Warmup: Cut out the glass pattern provided during and "**down time**" you during today's notes (between words, when Mrs. Rigdon is getting especially long-winded, etc.). **This should NOT cause you to not be able to keep up with your note-taking responsibility!!!**

After the notes, you will switch with a partner and assemble each other's glass cutouts onto today's funsheet.

2.2: The Forensic Analysis of Glass (2)

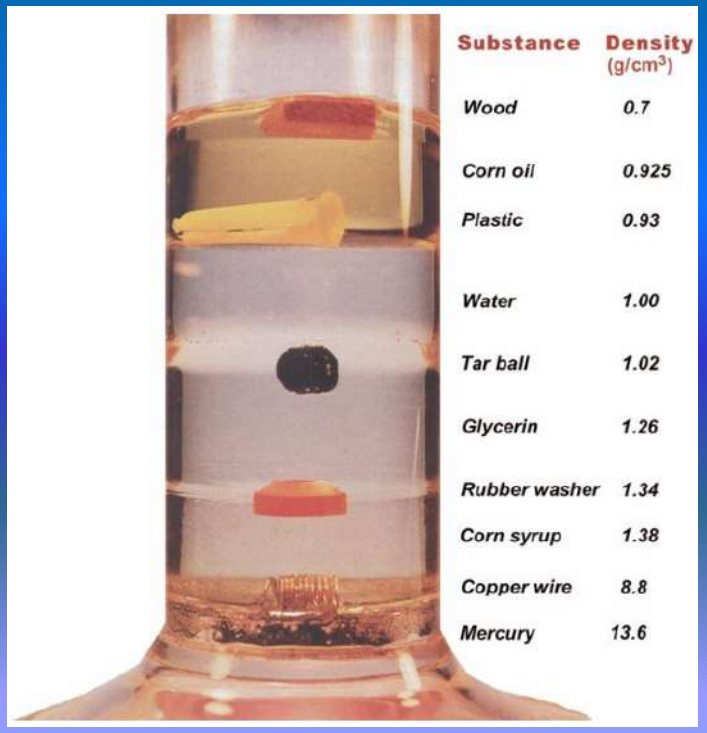
SFS 2: Use various scientific techniques to analyze physical and trace evidence

b. Analyze the morphology and types of hair, fibers, soil and glass

8/31/16

Part IV: Glass & Density

- remember, a solid particle will either float, sink, or remain suspended in a liquid, depending on its density relative to the liquid
  - this knowledge gives the criminalist rather precise and rapid method comparing densities of glass
- **flotation** = method for determining the density of a glass sample involving liquids of different densities
  - a standard/reference glass particle is immersed in a bromoform/bromobenzene mixture
  - the composition of the liquid is carefully adjusted by the addition of drops of bromoform or bromobenzene until the glass chip remains **suspended** in the liquid medium



- the composition of the liquid is carefully adjusted by the addition of drops of bromoform or bromobenzene until the glass chip remains **suspended** in the liquid medium
  - at this point, the standard/reference glass and liquid each have the **same density**
- glass chips of approximately the same size and shape as the standard/reference are now added to the liquid for comparison
  - if both the unknown and the standard/reference particles remain suspended in the liquid, their densities are **equal** to each other and to that of the liquid
  - particles of **different** densities either sink or float, depending on whether they are more or less dense than the liquid

SELF-CHECK QUESTION!

What is density?

the relationship between mass and volume: $D = \frac{m}{V}$

- particles of **different** densities either sink or float, depending on whether they are more or less dense than the liquid

Part V: Refractive Index Comparisons

- after a density determination, the added comparison of refractive indices is performed by use of the immersion method
- **immersion method** = method for determining the refractive index of a sample of glass through comparison with liquids of different refractive indices
  - glass particles are immersed in a liquid medium whose refractive index is adjusted until it **equals** that of the glass particles
  - at this point, known as the **match point**, the observer notes the disappearance of the Becke line and minimum contrast between the glass and liquid medium

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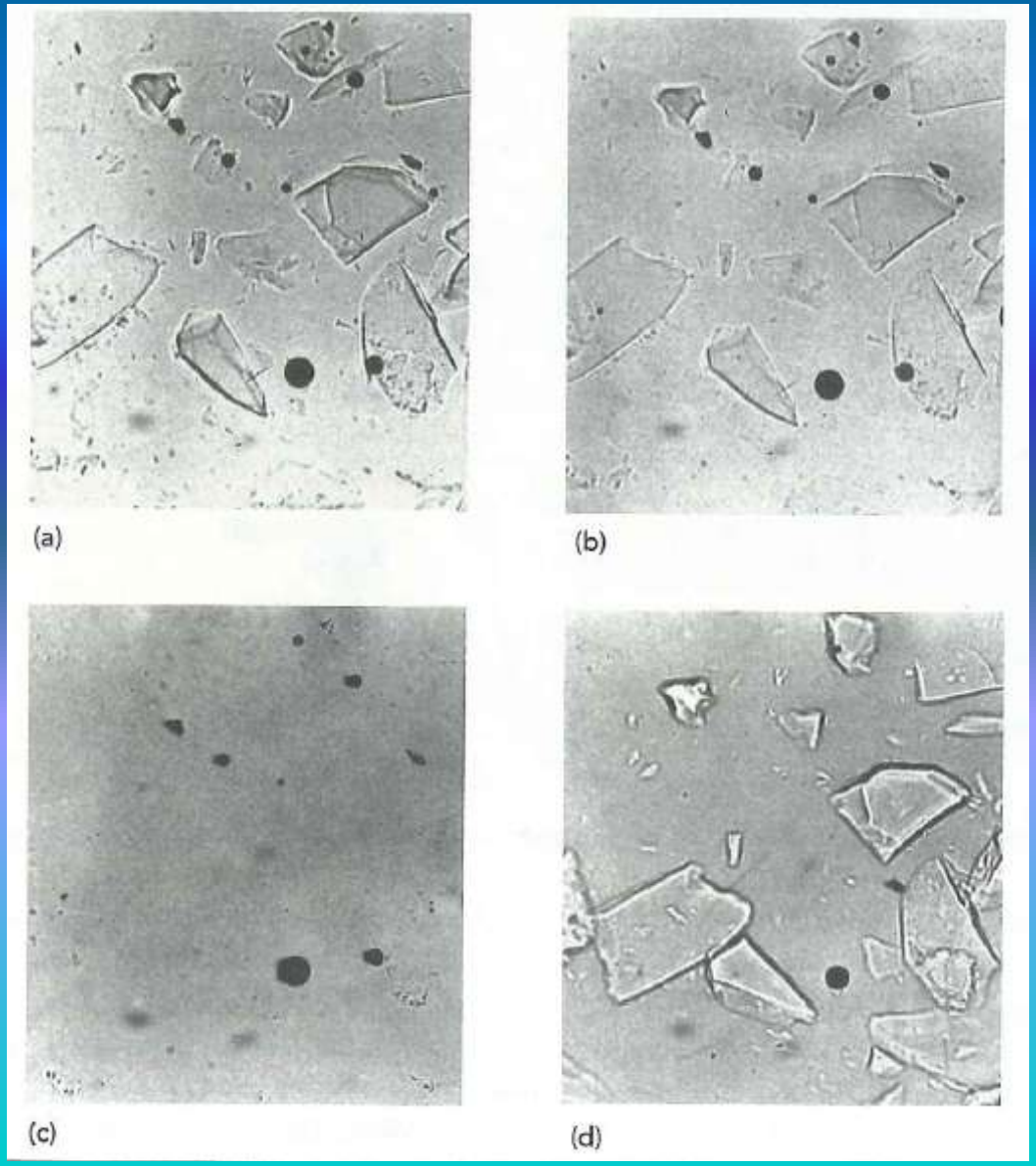
  - this halo **disappears** when the medium and fragment have **similar** refractive indices



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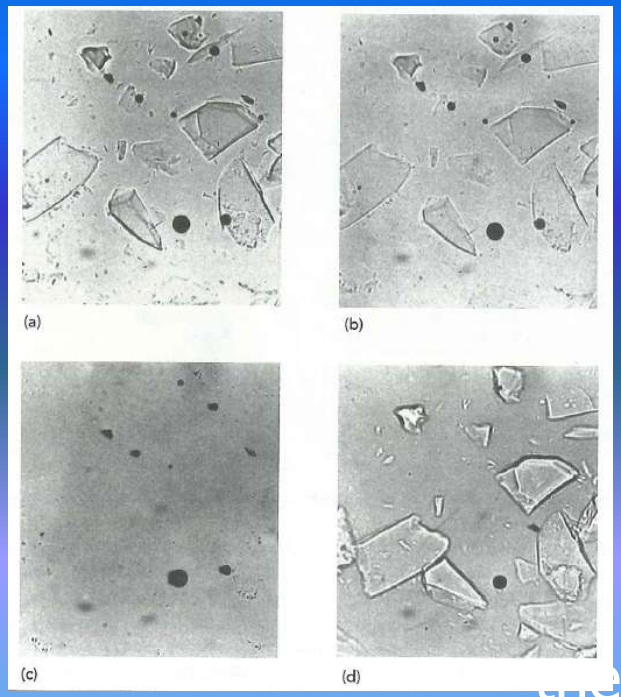
- the refractive index of an immersion fluid is adjusted by carefully adjusting temp. of the liquid in 0.2°C per minute increments



SELF-CHECK QUESTION!

The immersion method is used to determine the **refractive index** *of a sample of glass.*

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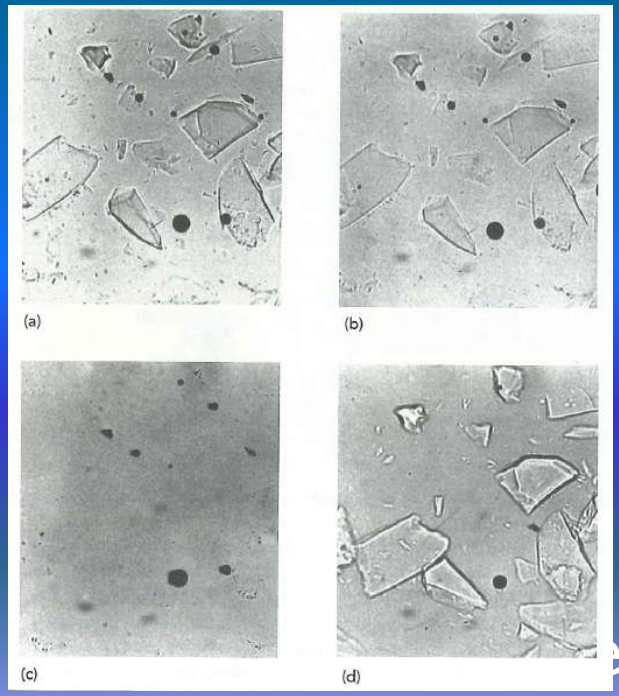

Part VI: Classification of Glass Samples

- a significant difference in either density or refractive index proves that the glasses examined do not have a common origin—but what if two pieces of glass exhibit similar densities and refractive indices?

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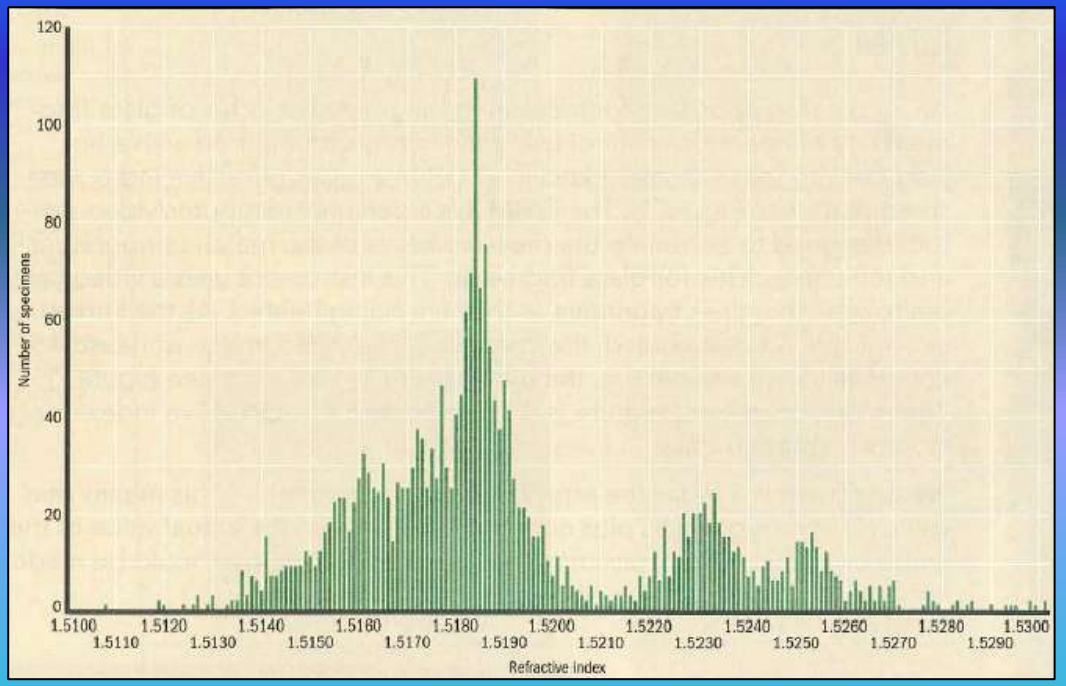
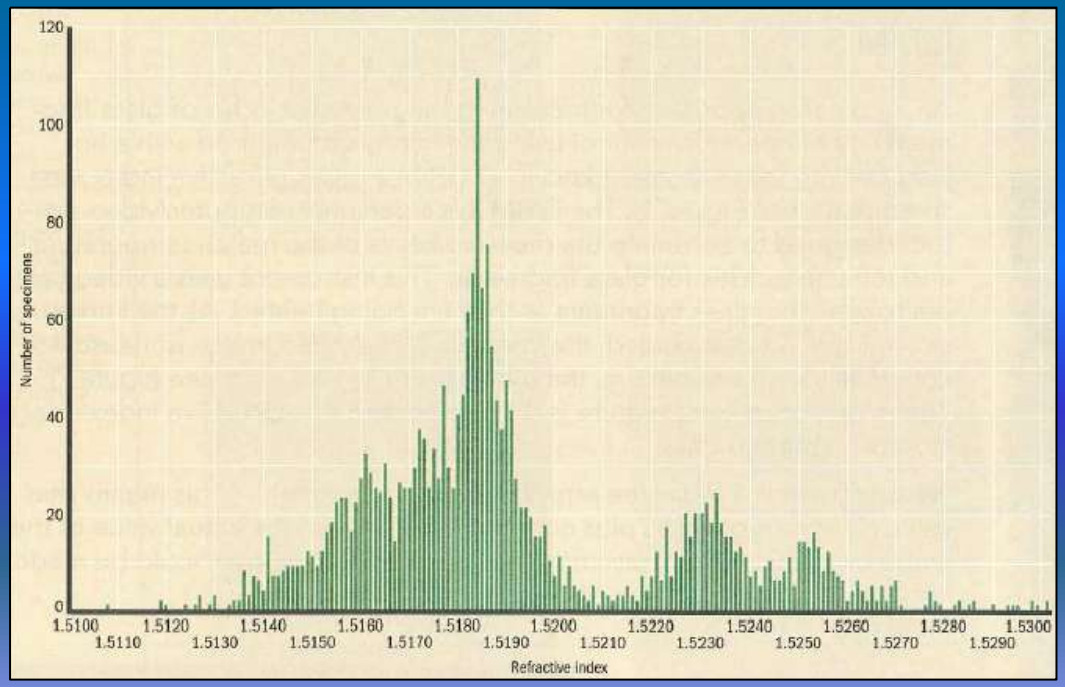
- to provide a reasonable answer to this question, the FBI Laboratory has collected density and refractive index values from glass submitted to it for examination, creating a data bank correlating these values to their frequency of occurrence in the glass population of the US



- to provide a reasonable answer to this question, the FBI Laboratory has collected density and refractive index values from glass submitted to it for examination, creating a data bank correlating these values to their frequency of occurrence in the glass population of the US
- once a criminalist has completed a comparison of glass fragments, he or she can correlate their density and refractive index values to their frequency of occurrence and find the probability that the fragments came from the same source—for example:
  - a glass fragment with a refractive index value of 1.5290 is found in approximately only 1 out of 2,000 specimens
  - glass with a value of 1.5180 occurs approximately in 22 glasses out of 2,000

SELF-CHECK QUESTION!



Who generated this graph?

the FBI

What does it show?

the frequency of a refractive index value's occurrence

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Part VII: Glass Fractures

- glass bends in response to any force exerted on any one of its surfaces—when the elasticity limit is reached, the glass fractures
- fractured window glass often reveals information that can be related to the force and direction of an impact (this may be useful for reconstructing events at a crime-scene investigation)
- the penetration of ordinary window glass by a projectile, whether a bullet or a stone, produces a familiar fracture pattern in which cracks both radiate outward and encircle the hole.
  - the **radiating** lines are known as **radial fractures**
  - the **circular** lines are termed **concentric fractures**

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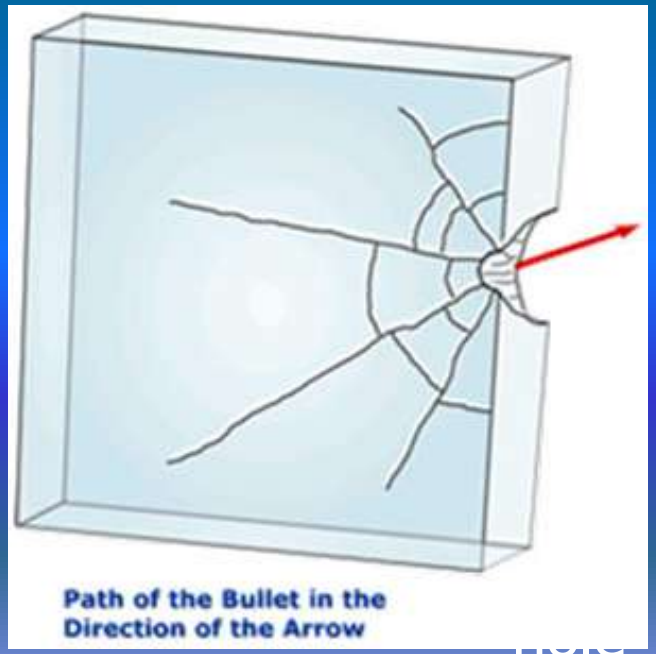
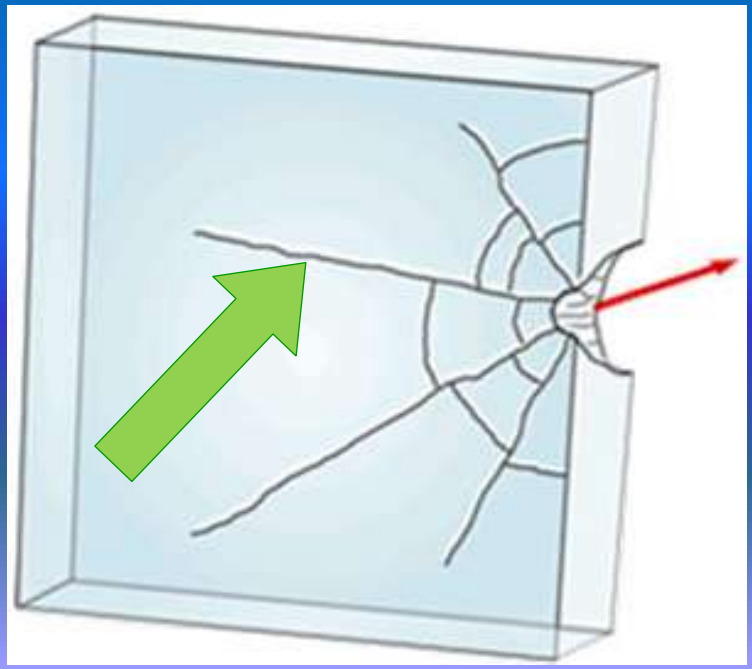
  - the **radiating** lines are known as **radial fractures**
  - the **circular** lines are termed **concentric fractures**
    - gunpowder deposits on the shattered glass fragments help determine whether the damage was caused by a firearm, or just a stone/other projectile
- when a high-velocity projectile (such as a bullet) penetrates glass it leaves a round, crater-shaped hole surrounded by a nearly symmetrical pattern of radial and concentric cracks
- the hole is inevitably **wider on the exit side**, and hence examining it is an important step in determining the direction of impact

- the hole is inevitably **wider on the exit side**, and hence examining it is an important step in determining the direction of impact
  - however, as the velocity of the penetrating projectile decreases, the irregularity of the shape of the hole and of its surrounding cracks increases, so that at some point the shape will not help determine the direction of impact
  - if needed, examining the radial and concentric fracture lines may help determine the direction of impact



SELF-CHECK QUESTION!

The hole from a bullet is wider on the (entry, exit) side of the glass.



Draw an arrow pointing to a radial line on the picture above.

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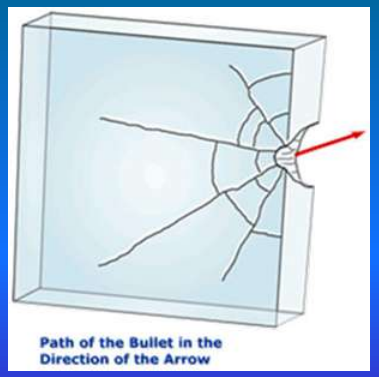

  - if needed, examining the radial and concentric fracture lines may help determine the direction of impact
- When a force pushes on one side of a pane of glass, the elasticity of the glass permits it to **bend in the direction of the force applied**
  - the first fractures form on the surface opposite that of the penetrating force and develop into **radial** lines
  - the continued motion of the force places tension on the front surface of the glass, resulting in the formation of **concentric** cracks

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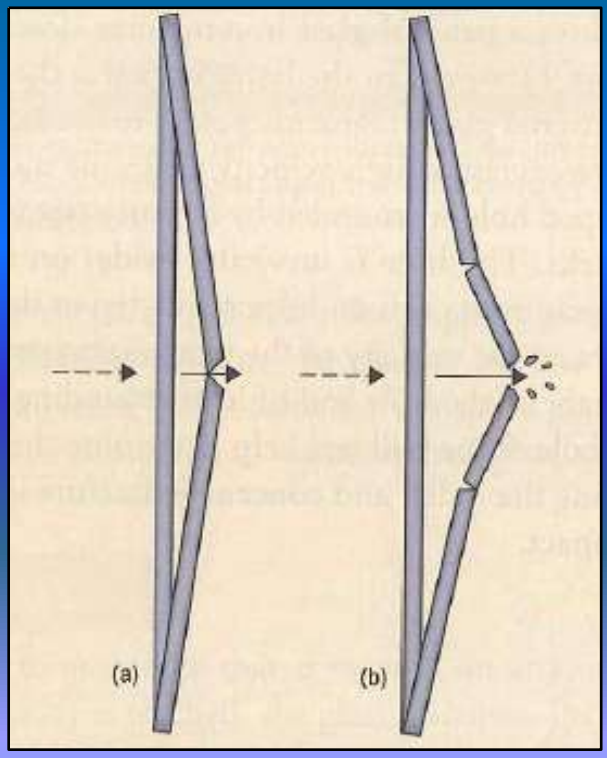
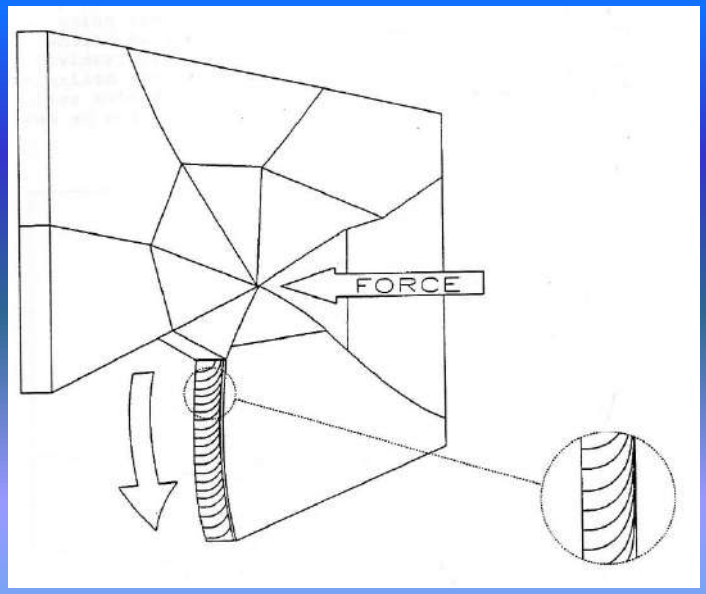


- the edges of the radial and concentric cracks show stress markings called **Wallner lines**
  - the shape of these lines shows which side the window cracked on

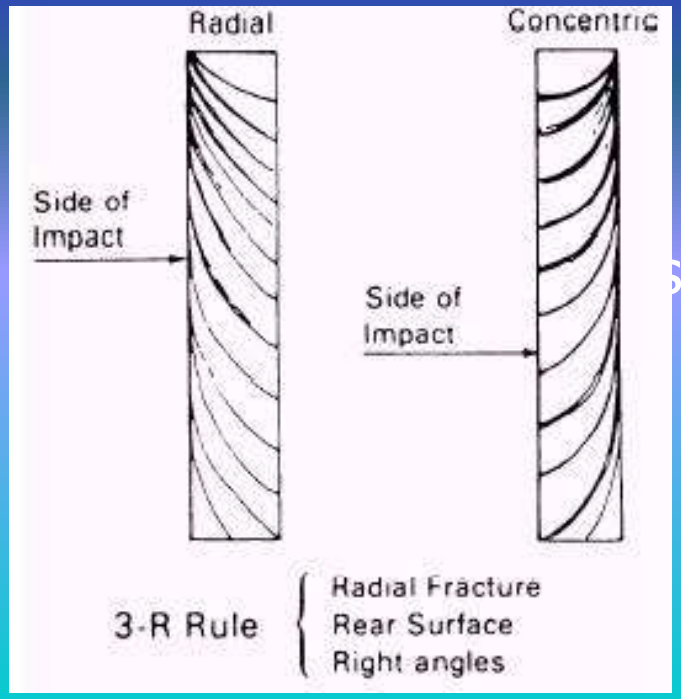
- the edges of the radial and concentric cracks show stress markings called **Wallner lines**
  - the shape of these lines shows which side the window cracked on
- stress marks are **shaped like arches** that are perpendicular to one glass surface and curved nearly parallel to the opposite surface
  - the perpendicular edge always faces the surface on which the crack originated
  - thus, for **radial** cracks, the perpendicular end is always found **opposite** the side from which the force of impact was applied
  - for **concentric** fractures, the perpendicular end always **faces the surface** on which the force originated



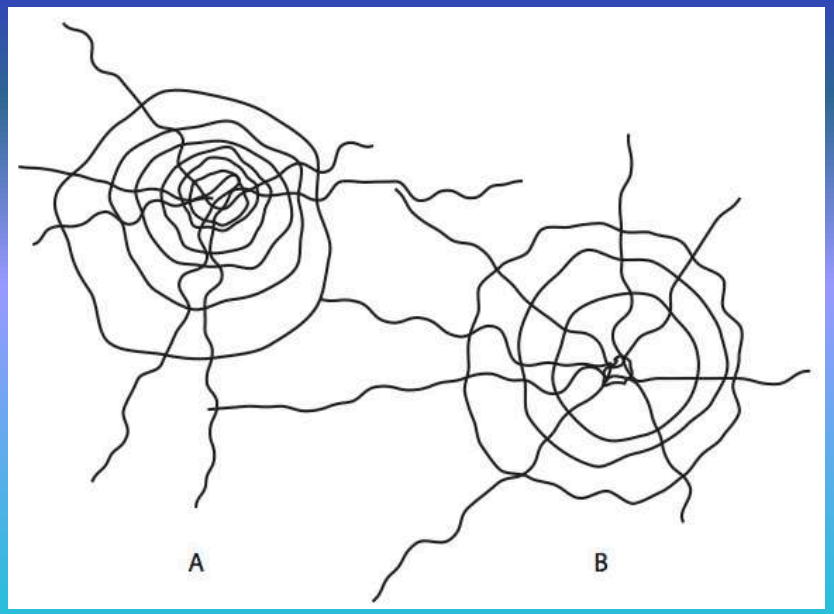
- thus, for **radial** cracks, the perpendicular end is always found **opposite** the side from which the force of impact was applied
- for **concentric** fractures, the perpendicular end always **faces the surface** on which the force originated
- a good way to remember this info is the **3R** rule:

Radial cracks form a **R**ight angle on the **R**everse side of the force

- these facts enable the examiner to determine the side on which a window broken
  - unfortunately, the absence of radial or concentric fracture lines prevents these observations from being applied to broken tempered glass



- unfortunately, the absence of radial or concentric fracture lines prevents these observations from being applied to broken tempered glass
- when there is more than one bullet hole in the glass, you can determine the sequence of impact by observing the existing fracture lines and their points of termination
  - a fracture always terminates at an **existing** line of fracture
  - bullet hole A preceded bullet hole B (we know this because bullet hole B's radial fractures terminate at the fracture lines from bullet hole A).



SELF-CHECK QUESTION!

The (left, right) side of this radial fracture was impacted.

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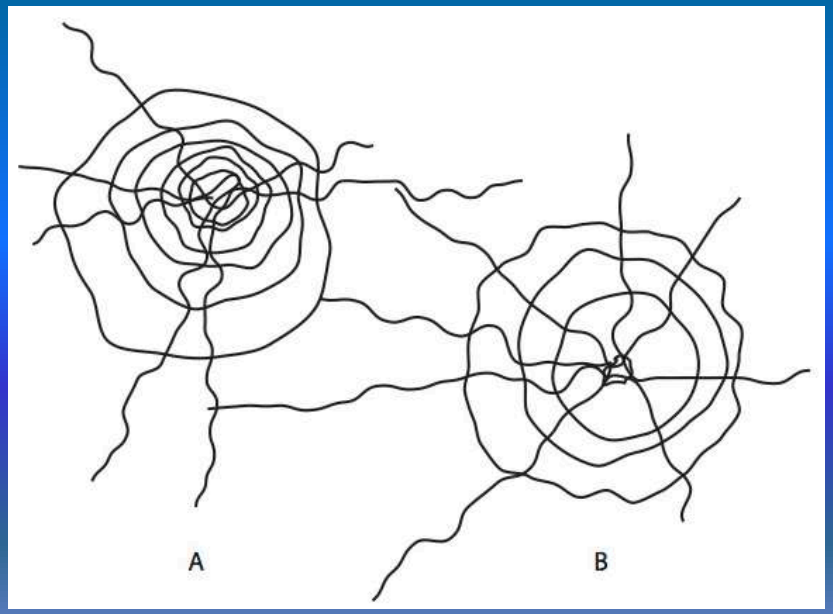

Part VIII: Collecting/ Preserving Glass Evidence

- if even the most remote possibility exists that fragments can be pieced together, every effort must be made to collect all the glass found—at a car accident, for example:
  - evidence collection must include all the broken parts of headlights and reflector lenses

Part VIII: Collecting/Preserving Glass Evidence

- if even the most remote possibility exists that fragments can be pieced together, every effort must be made to collect **all** the glass found—at a car accident, for example:
  - evidence collection must include all the broken parts of headlights and reflector lenses
  - headlight filaments may reveal whether the headlights were on or off at impact
  - the presence of dirt, paint, or grease may indicate the exterior surface of the glass
- a standard/reference glass sample should always be taken from any remaining glass, as close as possible to the point of breakage (about one square inch of sample is enough)

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- glass fragments should be packaged in solid containers to avoid further breakage
- suspect's shoes and/or clothing should be individually wrapped in paper (CSIs should avoid removing such evidence from garments unless absolutely necessary)

SELF-CHECK QUESTION!

True or False: A druggist fold would be a good container for glass evidence.

false

(a solid container is needed)

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