

# **FORENSIC SCIENCE LABORATORY**

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# IN THIS SESSION

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- ✖ FSL - introduction
- ✖ Methods for toxicological/biochemical analysis
- ✖ Locard's exchange principle
- ✖ Lie detection tests
  - 1) Polygraphy
  - 2) Narco analysis
  - 3) Brain mapping

# VARIOUS F.S.L.s

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- I. Central forensic science laboratories - New Delhi, Chandigarh, Bhopal, Pune, Hyderabad, Kolkata, Guwahati
- II. Regional forensic science laboratories
- III. State forensic science laboratories
  - I. Ahmedabad
  - II. Rajkot
  - III. Junagadh
  - IV. Vadodara
  - V. Surat
  - VI. Valsad

GFS University, Gandhinagar

# VARIOUS SECTIONS

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- Toxicology section
- Chemistry section
- Biology section
- Serology and immunology section
- Molecular biology section
- Ballistics and explosive section
- Fingerprint section
- Documents examination section
- Photography-videography section
- Physics section
- Lie detection section

# METHODS FOR DETECTION FOR TOXICOLOGY AND CHEMICAL/ BIOLOGICAL SUBSTANCES

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- I. Chromatography
- II. Electrophoresis
- III. Spectrophotometry
- IV. Neutron activation analysis



# CHROMATOGRAPHY

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- ✗ Method of qualitative and quantitative assessment of various poisons, drugs or chemicals in any physical form(solid, liquid or gas) from their characteristics of dispersion or spreading in different suitable media or environment.
- ✗ ***“Fingerprint of the substance”***

# DIFFERENT TECHNIQUES OF CHROMATOGRAPHY

- 1) Column chromatography
- 2) Paper chromatography
- 3) Thin layer chromatography
- 4) Gas chromatography

# ELECTROPHORESIS

- ✗ It is the process of identification of protein constituents in different body fluids by studying the distance of their movement, by passing them through a stationary phase made up of starch or agar gel on a glass slide on application of electric charge.
- ✗ The separated proteins in stationary phase if stained with colouring agent will show characteristic bands which is specific for a particular protein.
- ✗ Types of electrophoresis
  - + 1) gel electrophoresis
  - + 2) paper electrophoresis



# SPECTROSCOPY/ SPECTROPHOTOMETRY

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- ✖ Every substance has the capacity of absorbing light rays of various wave length, both visible as well as invisible range.
- ✖ Spectrophotometry is the study of the range of wave length of the light rays absorbed by the testing material for its qualitative and quantitative detection.

# DIFFERENT TYPES OF SPECTROPHOTOMETRY

- 1) Calorimeter spectroscopy
- 2) Ultraviolet and infrared spectroscopy
- 3) Mass spectrophotometry
- 4) Chemical ionization mass spectrophotometry
- 5) Emission spectrophotometry
- 6) Atomic absorption spectrophotometry

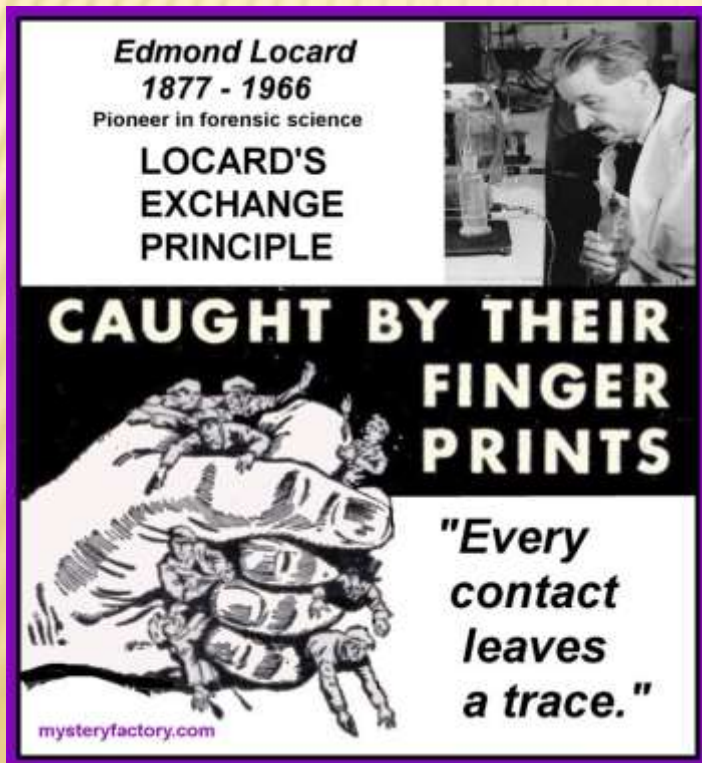
# NEUTRON ACTIVATION ANALYSIS

- ✗ Very sensitive method, Even the one billionth of 1 gm of an element can be identified. ( $1/1,000,000,000$ )
- ✗ Can identify minute traces of an element present in hair, nails, paints, gun powder residue around firearm entry wound or on hands of gun user, soil etc.
- ✗ **Principle :** the elements present in the testing material is bombarded with neutrons inside a nuclear reactor. Neutrons are captured by some nuclei of atoms and they become radioactive. During disintegration, gamma radiation liberated which is measured by a detector and then analyzed to identify the element and its concentration.



# LOCARD'S PRINCIPLE of EXCHANGE

- ✖ When two objects or person comes into contact with each other, there is always exchange of material- gross or trace (now also digital).



Examples of Physical Evidence		
Objects	Body materials	Impressions
Weapons	Blood	Fingerprints
Tools	Semen	Tire tracks
Firearms	Hair	Footprints
Displaced furniture	Tissue	Palm prints
Notes, letters or papers	Spittle	Tool marks
Bullets	Urine	Bullet holes
Vehicles	Feces	Newly damaged areas
Cigarette/ cigar butts	Vomit	Dents and breaks



# LIE DETECTION TESTS:

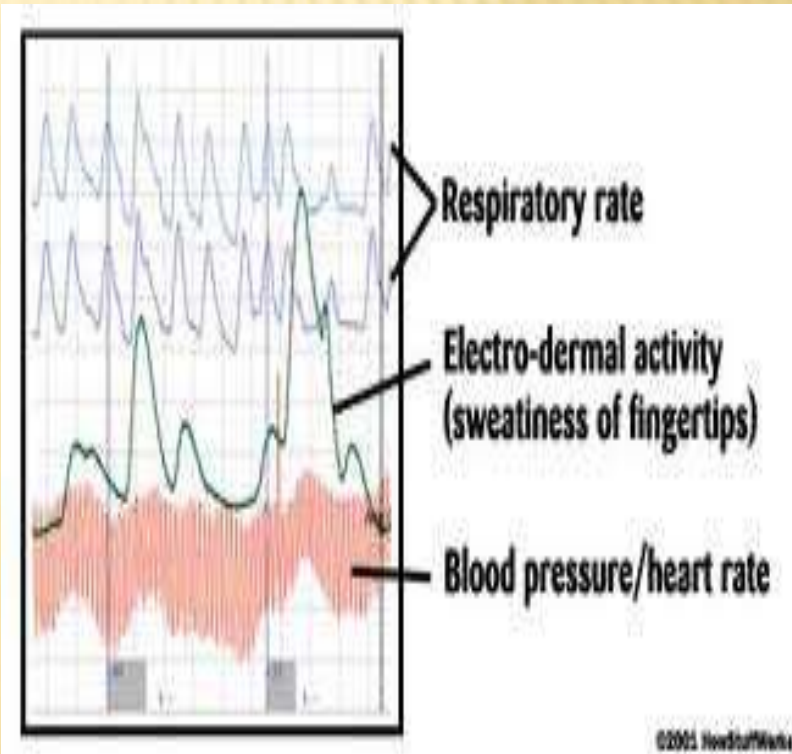
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1. Polygraph test
2. Narco-analysis
3. Brain mapping/brain fingerprinting

# POLYGRAPH OR MECHANICAL LIE DETECTOR

- ✖ Instrument used for comprehensive study of the body reactions of different body systems (circulation, respiration, peripheral nervous system etc.) while giving false statements or telling lie in answers to a question.
- ✖ Polygraphs commonly used
  - + 1) Keeler polygraph
  - + 2) steolling deceptograph

# POLYGRAPHY



# PROCESS OF POLYGRAPHY

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- ✗ Sit in a chair
- ✗ An pneumograph belt - respiration.
- ✗ A sphygmomanometer cuff - blood pressure.
- ✗ galvanic electrodes - electrodermal response(sweating).
- ✗ A pulse-oxymeter - pulse rate(HR), pulse volume and Sp O<sub>2</sub>.



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- ✖ All these responses collectively analyzed.
  - ✖ Respiratory and electrodermal reactions are more important than circulatory.
  - ✖ Before examination, the subject is prepared by physical and mental relaxation.
  - ✖ Persons with psychotic, neurotic personality; drug addicted, gross abnormality of body systems, restless, non cooperative nature are to be specially prepared before the test.

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- ✘ After preparation, 'pre test interview':
  - ✘ Subject is made aware about aims and objects, procedure and that he would be asked subjective questions whose answers in form of 'yes' or 'no'.

# TEST PROPER

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- ✗ Relevant, irrelevant and control questions mixed up, each question asked in every 20 to 25 seconds and polygraph recorded continuously for 3 to 4 minutes.
- ✗ Same test repeated twice or thrice.
- ✗ Alternatively different sets of tests like a) first test b) card test c) third test d) mixed question test e) yes test f) guilt complex test g) re-examination test h) peak of tension test may done to avoid errors or prevent attempts to fool the operator by habitual criminals.

# MEDICOLEGAL IMPORTANCE

- ✗ Its accuracy is 80 to 90%.
- ✗ For civil cases – disputed paternity, insurance claims, pre employment screening in responsible jobs and services.
- ✗ For criminal cases – to testify the statements made by offenders, suspects, victims, informants, witnesses.
- ✗ None of methods – mechanical lie detection, narco analysis, brain mapping fingerprinting – accepted as an evidence in Indian court of laws till date. They are mainly **used only as an investigating tool.**
- ✗ However, brain mapping/fingerprinting is accepted in court of laws in USA as an evidence since 2003.



# NARCO ANALYSIS

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- ✖ It is based on fact that when a suspect is brought to a point close to unconsciousness, the person will not be able to resist questioning or unable to manufacture falsehood to conceal guilt and answers properly or truthfully to the questions.
- ✖ Drugs known as 'truth serum drugs' used for this test.

# TRUTH DRUGS FOR NARCO ANALYSIS

- ✖ **Scopolamine hydrobromide** 0.5mg s/c followed by 0.25mg every 20 min. usually 3 to 6 injections required .
- ✖ **Sodium amytal** or **Sodium pentothal** 0.25 to 0.5 gm in 2.5 to 5 % solution slow i.v.
- ✖ S/c **sodium seconal** 0.5mg followed by morphine sulphate 15mg and scopolamine hydrobromide 0.5mg after 45 min.

# BRAIN MAPPING/BRAIN FINGERPRINTING



- ✘ In this method, an equipment called 'electro cap' is fixed on the suspect's head for recording EEG.
- ✘ Study of P300 wave in the EEG of a suspected criminal for scientific detection of certain information whether stored in the brain or not.
- ✘ Emission of such signals are dependent on cognitive brain responses and not on anxiety or fear.

- ✖ Than the suspect is questioned about the crime and also shown some photographs or visuals related to crime(weapons, scene of offence, photo of victim) along with some other irrelevant visuals for control.
- ✖ P300 wave will be generated when ever a question or visual stimulus matches the information stored in the brain if the suspect is the real offender.
- ✖ The question and the EEG response are printed for scientific evidence.
- ✖ This method of lie detection is claimed to be 100% effective by FBI. It is only method accepted in court of laws in USA as an evidence since 2003.



# ANY QUESTIONS?

## Reference books

1. The Essentials of FMT by Dr KSN Reddy
2. Forensic Medicine by Dr BK Bastiya
3. Essentials of FMT by Dr A Aggrawal
4. Review of FMT by Dr G Biswas
5. Textbook of FMT by Dr PC Dikshit
6. Textbook of MJFMT by Dr CK Parikh
7. Textbook of FMT by Dr VV Pillay