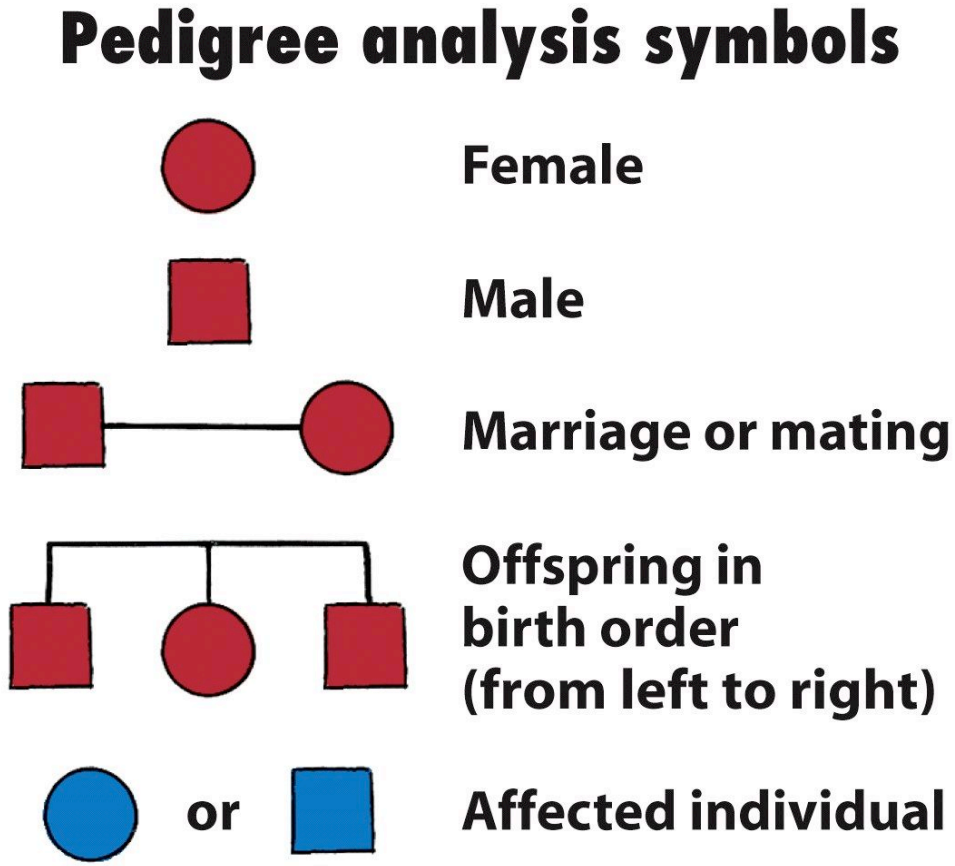
SECOND EDITION Colleen Belk • Virginia Borden

Chapter 7

DNA Detective: Extensions of Mendelism, Sex Linkage, Pedigree Analysis, and DNA Fingerprinting

7.3 Pedigrees

- A **pedigree** is a chart showing inheritance patterns in a family



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Dominant trait: Polydactyly

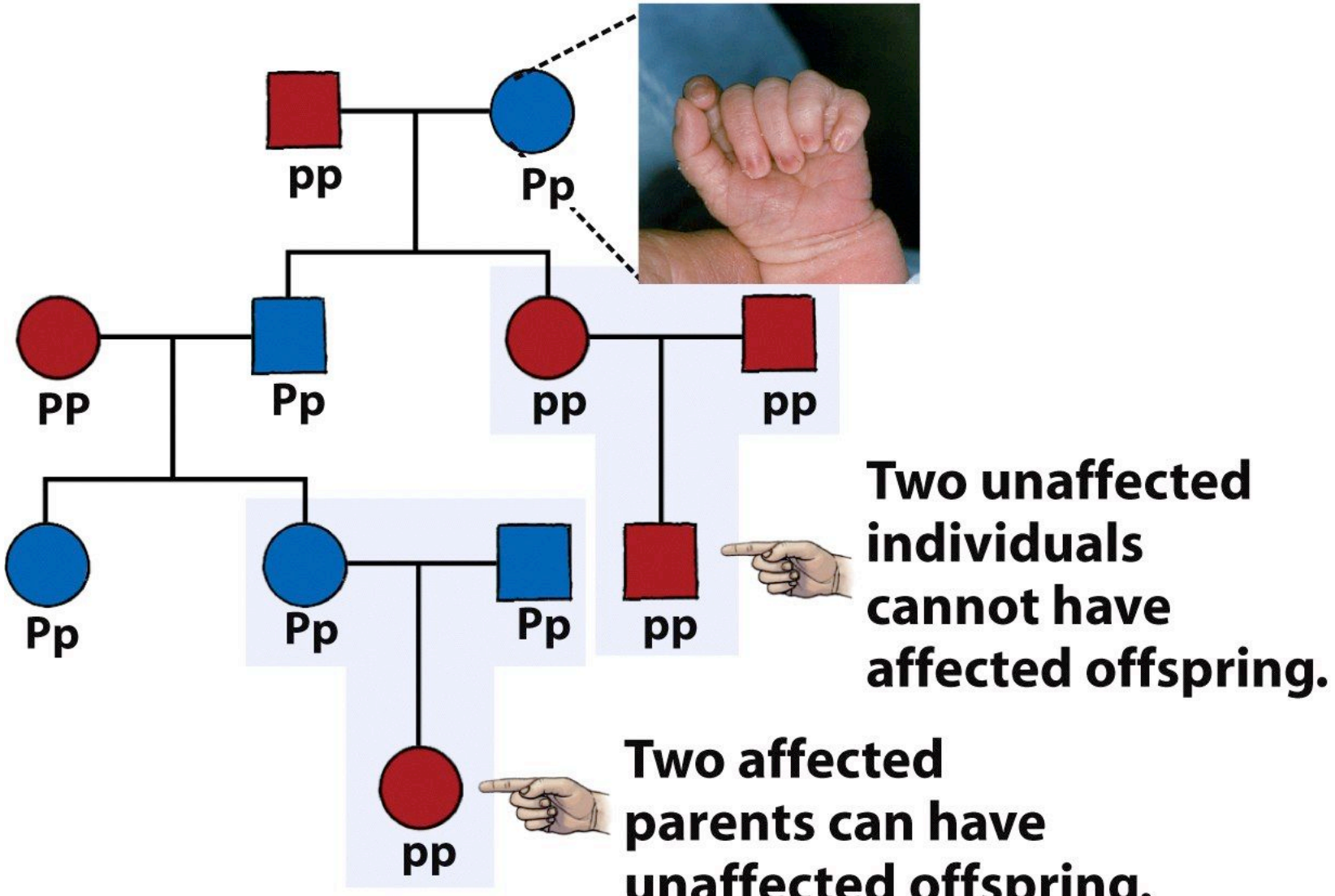
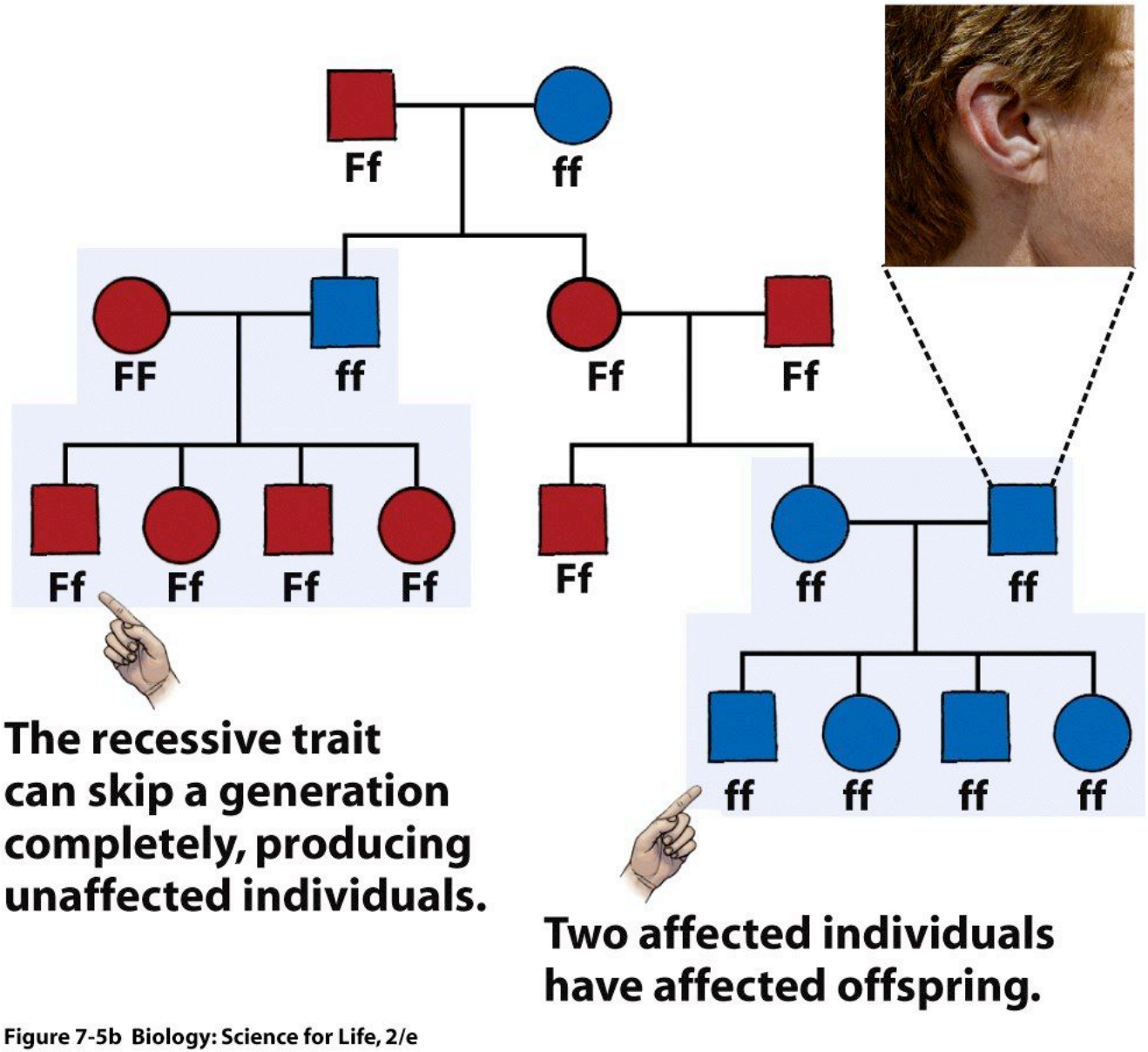


Figure 7-5a Biology: Science for Life, 2/e

Recessive trait: Attached earlobes



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Sex-linked trait: Muscular dystrophy

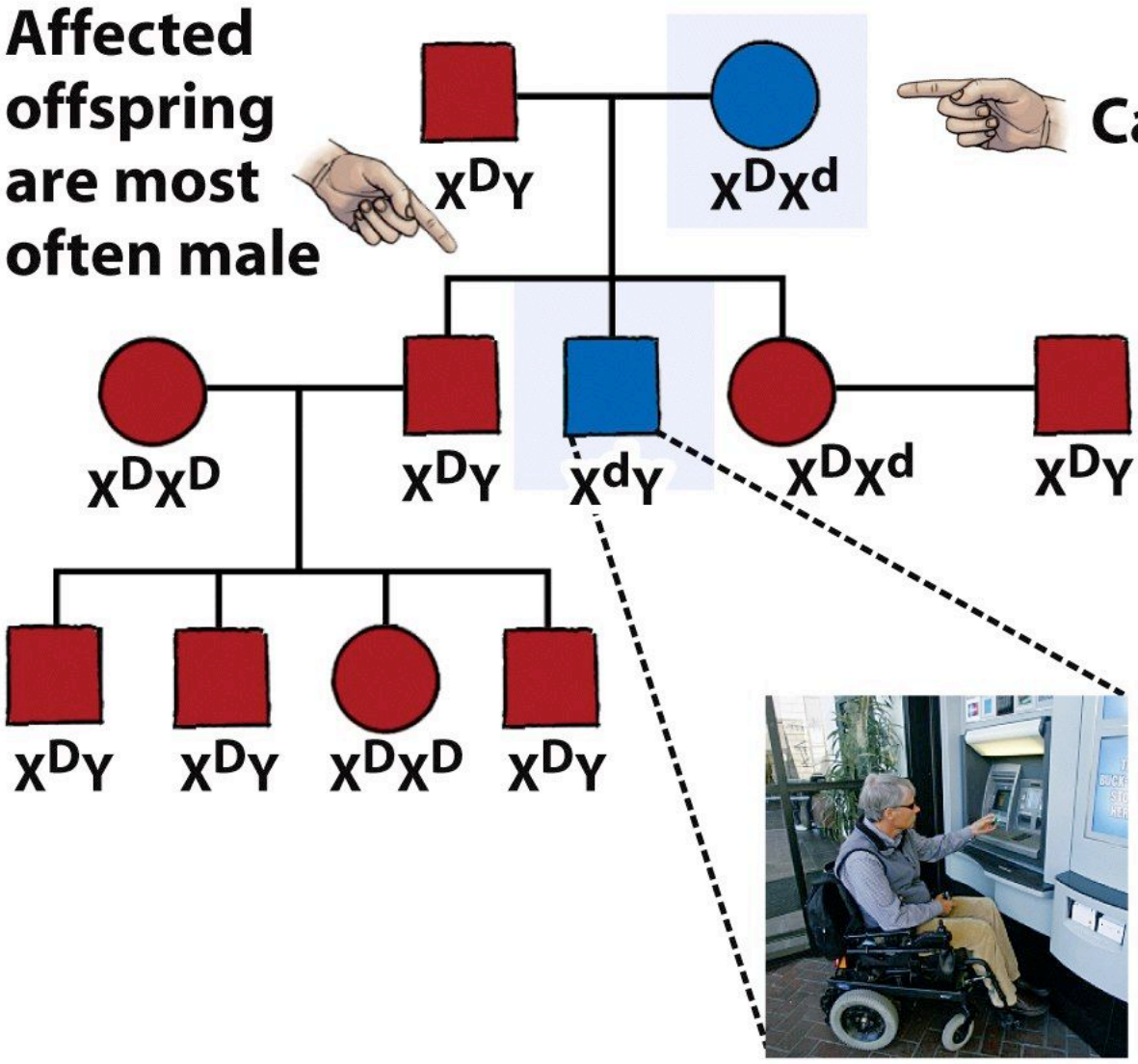
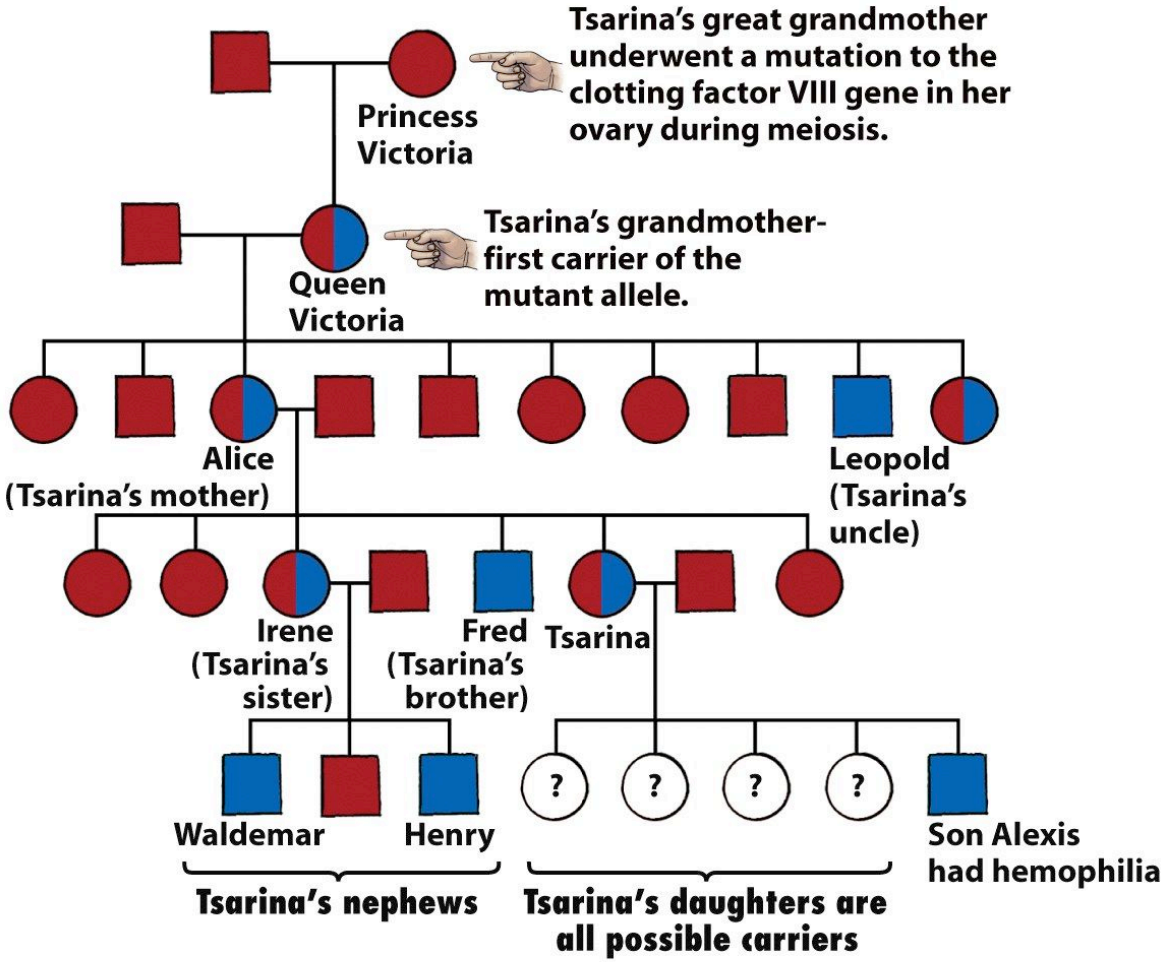


Figure 7-5c Biology: Science for Life, 2/e

Pedigrees

- Pedigrees involving the Romanov family (the former Russian royal family) are useful in showing inheritance of the hemophilia allele



C Figure 7-6 Biology: Science for Life, 2/e

7.4 DNA Fingerprinting

- Unless they are identical twins, individuals have unique DNA

- **DNA fingerprinting**
  - The name used for the unambiguous identifying technique that takes advantage of differences in DNA sequence

- The process of DNA fingerprinting begins by isolating DNA from
  - blood, semen, vaginal fluids, hair roots, skin, skeletal remains, or elsewhere

Polymerase Chain Reaction (PCR)

- If there is only a small amount of DNA available for DNA Fingerprinting
  - scientists can augment the amount of DNA using a technique called **PCR** (**polymerase chain reaction**)
  - PCR is doing DNA replication in a test tube

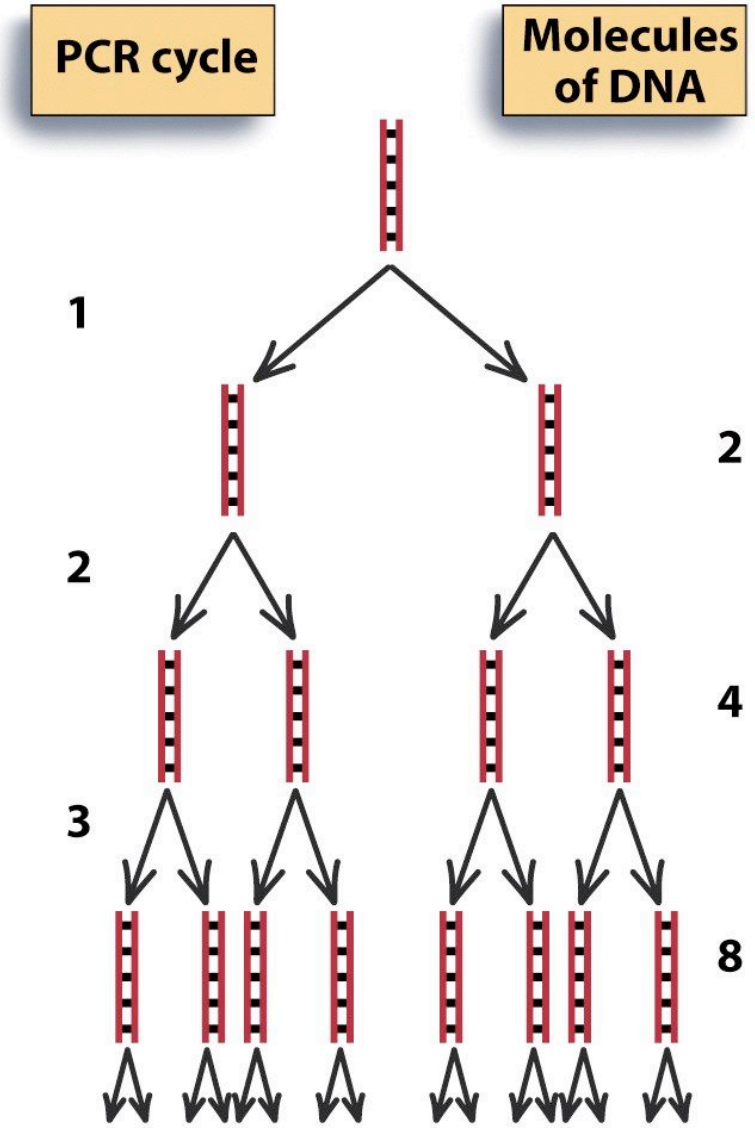


Figure 7-7b Biology: Science for Life, 2/e

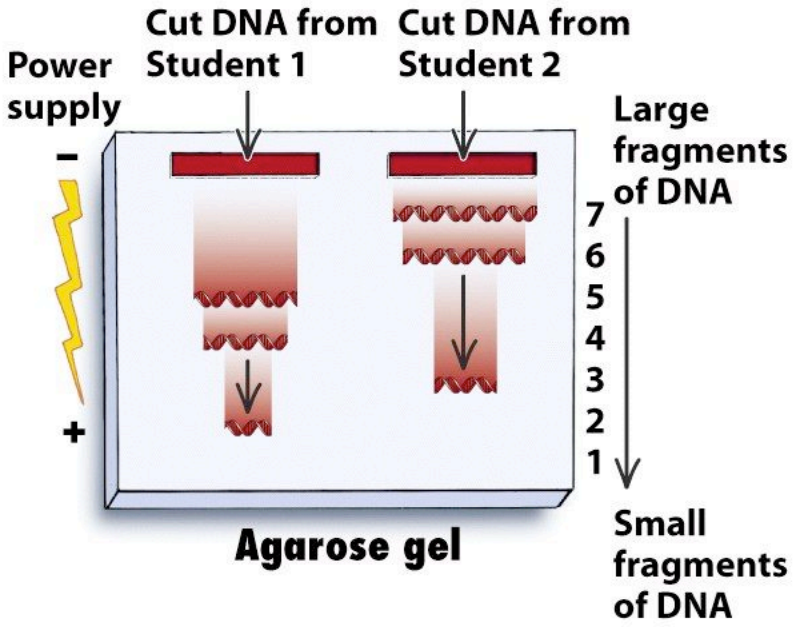
DNA Fingerprinting

- After we isolate the DNA and amplify it with PCR
- Treat the DNA with **restriction enzymes**
  - cut DNA at specific sequences
  - Everyone's DNA is different, so everyone's DNA will cut at different sites
- This results in different sized fragments
- The different sized fragments are called **restriction fragment length polymorphisms**, or **RFLPs**
- We can observe the different sized fragments in an experiment that separates DNA based on fragment size called Gel Electrophoresis

Gel Electrophoresis

- Fragments of DNA from restriction enzyme cleavage are separated from each other when they migrate through a support called an **agarose gel**
  - It is similar to the yummy food Jell-O gelatin
  - It is actually made out of some of the same ingredients
- The size-based separation of Molecules of DNA separate based on size when an electric current is applied to an agarose gel
  - This is **gel electrophoresis**
- The DNA fingerprint is the pattern of different sized DNA fragments which will be different for all individuals
  - The whole process is more complicated, but this is the main point of the experiment

Gel Electrophoresis



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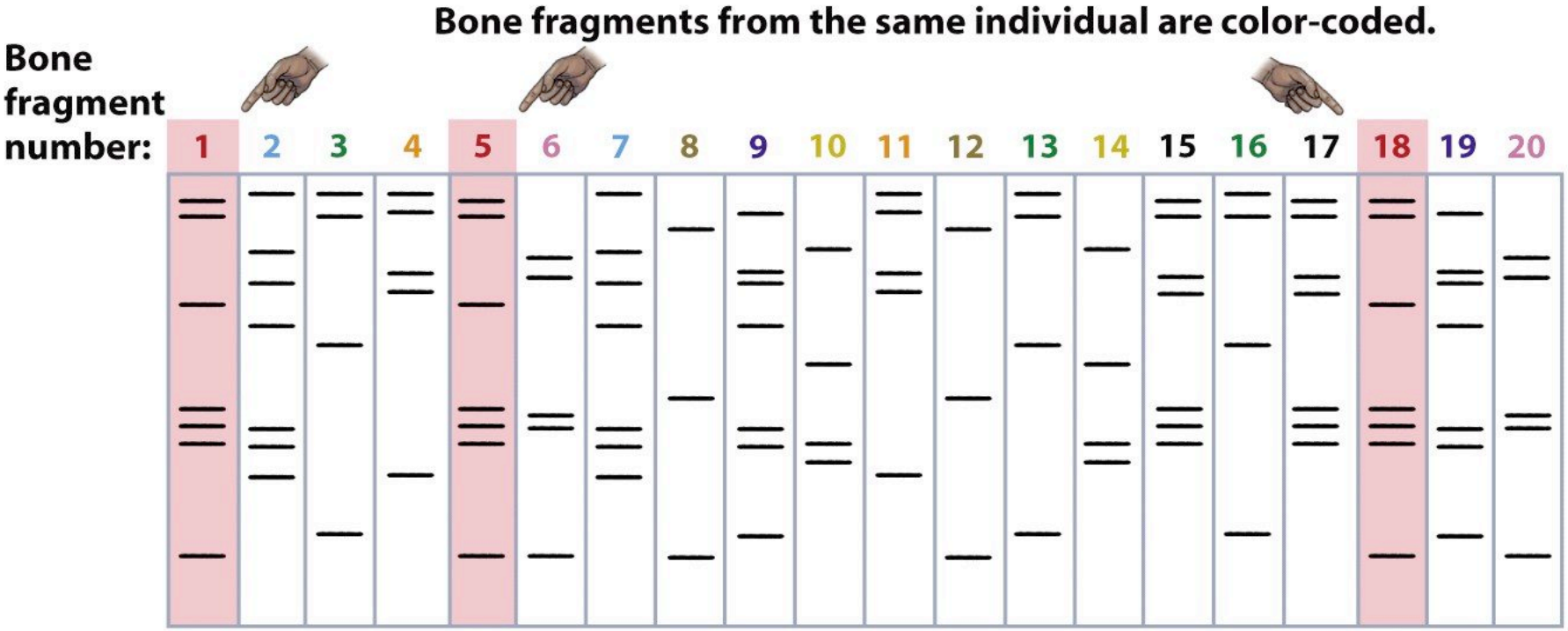
DNA from two different individuals is cut with restriction enzymes and loaded on an agarose gel. When these fragments are subjected to an electric current, shorter fragments migrate through the gel faster than do larger fragments.

Student 1 has DNA sequences that carry 4 and 5 repeat sequences. Student 2 has 3 and 6 repeats. The remaining DNA is DNA that does not carry repeat sequences. Even though the DNA is visible in this figure, DNA is not visible with the unaided eye.

DNA Fingerprinting

- DNA fingerprints can be used to determine which bone fragments belong to which individual



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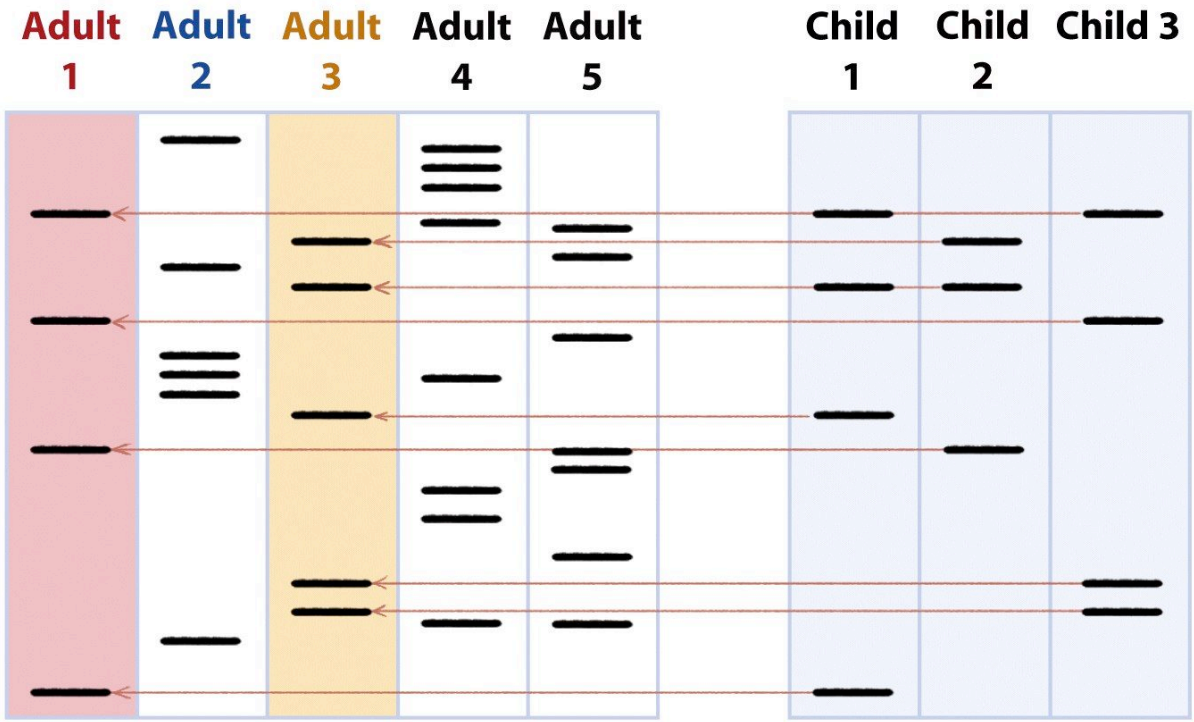
DNA Fingerprinting

- DNA fingerprints of children should be similar to the those of parents
- DNA fingerprinting can show which individuals are the parents of specific children



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DNA Fingerprinting

- Can be used to solve crimes and identify family members
- Anna Anderson was a young woman who claimed to be Anastasia Romanov
  - the supposedly executed Russian princess
- A DNA fingerprint showed she was not related to the family
  - based on DNA analyses of the family remains found in their grave

DNA Fingerprinting

- Recent scientific studies have applied numerous genetic rules and techniques to resolve mysteries involving the Romanov family

Hypothesis: The bones found in the Ekaterinburg grave belonged to the Romanov family and their servants.

Test	Description of Results
Analyze teeth	Expensive dental work was typically seen only in royalty.
Measure skeletons	The skeletons are those of 6 adults and 3 children.
Sex typing	One male child is missing from grave.
DNA fingerprinting	Children in grave are related to two adults in grave.
DNA fingerprinting	Claims to be one of the missing Romanov children or their descendants are disproved.
DNA fingerprinting	The buried Romanovs are related to known Romanovs.

Conclusion: When you look at each result individually, the evidence is less compelling than when you look at all the evidence together. As a whole, the evidence strongly supports the hypothesis that it was indeed the Romanovs who were buried in the Ekaterinburg grave.

Table 7-4 Biology: Science for Life, 2/e

Romanov Family Pedigree

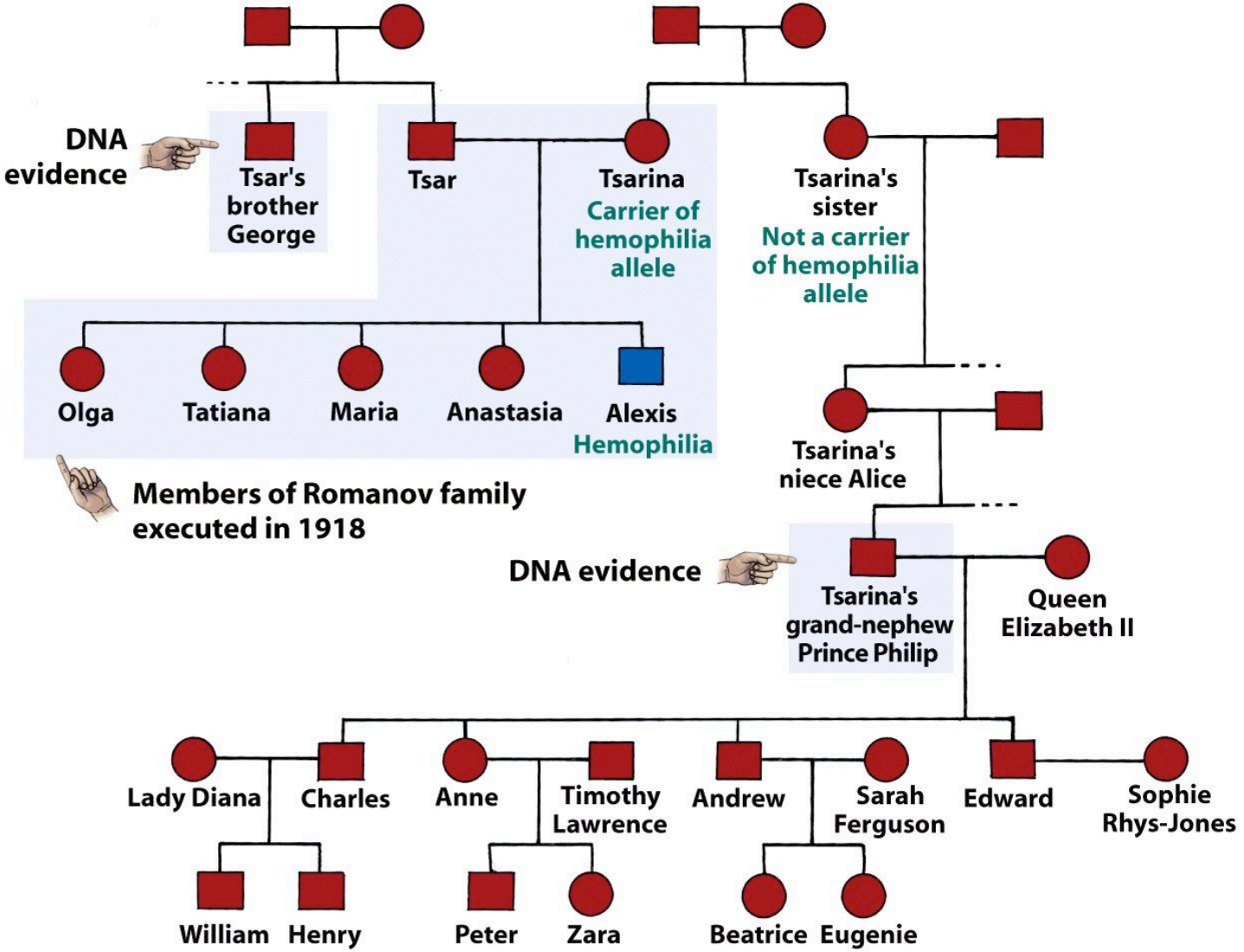

Figure 7-15 Biology: Science for Life, 2/e