UNIT 2

CONTENTS

- Tools and techniques in Forensic science
- INTERPOL and FBI
- Duties of forensic scientist
- Code of conduct for forensic scientist
- Data depiction
- Report Writing

TOOLS AND TECHNIQUES IN FORENSIC SCIENCE

- Scientific approach for evidence examination
- Multidisciplinary
- Depends on type of physical evidence under examination
- Questioned document division (VSC, ESDA, Stereo zoom Microscope)
- Physics (Refractometer, SEM, Differential Thermal Analysis, Sound spectrograph)
- Ballistics and explosives (IBIS, NAA for GSR, Comparison Microscope, Ballistic Chronograph, EDXRF)
- Fingerprint (AFIS, Polilight)
- Biology(STR, RFLP, PCR)
- Chemistry and toxicology (Spectroscopy, Chromatography, NIK)
- Psychology (Polygraph, Brain Mapping, Narco analysis)

QUESTIONED DOCUMENT DIVISION

1. VSC- Video Spectral Comparator
2. ESDA- Electrostatic Discharge Apparatus
3. Stereo Zoom Microscope

1. VIDEO SPECTRAL COMPARATOR (VSC)

- The VSC is a tool in the analysis of questioned and security documents
- Examination, comparison and authentication
- To analyze inks, visualize hidden security features, and reveal alterations on a document
- An imaging device for the visual examination
- VSC is a comprehensive digital imaging system
  - High resolution optics
  - Multi-spectral illumination
  - Powerful software

PRINCIPLE

- VSC works on the basic principles of light
- Reflection, Absorption, Transmission, Luminescence
- By using variety of illumination and filtering devices to reveal differences in IR absorption, transmittance, and luminescence and long wave UV excitation of visible luminescence (Fluorescence)

INSTRUMENTATION

- Two components
  1. Imaging device
  2. A desktop computer with Imaging software

Imaging Device

- A color charge coupled device (CCD) video camera,
- A black and white CCD video camera
- Excitation/barrier filters
- Radiant energy sources (tungsten, halogen, and fluorescent lam

Imaging Software

- Complete control of VSC system hardware
- Image processing, comparison and analysis

APPLICATION

- Handwriting comparison
- Analysis and examination of paper
- Altered documents
- Examination and comparison of ink
- Examination of altered or obliterated entries
- Security features in documents

2. ELECTROSTATIC DISCHARGE APPARATUS

- A specialized apparatus for questioned document analysis to decipher indentations or impressions
- Non-destructive technique
- Sensitive
- Capable of detecting indentations or impressions or sub-surface writings several layers beneath the top-most sheet

PRINCIPLE

- Based on principle of electrostatic attraction
- Indented areas of the document carry less negative charge than surrounding areas.
- The surface of the paper causes a different pattern of charging in those areas where there are indentations.
- This causes the toner used in the EDD to be attracted to these areas, revealing indentations that are present.

INSTRUMENTATION

ESDA machine consists of

- a thin base on which the document is to be kept
- a cellophane which is a plastic film kept on the document with the help of vacuum,
- electrostatic charge device
- Toner

APPLICATION

- Cheque Forgery
- Traced Forgery
- Ransom note
- Anonymous letter identification

3. STEREO MICROSCOPE

- The stereoscopic microscope is two compound microscopes mounted side by side
- It is easier to use, having a tube to occupy each eye (binocular vision)
- The wide area of view
- This instrument shows the image erect or upright, in its true position with respect to the viewer
- Its design permits the microscope to be moved over the object rather than the object moved under the microscope,

APPLICATION

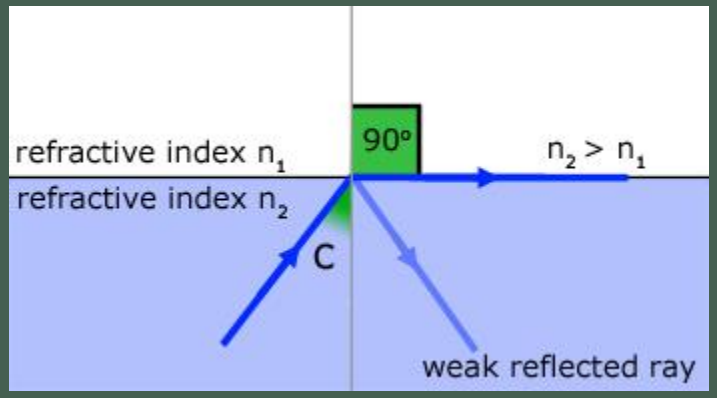
- Authenticity or spuriousness of signatures
- Traced signatures
- Folds in document
- Mechanical erasure,
- Alterations
- “Unusual documents" or objects related to document

PHYSICS DIVISION

1. Refractometer
2. SEM
3. Differential Thermal Analysis
4. Sound spectrograph

1. REFRACTOMETER

- A refractometer is a laboratory or field device for the measurement of an index of refraction.
- Abbe's refractometer is most widely used refractometer.
- Based on principle of critical angel.



APPLICATION

- For glass evidences
- Identity of a suspected vehicle.
- Comparison of two or more glass fragments
- Source of origin

2. Scanning Electron Microscope (SEM)

- SEM uses a fine beam of electrons for visualization of specimen.
- When the specimen is irradiated with a fine electron beam, the secondary electrons are emitted from the specimen surface.
- SEM has a much greater depth of field than optical microscopy, and can hence provide much clearer images.
- Allows focus on poorly visible or invisible microscopic traces of evidence
- Samples require no preparation, and can be examined in their natural state.
- Imaging, image comparison and X-ray micro-analysis

APPLICATION

- Gunshot residue analysis
- Firearms identification (bullet markings comparison)
- Examination of paint particles
- The cause of textile fiber damage
- Trace evidences in shoes
- Pollen on clothes
- Trace comparison

4. DIFFERENTIAL THERMAL ANALYSIS

- The analysis of a change in a property of a sample, which is related to an imposed change in the temperature.
- The temperature of a sample is compared with that of an inert reference material during a programmed change of temperature.
- This differential temperature is then plotted against time, or against temperature to generate **Thermogram**.
- A DTA curve can be used as a finger print for identification purposes.

APPLICATION

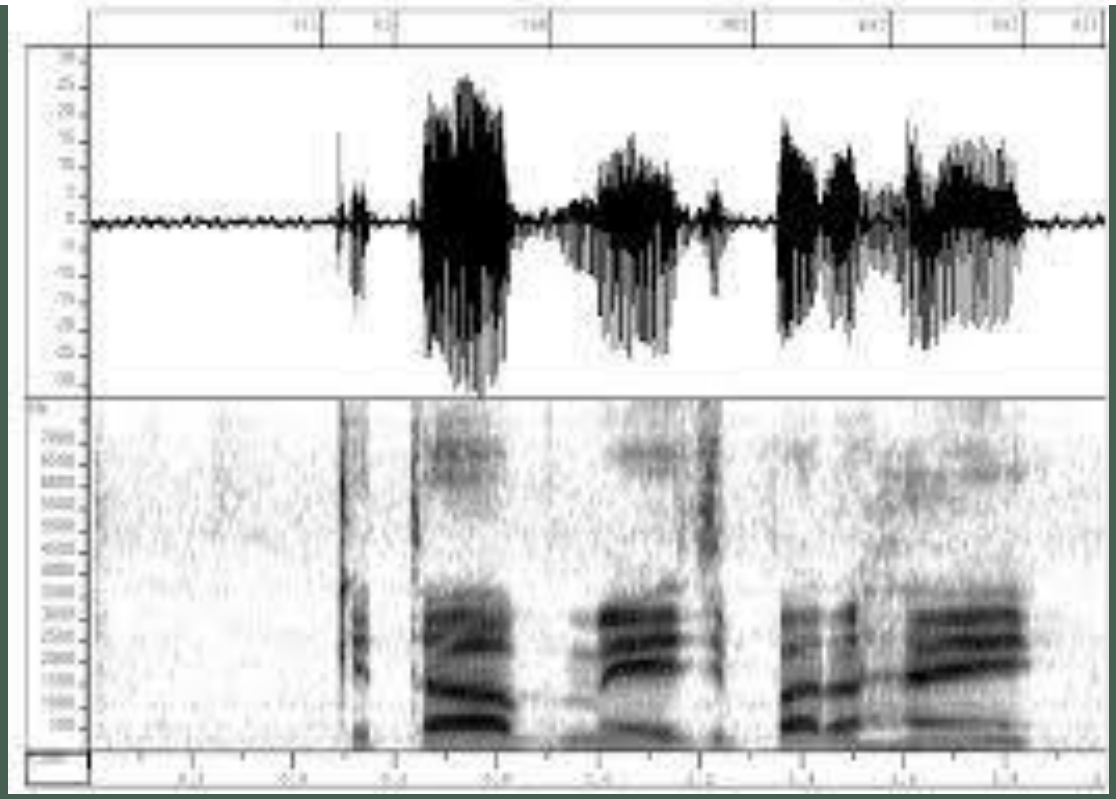
- Analysis to dating bone remains
- Characteristic of polymeric material
- Cement, soil, glass, etc.
- Food forensic analyses,

4. SOUND SPECTROGRAPH

- Automatic sound wave analyzer
- Analysis and classification of human speech sounds
- It is a graphic depiction of the patterns, in the form of bars or formants, of the acoustical events during the time frame analyzed.

APPLICATION

- Voice Analysis



BALLISTICS AND EXPLOSIVES

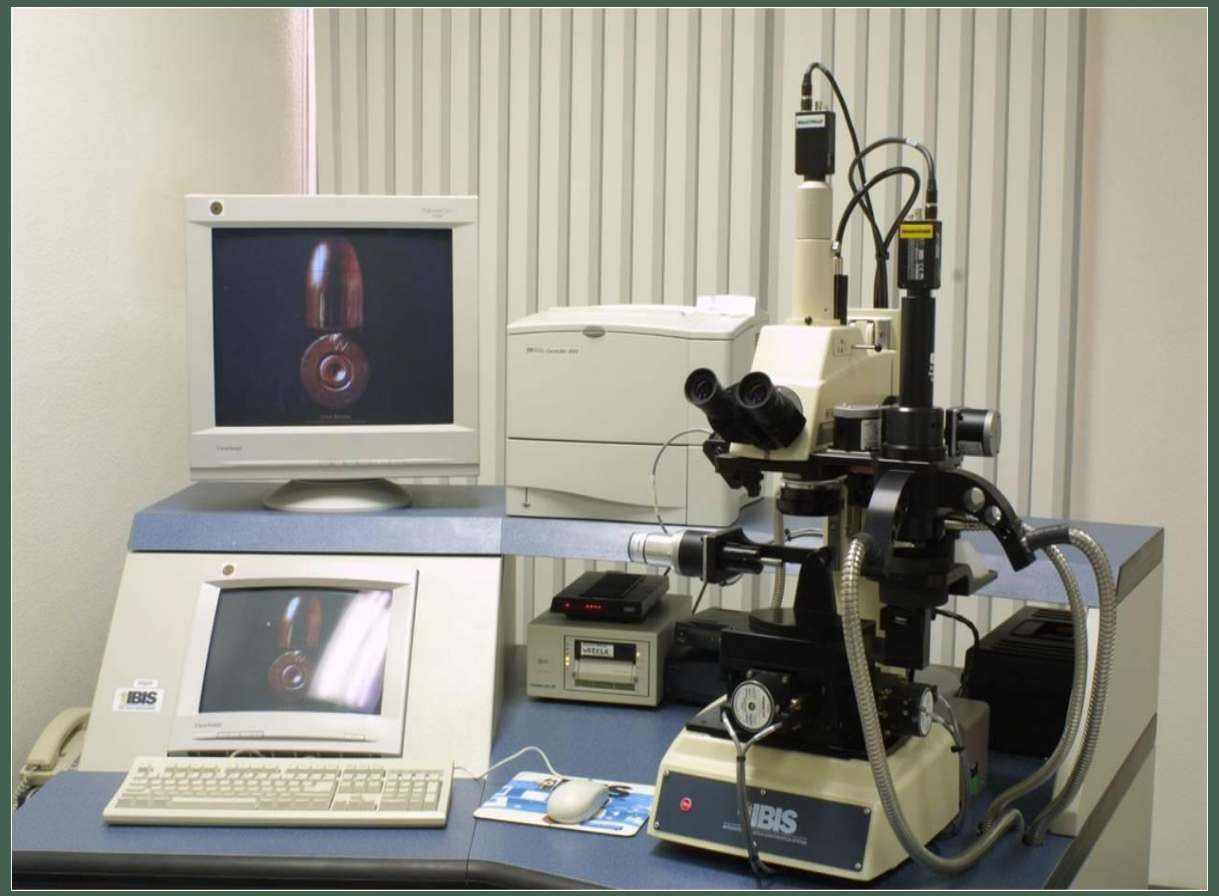
1. IBIS (Integrated Ballistics Identification System)
2. NAA (Neutron Activation Analysis)
3. Comparison Microscope
4. Ballistic Chronograph
5. EDXRF (Energy Dispersive X-Ray Fluorescence)

1. IBIS (Integrated ballistics identification system)

- The IBIS uses sophisticated electronic and optical technology to digitally compare evidence stored in the database.
- Uses several computer programs to help identify firearms.
- The acquisition, storage and comparison of digital images from projectiles and cartridge cases
- Imaging
- System storage
- Comparison

APPLICATION

- Firearm identification
- Bullet and cartridge case analysis



2. COMPARISON MICROSCOPE

- The comparison microscope is used to compare microscopic items side by side.
- Images from two microscopes are observed side by side in a single field of view

APPLICATION:

- Bullets comparison
- Cartridge case examination
- Comparison of paint chips
- Hairs and fiber analysis

3. BALLISTIC CHRONOGRAPH

- A chronograph measures projectile velocity
- The device infers the activation of the internal sensors caused by the passing projectile as time-stamped events.

APPLICATION

- Velocity of projectile or bullet

4. NAA (Neutron Activation Analysis)

- Sensitive analytical technique
- Non- destructive
- Qualitative and quantitative multi-element analysis
- Elemental compositions of samples.
- Determining the concentration of elements in a varied amount of materials.

APPLICATION

- Analysis of GSR

5. EDXRF (Energy Dispersive X-Ray Fluorescence)

- Based on the emission of characteristic X-ray radiation when a sample is exposed to exciting radiation from more energetic X-ray
- Non-destructive
- Widely used for elemental and chemical analysis

APPLICATION

- Investigation of
  1. metals,
  2. glass
  3. ceramics
  4. building materials

POLILIGHT

- Most versatile tool in forensic science.
- For detection of various types of invisible fingerprints, bodily fluids, blood stains and revealing document forgeries
- A powerful lamp containing the ultra-violet, visible and infrared components of light.
- Screens down the light into separate color bands that improve the imagining of evidence by light interface techniques

AFIS (Automated fingerprint identification system)

- To scan and digitally encode fingerprints for high speed computer processing
- Uses automatic scanning devices to convert the image of a fingerprint into digital minutiae
- To store each fingerprint in the form of a digitally recorded geometric pattern
- Search algorithm determines the degree of correlation for both the search and file prints
- Uses a scoring system
- Displays file prints with the closest correlation to the search prints
- Examined by a trained fingerprint expert for final verification.

NIK (Narcotics Identification kit)

- Drug identification system
- For field testing
- For speedily classification of prohibited or controlled materials
- Presumptively identification of the most commonly encountered narcotic and street drugs

CHROMATOGRAPHY

- Separating technique
- Process
  - First : Mixture is dissolved in a substance called **the mobile phase**
  - Second: Passed through a second substance called **the stationary phase**
- The different components of the mixture travel through the stationary phase at different speeds, causing them to separate from one another.
- The nature of the specific mobile and stationary phases determines which substances travel more quickly or slowly, and is how they are separated. Retention Time.
- Types
  - Liquid Chromatography
  - Gas chromatography etc.

SPECTROSCOPY

- The branch of science which deals with the study of interaction of Electromagnetic Radiation with matter.
- The quantitative study of electromagnetic spectra.
- The calculation of quantity of light absorption.
- Deals with visible light, near- ultraviolet, and near- infrared.
- Establishing the identity of two different compounds
- Types of spectroscopy
  1. UV-Visible
  2. IR (Infrared)
  3. Atomic
  4. Raman
  5. Mass
  6. XRF (X-ray fluorescence)

POLYGRAPH

- The mechanical lie detector
- Polygraph measures or records the following four parameters:
  1. **Blood Pressure**
  2. **Respiration**
  3. **Galvanic Skin Reaction**
  4. **Pulse**
- The person has to answer the questions in "Yes" or "No" as answers.
- Three types of questions are asked as:
  1. **Irrelevant questions**: Having no relation with the incident.
  2. **Relevant questions**: Having relation with the incident
  3. **Control questions:** Known, such as name, age, family etc.
- The response to change in respiration and galvanic skin reaction are assumed to be more reliable.

NARCO ANALYSIS

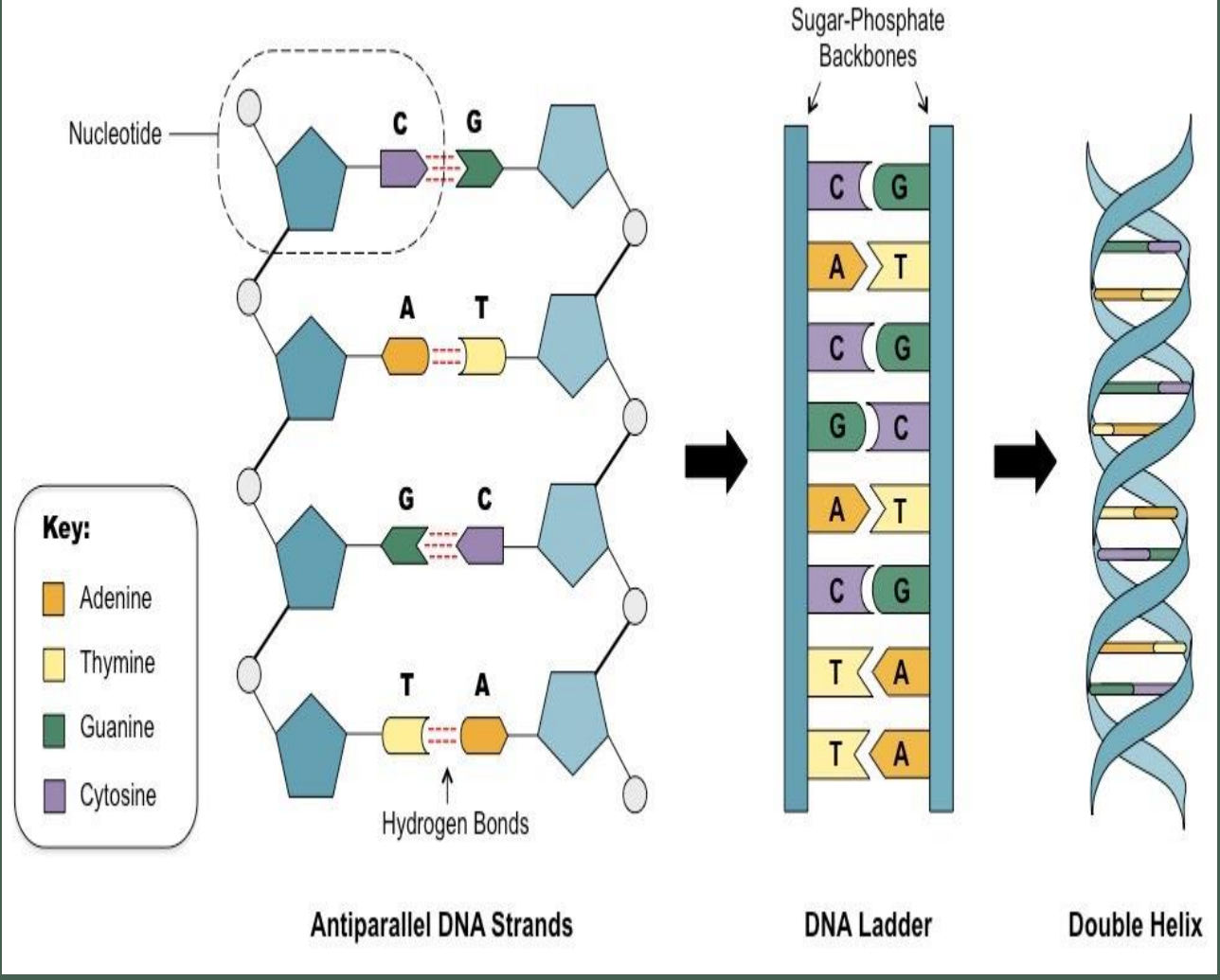
- Also known as "Truth Serum Test".
- Investigation of mental content of a person done after application of light general anesthetic drugs.
- Based on the principle that at a point very close to unconsciousness, the subject would be incapable of inventing falsehood that he has used to conceal his guilt.
- General drugs:
  - Scopolamine hydro bromide
  - Sodium secnol
  - Benzodiazepines
  - Thiopentone sodium or Sodium pentothal
- The drugs when induced intravenously cause several phases of aesthesia.

BRAIN MAPPING

- It is an **instantaneous psychophysiological valuation** of an individual's **response** to **certain stimuli** for example, pictures, words or phrases presented on a computer screen.
- Uses Electroencephalography (EEG), known as the P300
- P300 wave as "MERMER"- Memory and Encoding Related Multifaceted Electroencephalographic Response
- Human brain emits a characteristic P300 subject responds to a stimulus by updating his memory
- P300/MERMER response is not evoked when the stimulus is irrelevant to the subject's memory context
- Known and Unknown responses for baseline correction or to compare
- An overall result is obtained, demonstrating whether the probes have evoked a P300/ MERMER recognition response or a flat non-recognition response.

STRUCTURE OF DNA

- A very large molecule or polymer made by linking a series of repeating units called **nucleotides.**
- Four types of bases are associated with the DNA structure:
  - Adenine (A), Guanine (G), Cytosine (C), and Thymine (T)
- The bases on each strand are properly aligned in a double-helix configuration
- Adenine pairs with thymine and guanine pairs with cytosine. This concept is known as **base pairing**.
- The order of the bases is what distinguishes different DNA strands.

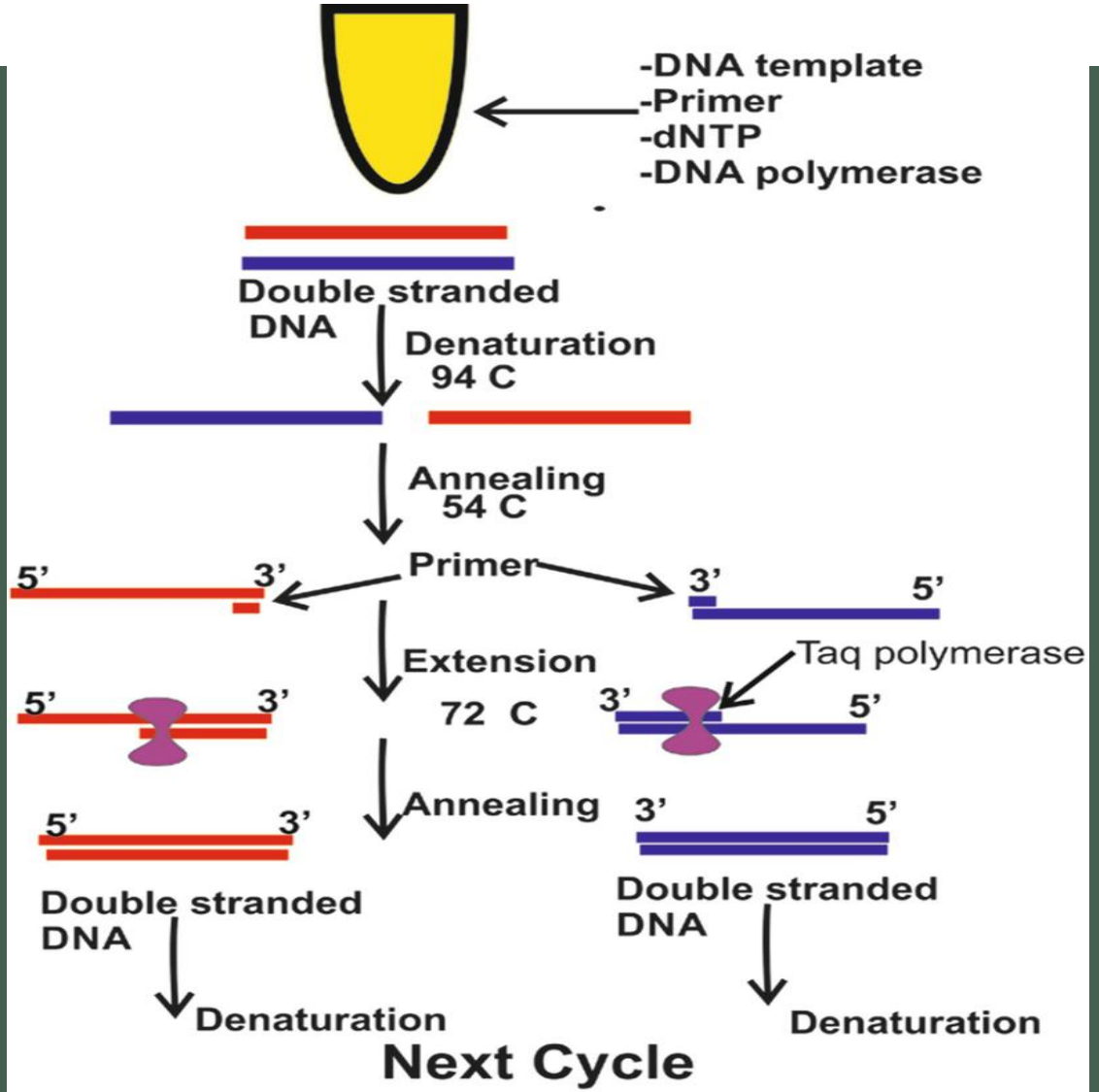


DNA PROFILING

- **Human genome is largely composed of repeating segments of DNA**
- Act as filler or spacers between the coding regions of DNA.
- Same type of repeats, but tremendous variation in the number of repeats.
- **Restriction Fragment Length Polymorphisms (RFLPs)**
- **STR (Short Tandem Repeats)-** short repeats (2-7 bps)
- A number of different RFLPs were selected for DNA Typing

PCR (POLYMERASE CHAIN REACTION)

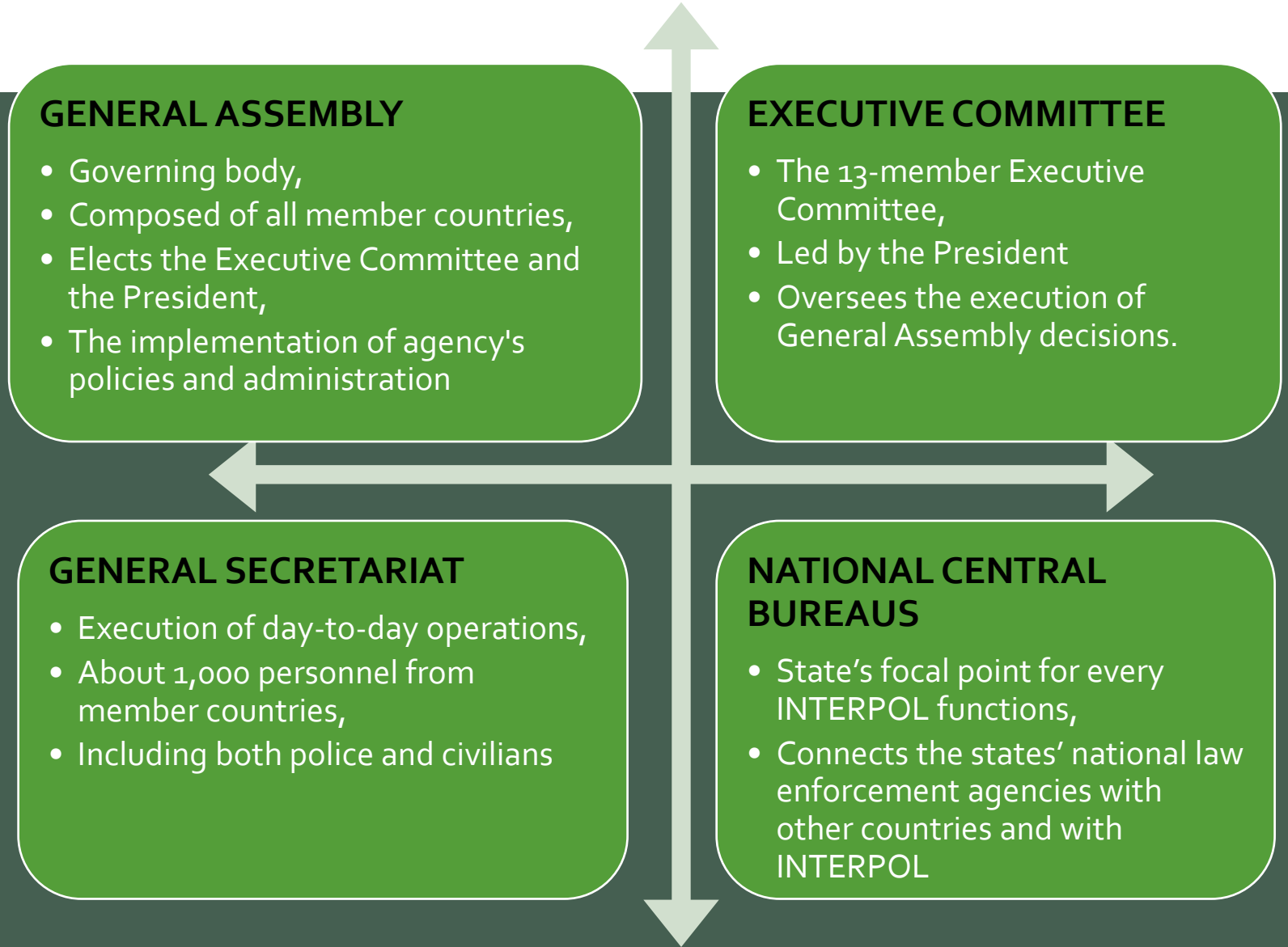
- PCR is a technique designed to copy or multiply DNA strands.
- PCR can be used to repeatedly duplicate or amplify a strand of DNA
- It is an enzymatic method and carried out invitro.
- PCR consists of three basic steps.
  1. **Denaturation**: Double to single strands, 92°C-96°C
  2. **Annealing**: Primer attachment, 45 °C-55 °C
  3. **Extension**: synthesis of new strand, 72 °C

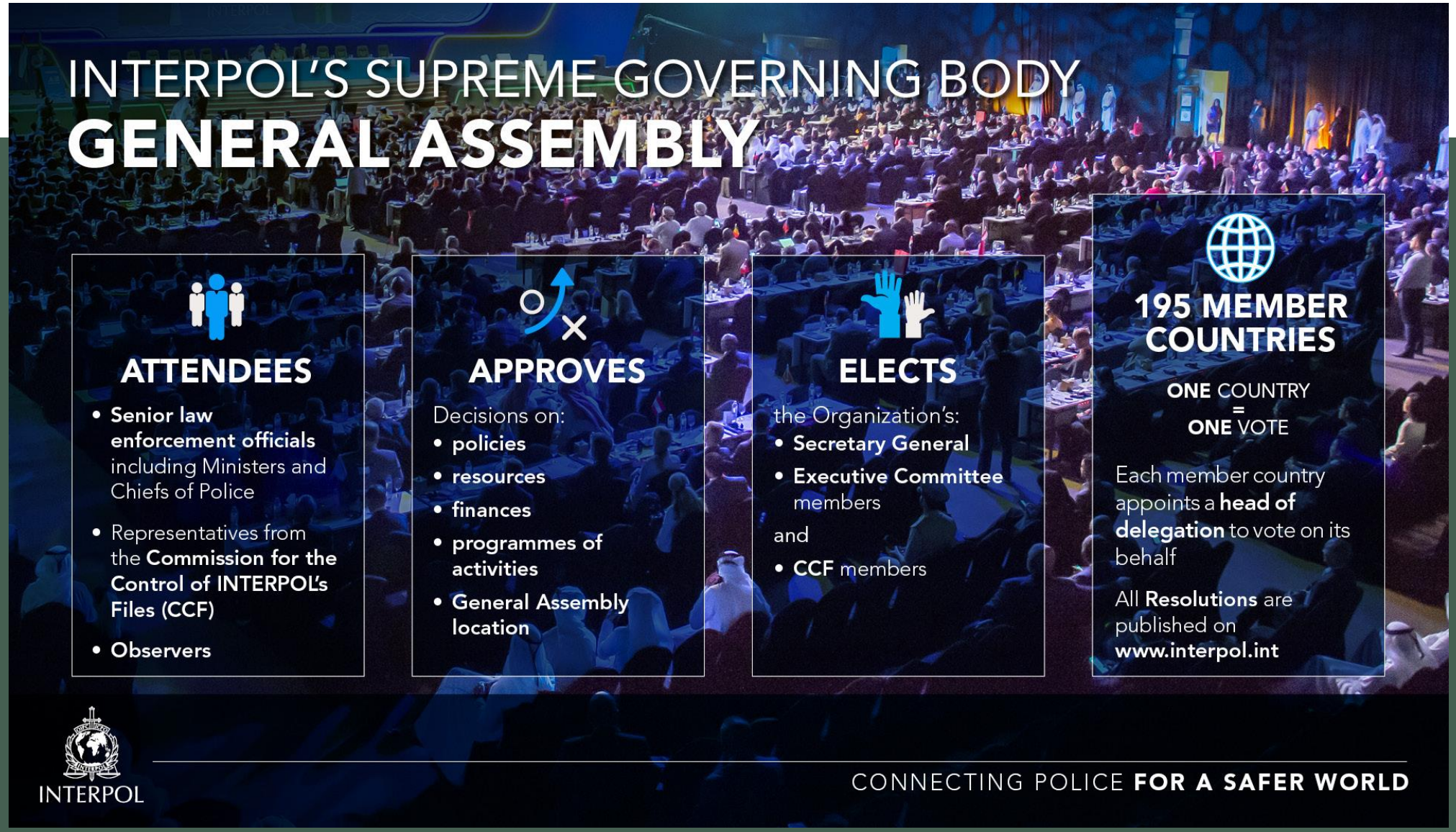


INTERPOL

- The International Criminal Police Organization (ICPO-INTERPOL)
- The world largest police organization
- Facilitates worldwide police cooperation and crime control
- Founded in Vienna, Austria on 7 September, 1923
- 7 regional offices
- Argentina, Cameroon, Côte d'Ivoire, El Salvador, Kenya, Thailand and Zimbabwe
- 195 member states
- Each member country maintains a National Central Bureau (NCB) linking National police and INTERPOL's global network

Functional Structure




INTERPOL'S SUPREME GOVERNING BODY
GENERAL ASSEMBLY
ATTENDEES
• Senior law enforcement officials including Ministers and Chiefs of Police
• Representatives from the Commission for the Control of INTERPOL's Files (CCF)
• Observers
APPROVES
Decisions on:
• policies
• resources
• finances
• programmes of activities
• General Assembly location
ELECTS
the Organization's:
• Secretary General
• Executive Committee members
and
• CCF members
195 MEMBER COUNTRIES
ONE COUNTRY = ONE VOTE
Each member country appoints a head of delegation to vote on its behalf
All Resolutions are published on www.interpol.int
INTERPOL
CONNECTING POLICE FOR A SAFER WORLD


INTERPOL'S EXECUTIVE COMMITTEE
OVERSEES IMPLEMENTATION OF GENERAL ASSEMBLY DECISIONS
13 MEMBERS
PRESIDENT
VICE-PRESIDENTS (3)
DELEGATES (9)
PART-TIME AND UNPAID ROLE
REPRESENTS INTERPOL'S 4 REGIONS
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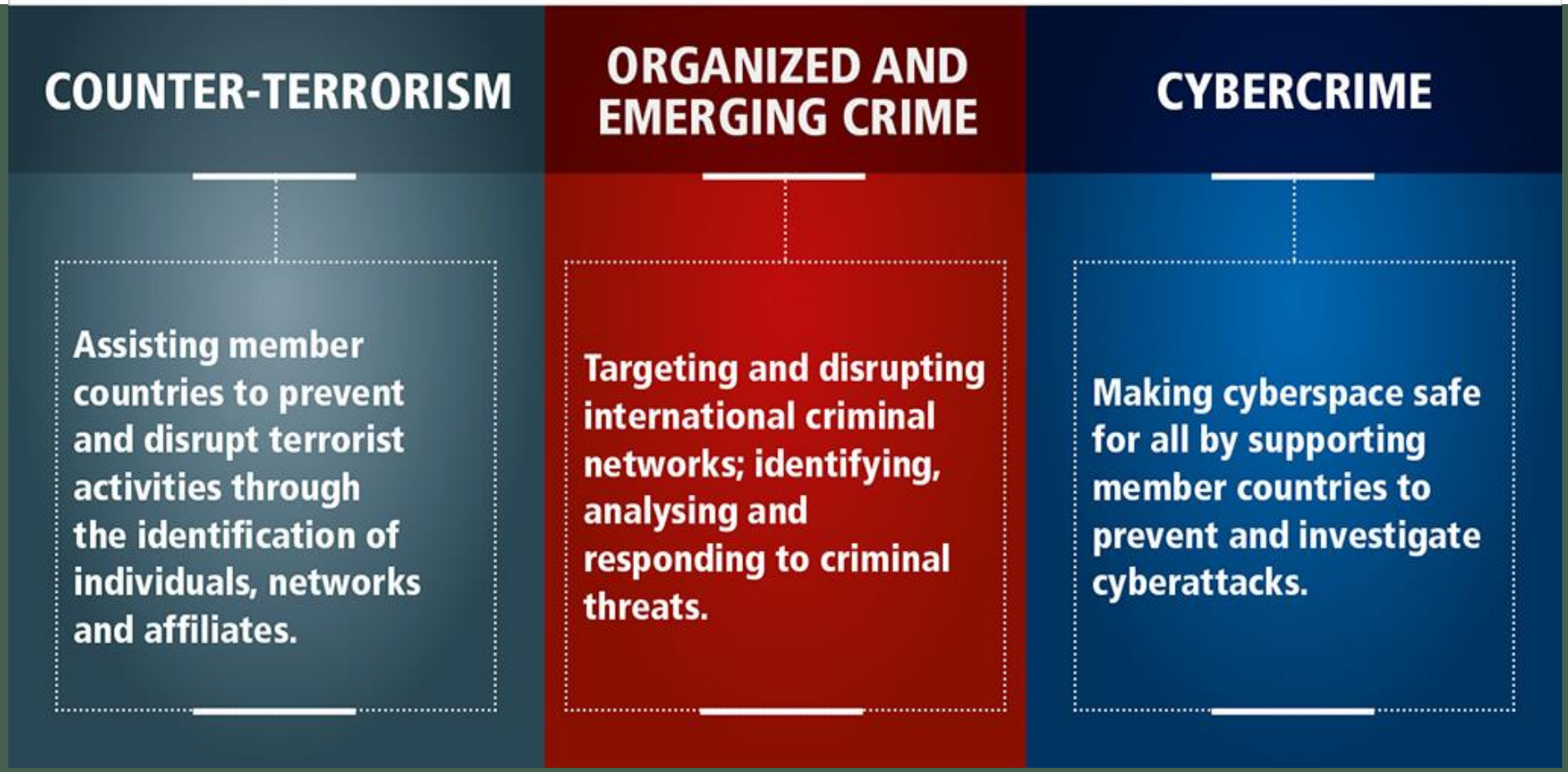
INTERPOL'S CRIME PROGRAMMES

INTERPOL

We provide a range of policing expertise and capabilities to our member countries, supporting three main crime programmes:




INTERPOL NOTICES
INTERPOL
RED NOTICE
RED NOTICE
WANTED PERSONS
INTERPOL
GREEN NOTICE
GREEN NOTICE
WARNINGS AND INTELLIGENCE
INTERPOL
YELLOW NOTICE
YELLOW NOTICE
MISSING PERSONS
INTERPOL
ORANGE NOTICE
ORANGE NOTICE
IMMINENT THREAT
INTERPOL
BLUE NOTICE
BLUE NOTICE
ADDITIONAL INFORMATION
INTERPOL
PURPLE NOTICE
PURPLE NOTICE
MODUS OPERANDI
INTERPOL
BLACK NOTICE
BLACK NOTICE
UNIDENTIFIED BODIES
INTERPOL
INTERPOL - UNITED NATIONS SECURITY COUNCIL SPECIAL NOTICE
INTERPOL–UN SECURITY COUNCIL SPECIAL NOTICE
GROUPS AND INDIVIDUALS SUBJECT TO UNSC SANCTIONS

Tools And Services

1. Police data management
2. Forensics
3. Criminal analysis.
4. Fugitive investigative support
5. Command and Coordination
6. Special projects
7. Innovation
8. Capacity building and training

FEDERAL BUREAU OF INVESTIGATION (FBI)

- Principal investigative agency of the federal government of the United States.
- Investigates cases related to
  - Violation of federal laws
  - Specially appointed
- A part of the Department of Justice (DOJ)
- Reports to the attorney general of the United States
- NOT a national police force

History

- 1908, Charles J. Bonaparte, the attorney general of the United States established the Bureau of Investigation within the Department of Justice.
- 1924, J. Edgar Hoover was appointed as its Director
- 1932, the bureau established a technical laboratory, now based in Quantico, Virginia forensic analyses of handwriting, fingerprints, firearms etc. for criminal investigation
- 1932, renamed the United States Bureau of Investigation
- 1935, Hoover founded a national academy to train special agents in police methods
- 1935, current name Federal Bureau of Investigation
- 1999, The Integrated Automated Fingerprint Identification System (AFIS), established by the bureau

Organization And Duties

- More than **50 field offices**
- Several hundred **"satellite"** offices, called **resident agencies**
- Several dozen **liaison posts** in foreign countries
- The **investigative jurisdiction** of the FBI
  - Computer Crime (Cybercrime)
  - White Collar Crimes (Embezzlement, Money Laundering)
  - Organized Crime (Including Extortion And Racketeering)
  - Piracy and Hijacking, Sabotage
  - Sedition
  - Terrorism (Including Ecoterrorism)
  - Treason
  - Counterintelligence

Basic Components of Bureau

- Identification Division
- Laboratory Division
- Domestic Intelligence Division
- Files and Communication Division
- Crimes Record Division
- Special Investigation Division
- Training Division

DUTIES OF FORENSIC SCIENTIST

- The typical examples of the work performed by forensic scientists in different divisions of forensic science laboratory

- Tests and analysis
- Develops new methods
- Qualitative and quantitative analyses
- Devises and adapts technical procedures
- Processes crime scenes
- Examinations of biological samples
- Field investigations
- Examines firearms evidence
- Examines different types of documents
- Processing and comparison of fingerprints
- Testifies in court
- Training
- Maintain records

CODE OF CONDUCT FOR FORENSIC SCIENTIST

Forensic sciences professionals must be

- Experts must have experience in their field
- Reliable, accurate, and free from bias
- Not extending beyond their skills, competencies, or knowledge
- Ethically correct behavior
- Objective
- Never be falsified, cut, adapted or modified

FORENSIC REPORT WRITING

- A critical and primary element
- Scientific way to communicate results
- In Criminal and civil investigations
- Acts as an aid to guide to conclusions
- Provides with facts to ensure a successful investigation.
- To link the evidences with the crime and the criminal (or suspect)
- To prove or disprove the fact in issue
- To exonerate the innocent from the case

General Structure Of A Forensic Report

1. Title of the Examination report
2. Name and address of the laboratory
3. Affiliation of the laboratory
4. Unique ID No. of the report with date
5. Name of the customer (client/attorney/individual) with reference letter number and date
6. Case Enquiry/ DD/ FIR no, date, Police Station, under which court
7. Mode of receipt of material (evidences/specimens)
8. Sampling Method
9. Reference to the Test Method(s)
10. Condition of Parcels/Test samples and seals
11. Description of Specimen/Samples/Exhibits etc.
12. Methodology of Examination
13. Result of Examination & Opinion
14. Signature or examining officer along with seal.

General Rules of Writing Forensic Report

1. The beginning
2. The middle (main body)
3. The End (Result, conclusion and opinion)