Understanding DNA (TB 14 - 3, p. 355)

In order to manipulate DNA and engineer transgenic organisms, we must understand how to "read" DNA in different ways.

This process is known as *DNA analysis* .

DNA evidence is now reliable enough to be admissible in court, and can be used as factual evidence in scientific research.

Nov 1-4:58 PM

Finding Specific Alleles

Most diseases are coded by a specific sequence of nucleotides. Scientists have created DNA probes for hundreds of such diseases.

DNA probes are designed to detect the presence of complimentary base pairs indicating the presence of a certain disease.

Parents can use this method to test their own DNA for recessive disease-causing alleles. The results can help them make an informed decision about having children, and the risks of passing on certain genetic defects.

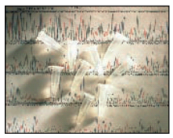

Figure 14 - 17, p. 355

Nov 1-5:02 PM

DNA Fingerprinting

A person's DNA is as unique as their fingerprints. (*Or is it the other way around?*)

It would be nearly impossible to code a person's entire genome, due to time and $$ constraints. Instead, scientists can analyze sections of DNA that are largely useless (as far as we know), but vary immensly between individuals.

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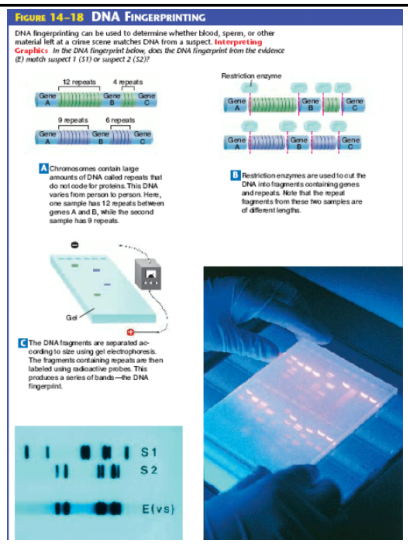

p. 356

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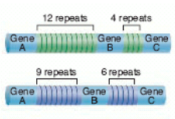
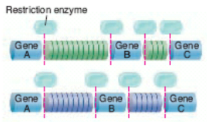
The process of DNA fingerprinting is as follows:

1) A small section of DNA is cut using a restriction enzyme.

Restriction enzymes are created to recognize particular sequences of DNA and to sever the molecule when it finds it.



A Chromosomes contain large amounts of DNA called repeats that do not code for proteins. This DNA varies from person to person. Here, one sample has 12 repeats between genes A and B, while the second sample has 9 repeats.



B Restriction enzymes are used to cut the DNA into fragments containing genes and repeats. Note that the repeat fragments from these two samples are of different lengths.

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2) The fragments obtained by the restriction enzymes are separated by a process called *gel electrophoresis* .

Electricity runs through the gel, and because of this, DNA molecules will move through the gel towards the positive end.

Gel electrophoresis separates molecules based on their size.

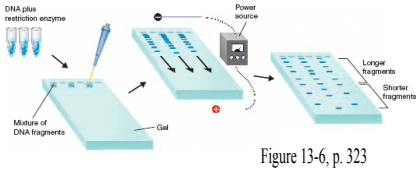
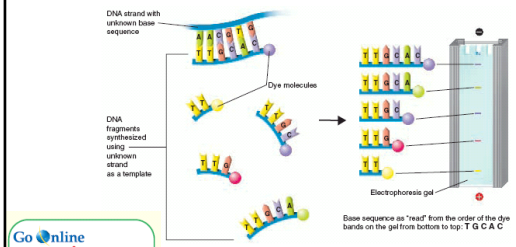


Figure 13-6, p. 323

Oct 29-9:35 AM

Larger molecules travel less far than smaller molecules in the gel. With the help of DNA probes, a distinctive pattern of DNA can be seen, unique to each person.



Go online active art
For: Gel Electrophoresis activity
Visit: PHSchool.com
Web Code: cbe-4132
Students interact with the art online.

Figure 13-7, p. 324

Nov 1-10:34 PM

Sometimes, DNA samples are too small, or scientists need multiple copies of the same DNA sequence.

They acheive this using a *Polymerase Chain Reaction* (PCR).

The following steps are used:

- Primers (short, complimentary strands of DNA are attached on each strand, at opposite ends)
- The DNA strand is heated to separate the two strands, which allows DNA polymerase to start creating a complimentary copy of DNA (basically synthetic DNA replication)
- Each copy can be used to make another copy, so a few cycles can result in millions of copies made quickly!

Nov 2-10:09 AM

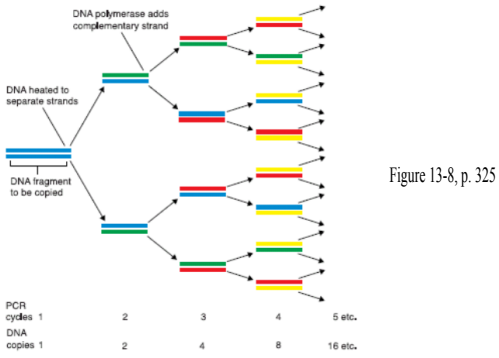
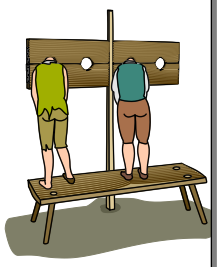


Figure 13-8, p. 325

Nov 2-10:08 AM

DNA samples for this process can be obtained from a person's blood, saliva (*cheek swabs*), semen (*sperm cells*) or hair (*base attached*).

DNA fingerprinting takes time, but has been successfully used to convict criminals (and overturn wrongful convictions as well!).



Nov 1-5:37 PM

The Human Genome Project

Scientists have been working with the sequenced genome of simple organisms for over a decade.

Eukaryotic organisms, however, are much more complicated and can contain as much as 1400 times the DNA to sequence!

Nov 1-5:43 PM

The Human Genome Project, a joint public and private endeavor, began sequencing the human genome in 1990. By the year 2000, they had a working copy of an entire set of DNA.

To accomplish this task, scientists used a "shotgun sequencing technique" consisting of:

1) Dividing the DNA into random, smaller molecules
2) Individually sequencing these fragments
3) Finding the overlap between sequences using computers
4) Assembling the final product much in the same way on would overlap photographs.

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Once the initial phase of the project was complete, the researchers moved onto "reading" the sequence and finding genes.

So far, they have found approximately 25 000 genes in humans.

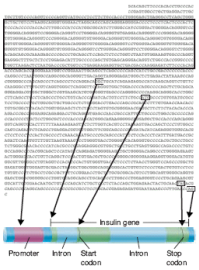

Figure 14 - 20, p. 328

To begin, scientists identify a *promoter* (a specific sequence known to appear before a gene).

How do we know?

These promoters are the locations where RNA polymerase binds to begin making a stand of RNA for protein synthesis.

Nov 1-5:50 PM

After the promoter is a section of nucleotides called the *open reading frame*. This section is made of definable codons, as in the RNA, for the assembly of amino acids.

However, there are also sections of *introns* (non-coding sections) that scientists must identify before they can identify the nucleotide sequence of a gene.

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The process is slow, expensive and difficult, but the results can help us develop new medecines, as well as understand more about life and inheritance.

Other processes such as gene therapy and cloning have been significantly advanced by the results of this project, which have been made publicly available on the internet.

Go Online
PHSchool.com
For: More information on the Human Genome Project
Visit: PHSchool.com
Web Code: cbe-4143

Nov 1-5:58 PM

Gene Therapy

In gene therapy, a faulty or absent gene can be replaced by a healthy one, allowing the recipient to start creating the protein they were originally lacking.

Although many individuals have been cured of their various diseases by using this technique, the long-term effects of this method are unknown.

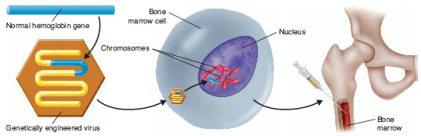


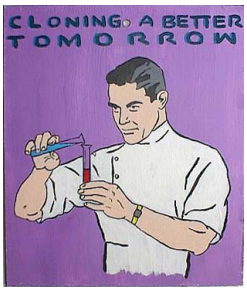
Figure 14 - 21, p. 360

Nov 1-6:10 PM

Cloning

Clones are genetically identical organisms, generally produced from a single cell.

Clones exist naturally, and are created by many organisms that reproduce asexually. Recently, however, scientists have been working on cloning more complicated, multicellular organisms, such as mammals.



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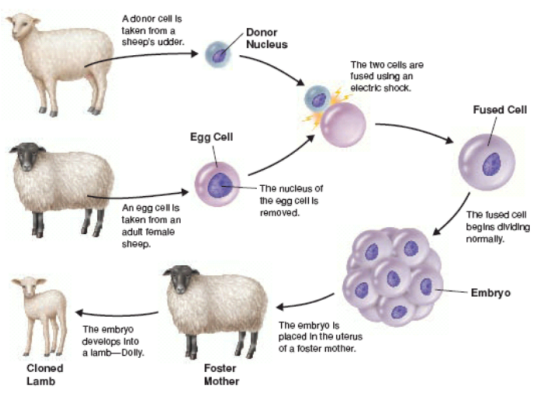

Figure 13-13, p. 332

Nov 1-6:14 PM

Figure 13 - 14, p. 333

Dolly the sheep

First mammal successfully cloned from an adult cell.

Nov 2-10:19 AM

Ethical Considerations

Scientists can now "read" our DNA, use our DNA and manipulate our DNA.

Does having the ability to do these things inherently give someone the right to do so?

If so, where do we draw the line?

- DNA fingerprinting?
- DNA probes?
- Genome sequencing?
- Gene therapy?
- Transgenic organisms?
- Cloning?
- Humans vs. Other Animals?
- Animals vs. Plants, Viruses, Bacteria, Fungi??
- Adults vs. Children?
- Volunteers vs. Volun"tolds"?

Nov 1-6:00 PM