Welcome to the Forensic Science Workshop

A few requests / details before we begin from our Hosts, the Embitec / MiniOne Folks:

Please enter your name, school info in the chat (we will use this for roll and your clock hour certificate), and something you'd like to share about yourself!

Forensic Science Online Workshop

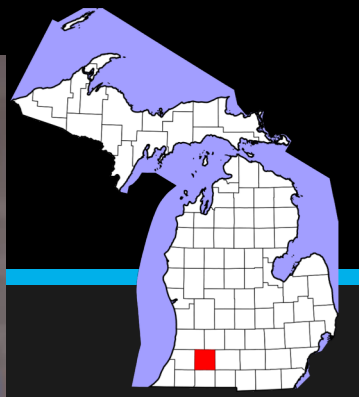
Kathy Mirakovits | Forensic Science Educational Consulting, LLC | Kalamazoo, Michigan

Agenda

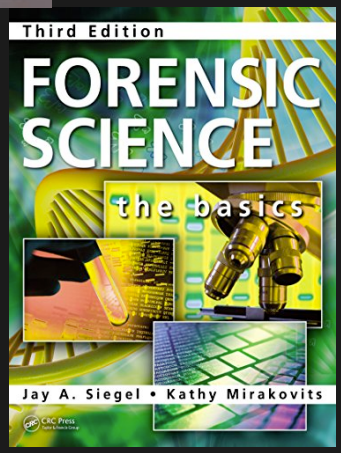
- About me (I promise to keep it short)
- Forensic Glass Analysis
- Accident Investigation
- Chromatography
- Steps to designing a Mock Crime Scene
- Training opportunities and FS Products
- Quick Survey and Q & A.

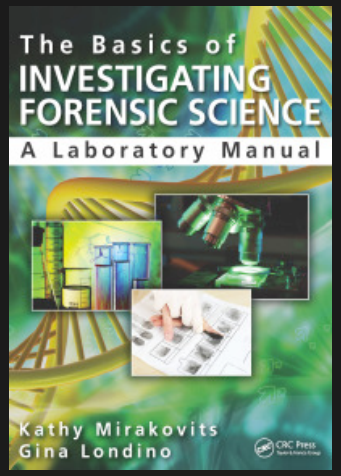
A bit about me….

email address: kmirakovits@gmail.com
my website: www.forensicscience-ed.com



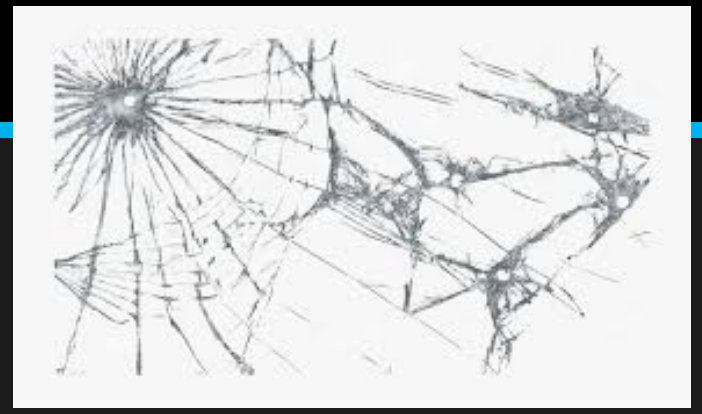
- Degrees: B.S. in Science Ed.—Miami Un… Western Michigan University
- Taught IB Physics, IB Biology, and other sciences. Now retired after 30 yrs.
- Got the FS bug in ~1995, Pre-CSI. Trained myself and developed kits for Forensic Science.
- Developed and taught two semester Forensic Science courses at PPS for 25 years.
- *Forensic Science, The Basics* …later this year)
- *The Basics of Investigating Fo…* (lab book); 2nd Ed later this year
- Currently teach part time at Ka… Community College (physics and forensic science) and do Work… Science Educators.
- Best job ever…Grandma!





Forensic Glass Analysis

- Types of analysis
  - Direction of force
  - Identification of the TYPE of glass
- Supplies
- Uses in a Crime Scene



Forensic Glass Analysis

- Glass is Silicon Dioxide ($Si0_2$)
- Various TYPES of glass have additives that change the properties
- Glass is forensically important
  - It is found at most crime scenes
  - It can be carried away from scene undetected
  - It is stable, does not decay
  - As class evidence contributes to the pool of evidence
- Glass is primarily CLASS evidence
  - Individual evidence only if can fracture match

Types of Glass

- Soda Lime Glass
  - Windows, picture frames, flat glass objects
  - SiO_2 with sodium carbonate (Na_2CO_3 and calcium oxide CaO)

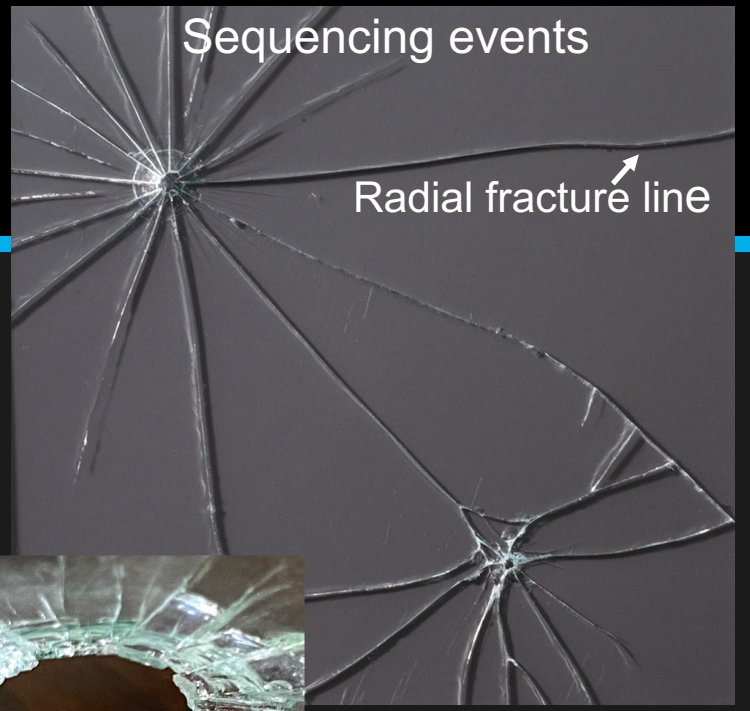
- Tempered Glass
  - Safety glass, auto glass, shower doors and plate glass store windows
  - Same chemical makeup as soda lime glass
  - Top layer is cooled first causing internal stresses.
  - When broken this glass fractures into small blunt pieces.

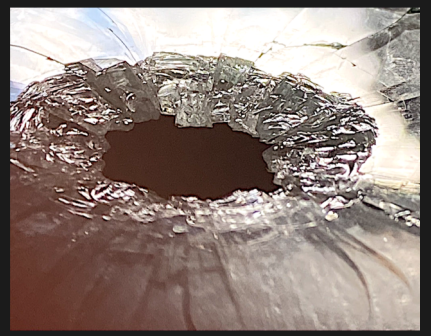
Types of Glass

- Borosilicate glass
  - Lab glassware (Kimex or Pyrex)
  - Kitchen items (Pyrex)
  - SiO_2 with Boron added
- Leaded glass (crystal)
  - Wine glasses, fine dining, figurines
  - SiO_2 with lead oxide added

Direction of Force

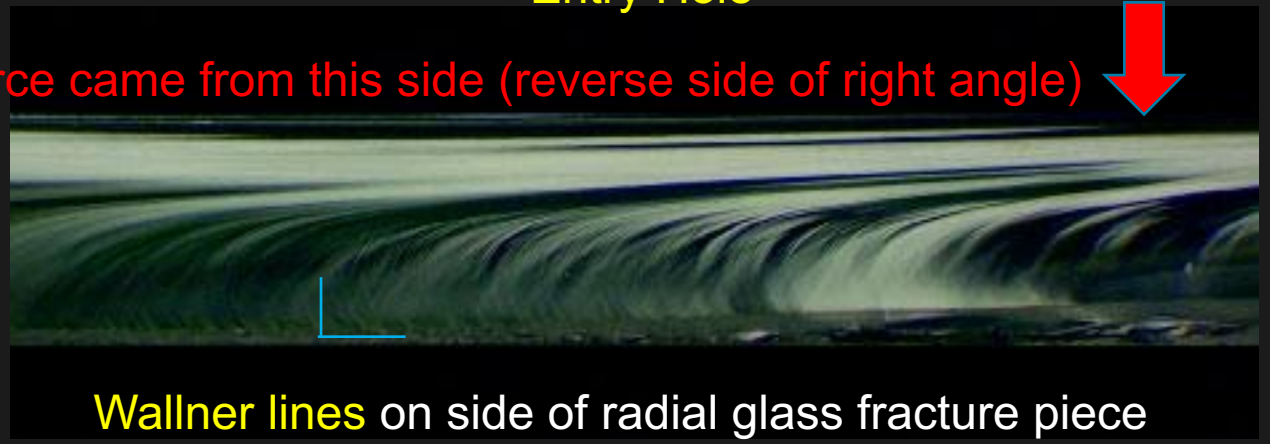
- Sequence of the fractures – order of events
- The direction of the force which caused the fracture – origination of force from the inside or outside
- Projectile direction
  - Entry: smaller hole, smooth surface
  - Exit: wider hole, crater shape, rough surface
- Wallner lines on cut side indicate direction of force
- 3R Rule:
  - **R**adial fracture
  - **R**ight angle
  - **R**everse side of force





Exit Hole

Entry Hole



Wallner lines on side of radial glass fracture piece

Determining Type of Glass (of the 4 Types)

- Two types of tests
  1. Density of glass
     - Window / Tempered Glass 2.53-2.54 g/ml
     - Pyrex Glass 2.29-2.39 g/ml
     - Leaded Glass 2.65-2.90 g/ml

2. Refractive Index

Glass Type	RI
Window Glass (soda lime)	~1.51
Pyrex	~1.47
Tempered Glass (auto)	~1.52
Leaded Glass (29%-55%)	1.57-1.67

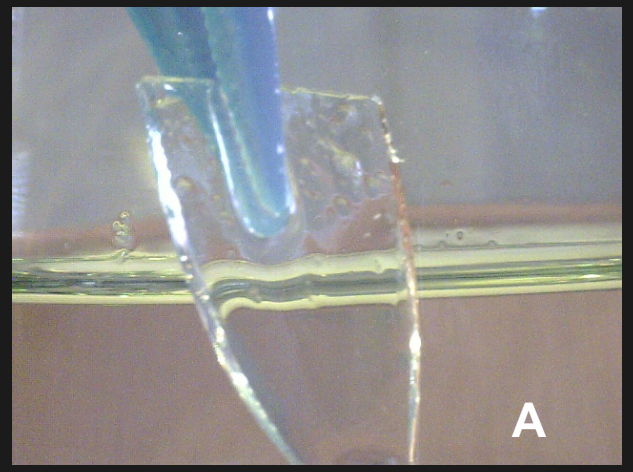
Liquid Medium	RI
Water	1.33
Vegetable Oil	1.47
Clove Oil	1.53
Cinnamon Oil	1.61

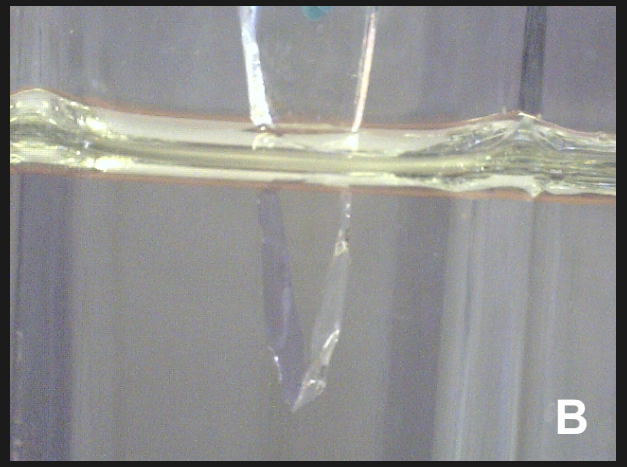
Measuring The Density Of A Small Piece of Glass

- Mass the piece of glass.
- Find Volume of glass.
  - Tare beaker with water
  - Tie thread around glass
  - SUSPEND the glass in water
  - Take mass reading
  - Mass of water displaced = Volume of water displaced =Volume of piece of glass
- Calculate density of the glass $\left(Density = \frac{Mass}{Volume}\right)$

Refractive Index Determination of a Small Glass Fragment

- Refractive index of small pieces of glass can be determined using commercially available liquids whose refractive indexes are known.





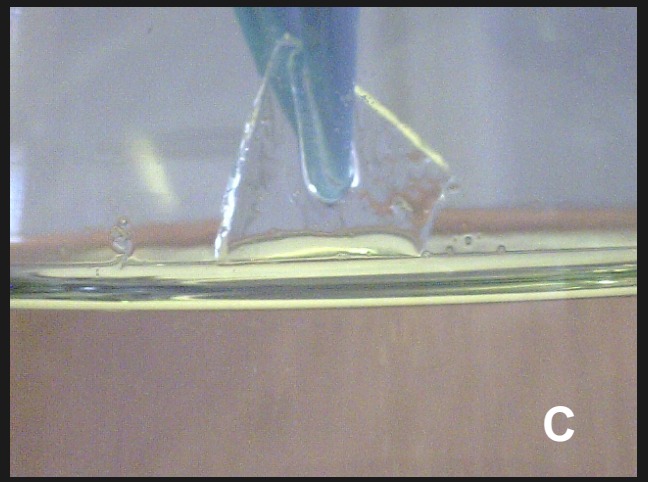


Photo A shows a small piece of Pyrex glass *not immersed* in a liquid.

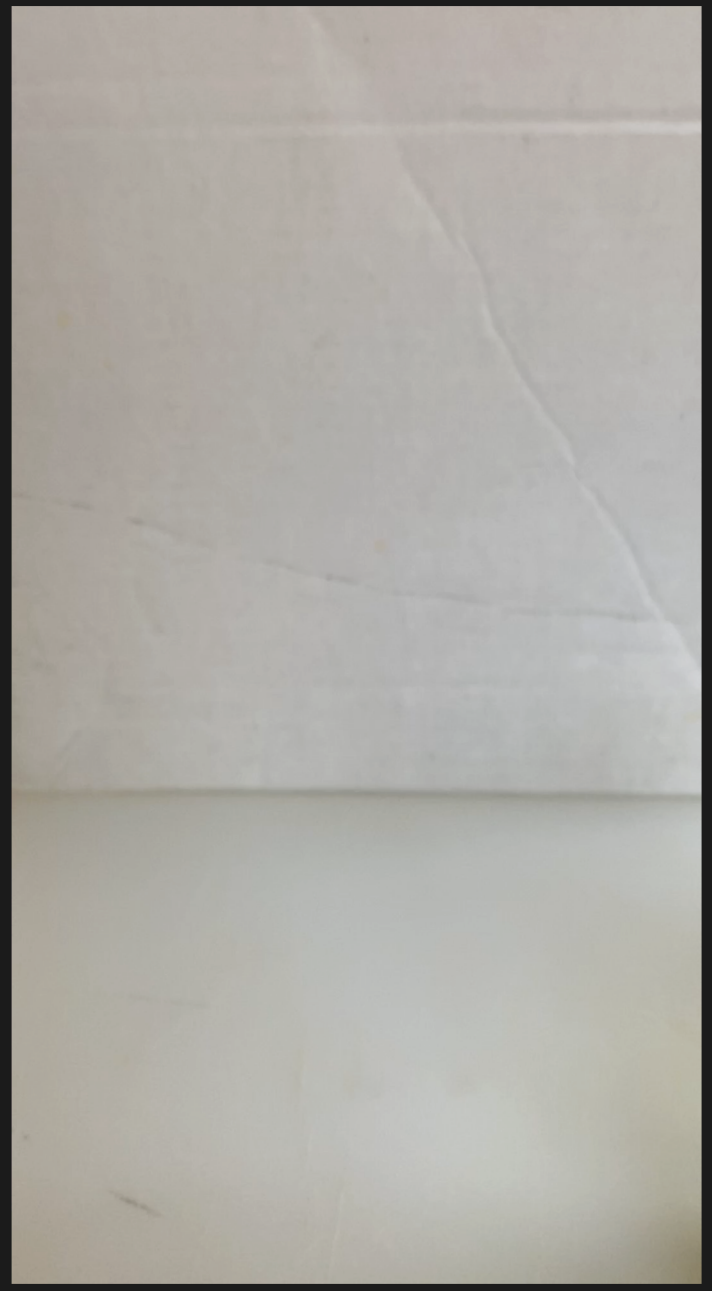
Photo B shows the same piece of glass *immersed in water*.

Photo C shows the piece *immersed in vegetable oil*. Pyrex and vegetable oil have similar indices of refraction as shown by the disappearance of the glass in the oil.

Glass Photos Handout

Video of Pyrex and Vegetable Oil

Link to Pyrex in Oil

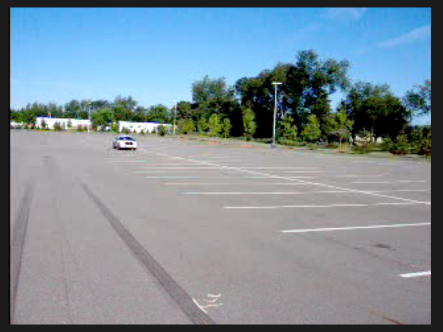


Glass Kit from Wards

- https://www.wardsci.com/store/product/12057595/forensic-analysis-of-glass-kit

Accident Investigation: Skid to Stop Analysis

- Crash reconstruction a 6 week course that includes lots of Physics
- Forces, Newton's Laws, Momentum, Mathematics, Kinematics (motion)
- Fun and easy: Skid to Stop Analysis
  - Enlist your local police officer with their vehicle
  - Take data outside, analyze inside
  - Opportunity for your local law enforcement to talk to high school students about safe driving practices!
  - Insurance Institute for Highway Safety (IIHS)
    - https://classroom.iihs.org/
    - https://classroom.iihs.org/category/lessons/ LOTS of great easy activities!
  - Uses in a Crime Scene



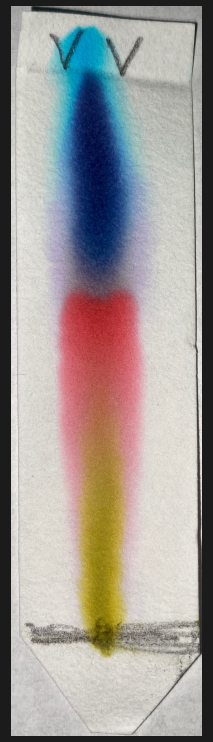
Link to Skid Link to Yaw

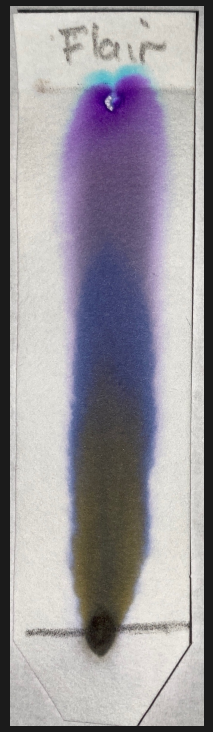
Paper (Ink) Chromatography

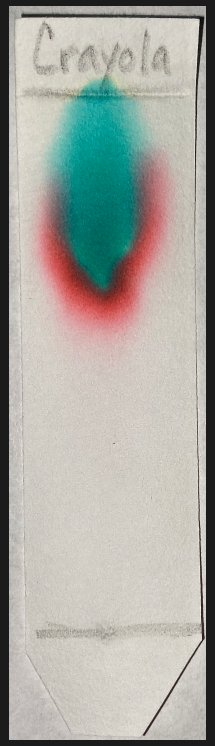
- Watercolor Ink Chromatography
- Permanent Ink Chromatography
- Science Concepts: Capillary action, solute, solvent, mobile phase, stationary phase,
- Two types of analysis
  - Qualitative
  - Quantitative

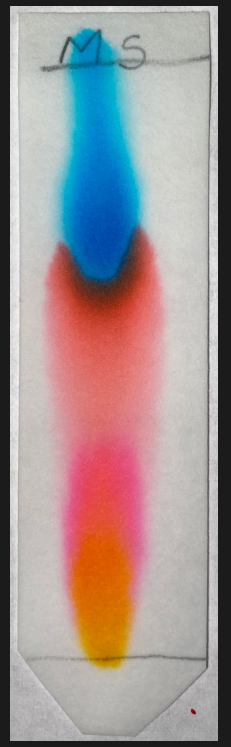
Paper Chromatography Qualitative Analysis

- Good Watercolor Inks: Vis A Vis, Crayola, Mr. Sketch (scented), PaperMate Flair, Prang, etc.
- Identify colors and Order of colors from start to finish.





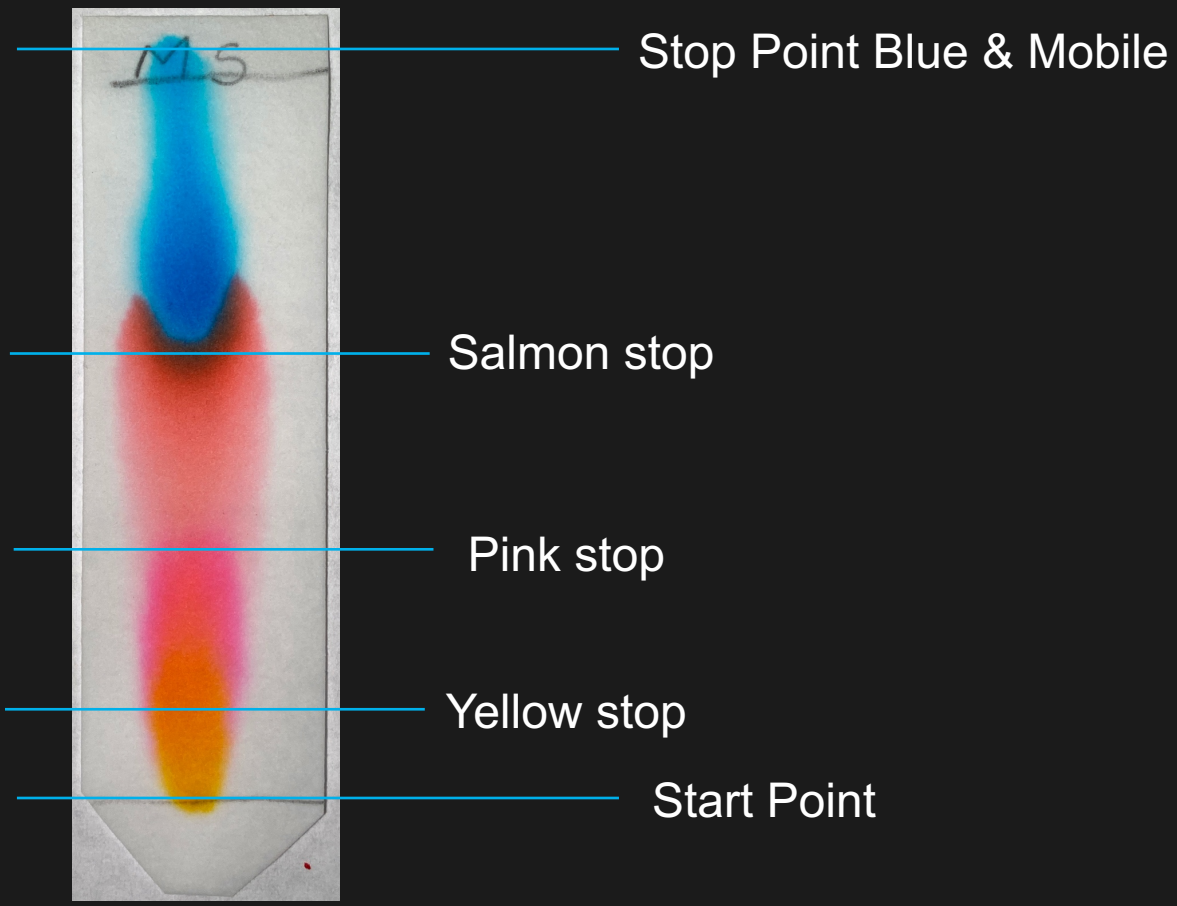




Paper Chromatography Quantitative Analysis

- Find the Retention Factor (R_f)

$$Rf = \frac{distance\ traveled\ pigment}{distance\ traveled\ solvent}$$



Example Calculations

Solvent distance = 40 mm
Pink distance = 20 mm

Rf Pink= 20 mm / 40 mm. = 0.5

Solvent distance = 40 mm
Yellow distance = 8 mm

Rf Yellow = 8 mm / 40 mm = 0.2

Setting up a Mock Crime Scene

Step 1

- What skills (evidence) do you want to assess?

Step 2

- What type of scene is conducive with the evidence?

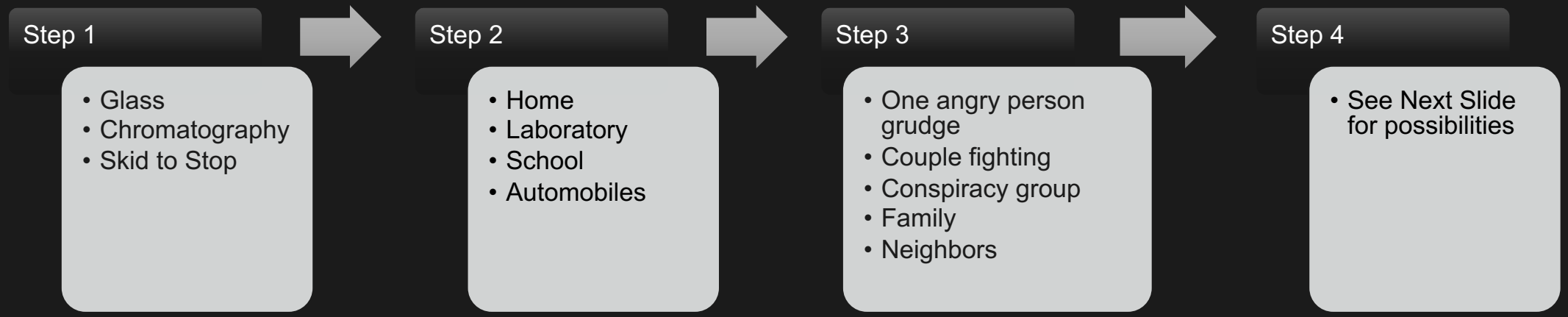
Step 3

- Who are in conflict?
- What is the motive(s)?

Step 4

- Get creative: Make up your story

Filling in the Steps



Creative Scenarios

- One Angry Person & Automobiles
  - Road Rage. Cars chase and one comes to Skid to Stop. Gets out and hurls rock at car, broken glass. Other person (2nd person) gets out of car and hits 1st person with bottle, broken glass. When 2nd person gets out of car he drops his grocery list, chromatography.
  - Fill in the details with names, places, etc.
- Conspiracy Group
  - Molotov Cocktail tossed into Laboratory along with a rock that has a threatening note. Skidded to a Stop to make the toss.
  - Fill in the details with names, places, etc.

Other Tips and Information

- Two Wonderful Facebook Groups
  - Forensic Science Teachers
  - Forensic Science Teacher Tribe
- The Forensic Teacher Magazine
  - FREE
  - http://www.theforensicteacher.com/intro.html
- Need more info or help?
  - kmirakovits@gmail.com
- Summer 2021 Teacher Workshops
  - Western Michigan University in Kalamazoo, Michigan
  - July 12-16 OR August 2-6
  - Info at www.forensicscience-ed.com
    - PDF with links to register
    - I will contact you as summer approaches with more details

Follow-Up Questions

1. Rate the workshop as to how it increased knowledge of the topics today:

   A: Big Help B: Somewhat Helpful C: Helped a Little D: Not Much

2. Of the topics we covered, which TWO do you really need to learn MORE about teaching in your course? Rank the two with 1 being the topic you need most.

   Glass Analysis Accident Investigation Chromatography Mock Crime Scenes

3. Choose ONE of the topics below that you feel you would like to learn more about (possibly during an online workshop dedicated to that ONE topic).

Forensic Anthropology Forensic Entomology DNA Analysis Blood & Bloodstain Pattern Analysis