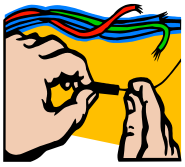
Name:_____ Period:____ Date:_____



Chemical & Dye Tests on Fibers Lab

Background Information:

Fibers are the smallest component of a textile material. They are used to form fabric, rope, carpet, etc. Fibers gathered as evidence at a crime scene may arise from numerous scenarios. They may be transferred via personal contact between suspect and victim and they can also be transferred to other items at the crime scene, such as furniture, weapons or flooring, due to physical struggle.

Fibers may be analyzed by visual inspection, based on their appearance and comparison with known samples. Identifying fibers based on appearance requires the use of a microscope to view miniscule details. Natural fibers are easier to distinguish under a microscope. Synthetic (man-made) fibers are traditionally less descriptive under a microscope because they can consist of practically any strand diameter or color. Synthetic or man-made fibers have typically have a more uniform diameter and appearance than natural fibers. Therefore, microscope analysis is not the main determining test used to identify fibers but it can be helpful as an ancillary test.

Fabrics are also identified based on how chemical dyes bond them. How well a dye is attracted to a piece of cloth (its *affinity*) depends on both the fabric and the dye molecules. Chemistry thus plays an important role in how and why dyes work. Dyes are water-soluble compounds that are charged. Animal fibers such as wool, which are composed of protein molecules, are usually easier to dye than plant fibers such as cotton, which are composed of cellulose. Wool fibers have many *dye sites* – groups of molecules that have positive or negative charges and thus attract the charged dye molecules. Dye sites may be ionic, that is, fully charged, or polar, that is, partially charged. In general, dyes have a greater affinity for natural fibers like wool and cotton than for most synthetic fabrics. Many synthetic fabrics such as acrylic and polyester are *hydrophobic* (water-fearing) and have fewer dye sites, making them more difficult to dye. One exception is nylon, the first completely synthetic fiber developed in the 1930s from petrochemicals. Nylon dyes more easily than many other synthetic fabrics because it has polar dye sites. Acetate, another synthetic fiber, is chemically similar to cotton, but has fewer dye sites.

Purpose: To determine how different fabrics react with different chemical & dye tests.

Materials:

- Known fabric samples
- Unknown fabric samples
- Spot plates (ceramic)
- 6 M NaOH (sodium hydroxide)
- NaOCl (sodium hypochlorite)
- 6 M HCl (hydrochloric acid)
- 6 M H_2SO_4 (sulfuric acid)
- toothpicks
- safety goggles

Procedure:

Part A: Chemical Analysis of Fiber

1. Add a few fibers from different samples and place in the same column in the spot plate. Organize using five vertical columns.
2. Add five different reagents in the separate columns.
3. Add enough reagents to cover sample. Use toothpicks to mush fabric in liquid.
4. After 5 minutes, record observations in table handout provided.

Data:

Table 1. Chemical Test of Fibers

Fibers	NaOH	NaOCl	HCl	H_2SO_4
Cotton				
Silk				
Polyester				
Rayon				
Un known				

Part B. Fabric Dyeing Analysis

1. Obtain a second multi-fiber test fabric strip. Mark one end of the strip with pencil so that the wool side is differentiated from the acetate side.
2. Using forceps or tongs, immerse the test strip into the congo red dye bath. *Caution:* The dye bath is red. Exercise caution to avoid burn.
3. After 10 minutes, remove the dyed test strip from the bath using forceps. Hold the fabric above the dye bath for approximately one minute to allow excess dye to drain back into the dye bath.
4. Pat the test strip with paper towels and rinse the dyed test strip under running water from the faucet or use a wash bottle. Continue rinsing the test strip until all of the excess dye has been removed and the rinse water is colorless.
5. Place the test fabric on a small piece of aluminum foil or weighing dish and allow it to dry overnight.
6. Record observations on the Forensics of Fiber Worksheet the following day.

Table 2. Fabric Dyeing Analysis

Fabric Type	Wool	Acrylic	Polyester	Nylon	Cotton	Acetate
Color						

Questions:

Part A: Chemical Analysis

1. What was your unknown? _____

2. How did you determine what your unknown was? Explain your results.

Part B:

1. Rank the six fabrics tested in order of their affinity for dyes, starting with the greatest affinity.

Extra Credit: Mrs. Nelson's house was robbed on the evening of Friday, May 13, 2011. The crime lab obtained a fiber from a broken screen where the suspect entered. The fiber was tested and found to twist and turn brown when heated but did not melt. When the fiber was ignited it burned extremely quickly with no smoke produced. When it was dyed with congo red it turned dark red. What type of fiber is it? _____