The structure of DNA

```
ATGCCGATCGTACGACACATATCGTCATCGTACTGACTGTCTAGTCTAAACACATCCATCGTACTGACTGCATCGATC
TACTGACTGCATCGTACTGACTGCACATATCGTCATCGTACTGACTGTCTAGTCTAAACACATCCCACATATCGTTTA
CATCGTACTGACTGTCTAGTCTAAACACATCCCACATATCGTCATCGTACTGACTGTCTAGTCTAAACACATCCCAGC
CATATCGTCATCGTACTGACTGTCTAGTCTAAACACATCCTATGCCGATCGTACGACACATATCGTCATCGTACTGCC
ACTGTCTAGTCTAAACACATCCATCGTACTGACTGCATCGTACTGACTGCATCGTACTGACTGCACATATCGTCATAC
TCGTACTGACTGTCTAGTCTAAACACATCCCACATATCGTCATCGTACTGACTGTCTAGTCTAAACACATCCCACTTT
ATATCGTCATCGTACTGACTGTCTAGTCTAAACACATCCCACATATCGTCATCGTACTGACTGTCTAGTCTAAACACA
GCCGATCGTACGACACATATCGTCATCGTACTGCCCTACGGGACTGTCTAGTCTAAACACATCCATCGTACTGACTGC
TGACTGCATCGTACTGACTGCACATATCGTCATACATAGACTTCGTACTGACTGTCTAGTCTAAACACATCCCACATA
CGTACTGACTGTCTAGTCTAAACACATCCCACTTTACCCATGCATCGTACTGACTGTCTAGTCTAAACACATCCCACA
ATCGTACTGACTGTCTAGTCTAAACACATCCCAGCATCCATCCATATCGTCATCGTACTGACTGTCTAGTCTAAACAC
GCCGATCGTACGACACATATCGTCATCGTACTGCCCTACGGGACTGTCTAGTCTAAACACATCCATCGTACTGACTGC
TGACTGCATCGTACTGACTGCACATATCGTCATACATAGACTTCGTACTGACTGTCTAGTCTAAACACATCCCACATA
CGTACTGACTGTCTAGTCTAAACACATCCCACTTTACCCATGATATCGTCATCGTACTGACTGTCTAGTCTAAACACA
TATCGTCATCGTACTGACTGTCTAGTCTAAACACATCCTATACATATCGTCATCGTACTGACTGTCTAGTCTAAACAC
GCCGATCGTACGACACATATCGTCATCGTACTGCCCTACGGGACTGTCTAGTCTAAACACATCCATCGTACTGACTGC
TGACTGCATCGTACTGACTGCACATATCGTCATACATAGACTTCGTACTGACTGTCTAGTCTAAACACATCCCACATA
CGTACTGACTGTCTAGTCTAAACACATCCCACTTTACCCATGATATCGTCATCGTACTGACTGTCTAGTCTAAACACA
TATCGTCATCGTACTGACTGTCTAGTCTAAACACATCCTATAGCCGATCGTACGACACATATCGTCATCGTACTGCCC
CTGTCTAGTCTAAACACATCCATCGTACTGACTGCATCGTACGCCGATCGTACGACACATATCGTCATCGTACTGCCC
CTGTCTAGTCTAAACACATCCATCGTACTGACTGCATCGTACTGACTGCATCGTACTGACTGCACATATCGTCATACA
CGTACTGACTGTCTAGTCTAAACACATCCCACATATCGTCATCGTACTGACTGTCTAGTCTAAACACATCCCACTTTA
ATCGTACTGACTGTCTAGTCTAAACACATCCCACATATCGTCATCGTACTGACTGTCTAGTCTAAACACATCCCAGCA
ATATCGTCATCGTACTGACTGTCTAGTCTAAACACATCCTATGCCGATCGTACGACACATATCGTCATCGTACTGCCC
CTGTCTAGTCTAAACACATCCATCGTACTGACTGCATCGTACGACTGCATCGTACTGACTGCACATATCGTCATACAT
GTACTGACTGTCTAGTCTAAACACATCCCACATATCGTCATCGTACTGACTGTCTAGTCTAAACACATCCCACTTTAC
ATCGTCATCGTACTGACTGTCTAGTCTAAACACATCCCACACTGTCTAGTCTAAACACATCCATCGTACTGACTGCAT
CGATCGTACGACACATATCGTCATCGTACTGCCCTACGGGACTGTCTAGTCTAAACACATCCATCGTACTGACTGCAT
```

DNA Fingerprinting
(aka Genotyping)

The structure of DNA
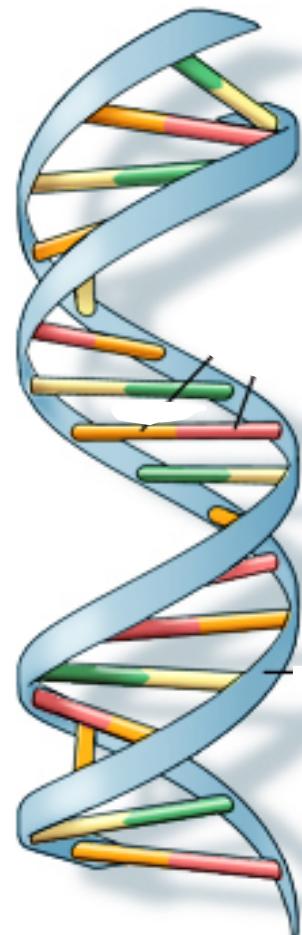
5′	3′
A	T
T	A
G	C
C	G
C	G
G	C
A	T
T	A
C	G
G	C
T	A
T	A
3′	5′

Humans can differ from each other by Single Nucleotide Polymorphisms (SNPs)

```
5'          3'
A           T
T           A
G           C
C           G
C           G
G           C
A           T
T           A
C           G
T           A
T           A
T           A
3'          5'
```

Human #1

```
5'-ATGCCGATCGTT-3'
3'-TACGGCTAGCAA-5'
```

Humans can differ from each other by Single Nucleotide Polymorphisms (SNPs)

```
5'        3'
A         T
T         A
G         C
C         G
C         G
G         C
A         T
T         A
C         G
T         A
T         A
T         A
3'        5'
```

Human #1

5'–ATGCC**G**ATCGTT–3'
3'–TACGG**C**TAGCAA–5'

Human #2

5'–ATGCC**A**ATCGTT–3'
3'–TACGG**T**TAGCAA–5'

What is DNA Fingerprinting (Genotyping) used for?

What is DNA Fingerprinting (Genotyping) used for?

-- Paternity Testing

-- Forensics

-- Discovering the gene that, when mutated, leads to a disease

Humans can differ from each other by Single Nucleotide Polymorphisms (SNPs)

```
5'        3'
A         T
T         A
G         C
C         G
C         G
G         C
A         T
T         A
C         G
T         A
T         A
T         A
3'        5'
```

Human #1

```
5'-ATGCCGATCGTT-3'
3'-TACGGCTAGCAA-5'
```

Human #2

```
5'-ATGCCAATCGTT-3'
3'-TACGGTTAGCAA-5'
```

Humans can differ from each other by Simple Sequence Repeats (SSRs)

Human #1

Human #2

```
5'-ATGCCGTGTGTGATCGTT-3'          5'-ATGCCGTGTGTGTGTGATCGTT-3'
3'-TACGGCACACACTAGCAA-5'          3'-TACGGCACACACACACTAGCAA-5'
```

Humans can differ from each other by Simple Sequence Repeats (SSRs)

Human #1

Human #2

```
5'-ATGCCGTGTGTGATCGTT-3'
3'-TACGGCACACACTAGCAA-5'
```

```
5'-ATGCCGTGTGTGTGTGATCGTT-3'
3'-TACGGCACACACACACTAGCAA-5'
```

one DNA that is 18 nucleotides long

one DNA that is 22 nucleotides long

Gel Electrophoresis

-- A technique that allows pieces of DNA to be separated by size

-- A gel is a matrix that molecules can move through

-- DNA is negatively charged

PCR - a way to copy one area of the DNA

PCR - a way to copy one area of the DNA
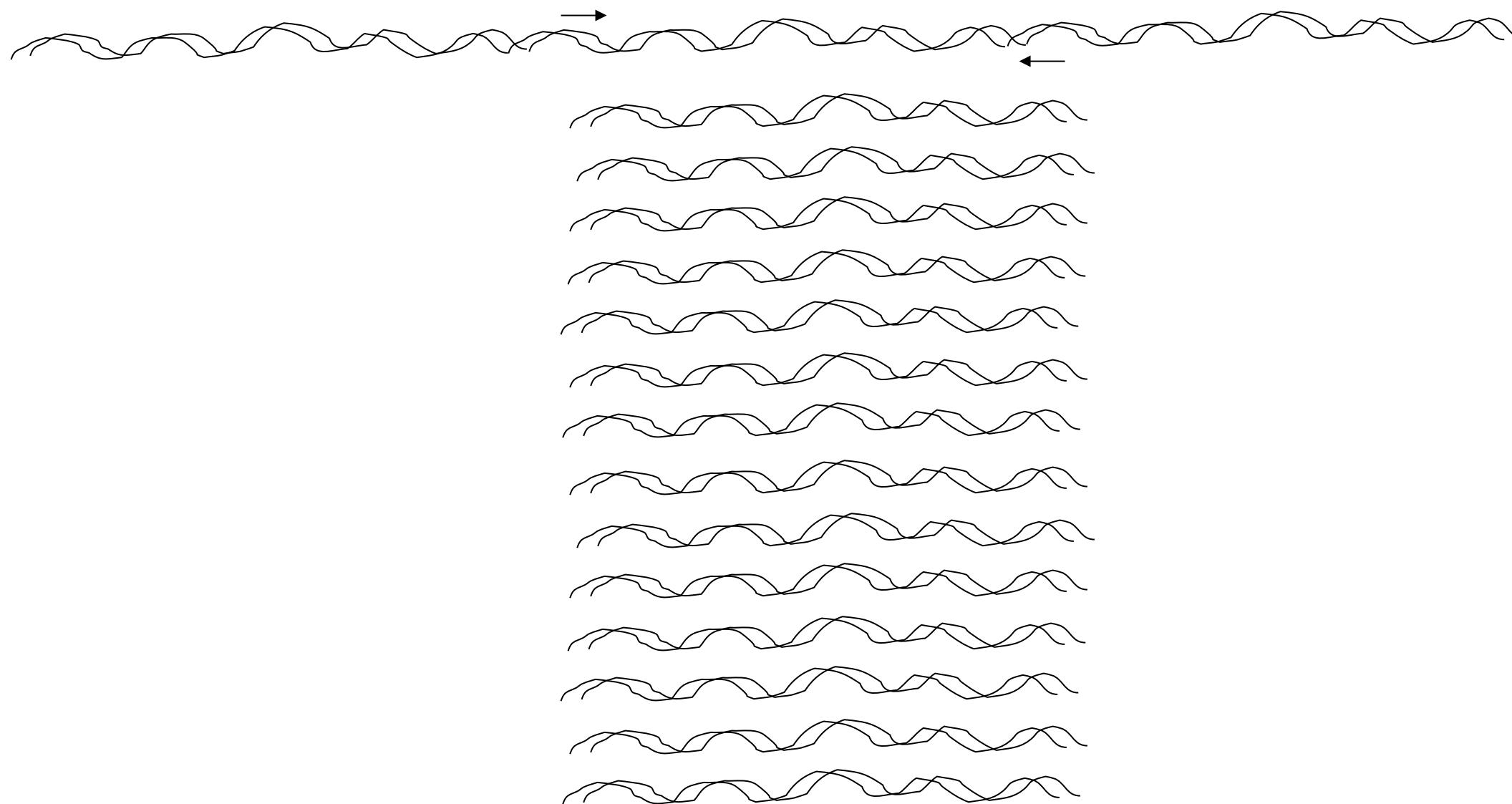
# Using Gel Electrophoresis for Fingerprinting

1) Isolate the DNA from a person

2) Make copies of just the one region of DNA you want to study

3) Run the DNA through a gel

Gel Electrophoresis
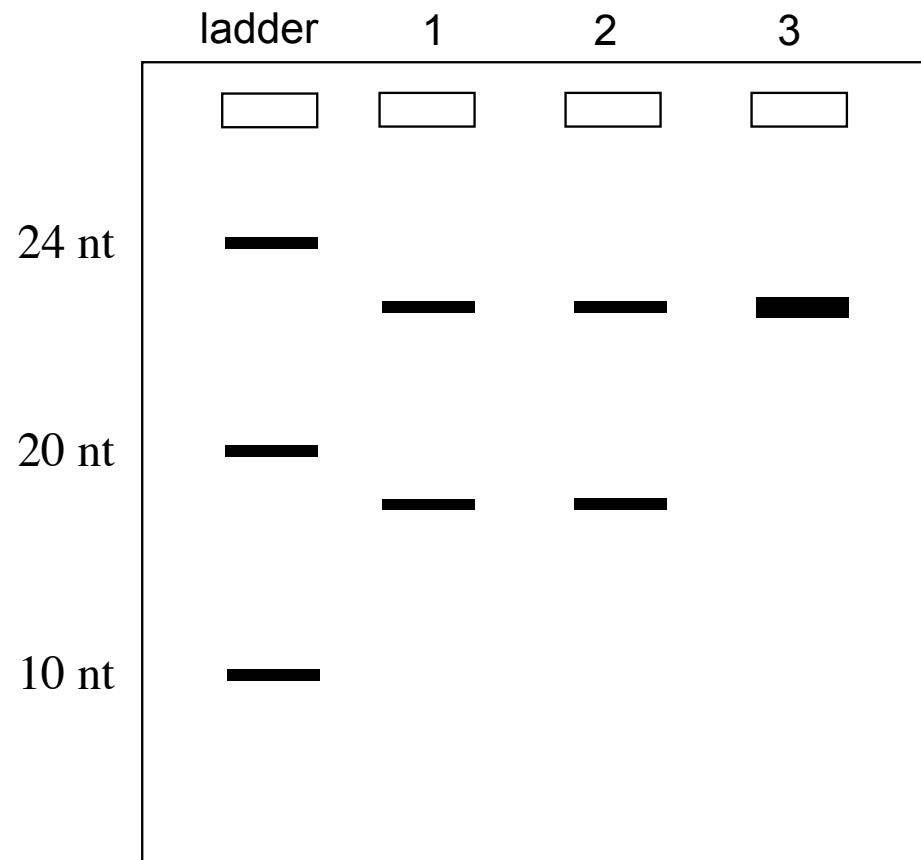
Half my DNA is from mom and half is from dad

CCAGTA**CCTCCTCCT**ACGGA   CCAGTA**CCT**ACGGA
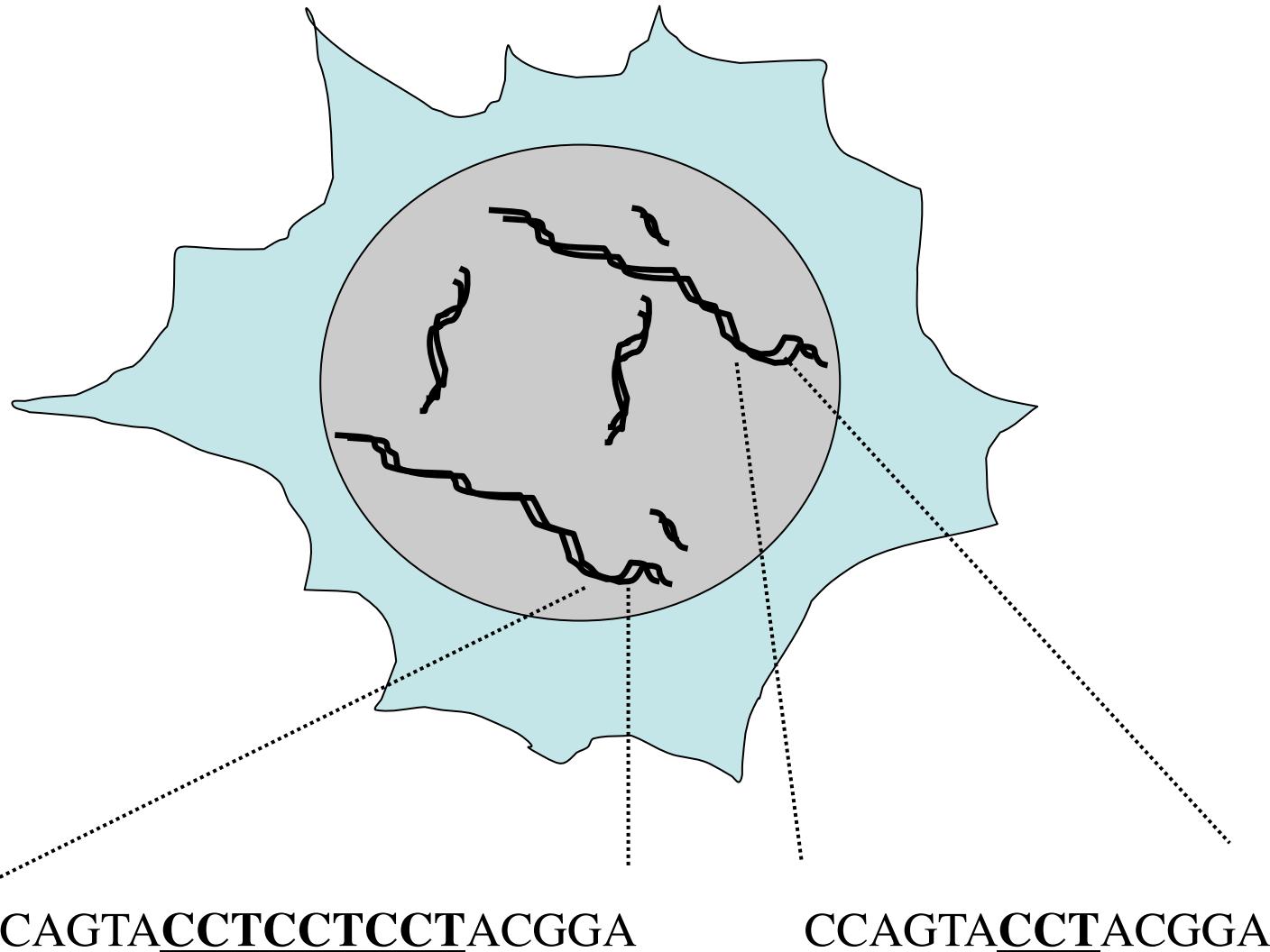
Can these people be my parents?
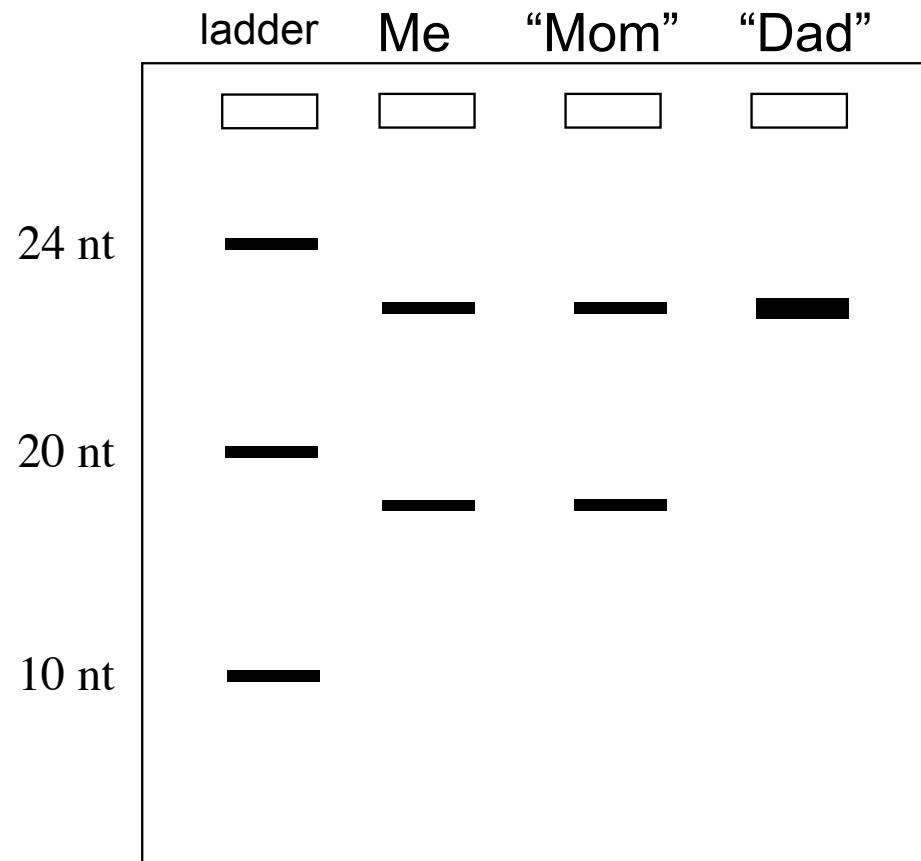
Are these my parents?

A mix up between 3 babies and 3 sets of parents

-- 3 babies in a maternity ward: A, B, C

-- 3 couples: Mom #1 & Dad #1

Mom #2 & Dad #2

Mom #3 & Dad #3

A specific region of chromosome #15

5′…GCTAAGTATTGCTCAAGA…(TTAGGAT)$_n$…GATAAATAACTGGCTAGTA…-3′
3′…CGATTCATAACGAGTTCT…(AATCCTA)$_n$…CTATTTATTGACCGATCAT…-5′
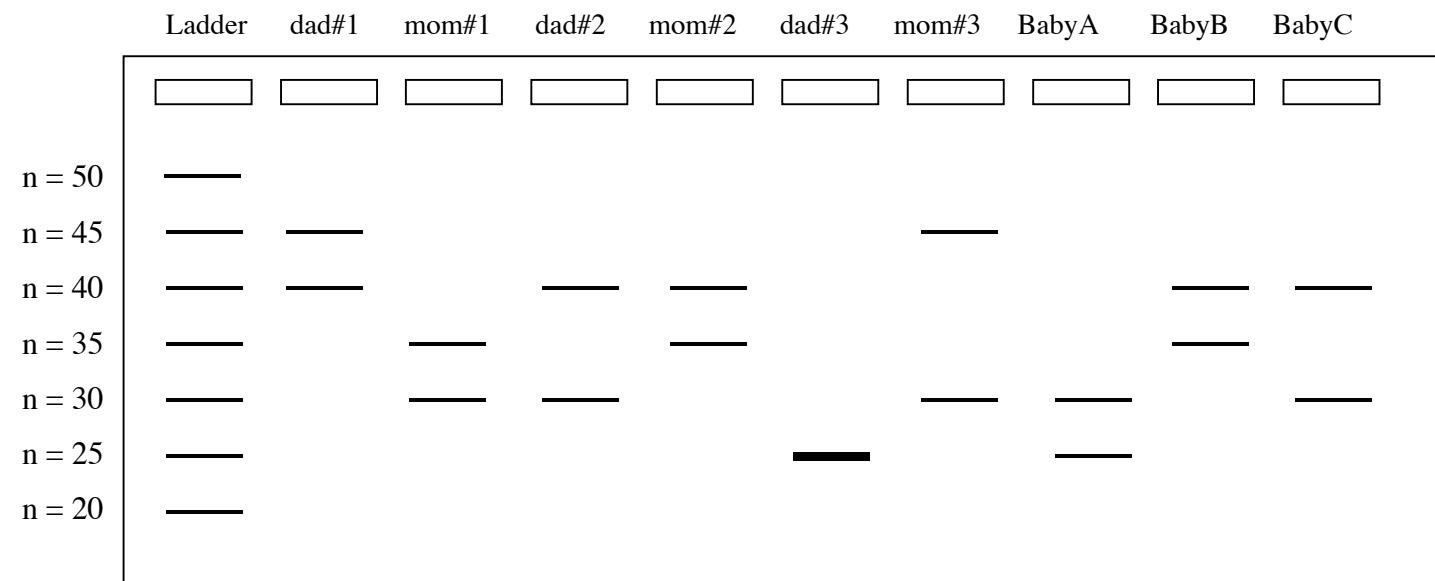
Questions to Answer

-- Given the data so far, which of the three babies can you already conclusively connect to a set of parents?

-- How did you conclude this?

-- Why can you not determine the parents of all of the babies at this point?

-- How do you think you would go about conclusively determining the parents of the remaining babies using DNA fingerprinting analysis?

Examining a region of chromosome #15
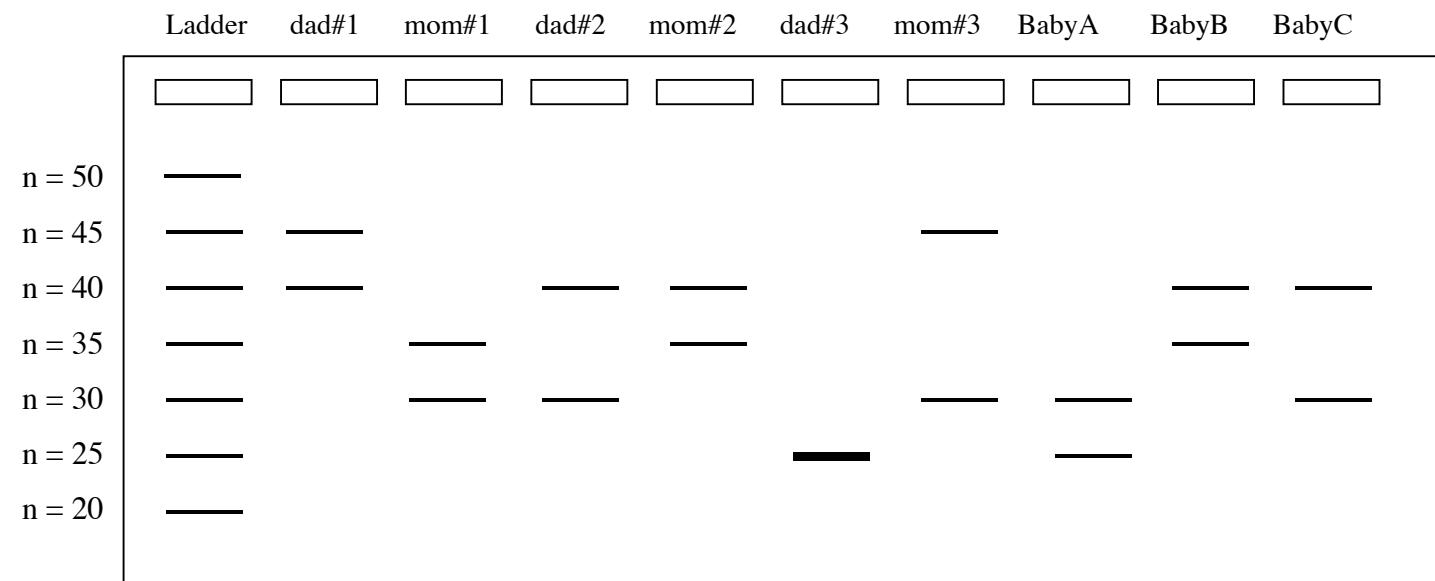
A specific region of chromosome #4

5′…ACTGTAAACGCTAGCTGGTTCACTG…(CAG)$_n$…CCTATAGCTAGCTTTACGGA…-3′
3′…TGACATTTGCGATCGACCAAGTGAC…(GTC)$_n$…GGATATCGATCGAAATGCCT…-5′

Examining a region of chromosome #4
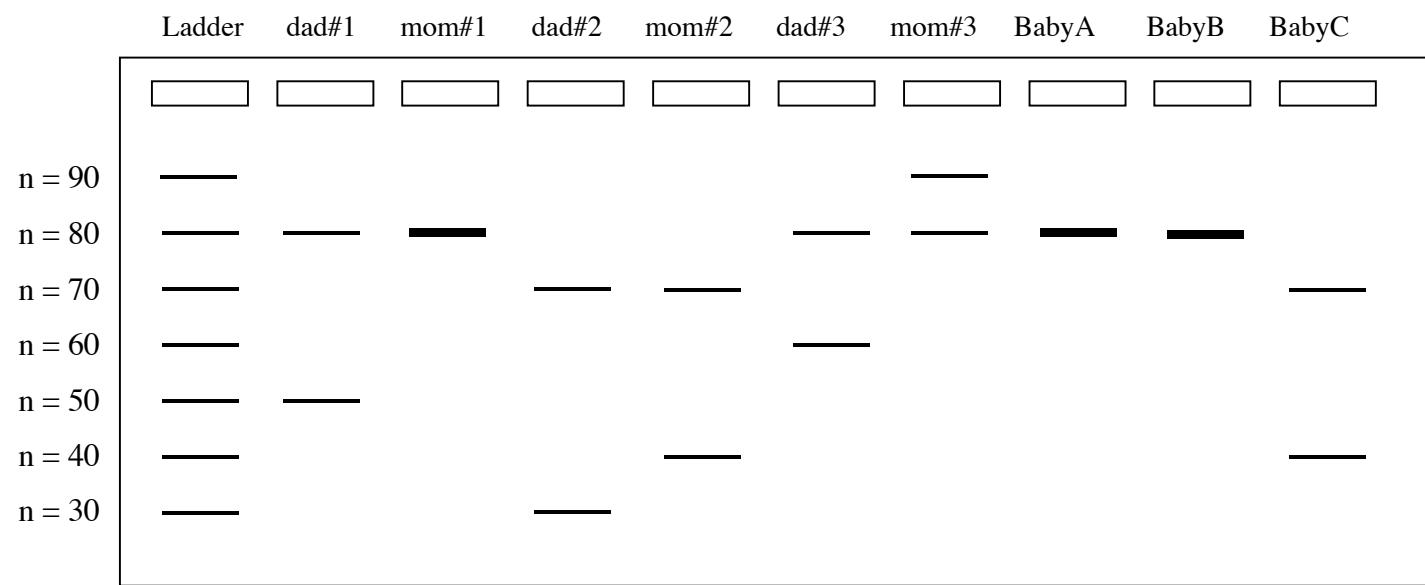
Questions to Answer

-- Given all the data in this problem, match the three sets of parents to the three babies.

-- Explain how this site on chromosome #4 allowed you to match parents #1 and parents #2 to the correct baby (B or C).

Examining a region of chromosome #4

Ladder	dad#1	mom#1	dad#2	mom#2	dad#3	mom#3	BabyA	BabyB	BabyC

n = 90

n = 80

n = 70

n = 60

n = 50

n = 40

n = 30
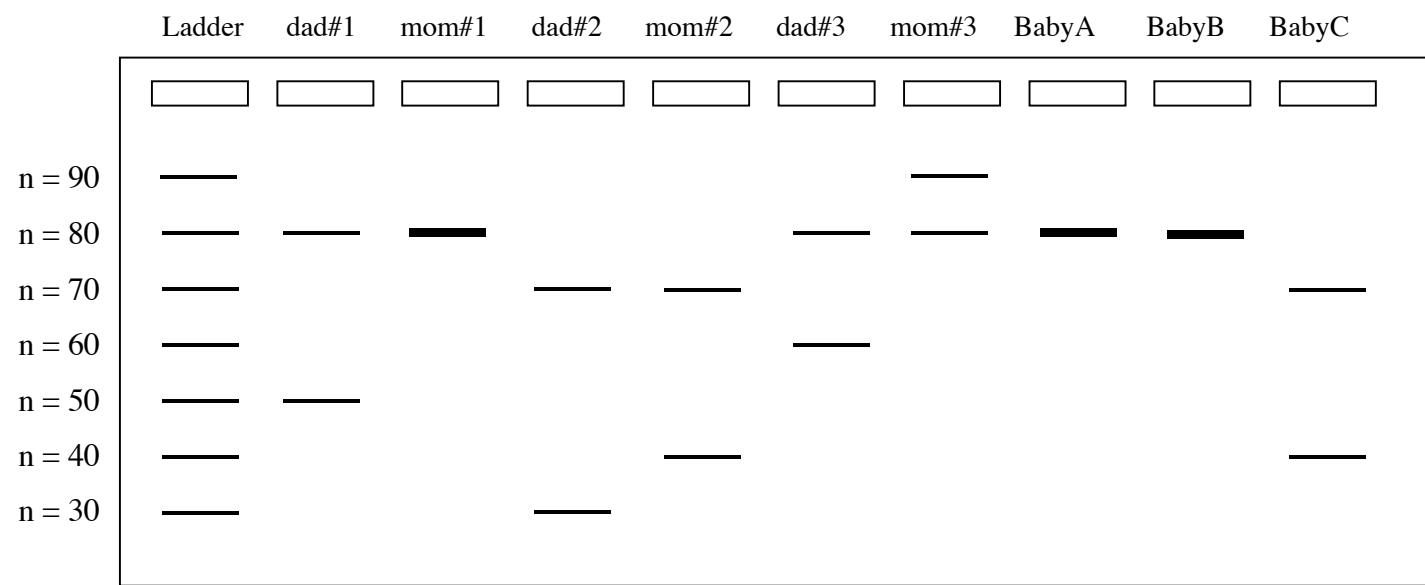
Whose DNA was found at the crime scene?