CRIME BUSTERS

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

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

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

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

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

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

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

   c. **Safety Requirements:** Students must wear the following or they will not be allowed to participate: closed-toed shoes, ANSI Z87 indirect vent chemical splash goggles (see http://soinc.org), pants or skirts that cover the legs to the ankles, **and** a **long** sleeved shirt **that reaches the wrists, and** a chemical apron or a lab coat that reaches the knees. **Chemical** gloves are optional. Students who unsafely remove their safety clothing/goggles or are observed handling any of the material or equipment in a hazardous/unsafe manner (e.g., tasting or touching chemicals or flushing solids down a drain and not rinsing them into a designated waste container provided by the supervisor) will be disqualified from the event.

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

Level	*Part a*	*Part a Mixtures*	*Part b*	*Part c*	*Part d*	*Part e*
Regional	6 – 15	Up to 2 of 2 solids with *	5-7	1 type	1-2 topics	Required
State	12 – 18	2-4 of 2-3 solids with *	7-10	1-2 types	2-3 topics	Required
National	14 - 20	2-6 of 2-3 solids with *	10-15	1-3 types	2-4 topics	Required

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

   a. **Qualitative Analysis**: The unknown common materials will be taken from the following lists.
      i. Solids: Anhydrous sodium acetate, *sand (white), *calcium carbonate (powdered limestone), vitamin C (Ascorbic Acid)**,** *table salt (NaCl), *sugar (crystal), *flour, *calcium sulfate $2H_2O$ (gypsum), *cornstarch, *baking soda, *powdered gelatin, *powdered Alka-Seltzer®, yeast.
      ii. Non-Powdered Metals: aluminum, iron, zinc, magnesium, copper, and tin.

iii. Liquids: lemon juice, rubbing alcohol (isopropyl), household ammonia (3%), water, vinegar, hydrogen peroxide (3%). Every team gets the same set of unknowns (evidence). The unknowns will be identifiable by performing tests such as solubility, acidity, magnetic property, color, density, and odor. The scenario will identify which containers may hold the mixtures.

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

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

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

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

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

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

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