CRIME BUSTERS / FORENSICS 2019

Coach Institute, October 2018

What's the event about this year?

- Qualitative Analysis / Solids

(B Division may include liquids and metals)

- Hair and Fiber Analysis
- DNA and blood splatter
- C Division may also include blood typing, blood analysis, paper chromatography, and mass spec.
- Questions may be included related to chemistry of unknowns, lab safety, and technique.

Not included this year are PLASTICS!

We reserve the right to include other topics at State Level!

What does the coach / team need to do to prepare?

What does the coach / team provide?

It varies from B to C, but here are some basics

Test tubes, reaction plates, or other devices teams can use for testing.

Cheap helpful hint: Bathroom cups, plastic condiment / restaurant cups.

C Division – Include 1-2 Pyrex type test tubes for Benedict's test in hot water!

What does the coach / team provide?

Something for scooping and stirring.

We will generally provide popsicle / craft sticks at tournaments.

Cheap helpful hints: Plastic spoons, gourmet coffee stirrers, small ice-cream spoons, popsicle / craft sticks can be effective substitutes.
Toothpick also work well!

Lab technique on safe and effective transfer

What does the coach / team provide?

pH paper Droppers Hand Lens

One 8.5 inch by 11 inch page of notes, front and back.

B division may not use calculators, C division may use **non-graphing** calculators.

Conductivity Tester for C Division

WHAT WILL THE EVENT SUPERVISOR PROVIDE?

Here are the basics:

Both Divisions

I_2 / KI Solution

1M or 2M HCl

DISTILLED WATER

C Division Only

1M NaOH

Benedicts Reagent

Hint: Be sure your teams practice with GOOD distilled water. Keep it capped to prevent CO_2 from dissolving!

SAFETY EQUIPMENT

Goggles (indirect vent)
Lab coat or apron, covered to wrist

Covered down to the toes

Long pants or skirt

Shoes that cover the entire foot

Shoulder length (or longer) hair restrained

Gloves are optional

http://www.sciencenc.com/event-help/Eye-Protection/eyeprotection.php

How does a team practice for this event?

Time Management

You may want to consider the “divide and conquer” approach:

One team member specializes in the qualitative analysis and works on that during the tournament….

One team member specializes in everything else and works on that during the tournament.

Cross – train just in case someone is OUT the day of the tournament or one team member is overwhelmed.

Tips and Tricks for Qualitative Analysis

- Have your students pre-read and research ahead of time properties of the potential unknowns before they start lab practice
- Good quality and clean practice materials, well plates, and DI water. CHECK pH of WATER before you test any chemicals!

HINT: Solids from different sources may look different, so have a back-up test! Especially be aware of hydrated versus anhydrous salts!

I encourage a master grid be filled out for each unknown. Fill out before practicing with predictions and during practicing with observations!

Tips and Tricks for Qualitative Analysis

- Start with physical observations, texture, color, etcetera. Odor, waft and record what first comes to mind.
- Water solubility:
  - If solid comes in large particles, crush with craft stick to check solubility!
  - Is it soluble or insoluble?
  - Note what happens while solid dissolves
  - Note behavior if solid is insoluble.

HINT: In LARGE amounts, a lot of solids are insoluble, so go small and go repeatable!

Tips and Tricks for Qualitative Analysis

- Even if solid seems water insoluble, check for pH and relative conductivity.
- If you suspect a carbonate or bicarbonate, you may want to treat BOTH solution and extra solid with HCl. With small amounts of solutions or dilute solutions, it may be hard to see bubbling.
- If time crunch exists, if an unknown has been correctly identified, DO NOT test it anymore! The fewer tests you can do to correctly identify an unknown, the better.

Tips and Tricks for Qualitative Analysis

You may want to have your team try other (safe) creative tests not mentioned here.

I suggest developing a flow-chart for quick identification.

For B Division, start with general appearance.

For C Division….

For the C Division Coaches

- Flame tests are GREAT at identifying certain cations! I suggest starting your flowchart or ID list with flame test results!
- You can expect written descriptions or pictures of flame tests at most regionals.
- Several factors (purity of chemicals, purity of water) can affect color and intensity.
- Include "perfect world" descriptions and/or pictures on your cheat sheets!
- Commonly Confused Solids:

Sodium Carbonate vs. Sodium Bicarbonate
Sucrose vs. Glucose

Magnesium Sulfate vs. Ammonium Chloride

For the B Division Coaches

You will also be identifying liquids and metals

- Examine color, odor, and pH of different liquids
- HINTS: Waft odors, do NOT directly inhale!
- One at a time – one odor may mask other odors.
- Commonly confused:
- Starch vs. Flour
- Water vs. hydrogen peroxide
- For metals, note relative density, magnetism, color, and reaction (and products!) with HCl.

How do you use cheat sheets?

Include the correct name (as listed in the rules!) of the possible unknowns!

Include common uses for the unknowns and any important chemical reactions. We may ask questions about lab technique.

Make sure your team knows HOW to use the flowchart, written description, or data tables.

If you have the option, take pictures BEFOREHAND of knows, pictures on paper for quick comparison

Once your team is confident with knowns, give them UNKNOWNS to identify

Hair and Fiber ID

Pay attention to lists given in rules!

You may want to include on your cheat sheet:

- Burn test results
- Sample microscope pictures

Scioly.org wiki is a great starting point for burn test results, microscopic images, and common uses of fibers.

C Division - Chromatography

Your team will perform paper chromatography with water (and possibly alcohol) on several pens.

Do's and don's of chromatography.

Practice with technique.

It's not chromatography, identification of unknown using provided mass spec results. Make sure your team can do appropriate calculations and interpret peaks in mass spec!

Physical Evidence: DNA

- Understand how to read and interpret Gel Electrophoresis results.
- C Division should also be aware of:
  - Structure of DNA
  - How DNA is copied in a cell
  - How Gel Electrophoresis works
  - Polymerase Chain Reaction (PCR) and other related biotechnology

Physical Evidence: Splatters

Be aware of general, qualitative relationships between:

- Shape of blood splatter and direction of travel.
- Shape of blood splatter and speed of travel.
- Shape of blood splatter and height.
- Voids produced in blood splatter.
- Folding patterns in blood splatter.

Physical Evidence – Blood Analysis (C Only)

Your teams may be expected to match types / species of blood and understanding key features that distinguish types /species of blood.

Your team may be giving a simulated blood typing kit and be asked to type a simulated sample. Your team may be asked to understand the physiology / biochemistry behind blood typing.

Underlying Frameworks of Event at Competition

A little suspension of disbelief for any story, regardless if mystery or not…

During the crime, the suspect will transfer evidence from herself or himself to the scene.

During the crime, some evidence will be transferred from the crime scene to the suspect.

Amounts of materials might be exaggerated.

Use of biotechnology might be exaggerated.

What’s competition like?

Your teams are given a test packet containing a crime story, “knowns” that are associated with the crime scene, “knowns” that are associated with the suspects, and “unknowns” found at scene and on each suspect.

What's competition like?

Your teams are given a packet containing:

- Unknown Solids (Liquids & metals for B Division)
- Unknown Hairs & Fibers. **Be prepared for real samples and microscope use!**
- Pictures for DNA chromatography, pictures of blood splatter,
- C Division: Pens and Chromatography supplies. Simple blood typing supplies. Pictures of different types of blood.

- We will NOT be providing labeled "knowns" for your students to compare the unknowns to!

What's competition like?

Your team will have up to 50 minutes!

Suggestions:

- Read crime story carefully to match unknowns to suspects.
- Tear apart crime scene story and answer key to make dividing the event easier.
- Divide and conquer approach.

Preparing for the analysis section

Make sure your team READS the questions several times and addresses everything!

The backstory of the crime is important!

- There may be evidence that SHOULD be at a crime scene that doesn't indicate any suspect.

Example: The crime features a broken aquarium. We might expect to find SAND at the crime scene. Don't make up a reason for a suspect have left sand at the crime scene!

Preparing for the analysis section

Likewise, a suspect may have evidence on him/her with a reasonable explanation.

- Don’t try to force evidence or make up evidence not listed in the story!

- Example: In the broken aquarium example, as knowns, sodium bicarbonate was also spilled at crime scene. Suspect C takes antacids containing calcium carbonate and sodium bicarbonate.
- Finding sodium bicarbonate at scene or on suspect as an unknown would not necessarily indicate the suspect!

Preparing for analysis section

- There will be at least one piece of contradictory evidence included. Be aware and be able to explain why it wasn't use to indicate a suspect.
- Example from last year's state test:

Suspect A was indicated by tire treads at crime scene. Suspect B was indicated by fingerprint on a wrench at crime scene.

A had visited B in her workshop before the crime took place.

How would you explain the contradictory evidence?

Preparing for Analysis Evidence

- If questions ask for "additional evidence," be sure to include reasonable examples based on the story. Example: Details of hair and fiber composition is good this year. Matching fingerprints is NOT good this year.

HINT: Some evidence is more conclusive and incriminating than others!

Other Suggestions for Hands On Activities

Test the potential unknowns ahead of time and determine key identification characteristics.

What are some problematic unknowns to identify or distinguish between?

What are some quick techniques to identifying those unknowns?

Encourage your team, with safety in mind, to develop their OWN quick techniques!

Practice Crime Scenes

There are several good (and several bad) sources of prior tests from different regionals and states from B/C Divisions.

(www.scioly.org)

If you can, it would be good to set up some of these practice tests for your team.

Keep in mind: Types of unknowns can vary, some questions on other tests are NOT fair game.

National Event Supervisor's Page:

http://mypage.iu.edu/~lwoz/socrime/index.htm

THANK YOU!

Your feedback is important to me! Before you leave, please answer the following:

1. If you've done Olympiad before, what is one thing that worked well with this event before?

2. If you've done Olympiad before, what is one suggestion for improvement for this event?

3. If you're new to Science Olympiad, what else could we provide to help you with this event?