Key Concepts of Chapter 9:

- **Chemistry Components:**
  - Element = any substance that cannot be broken down into a simpler one by a chemical reaction
  - Elements consist of atoms with the same number of protons in their nuclei
  - 92 elements occur naturally on Earth
  - Compounds = Two or More Elements
  - Molecule = Large Compounds
  - The smallest particle of an element that can exist and still retain its identity as that element is the **atom**

- **Physical and Chemical Properties**
  - **States of Matter:** Solid, Liquid, Vapor (Gas)
    - The same compound will always have a specific melting or boiling point
    - Solid has definite size and shape
    - Liquid has definite size but changes shape to fit container
    - Gas has no definite size or shape
  - **Physical**
    - Describes a substance without reference to any other substance
  - **Chemical**
    - Describes the behavior of a substance when it reacts or combines with another substance
  - **Weight & Mass:**
    - Pull of Gravity is what makes mass into weight
    - \( \text{WEIGHT} = \text{MASS} \times \text{GRAVITY} \)
    - On the Surface of the Earth, Weight = Mass
      - Measurement of weight is based on Mass and Gravity
  - **Density:**
    - \( \text{DENSITY} = \frac{\text{MASS}}{\text{VOLUME}} \)
    - Mass per unit of volume
    - If it takes up more space, it is more dense
    - A smaller volume with the same mass is more dense
    - Pound of Rocks and Pound of Feathers: same **mass** but different **volumes**
  - **Metric System**
    - Conversions:
      - 1 inch = 2.54cm
      - 1 meter = 39.37 inches
      - 1 liter = 1.06 quarts
      - 1 pound = 453.6 grams
      - 1 kilogram = 2.2 pounds
  - **Length:** Meters
    - Deci = 1/10
    - Centi = 1/100
- Milli = 1/1000
- Kilo = 1000

- Metric Volume
- Physical Properties
  - **Temperature:**
    - Melting point (MP): Solid to liquid
    - Boiling point (BP): Liquid to vapor
      - Water boils at 100°C
    - Sublimation: Directly from solid to vapor
  - **Refractive Index:**
    - Velocity of Light in Vacuum / Velocity of Light in Medium
    - Refraction is the same as “bending light waves”

- **Wavelength** is the distance from peak to peak or crest to crest
- **Frequency** is the number of wavelengths over a given unit of time

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**Glass**

- Windows:
  - Can be Automotive and/or Structural
- Considered Class Evidence because it is made in such large quantities
- Individual Characteristics may exist (Fracture Match)

- Glass as Evidence
  - Does glass correlate from scene to suspect?
  - The control sample must be from same pane as fracture
  - Class Evidence can exonerate a victim
  - Multiple combinations of class evidence can assist in building a case against a suspect

- Headlights/Tail lights:
  - If light is on, the filament is rusted because of oxidation with glass fragments attached
  - Heat adheres fragments
  - If light is off, the filament will be burned but NOT oxidized
  - If light is already broken prior to accident, the filament will be broken but no oxidation will occur
  - Use a rigid container for collection of glass and/or fragments

- **Glass Fractures**
  - Windshield
  - Residential/Commercial
  - Conveyance

- **Fracture Lines**
  - Radial
  - Concentric
Key Concepts of Chapter 13:

- **Analysis Method for Metals:**
  - **Emission Spectroscopy**
    - Used to obtain and record the line spectra of elements
    - Results are 1 spectrum
    - Qualitative Results
    - Can determine elemental composition of a substance
  - **Neutron Activation Analysis**
    - Specialized method for metal testing
    - Used for characterizing trace elements present in paint and soil
    - Requires neutrons and nuclear reactors
    - Most expensive test to run
  - **X-Ray Diffraction**
    - Works only on materials in crystalline form
    - Often combined with SEM
    - Gives Qualitative and Quantitative Results

- **Soil as Evidence**
  - Color
  - Texture
  - Density Gradient

- **Paint as Evidence**
  - **Types of paint evidence:**
    - Automotive
    - Architectural
    - Marine (i.e., boating accidents)
  - **Types of paint coatings:**
    - Solvent (spreadable)
    - Binder (carries the pigment)
    - Pigment (color)
  - **Layers of Paint**
    - Electrostatic primer
    - Base primer
    - Basecoat
    - Clearcoat
      - Additional layers after accident
    - Primer
    - Basecoat
    - Clearcoat
  - **Class Evidence**
    - Fracture Match
• Paint Analysis Techniques
  o Pyrolysis Gas Chromatography
    ▪ Melt fragment and retrieve resultant GC
    ▪ Whole piece of paint chip/evidence is vaporized
  o FT-IR
    ▪ Recognizes chemical makeup of different layers
    ▪ Does not damage evidence

• Paint spread onto a surface will dry into a hard film that can best be described as consisting of pigments and additives suspended in the binder
• Some of the most common types of paint examined in the crime lab are finishes from vehicles
• Auto manufacturers normally apply a variety of coatings to the body of a car. This wide diversity of auto paint contributes to the forensic significance of an auto paint comparison
• Questioned and known paint specimens are best compared side by side under a stereoscopic microscope for color, surface texture, and color layer sequence
• Pyrolysis gas chromatography and infrared spectrophotometry are used to distinguish most paint binder formulations

REFERENCE