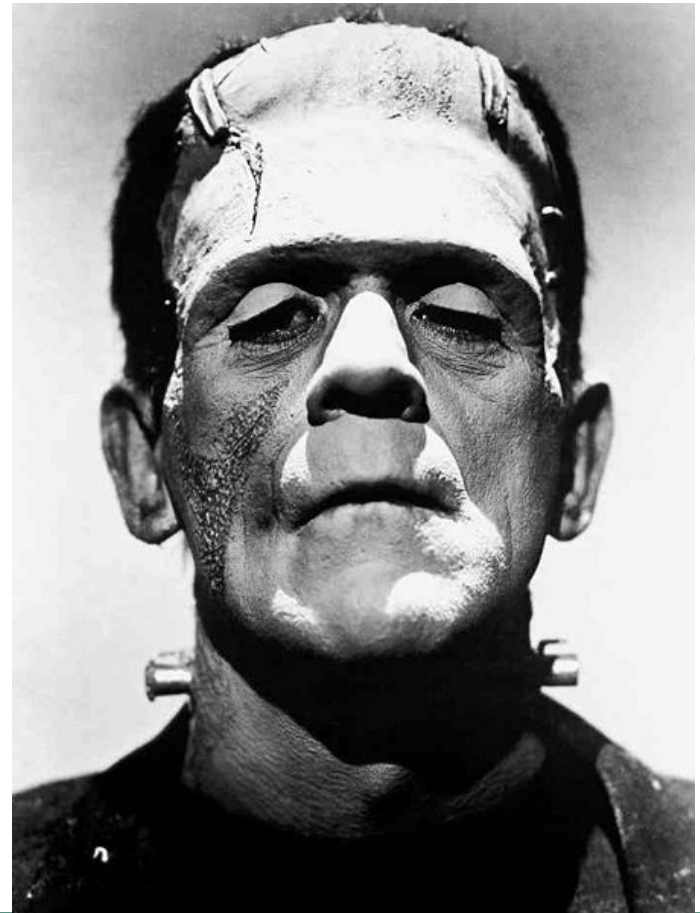


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# DNA Technologies or Frankenstein's Monsters?

A tale for our time: Mary Shelley's Frankenstein (1831)



# Cover of Mary Shelley's 1831 book



## FRANKENSTEIN.

*By the author of the last-mentioned  
book, I now the last volume of the  
series, and it contains the most  
interesting and complete of the  
series. I intend to publish it soon.*

Page 10

London, Published by W. Gifford, and R. Bentley, 1831.

---

# Here is another Frankenstein's Monster: A tobacco plant expressing a firefly gene

Because the genetic code is  
universal, you can take the  
gene that produces the  
glowing protein in the  
firefly, insert it in a plant,  
and make the plant and its  
offspring glow!



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# And here is another: Cats that glow in the dark!

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**Did you know that:**



**The first use of DNA  
fingerprinting proved one  
man innocent and another  
guilty of murder.**



**Chances are you ate a  
genetically modified food  
today.**



**The DNA of two people of the same sex is 99.9% identical.**





**Animals, plants, and even bacteria can be genetically modified to produce human proteins.**

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# Recombinant DNA Technology

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- Recombinant DNA technology is a set of techniques for combining genes from different sources into a single DNA molecule.
  - An organism that carries recombinant DNA is called a genetically modified organism (GMO).
- Recombinant DNA technology is applied to the field of biotechnology.

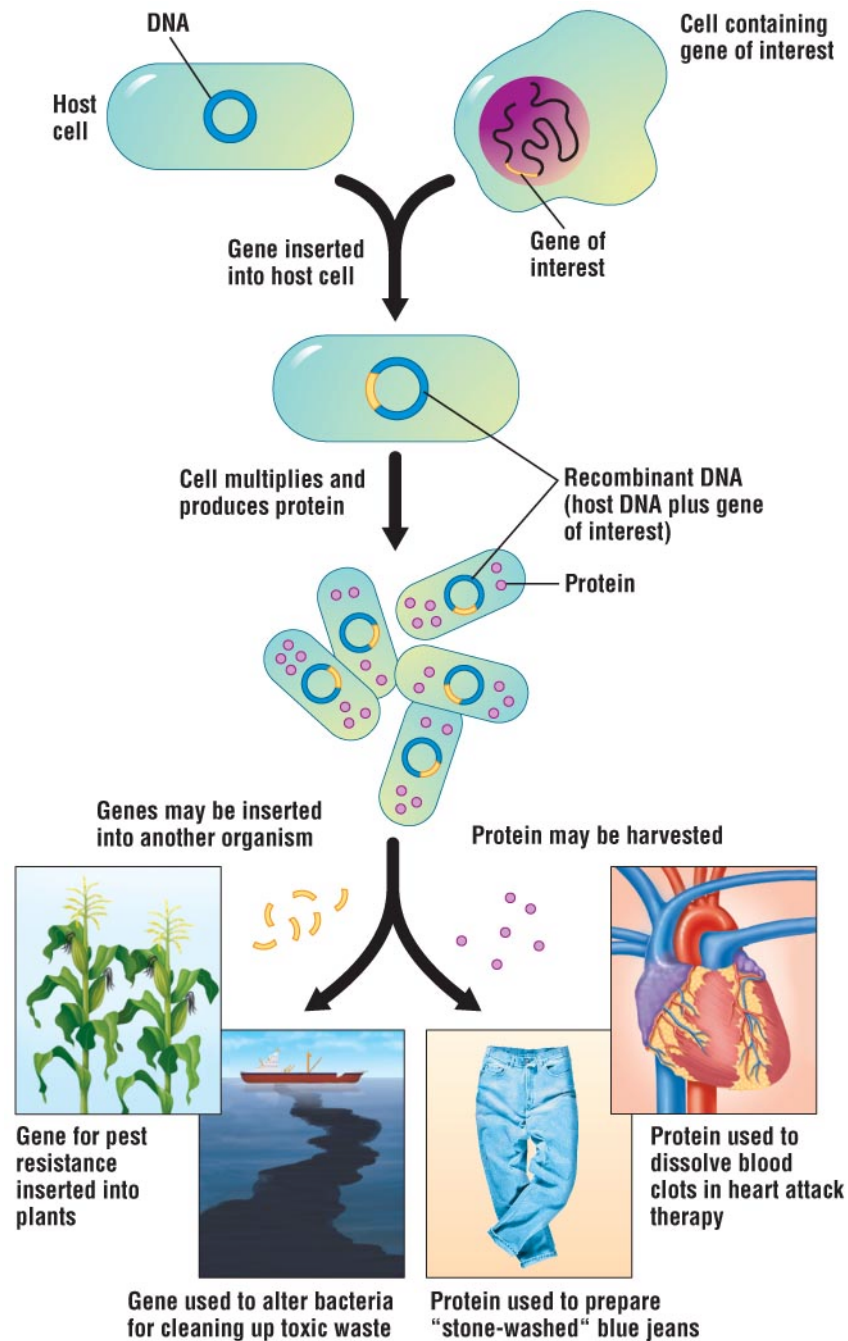


Figure 12.2

# From Humulin to Genetically Modified Foods

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- By transferring the gene for a desired protein product into a bacterium, proteins can be produced in large quantities.

# *Making Humulin*

---

- In 1982, the world's first genetically engineered pharmaceutical product was produced.
  - Humulin, human insulin, was produced by genetically modified bacteria.



- 
- Humulin was the first recombinant DNA drug approved by the FDA.





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Figure 12.3



- 
- DNA technology is also helping medical researchers develop vaccines.
    - If you don't put mercury in it, or other poisons (unlikely), a vaccine is a harmless variant or derivative of a pathogen.
    - Vaccines are used to prevent infectious diseases.

# *Genetically Modified (GM) Foods*

---

- Today, DNA technology is quickly replacing traditional plant-breeding programs.
  - In the United States, roughly one-half of the corn crop and over three-quarters of the soybean and cotton crops are genetically modified.

- 
- Corn has been genetically modified to resist insect infestation.
    - This corn has been damaged by the European corn borer.



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Figure 12.4

- 
- “Golden rice” has been genetically modified to contain beta-carotene.
    - Our bodies use beta-carotene to make vitamin A.



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Figure 12.5

# *Farm Animals and “Pharm” Animals*

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- While transgenic plants are used today as commercial products, transgenic whole animals are currently only in the testing phase.
- These transgenic sheep carry a gene for a human blood protein.
  - This protein may help in the treatment of cystic fibrosis.





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Figure 12.6



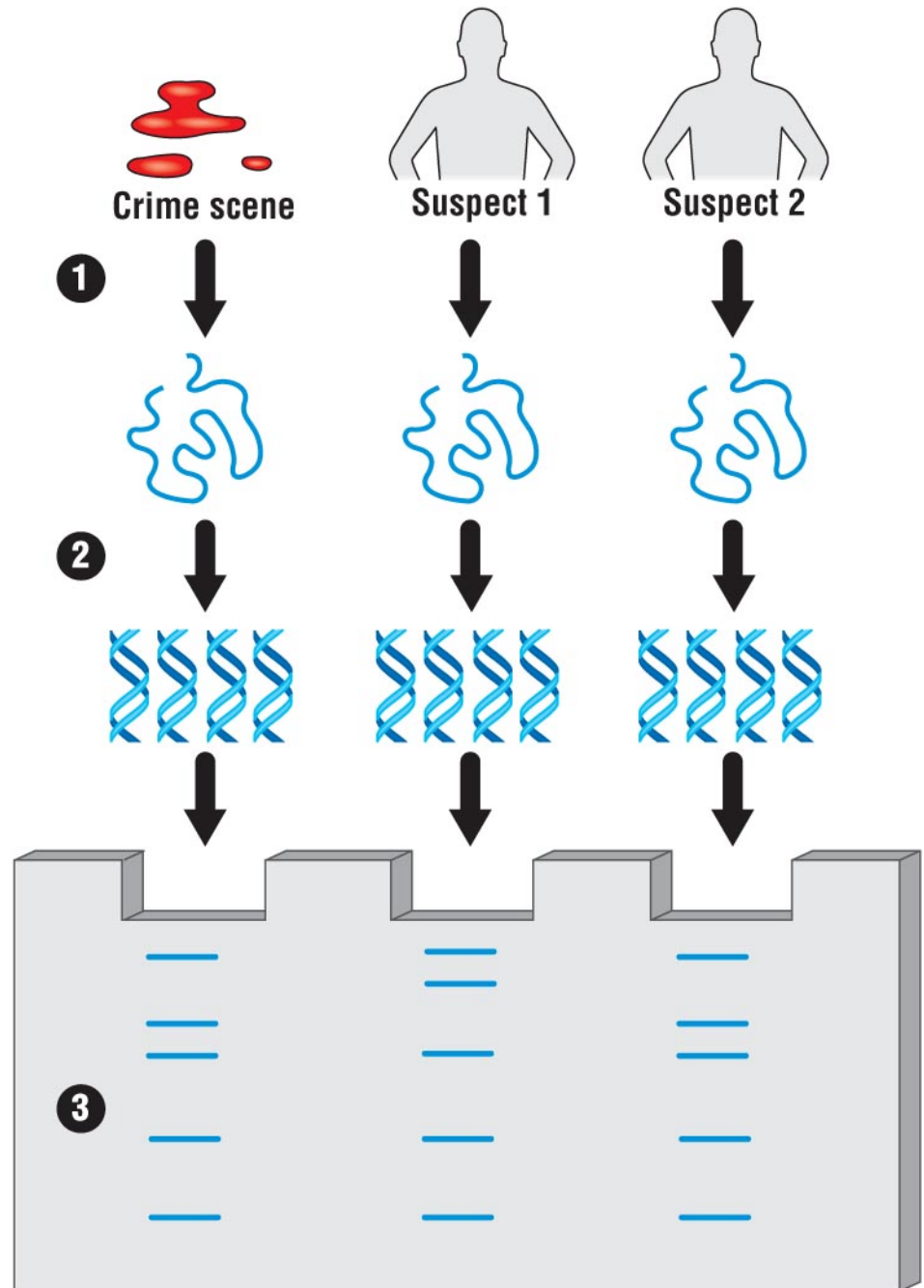
# DNA Fingerprinting and Forensic Science

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- DNA technology has rapidly revolutionized the field of forensics.
  - Forensics is the scientific analysis of evidence from crime scenes.
- DNA fingerprinting: Analysis of DNA fragments from two different sources to determine whether they belong to the same individual.

Overview of DNA fingerprinting.  
DNA from crime scene matches DNA of Suspect 2.

1. Collection of DNA samples
2. Amplification
3. Comparison



# Murder, Paternity, and Ancient DNA

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- DNA fingerprinting
  - Has become a standard criminology tool.
  - Has been used to identify victims of the September 11, 2001, World Trade Center attack.
  - Can be used in paternity cases. For example, here in Detroit, we had a case involving a famous mayor, Coleman Young, who later admitted paternity

- 
- DNA fingerprinting is also used in evolutionary research
    - To study ancient pieces of DNA, such as that of Cheddar Man.
    - **Cheddar Man** is the name given to the complete skeleton of a human male found in [Gough's Cave](#) (130 miles from London) in [Cheddar Gorge](#), [Somerset, England](#). The remains date to approximately [7150 BC](#), and it appears that he died a violent death, perhaps related to the [cannibalism](#) practiced in the area at the time.

---

A museum researcher holds the skull of Cheddar Man, who shares a common maternal ancestor with a 42-year-old history teacher and neighbor (photo above) living near the place where the skull was found.



---

Cheddar Man first found: 1903, and lived in a museum, while science progressed

**About 10 years ago**, DNA was extracted from one of Cheddar Man's molars, and his mitochondrial DNA sequenced.

Of 20 residents, 2 EXACT matches were found, in that one village, to one unique part of that DNA, and one almost exact match—a history teacher named Adrian Targett.



# Adrian Targett and his long-lost relative of 9,000 years ago!



Figure 12.13

# **This research . . .**

---

- Might point to the longest human lineage ever confirmed.
- Again confirms humanity's predisposition to aggression—that Cheddar fellow died a violent death, perhaps was eaten by other humans
- Shows that some people stay in the land of their ancestors for 1000s of years. So, e.g., it could be that Palestinians, not Jews, are the closest biological relatives of David, Jesus.
- Throws light on the ancestry of the English



# DNA Fingerprinting Techniques

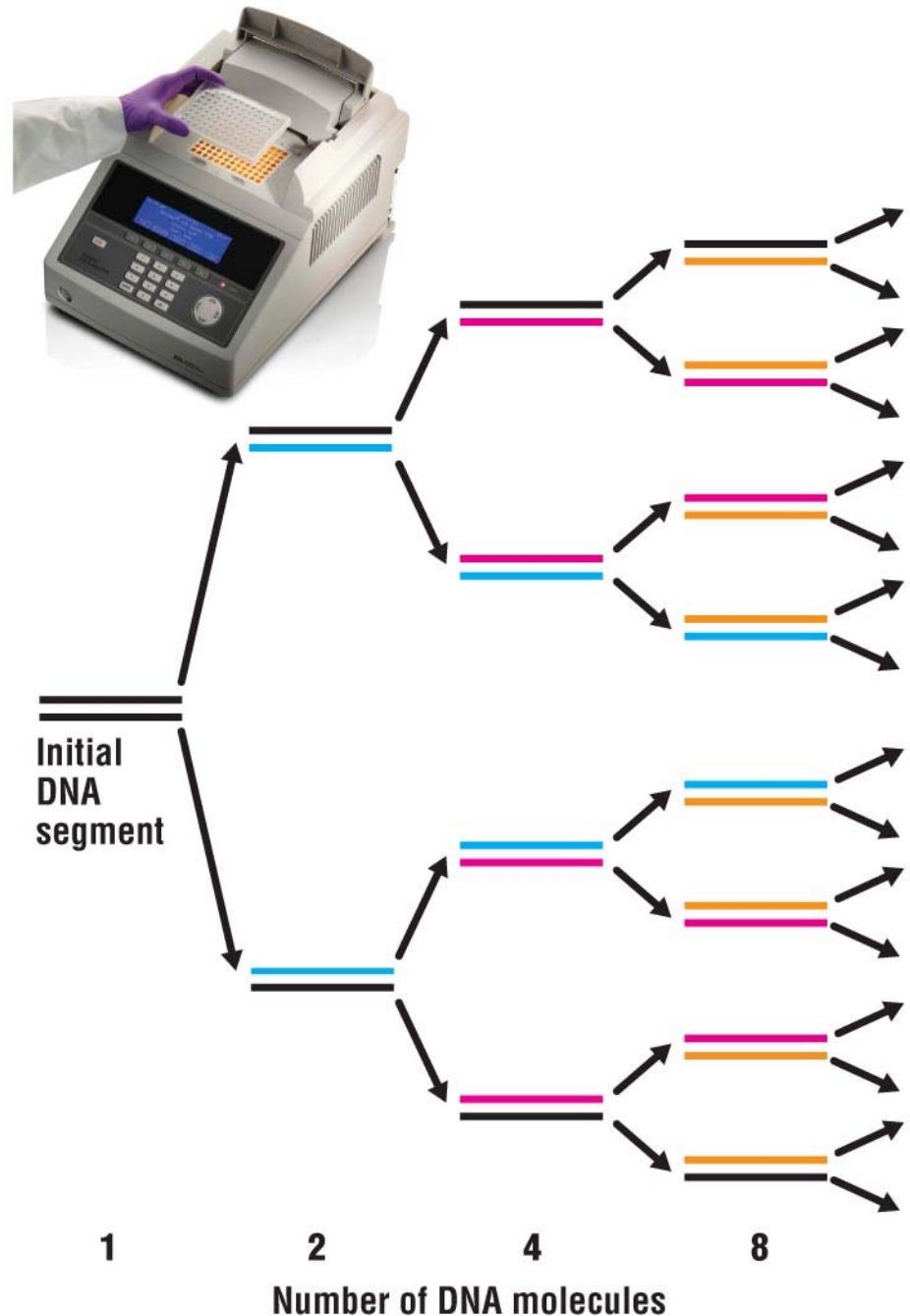
## *The Polymerase Chain Reaction (PCR)*

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- The polymerase chain reaction (PCR) is a technique by which any segment of DNA can be copied quickly and precisely.
  - Through PCR, scientists can obtain enough DNA from even minute amounts of blood or other tissue to allow DNA fingerprinting.
  - Since you don't have enough DNA, the first task is to make many identical copies

Using the machine on the right, you first amplify, make more, of the little DNA you obtained from the crime scene.

In doing so, and since you need heat to separate DNA strands, you ingeniously use an enzyme of bacteria from hot springs!



# *Short Tandem Repeat (STR) Analysis*

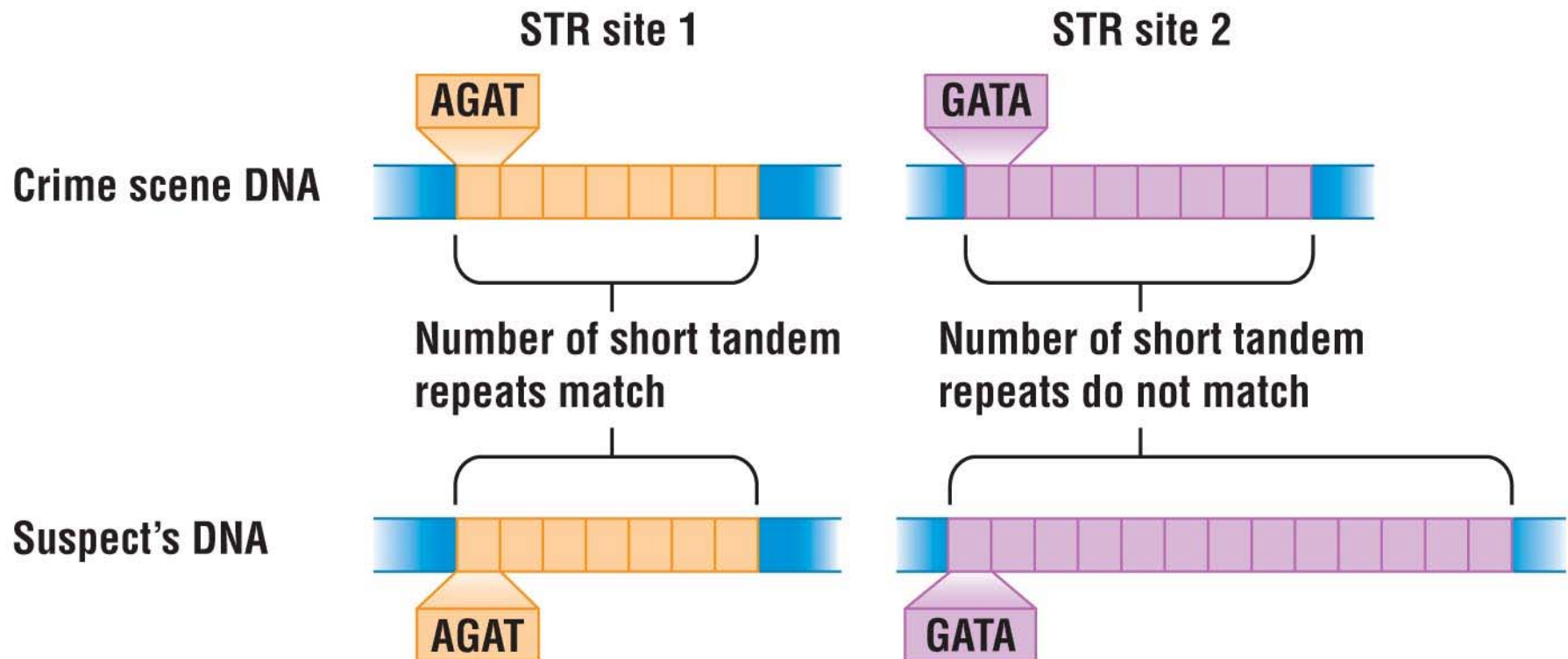
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- You can't really compare entire DNAs, which you don't have, and which would take too long to do. So, as in a Gallop pole, you sample some DNA.
- How do you prove that two samples of DNA come from the same person?

- 
- Short tandem repeats (STRs)
    - Are repetitive sequences of DNA that are repeated various times in the genome.

- 
- Scientists use STR analysis
    - To compare the number of repeats between different samples of DNA. DNA from same person will have the same number of repeats of nucleotides (e.g., AGATAGATAGAT) in same places.

Here, you study the number of repeating short sequences of 2 DNA sources. In Site 1, both have 7 repeats of nucleotides AGAT. But in Site 2, it's 7 vs. 13, suggesting that they belong to 2 different individuals.



# DNA Fingerprinting and Forensic Science

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- DNA technology has rapidly revolutionized the field of forensics.
  - Forensics is the scientific analysis of evidence from crime scenes.
- DNA fingerprinting can be used to determine whether or not two samples of genetic material are from a particular individual.

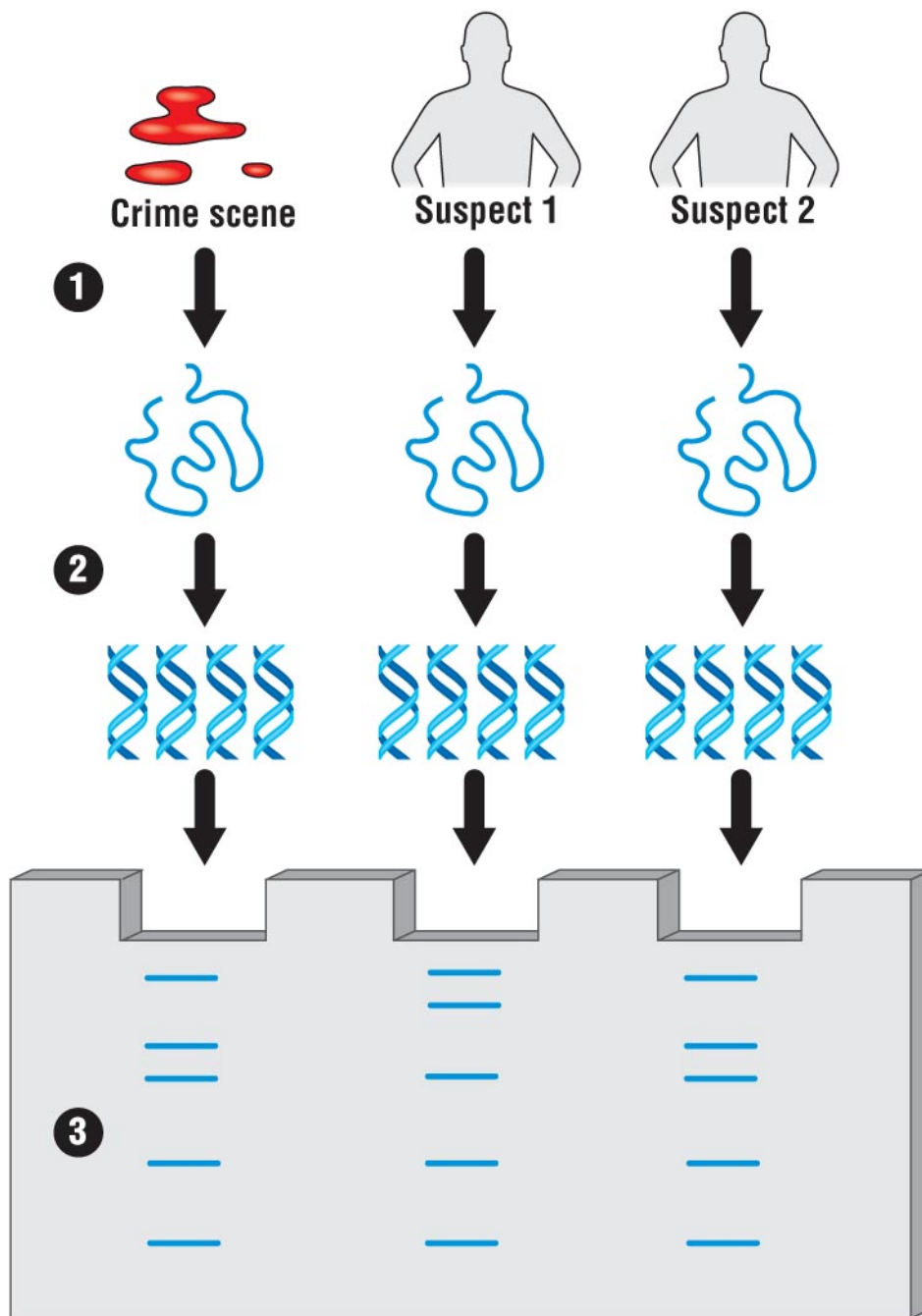


Figure 12.12



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*Here is one wonderful side-effect of genetic discoveries:  
DNA Fingerprinting Setting the Innocent Free!*

- On November 22, 1983,
  - A 15-year-old girl was raped and murdered on a quiet country lane.
  - Three years later, another 15-year-old girl was raped and murdered.


- 
- DNA fingerprinting of DNA samples from suspects and the crime scene
    - Proved one man guilty and another man innocent.

In England, 1983 and 1986, two 15-year-old girls raped and murdered, with only evidence, semen. One man convicted. Later, DNA fingerprinting—the first of its kind—showed that DNA in both cases was the same—but not of the man already in prison. DNA of local people taken, and criminal found (inset)

LEICESTERSHIRE CONSTABULARY

# MURDER

1983



LYNDA ROSE-MARIE MANN  
Aged 15 of Narborough

On Tuesday 22nd November, 1983, Lynda's body was found in a copse alongside the Black Pad footpath which runs between King Edward Avenue and Forest Road at Narborough. The last positive sighting prior to the discovery of her body was at 7.30 pm the previous evening in Coltbeck Avenue, Narborough.

1986



DAWN AMANDA ASHWORTH  
Aged 15 of Enderby

On Saturday 2nd August, 1986, Dawn's body was found in a field close to Ten Pound Lane, Enderby. The last positive sighting of Dawn was at 4.35 pm on Thursday 31st July, 1986, in Carlton Avenue, Narborough.

## £20,000 REWARD

A reward of up to £20,000 has been offered for information leading to the arrest and conviction of the person or persons responsible for the murders of Lynda Mann and Dawn Ashworth

If you think you can assist the police in any way, please ring the Incident Room on

LEICESTER 482400

If you would prefer to pass your information anonymously, please ring the special machine on

LEICESTER 482482

Printed and Published by the Chief Constable, Leicester



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**Since then, 100s have people have been exonerated and released from prison or death row.**

**Critical Thinking in Action: The Impact of Biological Research on Society**

What does exoneration by fingerprinting tell us about our criminal “justice” system?

What are the implications for the controversy about capital punishment?

## **In addition to exoneration: Did you know that:**

Ever though there are 5 Chinese for every American, U.S. has many more inmates?

1% of the adult population in the USA is in prison?

American prisoners are often tortured?

Prisons are often for-profit operations?

Big business lobbies to increase the prison population?

Michigan spends more on prisons than on higher education?

You can be tasered by your friendly cop for – nothing?

# Criminal Justice???

---

So DNA fingerprinting is just one more proof of what sociologists have known all along: Ours is a criminal INJUSTICE system

And, capital punishment is a crime—human beings are just too fallible, our country too corrupt, to be allowed to legally kill.

# Safety and Ethical Issues

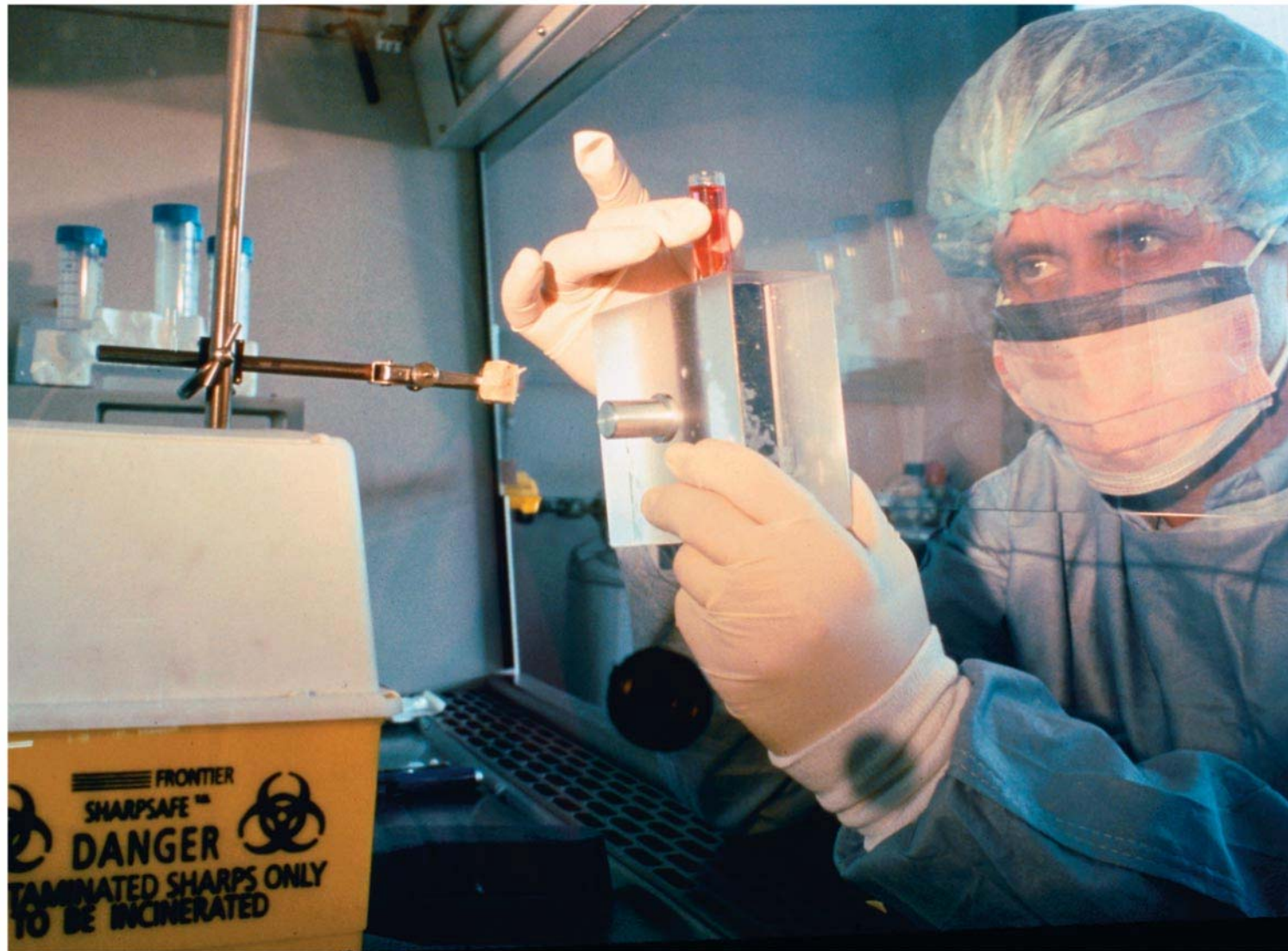
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- As soon as scientists realized the power of DNA technology, they began to worry about potential dangers such as:
  - The creation of hazardous new pathogens
  - The transfer of cancer genes into infectious bacteria and viruses



- 
- Strict laboratory safety procedures have been designed to protect researchers from infection by engineered microbes.
    - Procedures have also been designed to prevent microbes from accidentally leaving the laboratory.

Question: Can anything be quarantined for ever?  
Are we playing God here?



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Figure 12.24

# The Controversy over Genetically Modified Foods

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I am going to first present data from your textbook—which is produced for profit, by people who stand to gain from GMOs, and then provide something a bit better than the water-down “critique” of your text.

- GM strains account for a significant percentage of several agricultural crops in the United States.



Here is what the  
Belgian government  
is doing to GMOs  
crops: Destroying  
them! Shown is a  
canola field. The  
sign reads:

GMO, no thanks!  
Yes to  
biodiversity.”



- 
- Advocates of a cautious approach have deadly concerns for our future. Some of them, in fact, believe that we are out of our minds, or that we allow corporations to get away with *anything*:
    - Crops carrying genes from other species might harm the environment.
    - GM foods could be hazardous to human health.
    - Transgenic plants might pass their genes to close relatives in nearby wild areas.

- 
- Negotiators from 130 countries (including the United States) agreed on a Biosafety Protocol.
    - The protocol requires exporters to identify GM organisms present in bulk food shipments.

**Question: Is this enough? Shouldn't GMOs be labeled?**

---

- Several U.S. regulatory agencies evaluate biotechnology projects for potential risks:

- Department of Agriculture
- Food and Drug Administration
- Environmental Protection Agency
- National Institutes of Health

**Critical thinking in action: The above is what your textbook says, but the textbook industry is itself BIG BUSINESS. Do you believe the government cares about you? Do you think these agencies work for big business or for you?**



# Critical Thinking in Action: GMOs

---

Scientists and industry assure us that GMOs are good for us. They say that it is perfectly all right to let loose on the world these Frankenstein's monsters. But are they telling us the truth, or have we handed over the henhouse (the entire biosphere) to the foxes?

To begin with, they are suspect because they stand to gain from GMOs: money and power. We need unbiased views. But our government belongs to them. Where can we dig the truth then? Who will protect us?

# GMOs on your plate and palate . . .

---

More information:

Jeffrey Smith. 2007. *Genetic Roulette: The Documented Health Risks of Genetically Engineered Foods*.

F. William Engdahl. 2008. *Seeds of Destruction: The Hidden Agenda of Genetic Manipulation*.

# GMO on your plate and palate

---

To begin with, these foods are everywhere—you had them every day, but you don't know about it because labeling foods as GMO is not required. Sounds like democracy to you?

Environmental impact: Unknown. Some will become wild. And then what?

# GMO on your plate and palate

---



Dr. Arpad Pusztai, a leading scientist, voiced doubts about GMOs—and was fired.

His research: Rats fed GM potatoes had smaller livers, hearts, testicles and brains, damaged immune systems, and showed structural changes in their white blood cells making them more vulnerable to infection and disease compared to other rats fed non-GMO potatoes.

## **The negative data are troubling. A few examples:**

Iowa farmers reported a conception rate drop of from 80% to 20% among sows (female pigs) fed GM corn

When given a choice, animals avoid GM foods. 40 deer ate organic soybeans and corn from one field but shunned the GMO kind across the road.

---

## Biology and Society: Ethical and Political Questions Raised by DNA Technology

- Should we gain at long last control of our government, and stop sunshine bribery of EVERY congressman, every president, and indirectly, every judge in the land, by companies like Monsanto?
- Let's get out of the box a bit, and see what Michael Moore has to say about our congress and “regulatory” agencies: *Congressional Pimp*: [Part I](#) / [Part II](#)