



SCIENCE CRIME BUSTERS



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

1. **DESCRIPTION:** Given a scenario and some possible suspects, students will perform a series of tests, which 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:**

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

- i. **Team Should Provide:** small containers or reaction plates for mixing; something for scooping; pH paper; a magnet; a hand lens; microscope slides and cover slips; forceps or tweezers; writing instruments; a pencil (for chromatograms); and paper towels. No other items are allowed. There is no penalty for not bringing any of these items, but the team may be at a disadvantage. The event leaders 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. No calculators are allowed.
- ii. **Each team member** may bring one 8.5x11 sheet of paper with hand written notes (no photocopies), on either or both sides. The note sheet may be laminated or otherwise protected in a clear covering.

b. **Supervisor** will provide: Iodine reagent (Iodine dissolved in KI solution), 1M HCl, a method that may be used for differential density on plastics tests, a waste container, chromatography materials, and a wash bottle with distilled water (no more than 250 mL). The supervisor will provide a candle and matches for burn tests on the fiber samples. Flame tests may not be done on the polymers. The supervisor may provide other equipment (such as a microscope, calculators or probes) or reagents to perform additional tests. Supervisor will provide appropriate unknowns from lists below for event.

c. **Safety Requirements:** Students must wear pants or skirts that cover the legs to the ankles. In addition, students must bring and wear a lab coat or apron that reaches below the knees. Students must wear closed toed shoes and OSHA-approved non-vented or indirect vented chemical splash goggles. Students who fail to meet any of the above safety requirements will not be allowed to participate. Tasting or touching the chemicals will result in disqualification. Gloves are optional. Students who unsafely remove their safety clothing/glasses will be disqualified from the event. Anyone observed handling any of the material or equipment in a hazardous manner will be disqualified.

3. **THE COMPETITION:** There will be 4 parts and then the Analysis of the Crime. The event will consist of evidence from Parts 3a, 3b, and 3c at all competitions and up to 2 parts from the Crime Scene Physical Evidence (part 3d) at Regional, and up to 3 parts from (part 3d) at State and 4 parts from part 3d at Nationals. All competitions will require the Analysis (part 3e). **Questions can only be asked on the evidence areas found at the Crime Scene, so for instance if DNA was not one of the pieces of evidence found at the crime scene, no questions about DNA can be asked.**

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, *gypsum (calcium sulfate 2H₂O), *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%).

At regional competitions, teams will have 12-15 unknowns with one to two mixtures containing two of the solids with *asterisks. At the state level, teams will have 15-18 unknowns and will have at least two mixtures containing 2-3 of the solids with *asterisks. At the national level, teams will have 18-20 unknowns with at least two mixtures containing 2-3 of the solids with *asterisks. The unknowns will be identified by performing tests such as solubility, acidity, magnetic property, color, density (by hefting the sample in its container), and odor. Every team gets the same set of unknowns and the scenario will identify which containers hold the mixtures.

b. **Polymer Testing/Natural and Man-made Substances:** Students will also demonstrate their skill in identifying and collecting evidence from a variety of sources such as hair (differentiating between human, dog, cat), fibers (general differentiation between animal, vegetable, synthetic), 6 recyclable





SCIENCE CRIME BUSTERS (CONT.)

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plastics (PETE, HDPE, non-expanded PS, LDPE, PP, PVC). Students will have 5-8 samples at Regional, 7-10 at State, and 10-13 at Nationals.

- c. **Paper Chromatography:** Students will also demonstrate their skill in collecting evidence from paper chromatography (ink pens, juices, Kool-Aid®, etc.). Regionals will require paper chromatograms of one type of material, States will require paper chromatograms of 1 or 2 types of materials, and Nationals will require 2 or 3 types of paper chromatogram. The paper chromatogram will be attached to the score sheet. No calculations are required.
 - 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.** Students are expected to be able to compare prints and make conclusions such as whether the suspect was walking or running. No calculations are required.
 - iv. **Tire treads.** Students are expected to be able to compare prints and make conclusions such as direction of travel. No calculations are required.
 - v. **Spatters.** No calculations are required.
 - 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. Questions may include but are not limited to who is/are the prime suspect(s), who is/are not suspects, and sequencing of events. It is expected that conclusions made will be supported by reference to specific evidence and/or testing.
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:**
- a. 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. Ties will be broken by the crime scene analysis score (3.e.).
 - 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: SCIENCE CRIME BUSTERS MANUAL -see www.soinc.org store
NATIONAL SCIENCE EDUCATION STANDARDS:

- Students observe and measure characteristic properties, such as boiling point, melting point, solubility, and simple chemical changes of pure substances and use these properties to distinguish one substance from another.
- A substance has characteristic properties such as density, boiling point, and solubility all of which are independent of the amount of the sample. A mixture of substances often can be separated into the original substances using one or more of the characteristic properties.
- Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties. Substances are often placed in categories or groups if they react in similar ways; metal is an example of such a group.

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