

Lecture Guide: Introduction to Biotechnology

Name: _____

Period: _____

Instructions:

- 1) On one side of each page, provide the missing terms from the lecture to complete your notes.
- 2) On the opposite side of each page, write your own questions and comments based upon your understanding of the lecture.
- 3) Use the entire page when prompted to make drawings, complete tables, graphs etc. in the indicated boxes.
- 4) Use the completed lecture guide to prepare your own notebook, which should represent your best work!

SELECTIVE BREEDING:

Most of the organisms that are used in _____ (crops, livestock) have been produced by human beings by selective breeding, which is sometimes called _____ selection.

Humans have been doing this for thousands of years! For example, the wild _____ looks very different from the yellow Chiquita you might purchase in the store. These fruit are not _____ and are filled with unpleasant _____. The good-tasting varieties most of us take for granted were produced long ago by _____ who crossed different varieties, and selected the offspring that were more pleasant to taste in every generation. The

results of these crosses, called _____, became the basis of the modern fruit.

In the same way, native _____ selected varieties of a naturally-occurring plant called _____ that were a little bit taller and had *more* _____. Over time, this plant, known as _____ or corn, became very tall and produced a gigantic cob with many _____.

The same thing is true for most varieties of livestock and _____. Their _____ look different from those in nature. Why? Because, over time, _____ have selected for the _____ that they find most useful or attractive. To do this, they cross individuals with similar characteristics, a process known as _____.

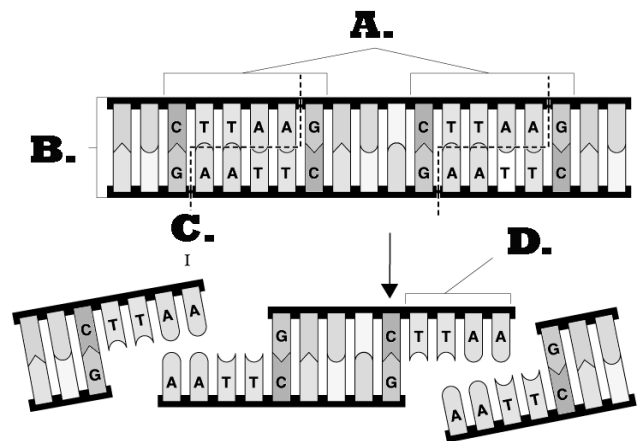
This is not necessarily in the animal's best interest, because it can increase the chances of offspring having _____ disorders. For example, _____ females often have pups born _____ in one ear, or with _____ disease.

_____ engineering is really no different! It's just another form of selective breeding, only in this case humans are selecting the _____ directly, instead of the _____ based on the _____.

MANIPULATING DNA:

Once scientists learned that DNA was the _____ material, they developed techniques to _____ it from living cells. Biology classes like ours do it all the time!

Scientists do more than just collect DNA, however. They concentrate and _____ it, then cut the long strands of DNA into smaller fragments with _____ enzymes made by bacteria. There are hundreds of different _____ enzymes known, and each one cuts the DNA at a specific nucleotide _____. For example, the enzyme _____ (read: 'Eco-R-one') cuts the sequence 'G|AATTC' between the 'G' and the first 'A'. This leads to many DNA fragments of different _____.

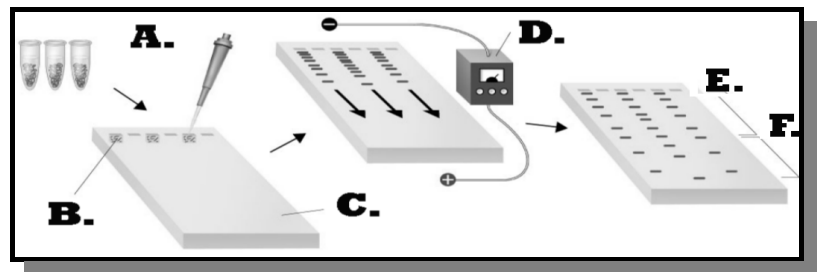


Identify the labeled portions of the picture above:

A: _____
 B: _____
 C: _____
 D: _____

GEL ELECTROPHORESIS:

☐ uses a _____ source, a tray filled with _____ solution, and an _____ gel

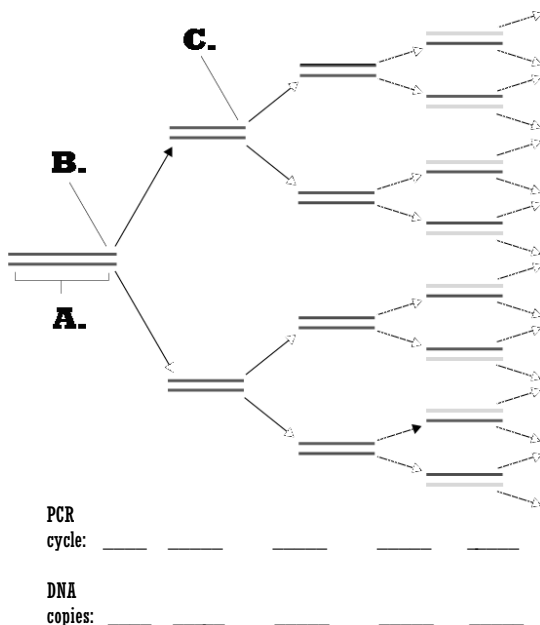


Identify the labeled portions of the picture above:

A: _____
 B: _____
 C: _____
 D: _____
 E: _____
 F: _____

- ☐ involves 'loading' a mixture of DNA fragments into little cavities in the gel, called _____.
- ☐ applies an electric field to the _____-charged DNA fragments, which move to the _____ pole.
- ☐ separates the fragments over time, since the _____ fragments move faster and _____.
- ☐ produces a pattern of lines that can be read like a _____ code at the supermarket.

COPYING DNA:



Identify the labeled portions of the picture above:

A: _____

B: _____

C: _____

In order to do PCR, scientists will use a machine called a thermal cycler that will raise and lower the temperature of the DNA fragment mixture over and over again. The size of DNA fragments is measured in the number of base pairs (bp) and most thermal cyclers can duplicate a 1,000-bp (1 kbp, kilobase pair) size fragment every 20 minutes.

So, if you start with 1,000 base pairs in a PCR cycle, how many will you have in 40 minutes?

_____ base pairs

How many will you have in 100 minutes?

_____ base pairs

How many will you have in 300 minutes?

_____ base pairs

Heating destroys most enzymes, including the enzyme that helps DNA copy itself, DNA _____. But in 1969, a microbiologist named Thomas Brock discovered a species of bacteria living in the hot springs of _____. National Park. This bacteria, which Brock named _____, thrives at just below the _____ point of water, and so its enzyme, now known as *Taq* _____, is not easily destroyed by high temperatures.

Researchers use this enzyme to make many copies with a technique called _____, or PCR.

PCR takes advantage of the fact that the double-stranded DNA fragments will _____ into two _____-stranded fragments when heated. In PCR, researchers will heat the DNA with the *Taq* enzyme, along with a vast surplus number of all the different _____: G's, C's, A's and T's.

The strands will separate! The mixture is then allowed to cool, and as it does the enzyme will attach the free _____ to the exposed strands, leading to _____ copies of double-stranded DNA.

This process of heating and cooling can be repeated several times, each time doubling the number of copies: in less than 12 hours, researchers can manufacture _____ of copies of a single strand.

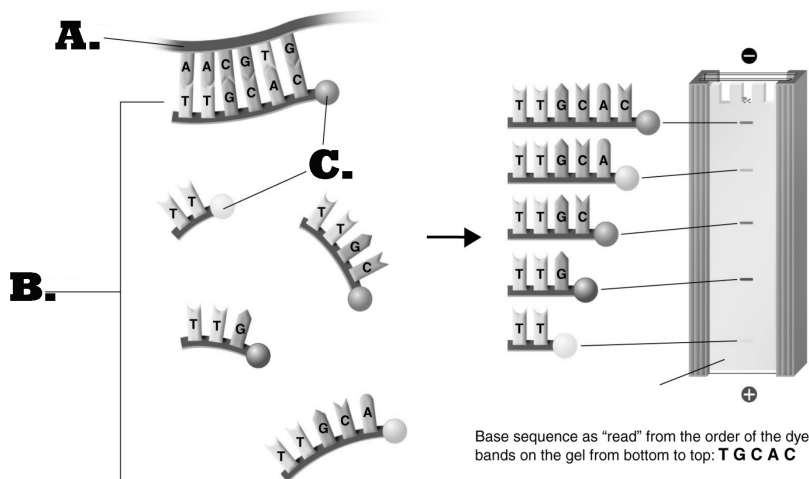
Once strands are copied, researchers will _____ the DNA by attaching different-colored chemical dyes to the different _____. Since each base is labeled with a different color, the order of the G's, C's, A's and T's can be 'read' by a _____ and recorded by a computer. The success of the Human _____ Project is based on the fact that the entire process has been _____.

HUMAN DNA ANALYSIS

Gel _____ and DNA _____ can be used to identify individuals (DNA _____) or to develop genetic profiles of entire _____. This information can be used to determine _____, to link suspects in a _____ investigation to a _____ scene or to probe an individual's _____ history or ancestry.

In many cases, it is not necessary to have a copy of all of an individual's DNA, only a specific _____ which is already well-described. Not all parts of the DNA are expressed, and many parts that are not expressed (so-called '_____' DNA) have sequences that are repeated over and over. These regions of DNA accumulate many harmless _____ which are different for every individual.

So, when these regions are 'cut' by _____ enzymes, they create unique patterns that can be used to identify an individual. This technique, often used in law enforcement, is called RFLP (_____ fragment length _____).



Identify the labeled portions of the picture on the left:

A: _____

B: _____

C: _____