trapped in tar/asphalt
- Relative dating: law of superposition, original horizontality, cross cutting relationships, unconformities (buried erosion surfaces)
- Absolute dating: radiometric dating, half-life, carbon dating, volcanic ash layers
- Geologic Time Scale
- Index Fossils
- Fossil bearing sedimentary rocks: limestone, shale, sandstone, mudstone, coquina, etc.
- Identification of all fossil specimens **restricted to those on the official Fossil List** posted at <http://www.soinc.org>
- Modes of life: filter feeder, predator, scavenger, deposit feeder, benthic, pelagic, etc.
- Environments: marine, terrestrial, fresh water, etc.
- Mineral and organic components of skeletons, shells, etc: calcite, aragonite, silica, chiton
- Taxonomic hierarchy: kingdom, phylum, class, order, family, genus, species
- Adaptations and morphologic features of major fossils groups (i.e., Trilobites—compound eye on Phacops; lack of eyes on Cryptolithus; body parts—cephalon, thorax, pygidium)
- Important paleontological events and discoveries and their significance, Ediacaran fossils, Burgess Shale, Permian extinction, Dinosaurs with feathers from China, Cretaceous extinction, Pleistocene Ice Age



4. **REPRESENTATIVE STATION TASKS:** Possible questions, tasks, stations and/or examples:
- Identify each fossil and record its mode of preservation.
  - Identify each dinosaur (model/image) by name. Record each specimen's order (Saurischia or Ornithischia) and the period in which it thrived (Triassic, Jurassic, or Cretaceous).
  - Identify each index fossil by its informal name and record the geologic period(s) during which it thrived.
  - Order each specimen according to age, oldest to most recent. Geologic Time Chart provided.
  - Based on the fossil and rock associations, determine the environment in which the organism lived.
  - Construct a range chart and determine the age of the fossil assemblage.
5. **SCORING:** Points will be awarded for the quality and accuracy of responses. Ties will be broken by the accuracy and/or quality of responses to several pre-identified questions.

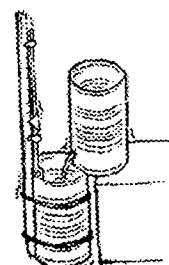
**RECOMMENDED RESOURCES:** **Smithsonian Fossil Handbook** and the **Fossils CD** may be ordered at the Science Olympiad Store: <http://www.soinc.org>

1. **DESCRIPTION:** Students will use a non-electrical device, which they have constructed prior to the tournament, to measure time intervals between 10 and 300 seconds. They will also be asked to answer questions about issues such as the concept of time, timekeeping, astronomy, physics, and mechanics.

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

2. **EVENT PARAMETERS:**

- a. Students may bring for use during both parts of the competition 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) and writing utensils.
- b. Students may bring for use only during Part I of the competition items such as stopwatches, water, sand, tools and supplies needed to set up, calibrate, operate, and clean up their device.
- c. Student 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.**
- d. Students may not bring watches, cell phones, or other time-keeping devices into the competition room (except for those used for the calibration step outlined below). No other resources are allowed.
- e. The event supervisor will provide all formulas, constants, or basic equations needed for Part II, provide scratch paper to the teams and hide from view any clocks present in the competition room.
- f. Eye protection must be worn during Part I, but does NOT need to be impounded.
- g. Devices and all components needed to operate and calibrate the device, including items such as 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.
- h. The impounded device should be clearly marked with the team school name and competition number. Any storage box for tools or individual items must be marked.



3. **CONSTRUCTION:**

- a. Prior to competition students are to build their own device. Some examples of acceptable devices include water or sand glasses, simple or torsional pendulums, or oscillating springs.
- b. Commercial counters, timepieces or parts of either are not allowed. **Commercial balances / scales / test tubes / beakers / graduated cylinders / etc. are not considered counters and are allowed.**
- c. The device may NOT utilize any electrical components or chemical reactions in order to operate **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 80cm cube (except for clean-up supplies, tools, stopwatch, etc.) and be able to be moved by the competing team members without outside assistance. **The device may become larger than an 80cm cube 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 setup, etc.).**

4. **COMPETITION:**

Part I:

- a. The event supervisor will pre-select a different target time (as described under SCORING) for each of 5 Time Trials. The same times will be used for all teams. Teams will not be informed of the selected intervals. **Time Trials will run in the order listed under the SCORING section.**

- b. Teams will be given five minutes to setup and calibrate their device against a stopwatch or other timing device (provided by the students). 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 will give the teams a short verbal notification that the trial is about to start.
- d. To prevent human error, the event supervisor will use a timing device that produces a tone or sound indicating the starting and stopping points. A stopwatch is not acceptable for this task. A computer with a program that can produce a beep at the start and end of a given time, or a prerecorded audio file that contains two beeps with a given time interval and is played to the teams is suggested. **Such audio files are available on the National Science Olympiad website for all possible time intervals.**
- e. Teams will then have at least one minute to **determine / calculate /** record the time from their device (to the nearest 0.1 second) and prepare for the next time trial.
- f. **Teams are allowed to interact with their devices during and between the time trials if so desired**

Part II:

- g. Teams will 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 problem solving calculation type.

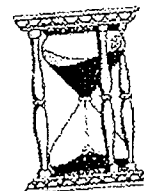
4. SAMPLE QUESTIONS:

- a. If the time in New York City is 9:30 AM EDT on June 21st, 2009 what is the sidereal time?
- b. What is the longitudinal time difference between St. Louis, Mo. (longitude 90° W approx.) and Kansas City, Mo. (longitude 94° W approx.) if 15° longitude = 1 hour. i.) no difference, ii.) 4 minutes, iii.) 16 minutes, iv.) 20 minutes, v.) none of these.
- c. A pendulum has a period of 1.5 seconds. If we take the period of a simple pendulum to be  $2\pi\sqrt{L/g}$  and the gravitational field strength at a given location is  $980 \text{ cm/sec}^2$ , what is the length of the pendulum?

5. SCORING

- a. Teams will start with 10 points per Time Trial (for a total of 50 possible points for Part I).
- b. Penalty points will be deducted from the initial 10 points as described below. The score for a trial can NOT be less than zero. There will be no carry-over of penalty points between trials. The trial interval ranges and penalty points are:

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



- c. The Part II written test will be worth a total of 50 points.
- d. The total of the scores from Part I and Part II, minus any penalties, will determine the winner (which is the highest scoring team).
- e. Event supervisors may disqualify any device that is operated in an unsafe manner or does not comply with the rules, resulting in 0 points for Part I.
- f. If any material or substance splashes, spills or falls on a table or floor the team will be assessed a penalty of up to 10 points. A penalty of 15 points will be deducted from the total score if a team does not completely clean up after their competition period. The event supervisor will make every effort to inform the team of such a situation and give them an opportunity to correct it prior to assessing the penalty.
- g. Ties will be broken first by the highest score from Time Trial 5, with the second tiebreaker on a designated question from the Part II test. The event supervisor will announce further tiebreakers prior to the competition.

