**Glass Notes**

**Case Study: Susan Nutt (1987)**

At 9:30pm on a cloudy, dark night in February, 19-year-old Craig Elliott Kalani went for a walk in his neighborhood in northwest Oregon but never returned home. A hit-and-run driver killed him. Crime-scene investigators collected pieces of glass embedded in Craig’s jacket and other glass fragments found on the ground near his body.

Police searched for a vehicle that had damages consistent with a hit-and-run accident. They found a car with those types of damages that belonged to a woman named Susan Nutt. In order to connect Ms. Nutt and her car with the crime, the police had to match the glass from the crime scene to the glass in her car. The scientists found that windshield glass from the crime scene contained the same 22 chemical elements as those used to make the glass in Ms. Nutter’s car. The scientists considered both samples of glass to be a definite match.

The glass evidence helped convict Susan Nutt of failure to perform the duties of a driver for an injured person. She was sentenced to up to 5 years in and prison and 5 years’ probation.

**Physical vs. Chemical Properties**

**The forensic scientist must constantly determine those properties that give distinguishing characteristics to matter, giving it a unique identity.**

**Physical properties**:

**Chemical properties**:

**Forensic Examination of Glass**

**Goals:**

**1.**

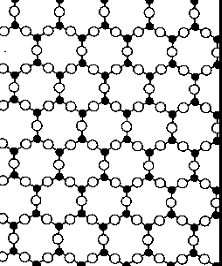
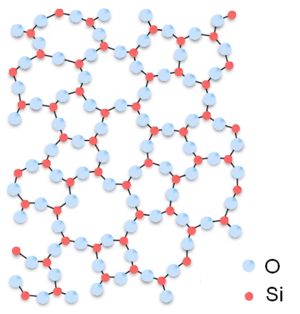
**2.**

**3.**

**4.**

**Compare physical and chemical characteristics:**

1. **Optical properties: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
2. **Non-optical properties: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
3. **Chemical properties: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Structure:**

Amorphous Structure: Glass

Crystalline Structure: Salt (NaCl)

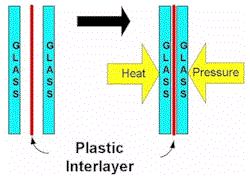
**Glass is Amorphous**

**Amorphous:**

**Example:**

**Physical properties:**

**Chemical Properties:**

**What Other Types of Glass Are There?**

**Laminated Glass:**

**Tempered Safety Glass:**

**Glass In Forensics**

**Used in solving \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Glass is a type of transfer evidence** **and can be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**

**🡪 Only can individualize a glass fragment, if can fit it like puzzle piece to its source**

**Collection of Glass**

**If even the remotest possibility exists that glass fragments may be pieced together, every effort must be made to collect \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**

**When an individual fit is thought improbable, the evidence collector must submit all glass evidence found in the possession of the suspect along with a representative sample of broken glass remaining at the crime scene.**

**The glass fragments should be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to avoid further breakage.**

**If the suspect’s shoes and/or clothing are to be examined for the presence of glass fragments, they should be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and transmitted to the laboratory.**

**Glass Examples**

**Can glass be shattered with your voice?**

**Glass Transfer Evidence**

**Glass flies \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_!**

**How Do Glass Windows Break?**

* **Glass acts initially as an elastic surface and bends away when a force is applied. When the force increases beyond its tensile strength, it cracks.**



**Because of a lack of order and pattern, glass breaks in random patterns**

**An impact in glass produces two types of fractures**

**Radial 🡪\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Concentric 🡪\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Projectile Patterns**

**Small projectiles passing through glass at a high velocity will produce characteristic patterns**

**🡪 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_A bullet will create an exit hole that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ than entry hole**

**Lower velocity impacts may not penetrate the glass but leave only a pit or crater on one side of the glass**

**Which Bullet Hole Was First?**

**Determining which bullet hole in glass was created first:**

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
* **cracks radiating out from the hole will stop when they encounter another crack**

**Putting it Back Together Again?**

* **Because glass is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, no two glass objects will \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**

**Glass Fragments**

**For the forensic scientist, the problem of glass comparison is one that depends on the need to find and measure those properties that will associate one glass fragment with another while minimizing or eliminating other sources.**

**To compare glass fragments, a forensic scientist evaluates two important physical properties: density and refractive index.**

**Density**

**Mass per unit volume**

**Density=**

**Remains the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Why Measure Density?**

**Can be used as a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**

**Useful in identifying \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ present in the known and/or questioned samples.**

**It is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and an intensive property (not dependant on sample mass).**

**Need to measure very precisely in parts per hundred or thousand or better.**

**Glass Density**

* **Density can be measured by:** 
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and volume (usually by water displacement)**
  + **comparison by flotation. The glass can be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_to other relevant pieces of glass which will \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**