

SCIENCE OLYMPIAD
MESA-WILSON INVITATIONAL
MESA ROBLES SCHOOL
JAN 28, 2017



CRIME BUSTERS - KEY

Do Not Open this Packet Until Directed to Do So

Return this entire packet to the Event Supervisor once completed

School Name: _____

Student Names: _____ and _____

Team Name/Number: _____

CRIME

On the morning of Jan 16th, police were called to Viking Middle School. It appears there had been a break-in and the principal was shocked to see the school's trophy case has been damaged. When the police got there, they found that someone had shot the lock off the trophy case and stolen just the Science Olympiad trophy (which the school won couple of days back). Everything else (such as other trophies from sports, Spelling Bee, music/dance, etc.) was not touched. The police gathered some powder, liquid and metal samples from the crime scene as well as fingerprints on the trophy case door knobs. The police also found an impression (footprint) in the ground and some liquid where the suspect appeared to have dropped their drink while running away. They extracted the liquid and developed a chromatography. When removing the trophy from the case, the suspect appears to have torn their clothes. The trophy was eventually found near a dumpster and police recovered a fingerprint on the trophy.

Officer Stephens, the school's resource officer, was able to narrow down the suspects to 4 people, and the police have now passed the case to the forensic scientists, otherwise known as you. On the next page, there is a suspect sheet, and on your station, there are samples of evidence found from the crime scene. Everything you need to figure out the crime should be at your station. If there are any questions, raise your hand, and the instructor will be right over to help you.

Remember to wear your goggles and lab-coat at all times and to clean up when you are done.

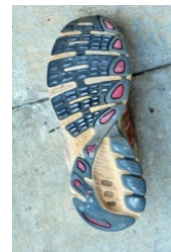
Good Luck!

SUSPECTS

Coach Strange, Science Olympiad Team Coach. Motive: He wanted to take the trophy home to use as an awesome drinking glass. Says he has been busy all day helping his son with fireworks and also drawing on the driveway with chalk (he is a real artist). He also said that he cut his finger while helping his son and used isopropanol to clean it. He is bald, has a dog as a pet and always wears blue denim cotton jeans. He and the top student, Aarti, helped put the trophy in the case.

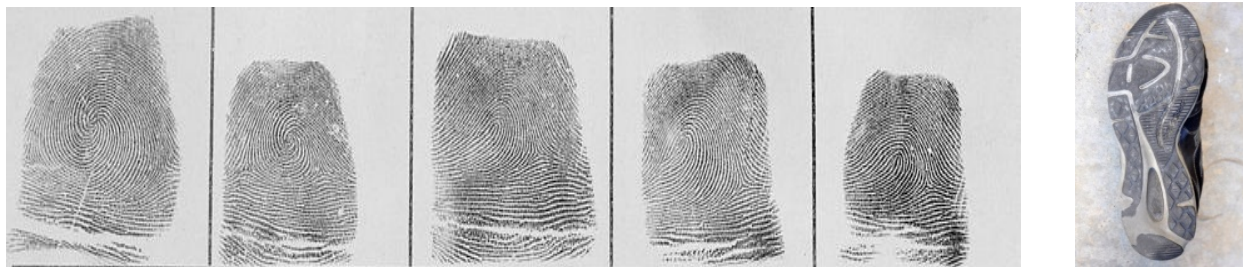


Director Upton, Athletic Director. Motive – jealous that science Olympiad had more trophies than the soccer team. She is the only one among the suspects that has blonde hair and bleaches it quite often. Claims she was working on the soccer field all day mending the synthetic nets, aluminum fencing and lining the field with chalk. She likes salty chips with vinegar flavor and wears starchy clothes. She also said, she is been suffering from allergies and likes Kool-Aid.



SUSPECTS (CONT.)

Aarti, captain of the Viking School Science Olympiad team, the ultimate competitor. Aarti would stop at nothing, including staging a robbery. She feels that she should keep the trophy because she is the only one placed in 4 events. However, she did not participate in the Crime Busters event. Says she had spent the entire day baking and making a doll with Plaster of Paris and decorating with copper ornaments. She is of Asian origin has a cat as a pet and always wears a wool scarf. She also helped the head coach Strange to put the trophy in the case.



Fred, an African American, a janitor at the school. Says he has to clean-up after everyday practice sessions and wanted to teach a lesson. He also cleans and polishes the trophy case every day because the principal prides on those prizes. Spent the day-before hunting with his dad wearing cotton clothes. On their way back they were drenched in rain. They followed deer tracks through the sand and chewed on un-salted sunflower seeds.



ANSWER SHEET

A. Qualitative Analysis (50 pts)

In the brown evidence bag given to you, there are samples of powders, liquids and metals. Identify each sample and write your answers below.

| Sample # | What is it? (2 pts each) | Whom does it implicate? (1 pt each) |
|----------|----------------------------------------------------|-------------------------------------|
| 1* | Salt + cornstarch | Upton + Aarti (1/2 pt each) |
| 2* | Alka-seltzer + Calcium carbonate (limestone) | Upton + Strange (1/2 pt each) |
| 3 | Sugar | Aarti |
| 4 | Vitamin C | Upton |
| 5 | Gypsum (calcium sulfate) | Aarti |
| 6 | Baking soda (sodium bicarbonate) | Aarti |
| 7 | Flour | Aarti |
| 8 | Sodium acetate | Upton |
| 9 | Sand | Upton + Alec (1/2 pt each) |
| 10 | Calcium carbonate (limestone) | Upton + Strange (1/2 pt each) |
| 11 | Rubbing alcohol (isopropanol or isopropyl alcohol) | Strange |
| 12 | Hydrogen peroxide | Upton |
| 13 | Aluminum (Al) | Upton |
| 14 | Magnesium (Mg) | Strange |

*mixture of 2 powders (4 pts total)

Theory Questions, not related to the crime scene (1 pt each).

| | |
|---------------------------------------------------------------------|-------------------------------|
| a. Which of the “allowed powders” is the primary component of Tums? | Calcium carbonate (limestone) |
| b. Which metal is used to inhibit rusting? | Zinc (Zn) |
| c. What is the chemical formula of salt? | NaCl |
| d. Which liquid has pH similar to water? | Hydrogen peroxide |

Part A: _____ / 50

ANSWER SHEET

B. Paper Chromatography (5 pts., 4 pts. for the chromatogram; 1 pt. for the question)

The finished chromatogram of an ink extracted from the liquid found at the crime scene is shown below:



Inks taken from each of the suspects (A – Aarti, B – Fred, C – Coach Strange, D – Director Upton) are provided in your brown bag and the chromatography supplies are at your station. Run a chromatogram of ink samples from each of the suspect’s inks. Attach finished chromatograms here.

| | |
|--|-------------|
| | B - Fred |
| | C - Strange |
| | D - Upton |
| | A - Aarti |


Which suspect’s pen matches to the chromatogram from the crime scene sample?

Upton

Part B: _____ / 5

ANSWER SHEET

C. Polymer Testing/Natural and Man-made Substances (10 pts)

| Question | Answer |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <p>A hair sample was found near the crime scene and the microscopic picture is shown below:</p>  <p>1. What kind of hair is this? (human, cat or dog) (2 pts)</p> | Human |
| 2. Whom does the hair sample implicates? (1 pt) | Upton |
| 3. What kind of fiber is Sample A? (animal/vegetable/synthetic) (2 pts) | Synthetic |
| 4. Whom does the fiber sample implicates? (1 pt) | Upton |

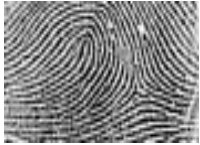


Theory Questions, not related to the crime scene (1 pt each)

| | |
|------------------------------------------------------|---------------------|
| 5. What is the formula for density? | Mass/volume or g/mL |
| 6. Which part of the hair contains DNA? | root |
| 7. What type of polymerization is used to make PETE? | Condensation |
| 8. Which fiber has irregular burn rate? | vegetable |

Part C: _____ / 10

ANSWER SHEET

D. Crime Scene Physical Evidence (10 pts, 2 pts each unless otherwise noted)

| | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| <p>Partial <i>fingerprint 1</i> at right was found on the trophy</p> <p>1. To whom does it belong? ___ Aarti _____</p> <p>2. What is the type of <i>fingerprint 1</i>? ___ Loop _____</p> | <p><i>fingerprint 1</i></p>  |
| <p>Partial <i>fingerprint 2</i> at right was found on the case knob</p> <p>3. To whom does it belong? _____ Upton _____</p> <p>4. What is the type of <i>fingerprint 2</i>? ___ Arch _____</p> | <p><i>fingerprint 2</i></p>  |
| <p>Footprint shown to right was found at the crime scene.</p> <p>5. To whom does it belong? _____ Upton _____</p> |  |

Part D: _____ / 10

E. Analysis (25 pts)

Which suspect(s) committed the crime? _____ **Upton** _____

Explain why it was this suspect, and why every other suspect didn't. Write a complete analysis. Start writing in the space below and continue on the next page if you need more space. After completing the analysis, clean your station and alert the supervisor you have completed. Return this entire packet to the supervisor.

Upton is the culprit (10 pt)

Listing of all 13 Supporting Evidence (0.5 pt for each, total: 6.5 pts)

- Salt + cornstarch (0.5 pt)**
- Alka-selzter + CaCO₃ (0.5 pt)**
- Vit. C (0.5 pt)**
- Sod acetate (0.5 pt)**
- Hydrogen peroxide (0.5 pt)**
- Sand (0.5 pt)**
- CaCO₃ (0.5 pt)**
- Al (0.5 pt)**
- Fingerprint 2 (0.5 pt)**
- Footprint (0.5 pt)**
- Fiber (0.5 pt)**

Hair (0.5 pt)

Ink (0.5 pt)

Half-point each for the following or related sentences (2 pts)

- All of this evidence supports that Upton is the culprit because none of this evidence should exist at the crime scene unless Upton was present (0.5 pt)
- Her fingerprint shouldn't be on the trophy (0.5 pt)
- Also, the fiber and hair sample shouldn't be there (0.5 pt)
- Ink matches to the culprit and shouldn't be there (0.5 pt)

Why the other suspects did not do it:

Aarti (3 pts)

Listing of all 5 supporting Evidence (2.5 pts):

Sugar (0.5 pt)

Gypsum (0.5 pt)

Baking Soda (0.5 pt)

Flour (0.5 pt)

Fingerprint 1 (0.5 pt)

- Fingerprint 1 matches to Aarti because she helped put the trophy (0.5 pt)

Coach Strange (2 pts)

His Evidence:

CaCO₃ (0.5 pt)

Mg (0.5 pt)

- Since he helped put the trophy, there is a reason these to present at the crime scene (1 pt)

Fred (0.5 pt)

His Evidence:

Sand (0.5 pt)

- There is not much evidence against other suspects (1 pt)

Neatness and makes a table with evidence (1 pt)