

MY SO STEM SHOWDOWN

CONTENT, RECOMMENDED MATERIALS & SCORING

STEM SHOWDOWN CONTENT

The STEM Showdown will consist of a series of online multiple-choice questions. Participants at both levels will be expected to demonstrate their understanding of analytic chemistry, physical evidence, and forensic analysis. In particular, Showdown participants will need to demonstrate an understanding of some standard analysis procedures used in chemistry as well as the analysis and meaning behind different types of physical evidence that may be found at a typical crime scene. A Showdown participant will have 55-minutes to login and answer as many questions as possible.

The Forensics content and skills covered by the Showdown this month are as follows:

1. Chemical Analysis:

- a. Understand how to conduct and analyze the results of the following tests:
 - i. Solubility
 - ii. Magnetic Properties
 - iii. Appearance (e.g., color, odor, opacity)
 - iv. Shape
 - v. Density
 - vi. Flame Test
 - vii. Reaction to Hydrochloric Acid (HCl)
 - viii. pH Value
- b. Recognize and understand the different properties of the following basic substances in different states of matter
 - i. Sodium Acetate
 - ii. Vitamin C (Ascorbic Acid)
 - iii. Yeast
 - iv. Table Salt (Sodium Chloride)
 - v. Sugar (Sucrose)
 - vi. Flour
 - vii. Gypsum (Calcium Sulfate Dihydrate)
 - viii. Cornstarch
 - ix. Baking Soda
 - x. Powdered Gelatin
 - xi. Powder Alka-Seltzer®
 - xii. Sand
- c. Understand and apply common tests and different properties of the following metals:
 - i. Aluminum
 - ii. Iron
 - iii. Zinc
 - iv. Magnesium
 - v. Copper
 - vi. Tin

- d. Understand and apply common tests and different properties of the following liquids:
- i. Lemon Juice
 - ii. Rubbing Alcohol (Isopropyl)
 - iii. Household Ammonia (3%)
 - iv. Water
 - v. Vinegar
 - vi. Hydrogen Peroxide (3%)
 - vii. Bleach
- e. Understand and apply the above tests and different properties of the listed substances to identify the individual components in mixtures containing no more than 3 different substances

2. Polymer Analysis:

- a. Understand the properties, structures, and uses of chemical polymers
- b. Apply knowledge about the properties, structures, and uses of chemical polymers to aid in the identification of unknown polymers
- c. Recognize and understand the different properties of the following types of plastics:
 - i. PETE
 - ii. HDPE
 - iii. Non-expanded PS
 - iv. LDPE
 - v. PP
 - vi. PVC
 - vii. PMMA
- d. Understand how to conduct and analyze the results of the following tests:
 - i. Reaction to Acetone
 - ii. Reaction to Heat
 - iii. Density
 - iv. Appearance (e.g., color, odor, opacity)
 - v. Shape
- e. Recognize and understand the different properties of the animal, plant, and synthetic fibers
- f. Recognize and understand the different properties and structures of human, dog and cat hair

3. Chromatography:

- a. Understand and be able to analyze data provided by Paper Chromatography

4. Physical Evidence:

- a. Fingerprint Analysis: Participants will be expected to know:
 - i. eight specific fingerprint patterns (plain arch, tented arch, radial loop, ulnar loop, plain whorl, central pocket whorl, accidental whorl, and double loop whorl)
- b. DNA: Participants may be asked to:
 - i. compare DNA chromatograms/electropherograms from materials found at the scene to those of the suspects
 - ii. know how DNA is copied
- c. Spatters: Participants 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 & the spatter origin direction
- d. Tracks and Soil: Participants may be asked to:
 - i. match tire tracks or footprints found at the scene to tires or shoes of the suspects
 - ii. determine if soil found at the scene or on the suspects implicates any of the suspects based on its composition

Unique High School (Division C) Content:

5. Chemical Analysis:

- a. Understand how to conduct and analyze the results of the following tests:
 - i. Reaction to Hydrochloric Acid (HCl)
 - ii. pH Value
- b. Recognize and understand the different properties of the following basic substances in different states of matter:
 - i. Sodium Hydrogen Carbonate
 - ii. Lithium Chloride
 - iii. Potassium Chloride
 - iv. Calcium Nitrate
 - v. Calcium Sulfate
 - vi. Glucose
 - vii. Magnesium Sulfate
 - viii. Boric Acid
 - ix. Ammonium Chloride
- c. Understand and apply common tests and different properties of the following metals:
 - i. Copper Alloys
- d. Understand and apply common tests and different properties of the following liquids:
 - i. Bleach
- e. Understand the purpose and development of a dichotomous key
- f. Use a dichotomous key to identify a variety of different chemicals

6. Polymer Analysis:

- a. Recognize and understand the different properties of the following common types of fibers:
 - i. Cotton
 - ii. Wool
 - iii. Silk
 - iv. Linen
 - v. Nylon
 - vi. Spandex
 - vii. Polyester
- b. Recognize and understand the different properties and structures (e.g., medulla, cortex, cuticle, and root) of the following common types of hairs:
 - i. Bat
 - ii. Cow
 - iii. Squirrel
 - iv. Horse

7. Chromatography:

- a. Understand and be able to analyze data provided chromatography and spectroscopy; particularly:
 - i. Thin Layer Chromatography (TLC)
 - ii. Mass Spectra
- b. Analyze and interpret provided R_fs

8. Physical Evidence:

- a. Fingerprint Analysis: Participants will be expected to know:
 - i. common fingerprint development techniques of dusting, iodine fuming, ninhydrin, and cyanoacrylate fuming
 - ii. terminology such as bifurcation, ridges, island, enclosure, loop, whorl, and arch.
 - iii. skin layers and how fingerprints are formed
 - iv. different methods of detecting fingerprints and the chemistry behind each of these methods.

- b. Glass analysis: Participants may be asked to:
 - i. use index of refraction to determine the type of a glass found broken at a crime scene
 - ii. 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
- c. Entomology: Participants 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
- d. Seeds and Pollen: Participants may be asked to compare pictures of seeds/pollen found at the scene with either seeds/pollen found on the suspects or seeds/pollen from different country regions.
- e. Blood: Participants may be asked to:
 - i. identify the ABO blood type
 - ii. identify if a blood sample is human, avian, mammalian, or reptilian/amphibian
- f. Bullet striations: Participants may be asked to match the striations on bullets or casings found at the crime scene and fired from a given gun.

Recommended Materials

- Each Showdown participant will need a computer with internet access, scratch paper, something to write with, and a stand-alone calculator
- Showdown participants may use resources available to help them answer the questions asked during the Showdown. These resources could be a collection of notes on the topics listed below, copies of magazine or journal articles, a textbook, or any combination of these items.

Scoring

- High score wins.
- Ties will be broken using:
 - a. The time it takes to complete the test; and
 - b. The number of test questions attempted.

Additional Resources

- The Science Olympiad Store (store.soinc.org) carries the Chemistry & Physics CD as well as other resources
- Additional resources can be found on the Crimebusters, Middle School, and Forensics, High School, Event Pages at <http://soinc.org/>
- Additional resources about DNA and DNA analysis can be found at http://nobelprize.org/educational_games/chemistry/pcr/index.html