Ballistics

(aka Firearms Identification)
The Identification of:
- fired bullets
- cartridge cases
- other ammunition components
as having been fired from a specific firearm

A form of Tool Mark Identification
- Firearm is the tool
- ammunition is the “impressed” surface
Because the ammunition is softer than the firearm

Typical Evidence Submitted to a Lab:
- fired bullets and shot
- spent cartridge cases and shot shells
- live ammunition
- clothing
In addition to matching a bullet to a specific firearm, examiners also determine …

- the muzzle-to-object distance
- the caliber and manufacturer of ammunition
- the manufacturer and type of firearms

Firearm Examiners …

- perform specific scientific examinations upon the evidence submitted.
- Submit reports detailing their findings to the investigating officer.
- present their findings in a court of law
Fundamentals

- No two firearms produce the same unique marks on fired bullets and cartridge cases because manufacturing processes, use, and abuse leave surface characteristics within the firearm that cannot be exactly reproduced in other firearms.

- Firearms do not normally change much over time. Tests have been conducted that found that even after firing several hundred rounds through a firearm the last bullet fired could still be identified to the first.

- Not all firearms leave consistent reproducible marks, but most leave a "mechanical fingerprint" on the bullets and cartridge cases that pass through them.
**Preliminary Examination**

Exam evidence for similar class characteristics. Class characteristics are intentional or design characteristics that would be common to a particular group or family of items.

Example - The color and eraser type are common class characteristics to all of the pencils in the picture below.

- Firearms Class Characteristics
  - caliber
  - barrel rifling pattern
- Cartridges & Cartridge Cases
  - breech marks
  - firing pin impressions
  - extractor marks
  - ejector marks

If class characteristics cannot be matched then the examination is over. If class characteristics are matched then the examination proceeds to the final stage.
Final Examination

Attempt to "match" the individual characteristics of ammunition and firearms.

Individual characteristics are …

• marks produced by the random imperfections or irregularities of tool surfaces
• produced during the manufacture and/or caused by use, corrosion, or damage.
• unique to that tool and distinguish it from all other tools

The transfer of individual characteristics from a firearm to the ammunition passing through it makes firearms identification possible.
3 Types of Ballistics Evidence

Internal Ballistics
Everything that happens inside the gun.

External Ballistics
Everything that happens from the time the bullet leaves the gun barrel until it hits an object.

Terminal Ballistics
Everything that happens once the bullet strikes an object.
Ammunition Basics

Ammunition and bullet are not the same thing. The bullet is a component of the ammunition.

- **Bullet** – the projectile that leaves the gun’s barrel.
- **Metal cartridge case** – holds the bullet, gun Powder and primer.
- **Powder** – the chemicals that ignite to accelerate the bullet.
- **Primer** – holds the primer compound, which is a pellet that ignites when struck by the firing pin, this in turn ignites the powder.
Caliber

- indicates the diameter of a bullet.
- for US Manufacturers measured in hundredths of an inch. A bullet that is 30 hundredths of an inch (.30) in diameter is called a 30 caliber bullet.
- for European Manufacturers measured in millimeters (mm). A 30 caliber bullet in the US would be referred to as an 7.62mm bullet in Europe.
Cartridges

• designation typically includes the approximate diameter of the bullet and the manufacturer's name.

• variations in length are designated by terms like Short, Long, or Magnum

• all of the cartridges seen on the right are in the 22 caliber "family" yet each has a different cartridge designation.

• cartridges designed for use in auto loading pistols will usually have the word AUTO in their cartridge designation

• cartridges with a +P designation contain different types of gunpowder to achieve higher velocities
To Determine Caliber

• measure the bullet's diameter
• weigh the bullet
• examine the physical characteristics of the bullet
• compare the bullet to known reference standards
Bullet Materials

• strike a balance between penetration and expansion
• if a bullet expands too much it may not penetrate deep enough to reach the internal organs of the target and immobilize or kill the target
• too much penetration and the bullet can pass through the target and continue down range wasting energy
Non-jacketed Bullets

• most common material used is lead
• usually an alloy of lead and antimony which is added to give the bullet some additional hardness.
• some have a thin coating of copper or brass plating referred to as a copper-washed or "Lubaloy" bullet.
• the Federal "Nyclad" bullet is coated with nylon to reduce lead emissions.
Jacketed Bullets

- a laminate of material, with the harder "jacket" covering a core typically made of lead
- jacket material cannot be easily removed
- most common bullet jacket material is copper
- sometimes plated with nickel to give the bullet a silver finish
- steel jackets are widely used in bullets made in Europe and China
- steel jacketed bullets are usually coated or plated to help prevent rusting

Cross section of copper jacketed lead bullet
Rifling

- most modern pistols, revolvers, rifles, and some shotgun barrels have rifling in their barrels.
- grooves cut or formed in a spiral nature, lengthwise down the barrel of a firearm.
- imparts a spin on the bullets to make their flight accurate, like a throwing a football
- lands are the raised areas between two grooves
- there will be the same number of lands as grooves
- firearms rifling can have any number of lands and grooves
- pattern can spiral either left or right
- common rifling patterns are 4/right, 5/right, 6/right, 6/left, 8/right, and 16/right
Examining Rifling Patterns
• determine if the bullet rifling pattern matches the firearm rifling pattern, if they do
• then look to match unique striation patterns that may have transferred to the bullet from the specific firearm under investigation
• these striations look like a bar code

Testing Procedure
• several bullets are fired from the gun being investigated into a water tank
• these are the standards that are compared to the bullet(s) from the crime scene
• use 5X to 40X magnifications
**Rifling (cont’d)**

- measure width of lands and grooves in either thousandths of an inch or millimeters
- lower right – bullets don’t have the same groove width
- observe the pitch of the lands and grooves, i.e. how slanted they are
- lower left – bullets are both 6/R but have different pitches
- use micrometers to take measurements of impressions on a bullet.
General rifling characteristics (GRC)

- the identified rifling pattern (i.e. 8/right) and the diameters of the individual lands and grooves.
- examiners search databases of known rifling data to narrow down the search for the unknown firearm.

**Example**

A typical GRC search might involve a 9mm LUGER bullet, fired from a 6/right rifled barrel, with a land width of .055 and a groove width of .125. The search produces data like this
Cartridge Cases

• usually brass
• but other materials such as steel and plastic are used
• materials are always softer than the gun
• can be identified as having been fired by a specific firearm
• unique tool marks may be created by loading the cartridge before it’s fired
Two Types of Tool Marks on Cartridges

Striated Action Marks

- "scratches" are produced when the cartridge case moves laterally against the inner surface of the firearm
- Most common are chamber marks, shear marks, firing pin drag marks, extractor marks, and ejector marks.
- Lower left and right images show matched striations
Impressed Action Marks

• impressions created on cartridge cases when it impacts the firearm with adequate velocity or pressure to leave a mark.

• most common are firing pin impressions, breech marks and ejector marks.

• lower left image shows matching breech marks

• lower right image shows bullets weren’t fired from the same gun because the breech marks and firing pin marks are different
Determining Distance

- evidence, typically clothing, examined for bullet holes
- try to determine which are entrance holes and which are exit holes; need entrance hole to determine distance
- for rifles and hand guns use gunshot residue to determine distance
- for shotguns use shotgun pattern tests to determine firing distance
Bullet Entrance Holes

• typically have very even margins
• most non-contact bullet entrance holes are smaller than the bullet due to the elasticity of the fabric
• contact or near contact entrance holes have uneven margins and severely damage clothing
• a bullet that struck an intermediate object typically has very uneven margins
• Bullets that strike a target at an extreme angle usually leave an elongated hole with fairly even margins
Entrance Holes (cont’d)

• common characteristic is presence of bullet wipe residue, which is a darkened ring around the immediate margins of the hole
• caused by lead being wiped from bullet surface as it passes through material
• lead bullets normally leave the heaviest residue
• jacketed bullets also leave residue because of lead fouling in barrel and lead primer residues can be on the surface of a jacketed bullet
• chemical tests for lead residue causes a pink reaction
Bullet Exit Holes

• non-jacketed bullets have an exit hole that is noticeable larger than the entrance hole

• expanding and fragmented bullets also have larger exit holes than entrance holes

• jacketed bullets have exit holes that are similar in size to entrance holes

• material may be frayed outward