DNA Analysis

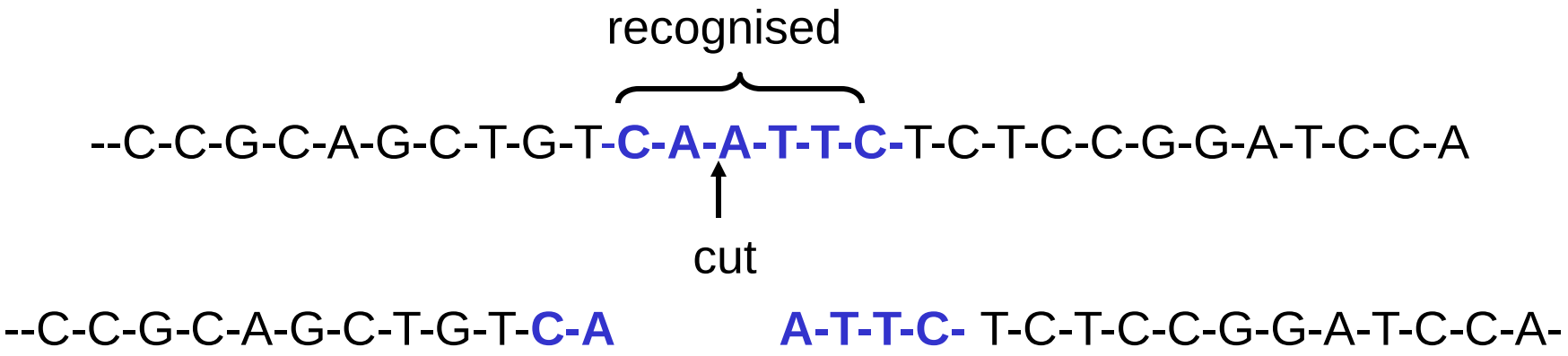
DNA molecules are very long

They may consist of millions of base pairs

In order to study the structure of DNA, the molecules are broken up into smaller fragments by enzymes called ***restriction enzymes***

Restriction enzymes do not break up the DNA molecule randomly but ‘cut’ it at particular sites

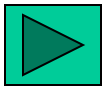
For example, a restriction enzyme called *EcoR1** ‘recognises’ the base sequence **CAATTC** and cuts it between the two **A**s



Other restriction enzymes cut the DNA in different places and so produce fragments which are easier to analyse

The fragments cut by the restriction enzymes are called **restriction fragments**

The fragments can be separated using ***gel electrophoresis***
(*See slides 7 – 11)*



Genetic fingerprinting

90% or more of DNA does not carry nucleotide triplets that code for proteins

The non-coding DNA is often called ‘junk DNA’ but this only means that its functions have not yet been discovered

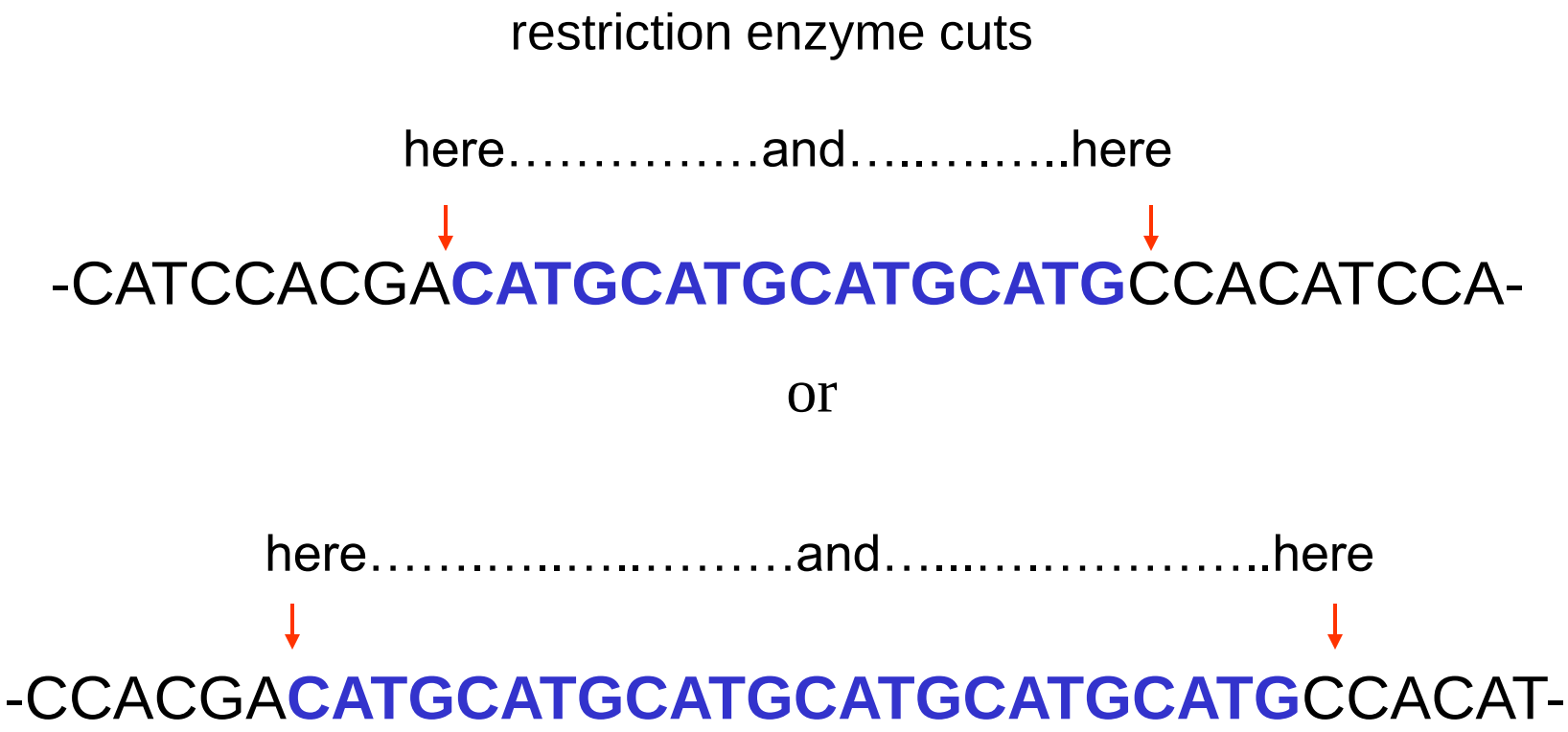
Some of the non-coding regions consist of repeated sequences of nucleotides

For example -C-A-T-G-C-A-T-G-C-A-T-G-C-A-T-G- *

The number of repeats in any one section of DNA varies from one individual to the next

Particular repeat sequences can be ‘cut out’ by restriction enzymes

For example



Gel electrophoresis

The different sized fragments are separated by a process called **gel electrophoresis**

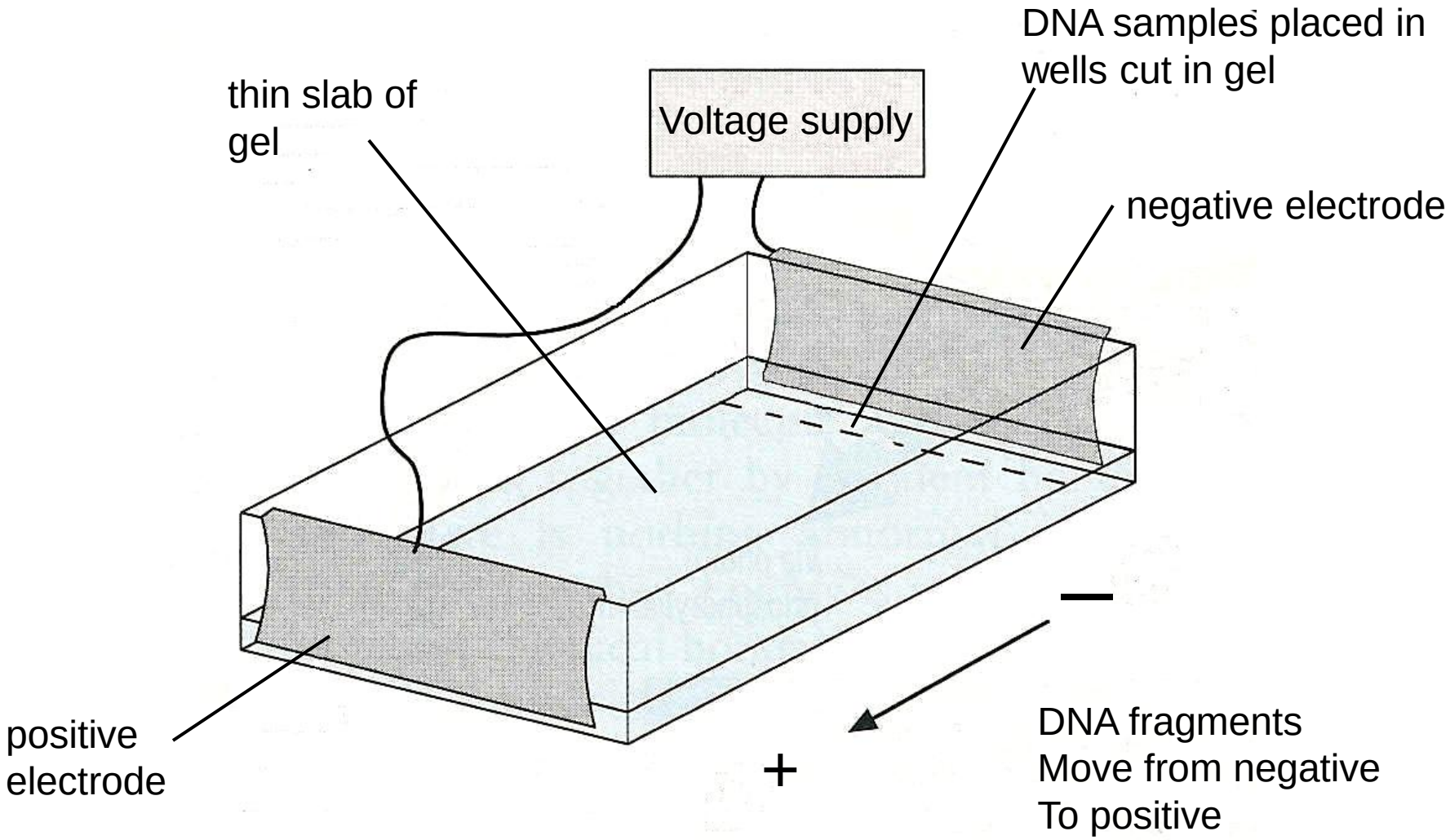
The separation takes place in a sheet of a firm but jelly-like substance (a ‘gel’)

Samples of the DNA extracts are placed in shallow cavities (‘wells’) cut into one end of the gel

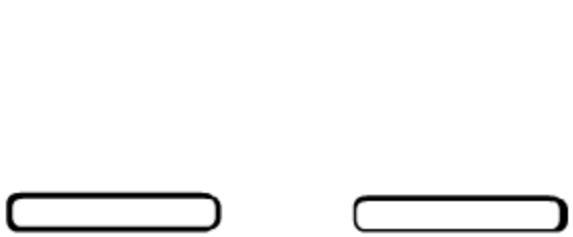
A voltage is applied to opposite ends of the gel

DNA has a negative charge and moves slowly towards the positive end

The shorter fragments travel through the gel faster than the longer fragments


DNA samples placed in wells cut in gel
thin slab of gel
Voltage supply
negative electrode
positive electrode
DNA fragments
Move from negative
To positive

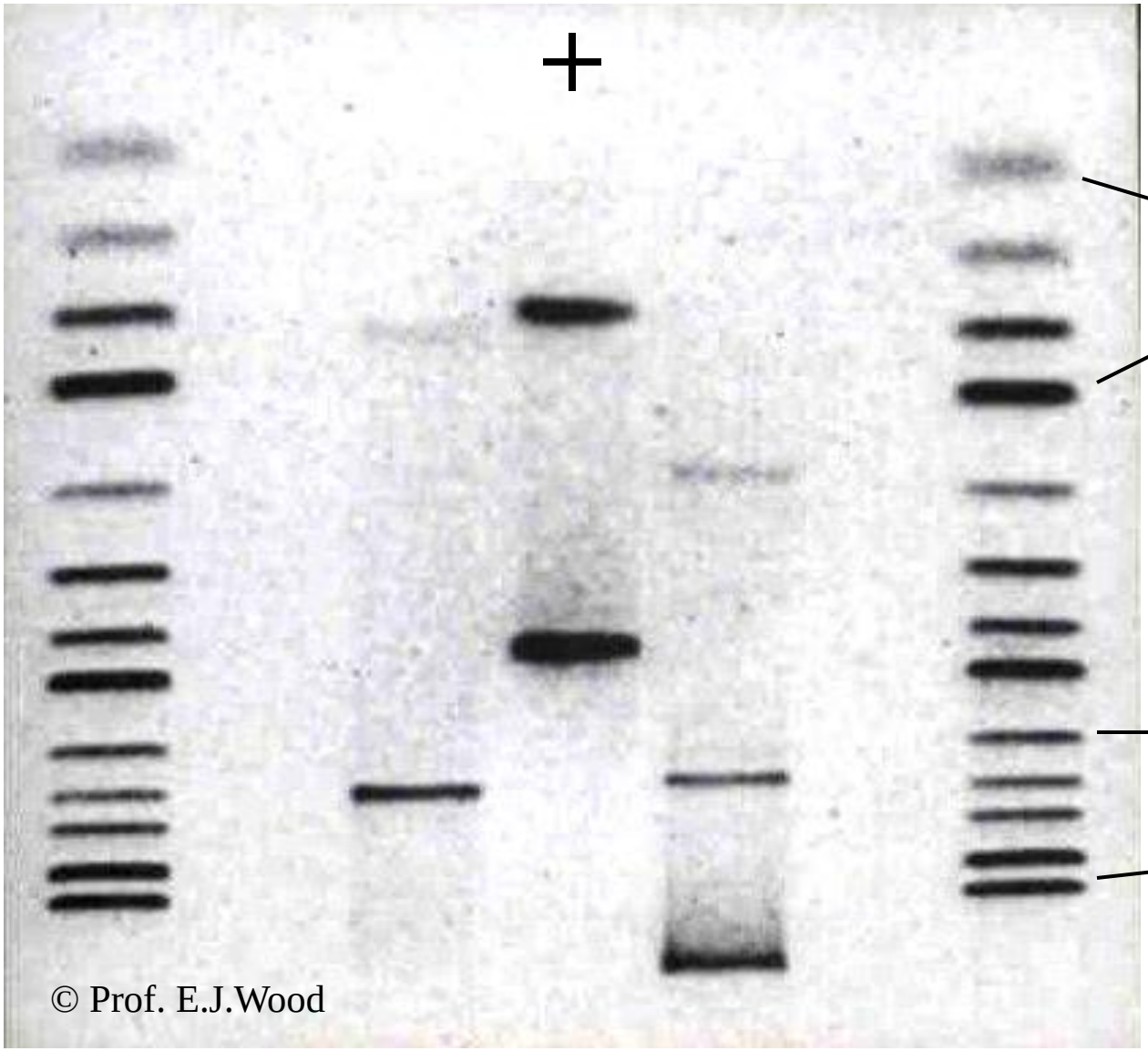
A sample with the shorter DNA fragments travels through the gel faster than a sample with the larger fragments



amples of the DNA extracts are placed in depressions cut in the gel

Next slide

Appearance of separated fragments on gel



starting positions

Genetic fingerprinting

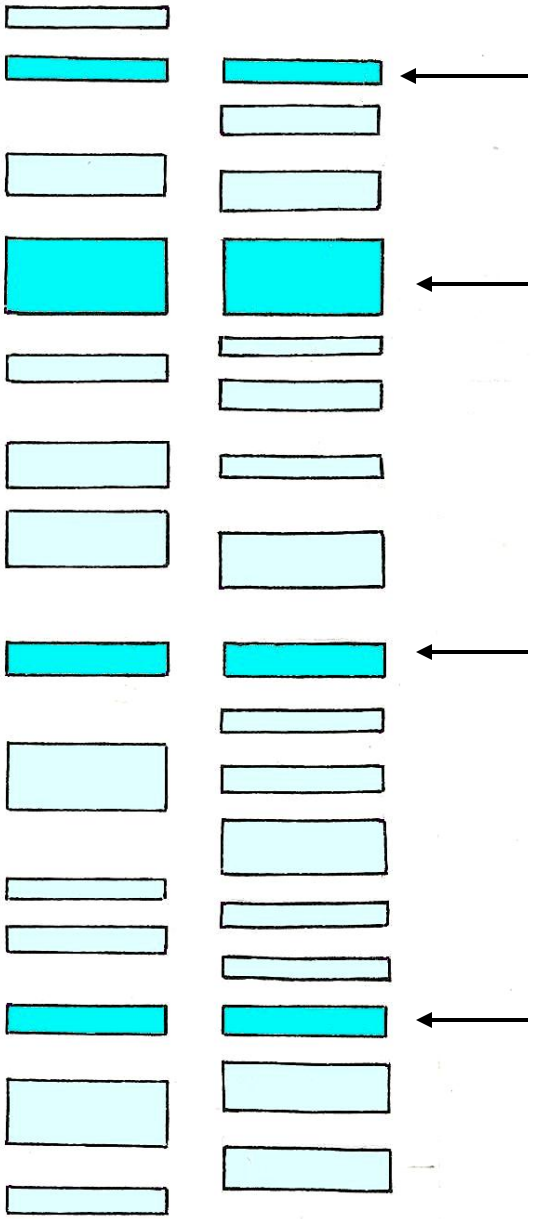
DNA analysis can be used for catching criminals, establishing parentage, finding how closely organisms are related and many other applications.

The pattern of bands in a gel electrophoresis is known as a **genetic fingerprint** or a ‘genetic profile’

If a genetic fingerprint found in a sample of blood or other tissue at the scene of a crime matches the genetic fingerprint of a suspect, this can be used as evidence

A DNA sample can be obtained from the suspect using blood, cheek epithelial cells taken from the mouth lining or even the cells clinging to the root of a hair

Suppose that……



….there is a chance of 1 in 10 that this fragment occurs in many individuals…

…and.there is a chance of 1 in 20 that this fragment occurs in many individuals…

…and.there is a chance of 1 in 10 that this fragment occurs in many individuals…

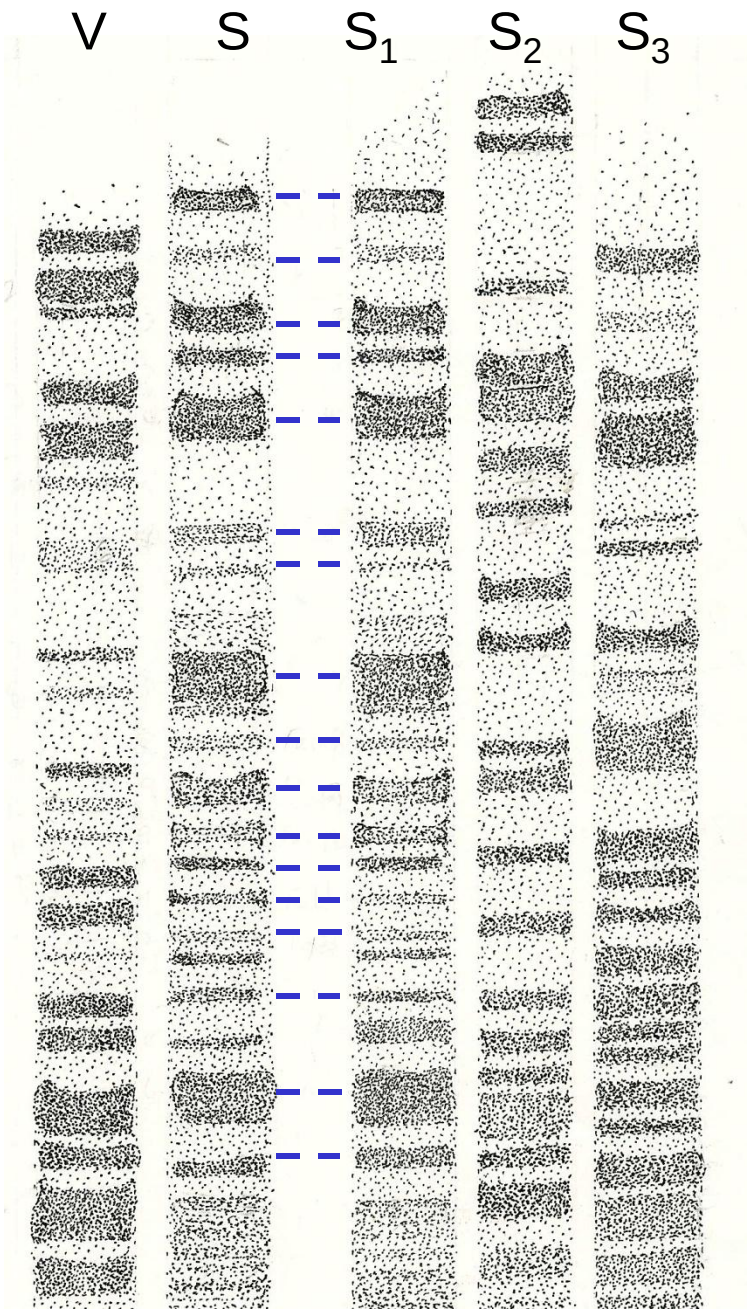
…and.there is a chance of 1 in 30 that this fragment occurs in many individuals, but…

…the probability of all 4 bands matching in any person other than the suspect is

1 in 10 x 1 in 20 x 1 in 10 x 1 in 30

= 1 in 10 x 20 x 10 x 30 That is 1 in 60,000

When a larger number of bands is involved, the probability that the suspect is not guilty becomes one in many thousands*



V Victim

S Sample from crime scene

S_1 Suspect 1

S_2 Suspect 2

S_3 Suspect 3

More than 20 fragments from Suspect 1 match those taken from the crime scene