WHAT IS FORENSICS?

- The term *forensic science* involves *forensic* (or *forensis*, in Latin), which means a public discussion or debate
- In a more modern context, however, *forensic* applies to courts or the judicial system
- Combine that with *science*, and forensic science means applying scientific methods and processes to solving crimes
- Entry-level forensic scientists usually have a bachelor's degree in forensic science or related field, such as biology, chemistry or physics
- A forensic science major typically includes those basic sciences, plus classes in pharmacology, statistics, computer modeling, biochemistry and criminal justice

WHAT IS FORENSICS?

- Forensics has evolved over the centuries
- In the 16th century, medical practitioners began using forensic science to uncover medical mysteries and learn about the body
- Writings in the late 18th century have revealed the first evidence of modern pathology (examination of body tissues) as part of forensic science
- The formation of the first school of forensic science occurred in 1909
- The development of forensic science has been used to uncover mysteries, solve crimes, and convict or exonerate (set free from guilt or blame) suspects of crime for hundreds of years

THE APPLICATION OF FORENSIC SCIENCE

- The extraordinary scientific innovations and advancements in forensic science have allowed it to become a highly developed science
- Forensic science involves a number of disciplines and thousands of forensic scientists specializing in everything from DNA and botany to dentistry, digital crime, fingerprints and art forgery
- The focus of the field of forensic science is on the recognition, identification, and evaluation of physical evidence
- It has become an essential part of the judicial system, as it utilizes a broad spectrum of sciences to achieve information relevant to criminal and legal evidence

THE APPLICATION OF FORENSIC SCIENCE

- Forensic science may prove the existence of a crime, the perpetrator of a crime, or a connection to a crime through the:
- Examination of physical evidence
- Administration of tests
- Interpretation of data
- Clear and concise reporting
- Truthful testimony of a forensic scientist

THE APPLICATION OF FORENSIC SCIENCE

- Forensic science has become an integral part of many criminal cases and convictions, with objective facts through scientific knowledge serving both defense and prosecution arguments
- The testimony of forensic scientists has become a trusted component of many civil and criminal cases
- Forensic scientists are professionals concerned not with the outcome of the case, but only with their objective testimony based purely on scientific facts
- Forensic scientists perform both physical and chemical analyses on physical evidence obtained by crime scene investigators and law enforcement officials at the crime scene

THE APPLICATION OF FORENSIC SCIENCE

- These scientific experts use microscopic examining techniques, complex instruments, mathematical principles, scientific principles, and reference literature to analyze evidence to identify both class and individual characteristics
- Although the majority of forensic scientists perform their jobs within the forensic laboratory or morgue, their work may also take them outside of the laboratory where they observe crime scenes and collect evidence
- Forensic scientists may work for local, state and federal law enforcement agencies, government, private laboratories, and hospitals
- They may also serve as independent forensic science consultants

THE ORGANIZATION OF FORENSIC SCIENCE

- Due to the highly complex field of forensic science, forensic scientists are most often skilled in a particular area of forensic science, such as art forgery, finger/latent prints, questioned documents, trace evidence, or firearms, just to name a few
- Forensic scientists may be divided into three, major groups: Forensic Pathologists, Forensic Scientists and Associated Scientists
- Forensic Pathologists include medical examiners and other professionals who oversee autopsies (an examination of the deceased person's body to discover the cause of death or the extent of disease) and clinical forensic examinations

THE ORGANIZATION OF FORENSIC SCIENCE

- Forensic Scientists include those forensic professionals working in law enforcement, government, or private forensic laboratories who are responsible for dealing with any number of specific tests and analyses, such as toxicology, ballistics and trace evidence
- Associated Scientists include scientific professionals lending their knowledge to forensic science, such as forensic odontologists, forensic botanists and forensic anthropologists to apply their knowledge to the forensic science field and to provide investigators with crucial information regarding everything from bite marks to insect infestation on a body (postmortem – after death)

FORENSIC SCIENCE

FORENSIC SCIENCE IN THE US: MEDIA PORTRAYAL

- Most people base the majority of their knowledge about forensic science on things they have seen on CSI and other TV shows
- But how accurate is what you see on TV?
- Do these shows reflect real forensics or are they pure fiction?

FORENSIC SCIENCE IN THE US: MEDIA PORTRAYAL

- The truth is that some shows are more realistic than others
- For example, some shows like CSI: Miami portrays forensic labs with resources and databases that real crime techs could only dream about
- It is more of a relationship drama set in a crime lab than a show about forensic science
- CSI: Miami is further from the truth than most other shows but is a good example of the problem with most forensics TV shows
- Forensics TV shows turn their main character or characters into something of superheroes who can solve any problem with science

FORENSIC SCIENCE IN THE US: MEDIA PORTRAYAL

- Many shows are based on true forensic science but show everything enhanced to make it more exciting
- This is both good and bad
- It makes the profession seem more interesting and attracts more people to forensics educations around the country, but it also makes criminals more paranoid
- They see what to do on TV and try to make sure not to leave any evidence that could allow the ability to be caught in a crime
- This makes it very hard for real forensics personnel with more limited resources

TRUE FORENSICS: BLOODSTAIN PATTERN ANALYSIS

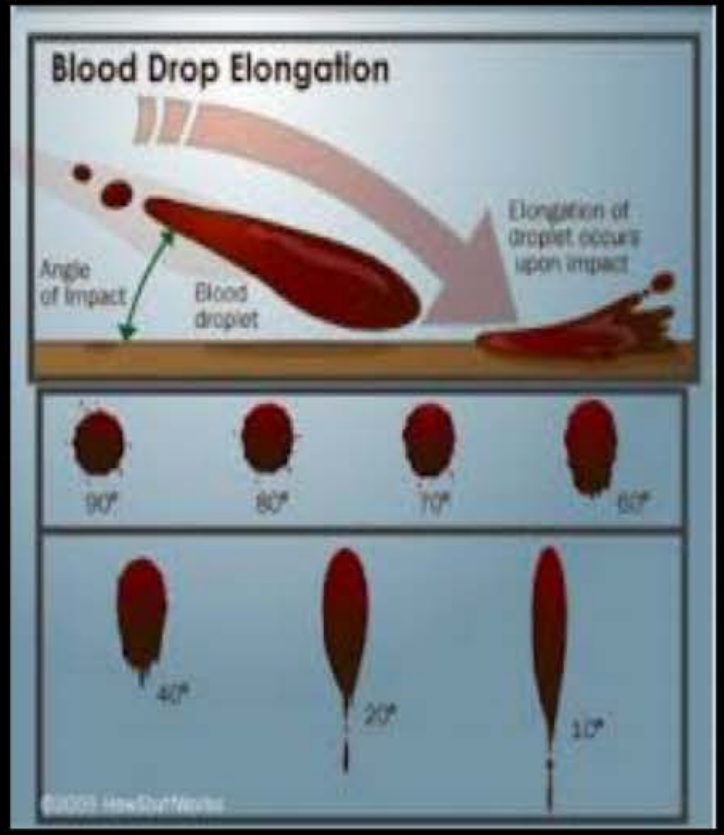
- Bloodstain pattern analysis (BPA) involves the study and analysis of bloodstains
- In forensic work, bloodstain pattern analysis can help investigators find out more about certain aspects of previous events at a known location or suspected of being linked to a crime in a significant way

BLOODSTAIN PATTERN ANALYSIS

- The bloodstain pattern can also give an indication of type of weapon used
- A small sharp weapon such as a honed cut throat razor will create a very different bloodstain pattern than that created by a blunt mallet or a stabbing blade
- A common misconception about blood in flight is that it has a natural tendency to form a teardrop shape
- Through experiments with blood, it has been shown that a drop of blood actually tends to form a sphere in flight
- The formation is caused by surface tension, which is what holds the drop together
- Surface tension gives fluids a tendency to acquire the least surface area possible

BLOODSTAIN PATTERN ANALYSIS

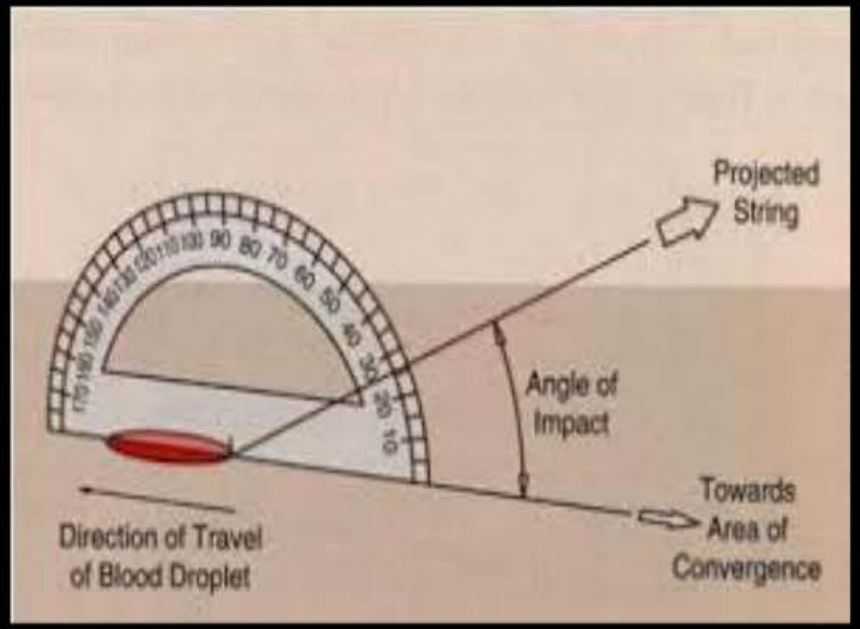
- So, why is the fact that blood drops in flight tend to be spherical important for bloodstain pattern (BP) analysts?
- Because it helps them make an accurate calculation of the angle of impact when they analyze blood that has hit a surface after being in flight
- Knowing the angle of impact is important for determining from which point or area the blood originated
- To reliably determine the area of origin, the BP analyst needs to consider several blood drop stains, and these stains should ideally be from opposite sides of the pattern
- Simply looking at a single drop isn't enough to come to any reliable conclusion


Blood Drop Elongation
Angle of Impact
Blood droplet
Elongation of droplet occurs upon impact
90°
80°
70°
60°
40°
20°
10°

BLOOD IN FLIGHT: AREA OF ORIGIN

- The area of origin is the three-dimensional space where the blood source was located when the blood began its journey
- It is important to remember that bodies tend to be dynamic
- Not only can the source of blood be engaged in major movements, but there are also small movements to take into account, such as the elasticity of skin
- When a force is applied to the blood source (e.g. when an attacker strikes the victim), an opposite reaction will be applied (see Newton's third law of motion) and this will moved the blood source somewhat, changing the exact point of origin

BLOOD IN FLIGHT: THE STRING METHOD



- The string method is one of the oldest techniques for determining space in which the bloodletting occurred, based on a bloodstain pattern
- First, angle of impact and area of convergence needs to be determined
- Then, the Blood Pattern (BP) analyst will place their protractor at the blood stain location and project a string at the angle of impact in the direction of the area of convergence
- Now, the string will show a general origin of the bloodletting

PHOTOGRAPHING BLOODSTAINS

- Bloodstains at a suspected crime scene are typically photographed in three different ways, since each way has its pros and cons when its time to analyze the scene
- Photographing the bloodstains is important for several reasons, and one of them is that a BP analyst might be unable to attend the scene personally and will have to relay on documentation, including photographs and videos, provided by others

OVERALL PHOTOGRAPHS

This is wide-angle images that capture a large part of a scene

By looking at these photographs, you will get a good idea about the general layout and how the bloodstains are located within this environment

Overall photographs of a crime scene are often taken parallel and perpendicular to the floor

OVERALL PHOTOGRAPHS

- Mid-range photographs are typically taken with a normal lens in the 45-55 mm range
- They provide greater detail than wide-angle images, but less detail than close-ups
- Mid-range photographs are often used to capture a single bloodstain pattern, giving the analyst a good idea about what the overall pattern looks like, but without providing information about how it related to the rest of the scene
- There is an art to taking photography in forensic science situations

OVERALL PHOTOGRAPHS

- Close-ups are taken with a macro lens and are useful when you need to see small details, such as stains that are just one or a few millimeters in diameter
- An analyst might wish to take a closer look at some of the thousands of individual stains that together form a medium velocity impact pattern
- One of the earliest scientific studies of bloodstain patterns was made by Dr. Eduard Piotrowski of the University of Kraków in 1895
- Even long before his study, bloodstain pattern analysis was sometimes used by law enforcement, but without much formal science to back it up
- Dr. Piotrowski's paper dealt with the formation, form, direction, and spreading of blood stains after blunt trauma to the head

BLOODSTAIN PATTERNS

- LeMoyne Snyder's 1941 book "Homicide Investigation," widely used by forensic analysts of that era mentions that bloodstains tend to fall in certain patterns based on the motion of an attacker and the victim, and that blood dries at a relatively predictable rate
- The International Association of Bloodstain Pattern Analysts (IABPA) was formed in 1983 in Corning, NY, under the guidance of Herbert MacDonell
- IABPA was founded by a group of blood stain analysts who wished to further the then emerging field of bloodstain pattern analysis via BPA education, standards for reporting, terminology, analysis and training
- It was in the early 1980s that forensic BPA started to grow and become a fairly regular occurrence in violent crime investigations in the US

BLOOD PATTERN CRITICISM

- A report released by the US non-profit organization The National Academy of Sciences in 2009 questioned the reliability of BPA methods, and highlighted several cases where blood splatter analysts had overstated their qualifications
- Just as with many other forms of forensic evidence, bloodstain pattern analysis used in the legal system rests on the analyst's interpretation of ambiguity, but this can be difficult to know for juries
- Another often overlooked fact is that not all blood is alike in humans, which in turn makes it difficult to actually obtain general facts based on conclusion drawn after carrying out a small set of experiments

FORENSIC DNA ANALYSIS

- If you have ever wondered if you were related to the Vikings or who your birth parents were or who committed a particular crime, then DNA may provide your answers
- In respect to DNA analysis, blood sampling is only one aspect
- There are as many ways in which distinct DNA characteristics can be harvested as there are reasons for the process

PURPOSE OF FORENSIC DNA ANALYSIS

- Forensics is one of the more popular pursuits in which the general population can appreciate the analysis of DNA
- DNA is genetic material, the fundamental and distinctive unchangeable characteristics or qualities of someone or something
- Applying forensics to the DNA of an individual can reduce the question of doubt almost to zero if done correctly
- If the DNA of a particular individual is harvested, it can be done in a variety of way as via blood, saliva, semen, vaginal lubrication and bodily tissues
- An investigation that hinges on sheer testimony alone can be completely overturned with the proof of a person's DNA analysis

PURPOSE OF FORENSIC DNA ANALYSIS

- The DNA profile can oftentimes prove to be the fact in a case due to its unique fingerprint like quality
- It only takes ***one tenth of one percent*** of human DNA to distinguish between one person and another
- That's 99.9% certainty!
- For example, during the 1980s in the UK, two teenagers had been raped and murdered within the span of three years; blood samples from 5,000 men were compared samples to the victims, to convict one may without question

SCIENCE BEHIND FORENSIC DNA ANALYSIS

- In addition to the gathering of blood, urine, tissue and bodily fluids, the reference sample needed to create a person's DNA profile can be collected several other ways
- Blood relatives can provide samples as well as sperm and tissue banks
- Samples can be obtained by analyzing human remains (body is exhumed)
- The reference sample is then purified by breaking the DNA away from the cell and its contents and analyzed through Southern Blot method, Polymerase Chain Reaction analysis, mitochondrial analysis, y-chromosome analysis, amplified fragment length polymorphism (AmpFLP) and STR (Short Tandem Repeats) analysis

SCIENCE BEHIND FORENSIC DNA ANALYSIS

- The bulk of what is used today around the world involves some form of STR analysis
- The amazing thing about our DNA is that the code in our cells is derived from the same two people
- Half of our information is from our mother and half from our father
- It can be harvested anywhere on our body from the day we are conceived until well beyond death
- This makes DNA analysis one of the most marvelous tools for justice systems ever to be discovered
- DNA can be quite convincing and convicting

FINGERPRINT FORENSICS

- The sense of touch is so important to us as human beings
- Many of the functions that our fingers do for us are mundane and rudimentary activities that we take for granted every day
- One of these that is not often taken for granted is to implicate (to show that someone is involved in a crime)
- Depending on which side of the law you are, your fingerprint can save or convict you
- Fingerprinting for the purpose of forensic investigation has been in use for a relatively short period of time compared to its impact on crime

PURPOSE OF FINGERPRINTS

- A human fingerprint does not change over time and is unique to each individual
- This fact alone makes it almost as vital to crime fighting as DNA analysis
- When fingerprints are analyzed forensically they are looked at for the purposes of detection of drug use, tobacco use and for criminal behavior

HISTORY OF FINGERPRINTS

- It was discovered in the middle of the 18th century that fingerprints were unique to each person
- As early as the 1930's criminal investigators found latent (hidden/concealed) prints in the insides of the very gloves used to protect the criminal's hands
- The technique of fingerprinting is relatively standard and straightforward in respects to a lot of other crime solving techniques
- One of the more recent developments in the field of fingerprinting is the use of the Scanning Kelvin Probe, a non-contact scientific device which scans the properties of materials
- There has also been the recent development of a technique which treats the fingerprint with gold nanoparticles leading to the detection of illicit and prescription drug use, tobacco products and even coffee

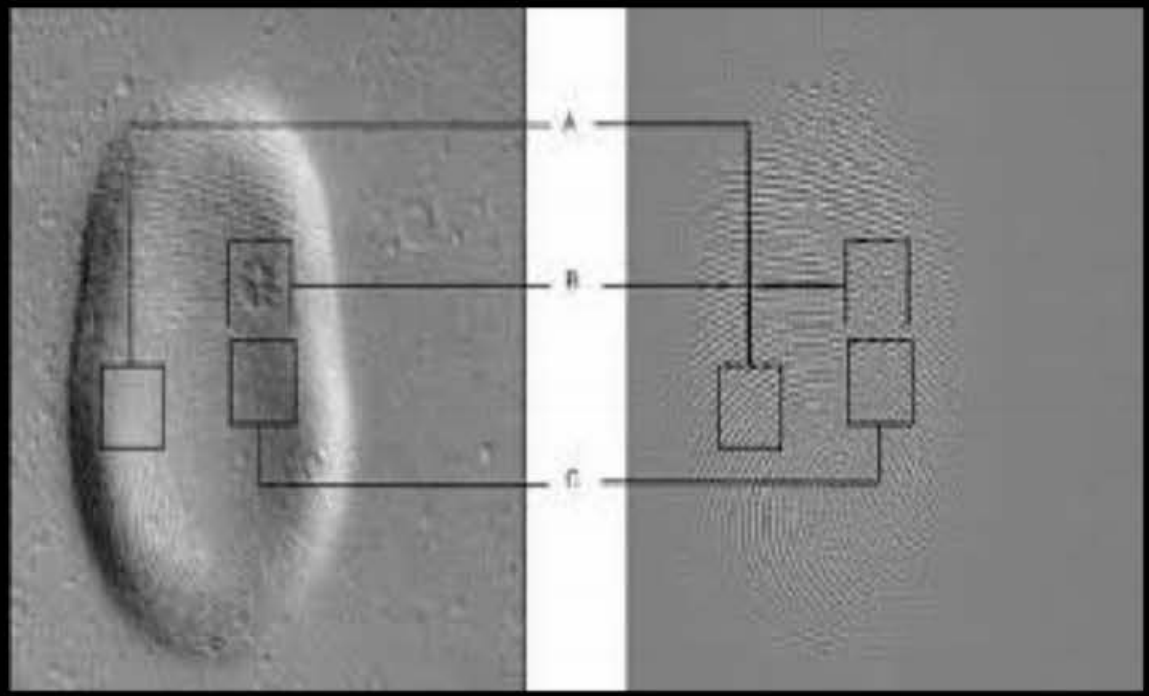
HISTORY OF FINGERPRINTS

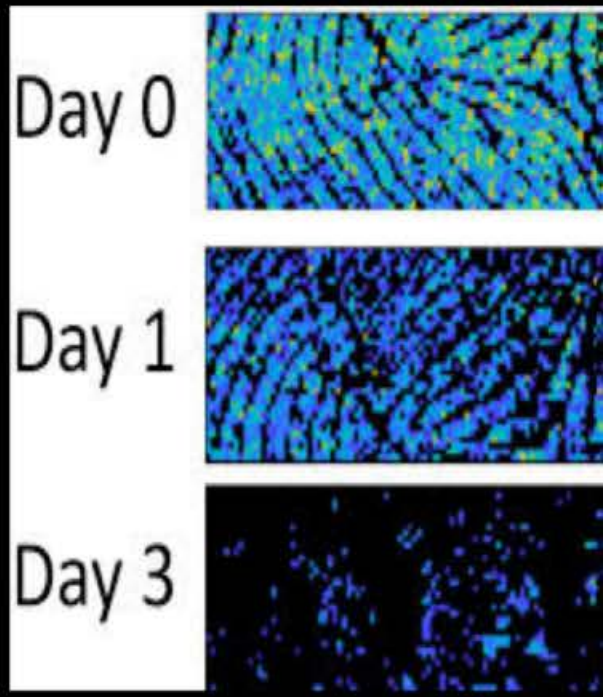
- Currently, one of the biggest problems with fingerprinting is at the site of the crime
- A decision must be made as to whether a DNA analysis swab must be done or a fingerprint dusting
- Once a swab for DNA is done, it destroys the fingerprint
- Prior to the discovery of DNA and its importance to forensics, the justice system had no such problem

SCIENCE BEHIND FINGERPRINTS

- The palmar (hand) surface of the skin on a human being has something called papillary ridges
- Oil and water combined with these ridges make up the fingerprint
- Since it is made up of the oils or sebaceous fluids gathered from touching ones face, it is able to remain on the surface that is touched
- Over 90% of the fingerprint is water secreted from the skin which eventually disappears
- The science behind fingerprinting ranges from the application of fine powders that act as the developer and adhere to the deposits from the fingertip to 3D visualization by the use of infrared lasers

FINGERPRINT DETECTION





SCIENCE BEHIND FINGERPRINTS

- It is known in the fingerprinting community that there are hundreds of techniques for detection
- Some of the more advance and technical methods are ninhydrin and vacuum metal deposition
- With metal deposition, gold and zinc is deposited and is able to detect fat layers within one molecule
- There are also ethyl cyanoacrylate polymerization which uses water based catalysis and polymer growth

FINGERPRINT ANALYSIS: CRITIQUE

- There are a lot of critics of the use of fingerprinting techniques and testing, but the practice has remained quite popular among the investigative community
- Forensically speaking, the fingerprint is as important to the criminal profile as is the mugshot

FORENSIC ODONTOLOGY

- Good teeth are so important to a good healthy life
- They can supply us with a warm smile and the ability to chew our food
- For some people, their teeth even serve as an extra hand or as a tool
- But for some people, their teeth are a weapon and can be used to hurt or even aid in murder
- Teeth can reveal so much about an individual like their identity, age and history
- Bite marks can even reveal a person's attacker or at the very least the abuse done to an individual

PURPOSE OF FORENSIC ODONTOLOGY

- This is where Forensic Odontology aids the criminal justice system
- Forensic Odontology helps to uncover the role a person's teeth and dental records have played in a potential or active crime investigation
- Odontology refers to dentistry
- The evaluation, assessment and opinion of bite marks alone can lead to a conviction in sexual assault, murder and child abuse cases
- Not only can a forensic odontologist asses bite marks on a victim, but they can also locate them on the perpetrator
- This is evidence of a struggle and proof of involvement with the victim

HISTORY OF FORENSIC ODONTOLOGY

- There are cases in legal history that support the effectiveness of forensic odontology and deny its effectiveness by leading to a wrongful conviction
- This can be the case for any forensic science, so it has been treated with ever increasing regulation and standardization over the years
- Forensic odontology has been in the forefront of legal investigations from as early as 1692 at the times of the Salem witch trials all the way into our current justice system

SCIENCE BEHIND FORENSIC ODONTOLOGY

- The science of Forensic Odontology centers around several core responsibilities that must be attended to like the assessment of abuse cases of any age of an individual and malpractice cases
- They also asses bite mark injuries, estimate age and identify human remains if found and unclaimed or unidentifiable
- With the proper evaluation of a crime scene and evidence, the forensic odontological professional will be able to distinguish a lot of information from an actual victim and perpetrator
- The investigator will use tools like dental records prior to death
- They will also use DNA information and post-mortem (after death) radiographs (images produced via radiation, such as X-rays)

SCIENCE BEHIND FORENSIC ODONTOLOGY

- Dental impressions will be made on a victim with bite marks which are then matched up with the suspects dental impressions to prove guilt
- A dental lineup can be created where multiple impressions of a person's teeth are compiled together
- In criminal cases, this is necessary to ensure accuracy
- Age evaluation is a vital part of forensic odontology because it can aid in victim identification, looking at how teeth have erupted from the gums over time, evaluating tooth wear and tissue that has mineralized
- The field of dentistry takes on a whole new dimension when used in conjunction with investigative techniques
- The forensic odontology report can really give an investigation the teeth it needs for a conviction, or at least the evidence to support the criminal case

ART FORENSICS

- Again, forensics is the investigation of a possible crime using an applied field of study
- Art forensics attempts to detect forgeries, deception and stolen property all with the intent to satisfy the owner, buyer, auction house, collector and insurance companies
- It is estimated that more than 20% of art produced and sold is forged (is fake)
- Given this statistic, art forensics is vital to the industry

ART FORENSICS

- The art behind a forgery is not unlike the art behind an original
- It takes skill, technique and a masterful hand to recreate a masterpiece
- So why do skilled artists try to pull the wool over unsuspecting collectors eyes?
- It is for the same reason that an armed robber breaks into a museum and steals the paintings right off of the walls
- It is to steal someone's work, lifelong dream and legacy all for profit
- It's all about the money

ART FORENSICS

- Art forensics is a field of study that has risen to a level of importance in the past years more than any other time in our history
- This is primarily because of the sophistication of thieves and forgers
- No other time in our existence have art thieves had the tools to commit such elaborate crimes with such credibility thanks to technology and the amount of knowledge at their fingertips
- The art behind a con artist deals with the same materials, artistic style, subject and form as the original
- It is only when this varies from the original that a crime is detected

ART FORENSICS

Please watch on YouTube this short video:

How to Spot a Fake Painting

(Art Forgery Forensics)

https://www.youtube.com/watch?v=KA5Kr1qhSyg

HISTORY OF ART FORENSICS

- One of the most famous artist ever known got his start by forgery
- Michelangelo carved a statue and posed it to be an ancient Roman statue, and was respected for his technique!
- Attitudes have certainly changed in respect to the authenticity of art
- There is a fine line between forgery and fraud
- Forgery during the Renaissance was commonplace, as it was how young apprentices learned their craft from their master painters
- They mimicked the masterpiece until perfect, to judge their own progress into their own right and style of painting

HISTORY OF ART FORENSICS

- Salvador Dali, the second most forged artist next to Picasso was known for signing blank canvases later to be painted by other artists
- It is known in the art world that Dali's lithographs have been forged thousands of times and rumored that he allowed it for a share of the profits
- Forgery in modern times is considered a crime
- For instance, in some fraudulent works of art, extremely powerful microscopes are able to be used to detect paint that may have not even been available at the time of the original piece

Dalí, Salvador: *The Persistence of Memory*
The Persistence of Memory, oil on canvas, by Salvador Dalí, 1931; in the collection of the Museum of Modern Art, New York City.

Picasso, Pablo: *Guernica* *Guernica*, oil on canvas by Pablo Picasso, 1937; in the Museo Nacional Centro de Arte Reina Sofía (Queen Sofía Museum), Madrid. 3.49 × 7.77 m.

SCIENCE BEHIND ART FORENSICS

- Sometimes a synthetic fiber is found in the artwork, revealing a clue that it was produced recently
- Contemporary materials found in a painting or sculpture are always a clue to fraud when the painting was from a different era
- Sometimes an art forensic consultant will find a paint pigment or a particular chemical in the painting that would have never been used at the time of the original
- Whatever the case, be it fraud or an investigation into a total loss, the forensics of art is always an art unto itself
- One has to be familiar with artist techniques and with criminal technique to truly detect the art of the con itself

HOW EXPERTS FIGURE OUT ART IS FAKE

- Please watch on YouTube this short video
- *Forgery Experts Explain 5 Ways To Spot A Fake | WIRED*

- Forensic scientist Thiago Piwowarczyk and art historian Jeffrey Taylor PhD from examine a purported Jackson Pollock painting and use their expertise to determine if the painting is legitimate or a forgery

- https://www.youtube.com/watch?v=Amu2mOslz-w

FORENSIC ART

- What about Forensic Artists?
- Some work on helping with facial sketches
- Please watch this amazing video on YouTube
- *Forensic artist helps catch over 1000 criminals - Meet the Record Breakers*
- https://www.youtube.com/watch?v=x6vj-3KlcJM

FORENSIC ART

- What about Forensic Artists?
- Some also help with facial reconstruction
- Please watch on YouTube
- *The Art of Forensics at the New York Academy of Art*
- https://www.youtube.com/watch?v=aCLwsKHvWmc

FORENSIC ART

- Composite Art is an artistic technique used to create a drawing from individually described parts into a single image
- It is intended to be a likeness or similarity of a victim's or witness's perception of a suspect or subject at the time a person was viewed
- It is used by law enforcement for the identification of a wanted suspect
- Age Progression is used for missing persons, after the death of a loved one in projecting what that individual may look like in the present
- http://www.forartist.com/forensic/modification/mlageings/mlaging.htm
-

FORENSIC ART

- Image Modification is an artistic technique, used for alteration or enhancement of a photograph for the purpose of age progression, age regression, updating or changing a subject
- This is done by drawing or digitally with a computer, and is primarily used by law enforcement for subject identification, but can be a useful and entertaining technique for many other purposes
- Photographic manipulation began almost as soon as photography was invented
- Some of the earliest recorded manipulations come from Civil War era America, where composite images were made of Abraham Lincoln and Ulysses S. Grant
- These early manipulations were done using inks, airbrushes and darkroom techniques, but since the 1980s, almost all manipulations have been done via computers

Airbrushing and photo-manipulation is now accessible to almost anyone and Adobe's Photoshop makes regular appearances on lists of most pirated software

FORENSIC ART

- Postmortem Reconstruction is the rendering of facial features of an unidentified deceased person or decomposed skeletal human remains created by sketching, digitally or with clay
- The final reconstructions are used for identification
- Morgue photographs of unidentified homicide victims, along with any additional information about the deceased from a medical examiner is provided to the artist
- This subject was eventually identified with the help of this reconstruction
- http://www.forartist.com/forensic/reconstruction/mwdoapage.htm

THOUGHTS?

- Art, drugs, addiction and forensics have all been brought together in the course by this point
- Answer the following, 200-300 words and post to Bb Discussion Board. Please put your name on the post, and use each question as a heading to be followed by your answer
- (1) What aspect of the presentation on forensics did you find most interesting?
- (2) What about the aspect made it most interesting?
- (3) Go onto any of the links provided and describe how you felt once you finished viewing the content
- (4) What about the link's content did you find interesting and why?