

# Susan Walsh, Ph.D.

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## EDUCATION

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- Doctor of Philosophy** (Forensic Genetics) **Feb. 2009 – June 2013**  
Erasmus University, Rotterdam, The Netherlands.
- Master of Science** (DNA profiling) **Sept. 2005 – Sept. 2006**  
University of Central Lancashire, Preston, UK.
- Bachelor of Science** (Biochemistry (Hons.)) **Sept. 2001 – June 2005**  
University College Cork, Cork, Ireland

## ACADEMIC APPOINTMENTS

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- Adjunct Appointment** **Oct 2016 – Present**  
Department of Medical and Molecular Genetics  
Indiana University School of Medicine, Indianapolis, IN, USA
- Assistant Professor** (Tenure Track) **Aug 2014 – Present**  
Department of Biology  
Indiana University Purdue University Indianapolis, USA
- Graduate Coordinator** **Aug 2015 – July 2017**  
Forensic & Investigative Sciences Program  
Indiana University Purdue University Indianapolis, USA
- Post Doctoral Research Associate** **June 2013 – July 2014**  
Department of Anthropology  
Yale University, CT, USA.
- Research Assistant** **June 2007 – Jan. 2009**  
SUPAMAC Analysis Centre  
University of Sydney, NSW, Australia.

## RESEARCH FOCUS

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- Assistant Professor (PI)** **August 2014 – Present**

### **Identification of phenotype:genotype correlations with regards human physical appearance, and its prediction from DNA**

Our current work focuses on identifying genes associated with human appearance variation through genome-wide association, with pigmentation and craniofacial morphometrics being the prime traits of interest at present. Our current (ongoing) research database exceeds 4000 individuals with access to multiple collaborator cohorts (Professor Manfred Kayser – Erasmus MC, Professor Mark Shriver – Penn State University, Professor Nick Martin – QIMR Berghofer, Dr. Peter Claes – KU Leuven) that expand these numbers for replication and meta-analyses. A combination of wet laboratory work with bioinformatics is at the research core of this group.

❖ Physical Appearance Prediction from DNA

- Through a combination of fundamental research and practical tool development, it is our hope to expand our knowledge on what genes are responsible for global quantitative pigmentation as well as facial morphology variation with a view to designing prediction models/systems that render an image solely using DNA variant information.

❖ Ancestry inference from DNA

- The laboratory also conducts research associated with identity and ancestry inference through population-based studies (e.g. Ireland, Lebanon) through the identification of ancestry informative (both autosomal & Y-chromosome) markers.

## PEER-REVIEWED PUBLICATIONS

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\* corresponding author

### Research Articles

1. S Brace, Y Diekmann, T Booth, L van Dorp, Z Faltyskova, N Rohland, S Mallick, I Olalde, M Ferry, M Michel, J Oppenheimer, N Broomandkoshbacht, K Stewardson, R Martiniano, **S Walsh**, M Kayser, S Charlton, G Hellenthal, I Armit, R Schulting, O Craig, A Sheridan, M Parker Pearson, C Stringer, D Reich, M Thomas, and I Barnes. Ancient Genomes Indicate Population Replacement in Early Neolithic Britain. **Nature Ecology & Evolution**. 2019
2. Peng F, Zhu G, Hysi P.G, Eller R.J, Chen Y, Li Y, Hamer M.A, Zeng C, Hopkins R.L, Jacobus C.J, Wallace P.L, Uitterlinden A.G, Ikram M.A, Nijsten T, Duffy D.L, Medland S.E, Spector T.D, **Walsh S**, Martin N.G, Liu F, Kayser M. Genome-wide association studies identify multiple genetic loci influencing eyebrow color variation. **Investigative Dermatology**. 2019
3. Pośpiech E, Chen Y, Kukla-Bartoszek M, Breslin K, Aliferi A, Andersen J.D, Ballard D, Chaitanya L, Freire-Aradas A, van der Gaag K.J, Girón-Santamaría L, Gross T.E, Gysi M, Huber G, Mosquera-Miguel A, Muralidharan C, Skowron M, Carracedo Á, Haas C, Morling N, Parson W, Phillips C, Schneider P.M, Sijen T, Syndercombe-Court D, Vennemann M, Wu S, Xu S, Jin L, Wang S, Zhu G, Martin N.G, Medland S.E, Branicki W, **Walsh S**, Liu F, Kayser M, EUROFORGEN-NoE Consortium. Towards broadening Forensic DNA Phenotyping beyond pigmentation: Improving the prediction of head hair shape from DNA. **Forensic Sci. Int. Genet.** 2018
4. Kukla-Bartoszek M, Pośpiech E, Spólnicka M, Karłowska-Pik J, Strapagiel D, Żądzińska E, Rosset I, Sobalska-Kwapis M, Słomka M, **Walsh S**, Kayser M, Sitek A, Branicki W. Investigating the impact of age-depended hair colour darkening during childhood on DNA-based hair colour prediction with the HlrisPlex system. **Forensic Sci. Int. Genet.** 2018
5. Chaitanya L, Breslin K, Zuñiga S, Wirken L, Pospiech E, Kukla-Bartoszek M, Sijen T, de Knijff P, Liu F, Branicki W, Kayser M\*, **Walsh S\***. The HlrisPlex-S system for eye, hair and skin colour prediction from DNA: Introduction and forensic developmental validation. **Forensic Sci. Int. Genet.** 2018
6. Liu F, Chen Y, Zhu G, Hysi P, Wu S, Adhikari K, Breslin K, Pośpiech E, Hamer MA, Peng F, Muralidharan C, Acuna-Alonzo V, Canizales-Quinteros S, Bedoya G, Gallo C, Poletti G, Rothhammer F, Bortolini MC, Gonzalez-Jose R, Zeng C, Xu S, Jin L, Uitterlinden AG, Ikram MA, van Duijn CM, Nijsten T, **Walsh S**, Branicki W, Wang S, Ruiz-Linares A, Spector T, Martin N, Medland S, Kayser K. Meta-analysis of genome-wide association studies identifies 8 novel loci involved in shape variation of human head hair. **Human Molecular Genetics**. 2018
7. **Walsh S\***, Chaitanya L, Breslin K, Muralidharan C, Bronikowska A, Pospiech E, Koller J, Kovatsi L, Wollstein A, Branicki W, Liu F and Kayser M\*. Global skin color prediction from DNA. **Human Genetics**. 2017
8. Wollstein A, **Walsh S**, Liu F, Chakravarthy U, Rahu M, Seland H, Soubrane G, Tomazzoli L et al. Novel quantitative pigmentation phenotyping enhances genetic association, epistasis, and prediction of human eye colour. **Scientific Reports**. 2017

9. Caliebe A, **Walsh S**, Liu F, Sjerps M, Kayser M, Krawczak M. Likelihood ratio and posterior odds in forensic genetics: Two sides to the same coin. **Forensic Sci. Int. Genet.** 2017
10. Haeusler M, Haas C, Seiler R, Lösch S, Moghaddam N, **Walsh S**, Kayser M, Rühli F, Janosa M, Papageorgopoulou C. Multidisciplinary identification of the controversial freedom fighter Jörg Jenatsch, assassinated 1639 in Chur, Switzerland. **Plos One.** 2016
11. Chaitanya L, Pajnič IZ, **Walsh S**, Balažic J, Zupanc T, Kayser M. Bringing colour back after 70 years: Predicting eye and hair colour from skeletal remains of World War II victims using the HIrisPlex system. **Forensic Sci. Int. Genet.** 2016
12. Liu F, Visser M, Duffy D.L, Hysi P.G, Jacobs L.C, Lao O, Zhong K, **Walsh S**, Chaitanya L *et al.* Genetics of skin color variation in Europeans: genome-wide association studies with functional follow-up. **Human Genetics.** 2015
13. King T.E, Fortes G.G, Balaesque P, Thomas M.G, Balding D, Delser P.M, Neumann R, Parson W, Knapp M, **Walsh S**, Tonasso L, Holt J, Kayser M, Appleby J, Forster P, Ekserdjian D, Hofreiter M, Schürer K. Identification of the remains of King Richard III. **Nature Communications.** 2014
14. Chaitanya L#, **Walsh S#**, *et al.* Collaborative EDNAP exercise on the IrisPlex system for DNA-based prediction of human eye colour. **Forensic Sci. Int. Genet.** # equal contributors 2014
15. Pośpiech E, Wojas-Pelc A, **Walsh S**, Liu F, Maeda H, Ishikawa T, Skowron M, Kayser M, Branicki W, The common occurrence of epistasis in the determination of human pigmentation and its impact on DNA-based pigmentation phenotype prediction. **Forensic Sci. Int. Genet.** 2014
16. **Walsh S**, Chaitanya L, Clarisse L, Wirken L, Draus-Barini J, Kovatsi L, Maeda H, Ishikawa T, Sijen T, de Knijff P, Branicki W, Liu F, Kayser M, Developmental Validation of the HIrisPlex system: DNA-based eye and hair colour prediction for forensic and anthropological usage. **Forensic Sci. Int. Genet.** 2014
17. Liu F, **Walsh S**, Kayser M, Of sex and IrisPlex eye colour prediction: A reply to Martinez-Cadenas *et al.* **Forensic Sci. Int. Genet.** 2013
18. Keating B, Bansal A.T, **Walsh S**, Millman J, Newman J, Kidd K, Budowle B, Eisenberg A, Donfack J, Gasparini P, Budimlija Z, Henders A.K, Chandrupatla H, Duffy D.L, Gordon S.D, Hysi P, Liu F, Medland S.E, Rubin L, Martin N.G, Spector T.D, Kayser M, on behalf of the International Visible Trait Genetics (VisiGen) Consortium, First All-in-One Tool for DNA Forensics: Parallel Genome-wide Inference of Bio-Geographic Ancestry, Appearance, Relatedness and Gender With Identitas Forensic Chip. **Int. J. Legal Med.** 2013
19. Draus-Barini J, **Walsh S**, Pośpiech E, Kupiec T, Głęb H, Branicki W, Kayser M, Bona fide colour: DNA prediction of human eye and hair colour from ancient and contemporary skeletal remains **Investigative Genetics.** 2013
20. **Walsh S**, Liu F, Wollstein A, Kovatsi L, Ralf A, Kosiniak-Kamysz A, Branicki W, Kayser M, The HIrisPlex system for simultaneous prediction of hair and eye colour from DNA. **Forensic Sci. Int. Genet.** 2013
21. Pinggen M, Nouwen J.L, Dinant S, Albert J, Mild M, Brodin J, Simen B.B, Walsh S, Kayser M, van der Ende M.E, Schutten M, Boucher C.A.B. Therapy failure resulting from superinfection by a drug resistant HIV variant. **Antiviral Therapy.** 2012
22. **Walsh S**, Wollstein A, Liu F, Chakravarthy U, Rahu M, Seland J.H., Soubrane G, Tomazzoli L, Topouzis F, Vingerling J.R., Vioque J, Fletcher A.E., Ballantyne K.N., Kayser M. DNA-based eye colour prediction across Europe with the IrisPlex system. **Forensic Sci. Int. Genet.** 2011
23. Branicki W, Liu F, van Duijn K, Draus-Barini J, Pospiech E, **Walsh S**, Kupiec T, Wojas-Pelc A, Kayser M. Model-based prediction of human hair color using DNA variants. **Human Genetics.** 2011
24. **Walsh S**, Lindenbergh A, Zuniga S.B, Sijen T, de Knijff P, Kayser M, Ballantyne K.N. Developmental validation of the IrisPlex system: Determination of blue and brown iris colour for forensic intelligence. **Forensic Sci. Int. Genet.** 2010

25. Liu F, Wollstein A, Hysi P.G, Ankra-Badu G.A, Spector T.D, Park D, Zhu G, Larsson M, Duffy D.L, Montgomery G.W, Mackey D.A, **Walsh S**, Lao O, Hofman A, Rivadeneira F, Vingerling J.R, Uitterlinden A.G, Martin N.G, Hammond C.J, Kayser M. Digital quantification of human eye color highlights genetic association of three new loci. **PLoS Genetics**. 2010
26. **Walsh S**, Liu F, Ballantyne K.N, van Oven M, Lao O, Kayser M. IrisPlex: A sensitive DNA tool for accurate prediction of blue and brown eye colour in the absence of ancestry information. **Forensic Sci Int Genet**. 2010

### Invited Book Chapters

27. Walsh S, Kayser M. A Practical Guide to the HirisPlex System: Simultaneous Prediction of Eye and Hair Color from DNA in Forensic DNA Profiling Protocols (2nd edition) pp 213-231. Springer NY. 2016
28. Walsh S, Kayser M. Predicting Human Appearance from DNA in forensic investigations in Handbook of Forensic Genetics: Biodiversity and Heredity in Civil and Criminal Investigation (vol2). Imperial College Press. 2016

### Invited Commentary

29. Walsh S, Pośpiech E, Branicki W. Commentary: Hot on the Trail of Genes that Shape Our Fingerprints. **Investigative Dermatology**. 2016

## **RESEARCH FUNDING**

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### Current Support

#### **Research and Development in Forensic Science Grant (2018-DU-BX-0219)** 01/01/19 to 12/31/21

National Institute of Justice (NIJ) (3 year grant)  
 Title: Ensuring standards and enhancing the field of predictive biometrics using a globally-diverse genotype-phenotype database  
 Role: Principal Investigator  
 Total Funding Amount: \$651,242

#### **Research Support Funds Grant (RSFG)** 01/01/18 to 12/31/19

IUPUI internal grant OVCR (2 year grant)  
 Title: Collection of human skeletal facial soft tissue thickness to assist phenotype prediction for forensic and anthropological applications  
 Role: Principal Investigator  
 Total Funding Amount: \$34,812

### Completed Support

#### **Graduate Research Fellowship STEM Award (2015-R2-CX-0023)** 01/01/16 to 12/31/18

National Institute of Justice (NIJ) Graduate Student Fellowship with 3 year support  
 Title: An Investigation into the genetic basis of human facial morphology and its prediction from DNA, using a globally distributed panel of individuals from the US and Europe.  
 Role: Co-PI/Advisor  
 Total Funding Amount: \$113,364

#### **Research and Development in Forensic Science Grant (2014-DN-BX-K031)** 01/01/15 to 06/30/18

National Institute of Justice (NIJ) (3 year grant including 6 month NCE)  
 Title: Improving the prediction of human quantitative pigmentation traits such as eye, hair and skin color using a worldwide representation panel of US, and European individuals  
 Role: Principal Investigator  
 Total Funding Amount: \$1,123,404

#### **Defense University Research Instrumentation Program (DURIP) (66843-LS-RIP)**

Department of Defense (DOD) equipment grant  
 Title: Improving knowledge on the genetic basis of human physical appearance for human identification through next generation sequencing technologies  
 Role: Principal Investigator  
 Total Funding Amount: \$146,450

## ABSTRACTS AND PRESENTATIONS

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### INVITED SPEAKER/WORKSHOP

**March 2019:** The prediction of human physical appearance from DNA. Wabash College, IN.

**November 2018:** The modeling of human physical appearance prediction from DNA. School of Informatics, Computing, and Engineering (SICE) Seminar Series, Indiana University, Bloomington, IN.

**November 2018:** Research overview presentation on human physical appearance prediction from DNA. Department of Biology Seminar Series, IUPUI, Indianapolis, IN.

**November 2018:** Human physical appearance prediction from DNA. Department of Anthropology Seminar Series, University of Chicago-Urbana Champaign, IL.

**Sept 2018:** Invited workshop on Forensic DNA Phenotyping at the Midwestern Association of Forensic Scientists (MAFS) Conference. Indianapolis, IN.

**June 2018:** Discussion Leader for the Gordon Research Conference (GRC) on Forensic Analysis of Human DNA: Age, Appearance and Ancestry. Sunday River, Maine.

**October 2017:** Webinar: Predict Human Appearance From DNA, Focusing On Pigmentation for NIJ's Forensic Technology Center of Excellence.

**September 2017:** Invited workshop on Forensic DNA Phenotyping at the International Society for Forensic Genetics (ISFG) Conference, Seoul, South Korea. (provided workshop materials and website)

**April 2017:** AAPA pigment symposium. Evolutionary responses to solar radiation: eye, hair and skin color prediction, New Orleans, LA.

**Feb 2017:** Research progress on quantitative pigment prediction, NIJ research symposium, New Orleans, LA.

**Oct 2016:** Invited seminar for the Medical and Molecular Genetics CME Seminar Series on Forensic DNA phenotyping, Indiana University School of Medicine, Indianapolis, IN, USA.

**Oct 2016:** Invited talk at the Indiana Medical History Museum talk on Forensic DNA phenotyping, Indianapolis, IN, USA.

**September 2016:** Invited to give a workshop on Forensic DNA Phenotyping at the International Symposium on Human Identification (ISHI) Conference, Minneapolis, Minnesota, USA.

**June 2016:** Gordon Research Conference (GRC) on Forensic Analysis of Human DNA, Waterville Valley, NH. Predictive biometrics and the human face.

**Jan 2016:** Science on Tap: Finding the right genes: are you a biological witness? School of Science at IUPUI, Indianapolis, IN, USA.

**September 2015:** Invited to conduct a workshop on Forensic DNA Phenotyping at the International Society for Forensic Genetics (ISFG) Conference, Krakow, Poland.

**November 2013:** Yale Biological Anthropology Colloquium Series, New Haven, CT, USA. The prediction of human physical appearance (pigmentation) from DNA.

**September 2013:** Invited to conduct a workshop on Forensic DNA Phenotyping at the International Society for Forensic Genetics (ISFG) Conference, Melbourne, Australia.

**May 2012:** Qiagen Investigator Meeting, Hilden, Germany. HirisPlex eye and hair colour prediction tool.

**April 2012:** Invited to give an undergraduate lecture (final year Biochemistry students) on human physical appearance/trait prediction at UCC, Cork, Ireland.

**October 2011:** Visiting researcher, The Office of Chief Medical Examiner (OCME), NY City, USA. Current forensic phenotyping work: from IrisPlex to HirisPlex.

**October 2011:** Invited to conduct a workshop on Forensic DNA Phenotyping at the International Symposium on Human Identification (ISHI) Conference, National Harbor, MD, USA.

**February 2011:** NFI (Nederlands Forensisch Instituut), Den Haag, The Netherlands. DNA-based eye colour prediction across Europe with the IrisPlex system.

#### **PRESENTATIONS/CONFERENCE TALKS**

**Feb 2019:** American Association of Forensic Scientists (AAFS) Conference, Baltimore, MD. Eye, Hair, and Skin Color Prediction using the HirisPlex-S (HPS) System and Massive Parallel Sequencing (MPS). (Student oral presentation).

**May 2018:** Haploid Markers 2018 Conference, Bydgoszcz, Poland. Examining Viking Ancestry in Irish surnames. (Student oral presentation).

**April 2018:** Emirates International Forensic Conference and Exhibition, Dubai, United Arab Emirates. Eye, hair and skin pigmentation prediction of a Lebanese Population. (Student oral presentation).

**September 2015:** International Society for Forensic Genetics (ISFG) Conference, Krakow, Poland. The HirisPlex-S system: Combined DNA prediction of eye, hair & skin colour.

**September 2013:** International Society for Forensic Genetics (ISFG) Conference, Melbourne, Australia. The prediction of human skin colour using a model-based approach.

**October 2012:** International Symposium on Human Identification (ISHI) Conference, Nashville, TN, USA. HirisPlex: DNA test system for Eye and Hair Colour Prediction.

**August 2012:** 6<sup>th</sup> European Academy of Forensic Science (EAFS) Conference, Den Haag, The Netherlands. HirisPlex: DNA test system for Eye and Hair Colour Prediction.

**January 2012:** NFI Symposium, Den Haag, The Netherlands. IrisPlex and HirisPlex systems.

**August 2011:** International Society for Forensic Genetics (ISFG) Conference, Vienna, Austria. The HirisPlex system: simultaneous prediction of both hair and eye colour from DNA.

#### **POSTER PRESENTATIONS**

**Oct 2018:** The search for quantitative iris pigmentation markers using automation in genome-wide association studies: from phenotype to genotype. American Society of Human Genetics (ASHG), San Diego, CA. (Student presentation)

**Oct 2018:** Tissue transcriptomics: potential for postmortem interval predictions. American Society of Human Genetics (ASHG), San Diego, CA. (Student presentation)

**March 2018:** Unearthing New Variants Related to Common Variation in Human Facial Morphology Using Genome Wide Association Study (GWAS) Methods. PITTCON conference and expo, Orlando, Florida. (Student presentation)

**September 2016:** Measuring Epistatic interactions between known DNA variants for eye and hair color to improve statistical prediction models. International Symposium on Human Identification (ISHI) Conference, Minneapolis, Minnesota. (Student presentation)

**September 2016:** Forensic DNA Phenotyping through Massive Parallel Sequencing. International Symposium on Human Identification (ISHI) Conference, Minneapolis, Minnesota. (Student presentation)

**September 2016:** A Quantitative Approach to Measuring Eye Pigmentation for Genome Wide Association Studies. International Symposium on Human Identification (ISHI) Conference, Minneapolis, Minnesota. (Student presentation)

**July 2016:** Novel quantitative pigmentation phenotyping enhances genetic association, epistasis, and prediction of human eye colour. Waterville Valley, NH. GRC conference.

**October 2015:** HirisPlex-S – eye, hair and skin color prediction from DNA. International Symposium on Human Identification (ISHI) Conference, Grapevine, Texas. (Student presentation)

**September 2013:** Developmental validation of the HirisPlex system: DNA-based eye and hair colour prediction for forensic and anthropological usage. International Society for Human Genetics (ISFG) Conference, Melbourne, Australia.

**June 2010:** IrisPlex: A sensitive DNA tool for accurate prediction of blue and brown eye colour in the absence of ancestry information. 17<sup>th</sup> MGC PhD student workshop, Cologne, Germany.

## TEACHING EXPERIENCE

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### Indiana University Purdue University Indianapolis

Population Genetics, Undergraduate FIS43000 (Lecture).

**Spring 2015 to present.**

Population Genetics, Graduate FIS53000 (Lecture). Forensic

**Spring 2015 to present.**

Genetics, Undergraduate Laboratory FIS40301. Forensic

**Spring 2016 to present.**

Genetics, Undergraduate FIS40300 (Lecture).

**Spring 2016 to 2018 inclusive.**

## MENTORING EXPERIENCE

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### Walsh Laboratory

#### Graduate Students

- Ryan Eller (2015-present) - Biology PhD Candidate
- Noah Herrick (2017-present) - Biology PhD Candidate
- Bailey Wills – (2017-present) - Forensic MS Candidate
- Racquel Hopkins (2018-present) - Biology MS Candidate

## **Graduated MS Students**

- Stephanie Farmer (2016-2018)  
An Exploration of Irish surname history through Patrilineal genetics
- Mirna Ghemrawi (2016-2018)  
Investigation into the Lebanese genome: ancestry markers, autosomal strs, y-dna, and phenotype prediction
- Krystal Breslin (2015-2017)  
Forensic DNA Phenotyping & Massive Parallel Sequencing
- Wesli Kay Stubbs (2015-2017)  
Forensic applications of associating human scalp hair morphology and pigmentation analysis at a the microscopic and molecular level
- Charanya Muralidharan (2015-2017)  
Elucidating the mechanisms/interactions involved in differing hair color follicles

## **SERVICE CONTRIBUTIONS**

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- **Grant Ad-hoc Reviewer**  
National Science Foundation (NSF), USA - Biological Anthropology  
Medical Research Council, United Kingdom  
National Science Council, Poland
- **Journal Ad-hoc Reviewer**
  - ◆ Nature Communications ◆ Forensic Science International: Genetics ◆ Human Biology
  - ◆ Scientific Reports ◆ Science & Justice ◆ Royal Society Open Science
  - ◆ Annals of Human Genetics ◆ Electrophoresis

## **PROFESSIONAL MEMBERSHIPS**

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- ❖ International Society for Forensic Genetics (ISFG)
- ❖ American Academy of Forensic Scientists (AAFS)