

FINAL SCORE: _____

ANSWER
KEY

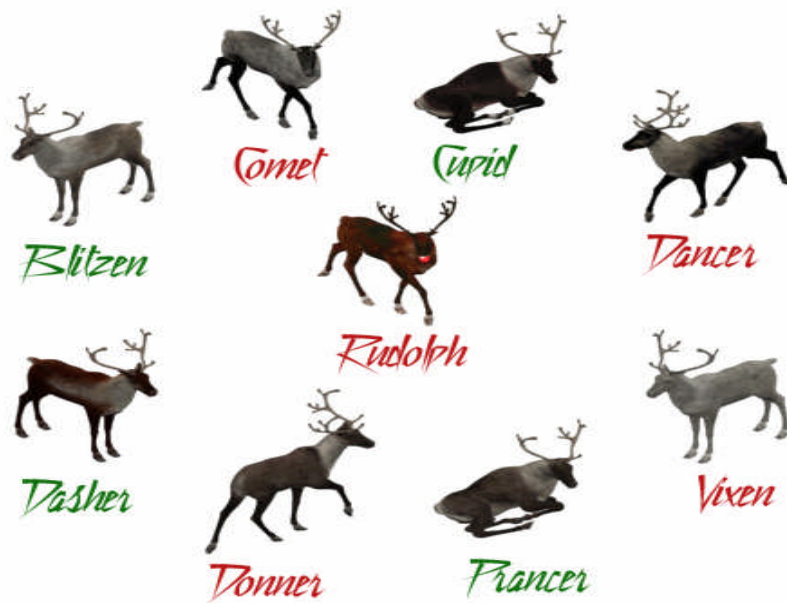


“Trouble at Santa’s Stalls”
A Forensic Experience
You Shall Not Soon Forget!

Team: _____

Number: _____

Members: _____



Since this is the first competition of the year and many of you have not competed in the event in the past, the page is for you...

Possible Polymers:

Abbreviation:

Common Uses:

Polyethylene Terephthalate	PETE	bottles, peanut butter jars, salad dressing bottles, non-breakable bottles
High Density Polyethelene	HDPE	car parts, toys, fibers like textiles and carpet, wire, rope, strapping
Polystyrene	PS	Styrofoam cups, grocery store meat trays, cafeteria trays, refrigerator insulation, protective packing and many more
Low Density Polyethelene	LDPE	bread bags, frozen food bags, grocery bags
Polypropylene	PP	dishwasher safe containers, yogurt containers, margarine tubs, medicine bottles. Most bottle tops
Poly Vinyl Chloride	PVC	unplasticized form: water pipe, plumbing fittings, phonograph records, synthetic floor tiles, credit cards. Plasticized form: raincoats, shower curtains, and packaging film
Polymethylmethacrylate	PMMA	plexiglass, barrier at ice rinks, basketball backboards

Possible Chemicals:

Sodium Acetate	CH ₃ COON	Used in tanning, soap making, a buffering agent, photography, diuretic expectorants, systemic alkalizers and heat packing industries
Sodium Chloride	NaCl	Predominantly used as a seasoning for foods, believed to cause high blood pressure
Sodium Hydrogen Carbonate	NaHCO ₃	Used as an antacid, to absorb moisture and odors, a cleaning agent, and toothpaste
Sodium Carbonate	Na ₂ CO ₃	Used in the manufacture of glass, chemicals such as sodium silicates and sodium phosphates, pulp and paper, detergents and for water treatment.
Lithium Chloride	LiCl	Used for the production of lithium metal via electrolysis. Also used as a brazing flux for aluminum in automobile parts.
Potassium Chloride	KCl	Used in making fertilizer and to manufacture potassium hydroxide and potassium metal. It is also used in medicine, scientific applications, food processing and in judicial execution through lethal injection
Calcium Nitrate	Ca(NO ₃) ₂	It is used as a reagent, a catalyst in rubber production, a pyrotechnic and a fertilizer
Calcium Sulfate	CaSO ₄	AKA Plaster of Paris. Used for several crafts such as casting statuary. Used in forensics for casting tire tracks and footprints
Calcium Carbonate	CaCO ₃	Used as an ingredient of cement. Also used as an antacid, as whitening in ceramics/glazing, as chalk, used in the production of glossy paper
Cornstarch		Primary use is in cooking: anti-caking agent, a binder in puddings, and a thickener. Can also be used to make Oobleck, a non-Newtonian dilatant fluid used in various physics demonstrations
Glucose	C ₆ H ₁₂ O ₆	a simple monosaccharide sugar
Sucrose	C ₁₂ H ₂₂ O ₁₁	a disaccharide sugar commonly known as table sugar
Magnesium Sulfate	MgSO ₄	AKA Epsom Salts: Used in gardening. Also used to control seizures, asthma, and atrial fibrillation. Also used in foot baths
Boric Acid	H ₃ BO ₃	antiseptic for burns and cuts, treatment for yeast infections and athletes foot. Also used as a pesticide and a jewelry cleaner
Ammonium Chloride	NH ₄ Cl	Used in soldering, a feed supplement for cattle, in hair shampoo, in textile printing, in plywood glue, in cleaning products, as cough medicine, and a pH regulator for alkaline bodies.

Possible Fibers: Cotton, Wool, Silk, Nylon, Spandex and Polyester

“The Caper”

Santa has been under extreme stress this year, nearly giving himself an ulcer. In past years, January has typically been the month that Santa’s Reindeer have negotiated new yearly labor contracts. However, this year has proven to be more challenging than most. The reindeer, feeling they needed more leverage, have joined the Professional Elf Tactical Environment (PETE), which is a splinter group from HDPE, (Height Deprived Professional Elves), which is affiliated with the Professional Miniature Men’s Association (PMMA). This group’s mode of operation is to sabotage and maliciously destroy various targets, hoping to bring pressure to the other side of the negotiating table.

The workshop is cleaned every night from top to bottom, but last night Santa was still busy at his workbench when the cleaning crew left. Sometime during the night, the workshop was vandalized by a not so professional group, as there was multiple pieces of evidence left at the scene:

When Mrs. Claus arrived at the workshop to bring Santa his morning coffee (heavy cream, heavy sugar) and a Danish, she found a broken window so she went inside and immediately called the ‘Pole Police (PP). Upon their arrival, they noticed a very foul smell emanating from the building. After donning their gas masks they collected the following evidence:

Chemical Evidence Collected:

- A statue of a garden gnome was knocked over and broken into pieces, with a small pile of powder next to it. LABELED AS SAMPLE 1($MgSO_4$)
- A box of powder apparently kicked across the breakroom LABELED AS SAMPLE 2 (*Boric Acid*)
- Traces of a powder right in front of the door LABELED AS SAMPLE 3 (*Sucrose*)
- Traces of a powder just inside the front door LABELED AS SAMPLE 4 (*Cornstarch*)
- A powder found on a workbench where Santa typically works LABELED AS SAMPLE 5 ($CaCO_3$)
- A Powder found on the floor of the restroom LABELED AS SAMPLE 6($LiCl$)
- Another powder found on the workbench LABELED AS SAMPLE 7(*Glucose*)
- A broken hand-warmer with powder inside LABELED AS SAMPLE 8 (*Sodium Acetate*)

Polymer Evidence Collected:

- Pieces of a broken Plexiglas window LABELED AS SAMPLE 9 (*PMMA*)
- Packaging materials used on the toy LABELED AS SAMPLE 10 (*PS*)
- An empty peach yogurt container LABELED AS SAMPLE 11(*PP*)
- A broken and smashed toy laid to the left inside the front door LABELED AS SAMPLE 12 (*HDPE*)

Physical Evidence Collected:

- A hoof print left near the broken gnome LABELED AS EVIDENCE A
- 2 Fingerprints left on the door knob LABELED AS EVIDENCE B AND C
- A piece of fabric found hanging from the window frame, LABELED AS EVIDENCE D, stained with what appeared to be blood EVIDENCE E
- Hideous gas samples to be analyzed at the lab EVIDENCE F

Based on the evidence collected, the Pole Police believe this crime to be an inside job perpetrated by **at least** one reindeer and one elf. They have asked the CSI division of the PP to identify the prime suspects.

List of Suspects (Reindeer):

- Rudolph - Santa found Rudolph in a snow drift on death's doorstep, brought him in and nursed him back to health. His flashing nose often telegraphs his moods, going from upbeat, to down quickly.
(Note, it doesn't state that he is taking anything for his by-polar disorder!)
- Dasher - Dasher is the hypochondriac of the group. He is always taking dietary supplements. If it comes in a bottle, he'll take it! Even with all the supplements, he has been battling a pesky yeast infection in his ear. Dasher is a very deep thinker but appears not to be too upset about the lack of a contract.
(Calcium Carbonate, Sodium Acetate, Sodium Hydrogen Carbonate, Potassium Chloride, Magnesium Sulfate, Boric Acid, Ammonium Chloride)
- Dancer - Twin brother of Prancer, youngest of the group. Santa has both of these twins on a prescription diet to curb their overactive adolescent libidos.
(Magnesium Sulfate)
- Prancer- Twin Sister to Dancer, born 2 minutes earlier than him. This is the first contract negotiations either of these twins have been through. They honestly believe that if a contract is not reached soon, there may not be a Christmas next year!
(Magnesium Sulfate)
- Vixen - The Matron of the group. Mother of the twins. She would have lost both at birth due to premature contractions if it hadn't been for Santa's quick administering of first aid! Since then, she has taken this home remedy consistently, sometimes to a point of overdose, causing severe kidney damage.
(Magnesium Sulfate)
- Comet - Santa bought Comet from the local Pet Store when he was just a fawn. Comet has developed an ulcer over these entire contract negotiations and takes medicine regularly for it. He is outspoken brash, and sometimes downright rude. He just wants the negotiations resolved.
(Calcium Carbonate, Sodium Hydrogen Carbonate,)
- Cupid - He is the lover of the bunch. Not a harsh bone in his body. Not a likely suspect, but still has motive and opportunity. Cupid has asthma, and regularly takes medicine for it.
(Magnesium Sulfate)
- Donner - The oldest of the group. His diet is supplemented due to concern over osteoporosis. He has listened carefully to both sides and feels that compromise by both parties will ultimately result in a contract.
(Calcium Carbonate)
- Blitzen - Tends to be hot-headed, often speaking without thinking. Politics is not a strong suit, as he often blurts out his true feelings. Likes to go to the shop where Grumpy works because it is always warm there.
(Magnesium Sulfate)

List of Suspects (Elves):

- Sleepy - Has been diagnosed as having a very alkaline system, requiring medicine to rectify the problem. Most of his days he either spends at the statue shop casting garden gnomes, gardening in his window boxes, or sleeping. Although disenchanted by the entire contract talks, Sleepy can't stay awake long enough to hear both viewpoints. Has Type A blood and is allergic to Cotton, Wool, Silk, Nylon, Spandex and Polyester (Yes, he wears leather!)
(Ammonium Chloride, Calcium Sulfate, Calcium Nitrate)
- Grumpy - During the off-season, Grumpy spends his time casting rubber toys. He recently determined that by adding certain chemicals to the rubber, the set time of the rubber is reduced substantially. He is probably the most outspoken of the elves, constantly bringing up thoughts of a strike. Has Type A blood and is allergic to Cotton, Wool, Silk, Nylon, Spandex and Polyester.
(Calcium Nitrate)
- Doc - Doc is called that for a reason. Whenever any of the reindeer or other elves are sick or need medicine, they come to him. He is a walking pharmacy. Before receiving his doctorate, Doc worked in Detroit on an Automobile assembly line assembling aluminum parts. Recently, Doc himself is said to have been taken ill, telling Santa that he has been unable to leave his bed for the past week and a half. He believes that a contract is unachievable at the current level of talks. Has Type O blood and is allergic to cotton, wool, nylon, and polyester.
(Magnesium Sulfate Calcium Carbonate, Glucose. Potassium Chloride, Lithium Chloride, Sodium Acetate, Ammonium Chloride)
- Dopey - Dopey is a diabetic, requiring a constant balance of insulin and sugar. He has been a member of PMMA for the past 20 years and feels that it is high time that Santa pony's up some cash for this contract. Has Type AB blood and is allergic to Cotton, Wool, Silk, Spandex and Polyester
(Glucose)
- Sneezzy - Sneezzy has had his share of health issues which include epilepsy and asthma, both of which he is currently getting medication from Doc for it. Has Type AB blood and is allergic to Cotton, Wool, Silk, Spandex and Polyester
(Magnesium Sulfate)
- Bashful - No one seems to know how Bashful feels about the contract issue. He has never voiced an opinion, he just keeps baking those Danishes that Mr. And Mrs. Claus seem to love. Has Type O blood and is allergic to Cotton, Wool, Silk, Nylon, and Spandex
(Cornstarch, Sucrose Salt)
- Happy - Happy loves salt! He salts everything! Because of this he has developed high blood pressure and a diuretic condition, creating a constant danger of dehydration which has caused Doc to put him on medicine. With a name like Happy, he is probably not one of the Prime Suspects. Has Type B blood and is allergic to Cotton, Wool, Silk, Nylon, and Polyester
(Sodium Acetate)

Part I - Qualitative Analysis (5 points each, 40 points possible):
Identify the 8 unknown chemicals found at the scene:

SAMPLE #	CHEMICAL NAME
Sample 1	Magnesium Sulfate or $MgSO_4$
Sample 2	Boric Acid or H_3BO_3
Sample 3	Sucrose or $C_{12}H_{22}O_{11}$
Sample 4	Cornstarch
Sample 5	Calcium Carbonate or $CaCO_3$
Sample 6	Lithium Chloride or $LiCl$
Sample 7	Glucose or $C_6H_{12}O_6$
Sample 8	Sodium Acetate or CH_3COON

Part II - Polymer Analysis (8 points each, 40 points possible):

SAMPLE #	POLYMER:
Sample 9	PMMA
Sample 10	PS
Sample 11	PP
Sample 12	HDPE
Evidence D (Fabric Sample)	Spandex

Part III - Forensic Serology (40 points possible):

EVIDENCE #	Blood Type
Evidence E	Type O (20 Points)
Identify which of the Elves this may implicate:	Bashful and Doc (10 Points Each)

Part IV - UV Spectrophotography (20 points possible):

EVIDENCE #	Blood Type
Evidence F	Boric Acid or H_3BO_3
Identify from which of the Reindeer this foul odor most likely emanated:	Dasher (Yeast infection of the ear, using Boric Acid to cure)

Part V - Fingerprint Analysis (5 points each, 20 points possible):

EVIDENCE #	Belonged to:
Evidence A (Hoof Print)	Dasher
Evidence B (Fingerprint)	Mrs. Claus
Evidence C (Fingerprint)	Doc
What type of a fingerprint would you classify Evidence B as?	Tented Arch

Part V - Crime Analysis. Provide in outline format, sorted by evidence, who the most likely suspects are (40 points possible):

Sample 1 (MgSO₄) Is used in a broad range of ways and could implicate Dasher, Prancer, Vixen. Comet, Blitzen, Doc, or Sneezzy, based on the backgrounds provided. Although not totally discounted, should not be used as a primary means of Criminal ID.

Sample 2 (Boric Acid) Was most likely used as rodent control as this is the primary ingredient of many rat killers, but it is also used to control yeast infections. If this evidence implicates anyone, it would be Dasher and / or Doc but is too weak to implicate either on its own merit.

Sample 3 (Sucrose) would seem to implicate Bashful, as this is an ingredient in the Danishes, but Mrs. Claus entered the room through that door, and may have dropped some powder on the floor while opening it.

Sample 4 (Cornstarch) may also seem to implicate Bashful, but again it may just be a component of the danishes, dropped by Mrs. Claus when closing the door.

Sample 5 (CaCO₃) is used broadly to cure stomach acid, which there is plenty of around here! It could implicate Dasher, Comet, Donner, or Doc, but more than likely since Santa was working until after the cleaning crew finished, it was medicine taken by Santa sometime during the previous day, and not cleaned up because he was still working at his bench.

Sample 6 (LiCl) could only be attributed to Doc from the background information furnished. He is the only one that may have even known how to use it. Since the restroom was cleaned that afternoon, it is likely that the powder was placed there during the night.

Sample 7 (Glucose) would seem to indicate that Dopey may be involved, but then again, with a name like "Dopey" can you really visualize him as a Criminal Mastermind? This is the only evidence implicating him, and was probably left from the day prior because Santa was still at his bench when the cleaning crew left

Sample 8 (Sodium Acetate) This is a common fuel used in hand warmers, and being the North Pole, I would suspect that everybody has one. This evidence should be discounted.

Sample 9 (PMMA) as one might expect, is a piece of the Plexiglas window that was busted out, but does not implicate anyone specific.

Sample 10 (PS) again does not really implicate anyone, as it is generic packaging material.

Sample 11 (PP) also does not specifically implicate a suspect, as the background information does not identify any health food fanatics or acidophilus cravings, however, Dasher the hypochondriac is probably the most likely to have left it there.

Sample 12 (HDPE) does not implicate anyone, since it came from the workshop to begin with.

Evidence A (Hoof print) was obviously left by Dasher, and is the most convincing evidence found so far

Evidence B and C (Fingerprints) were left by Mrs. Claus when she opened the door, and by Doc, who was supposedly so sick he could not get out of bed. Being caught in a lie, in addition the fingerprint, provides convincing proof of Doc's involvement

Evidence D (Spandex) and E (Blood stained fabric). All of the Elves were allergic to Spandex except Doc and Happy. The only elves with Type O blood were Doc and Bashful, but since Bashful is allergic to spandex, Doc is the Primary Suspect.

Evidence F (Gas Spectrophotography) can be clearly identified as Boric Acid and the only suspects this implicates are Dasher and Doc. The gas most likely was generated due to Dancer's flatulence caused by mixing all of the supplements. The boric acid that was being used to treat his ear infection was absorbed through the skin and into his system, then "vented."

Based on the review of evidence above, the most likely suspects are Dasher and Doc