

DNA Fingerprinting

- Scientists first discovered DNA in the 1800's but it had no interest for the legal system until 1985 when _____ revealed his research that suggested that DNA is a unique as a fingerprinting. (thus the term DNA fingerprinting)

The Basics

- We have about 60 trillion cells and each of those cells contains a full set of our chromosomes
 - _____ (2 sets of 23) in a regular cell
 - 23 (one set) in a _____
- You inherit 1 set of chromosomes (23) from your mother and one set (23) from your father.
- Your sex cells (sperm or egg) only have _____ that is randomly made from a mixture of your two sets.

The Basics

- Chromosomes are found in the _____
- They typically take the form of _____
- Chromosomes are made of _____ (deoxyribonucleic acid). DNA is in the shape of a spiral double helix (twisted ladder)
- DNA has three parts
 - Sugar (deoxyribose)
 - _____
 - Nitrogen base (Adenine, Cytosine, Thymine, or _____)
- The sugar and phosphates make up the sides of the ladder. The _____ make up the rungs.

DNA

- It is the sequence of _____ (A,C,T, G) that make each person's DNA unique.
- A is always found paired with T; _____
- However, the large majority of the sequence is identical person to person (99.9%)
- It is the _____ difference that causes us to be unique.
- There are about _____ in a Human's DNA.

The Basics

- On those chromosomes there are about _____.
- Genes are the basic unit of heredity.
- Each gene has a single function (in other words it codes for a single protein.)
- It codes for something by having a specific set of _____.
- A change in the base pair order can change what the gene codes for.
- Together, the proteins our genes code for make us who we are.

Alleles

- Each person has _____ of each gene (one from each parent)
- Those two copies are referred to as _____ from that gene.
- If the alleles are the same we say the person is _____
- If the alleles are different we say the person is _____

Tandem Repeats

- A region of a chromosome that contains multiple copies of a DNA sequence arranged in a repeating fashion.
- CAGCAGCAGCAGCAGCAGCAGCAG
- Roughly _____ of our DNA
- Large variation in number of repeats from person to person. (This is what makes our DNA unique)
- Follow basic Mendelian inheritance (Think Punnett Squares)

Genome

- _____

VNTR

- Variable Number of Tandem Repeats
- This is why _____ works
- Refers to the length of _____ in the DNA of individuals
- The chances of anyone having the same results are less than one in a million.

Other types of DNA

- The DNA we are familiar with is nuclear DNA. It is our genetic material.
- However, there is also mitochondrial DNA in your mitochondria.
- Mitochondrial DNA comes only from your _____.
 - Why?
- Your mitochondrial DNA matches all your maternal relatives.

Nuclear DNA vs. Mitochondrial DNA

- Nuclear DNA is more useful in that it can be linked to a _____.
- _____ DNA however lasts longer (more stable)
- There are thousands of mitochondria in a cell so there is a lot of mitochondrial DNA in each cell.

DNA Replication

- Our body has to copy DNA every time we need a new cell.
- DNA replicates through a process called semiconservative replication. It follows complementary base pairing rules.
- The primary enzyme responsible is _____

Why is DNA useful?

Where can DNA be found?

Reference samples

- Reference samples are taken from:

Collecting DNA

- Care should be taken to avoid contamination
 - Disposable forceps, change gloves between items, Package separately
- Must be air dried before packaging to avoid _____ (which destroys the evidence)
- Evidence should be kept _____
- Contamination is usually easily seen in the lab (if more than 2 bands are present)
- If blood can't be seen it can be detected with _____ without any damage to the DNA.

Collection of DNA

- It is necessary only to collect 36 dna-bearing cells in order to have enough DNA to test and some new tests can go as low as 9 cells

- Samples should never be packaged in air tight containers to prevent the accumulation of moisture and increase bacterial and fungal growth which could destroy DNA
- Should be packaged in _____

DNA Restriction

- Restriction enzymes can be added to DNA to _____ the DNA at specific sequences.

RFLP

- Restriction Fragment Length Polymorphisms
- Involves splicing repeating segments out of the DNA via restriction enzymes.
- Number of repeats a person has will vary from person to person (remember—VNTRs)
- _____ a person has can be determined by running the sample in an electrophoresis gel.
- The gel is spiked with ethidium bromide which causes the DNA bands to glow when exposed to UV light
- The resulting fragments will be of different sizes based on a _____.
- It was the first accepted protocol.
- Fame was short lived. It was replaced by STR.
- Most famous case— _____
-

In the Lab

- DNA found at a crime scene needs to be replicated in order to be tested.
- Outside of the body, DNA can be replicated by using a technique called _____

Steps of DNA testing

PCR

- Polymerase Chain Reaction
- Replicates even the smallest sample of DNA.
- Takes about 90-100 minutes to give you millions of copies of DNA.
- Uses a thermostable enzyme called _____. (let's replication happen at a higher temp which makes it faster)
 - Taq is very expensive and is isolated from bacteria that live in deep sea thermal vents
- Without PCR, forensic testing would be impossibly slow

Steps of PCR

- 1) Denature DNA- heat to 95°C
- 2) _____ - cool to 55°C
- 3) Polymerization- 72°C using *Taq* Polymerase

PCR Revolution

- From 85-95, RFLP was dominant but in 1995 PCR changed everything.
- PCR replicates DNA much the same way as the body except much faster and only small segments (identified by the attachment of primers)
- Works with smaller segments of DNA than RFLP which means it is less likely to degrade (break down)
- Only need _____

STR

- _____
- Newest form of DNA testing
- Location on the chromosomes where short sequences of DNA (3-7 base pairs) repeat themselves.

- Because the strands are so short they can often be recovered from a body even after tremendous decomposition
- Short length makes the ideal for PCR replication

STR

- Once copied the fragments can be run on an electrophoresis gel and their length can be determined (number of repeats)
- Hundreds of STRs exist
- _____ have been used to form the national database (CODIS)
- The more STRs that match the better the probability

CODIS

- _____
- All 50 states mandate the collection of DNA from criminals convicted of certain crimes (types of crimes are decided by states)
 - Sex offender
 - Felony offender
 - Felony arrest
 - All arrest (Virginia)
- Maintained by the FBI but it contains databases from all jurisdictions.
 - Over 9.7 million profiles
 - 35 million profiles world-wide
- NY recently started collecting from all convictions (felony and misdemeanor)
- If your conviction is overturned, you can petition to have your sample removed
- _____ of hits came from profiles from criminals convicted of nonviolent crimes
- _____ of rape hits had a prior conviction for burglary (a nonviolent crime)

CODIS

- Based on 13 STRs; when all 13 match a sample---it is considered a match
- Functions:
 - Provides a way to link serial crimes
 - _____
- Hits just get you _____ for a warrant to collect a new sample for comparison.
- 49 hits/month in AL making it #1 in the nation.

Amelogenin gene

- When conducting STR analysis, scientists look at the amelogenin gene to determine sex.
- This gene is on both the X and Y chromosomes but it is _____
- In a female you should only see _____ on the gel whereas in a male you should see 2.

Y-STRs

- New test that looks only at STRs on the Y chromosome
- Can help in sexual assault cases
- Female DNA (victim) will not be present since she doesn't possess the Y chromosome.
 - _____