Main techniques of modern gene technology (PCR and gel electrophoresis)

1. POLYMERASE CHAIN REACTION (PCR)

1 *Add these pieces of in-depth information to the text to give more details where indicated by the asterisks.*

a. DNA that contains the region to be copied, such as a gene

b. enzyme that does the building by sequentially adding on free nucleotides according to the instructions of the template

c. field of biology that studies the composition, structure and interactions of cellular molecules – such as nucleic acids and proteins – that carry out the biological processes essential for the cell's functions and maintenance

d. process of detecting, investigating, and documenting the reason, course and consequences of a security incident or violation against laws. Forensic analysis is often used for providing evidence in court hearings, especially in criminal investigations

e. process of identifying a disease, condition or injury from its signs and symptoms

f. short stretches of nucleotides that correspond to the template sequences

g. subdiscipline of the biological sciences concerned with the origin of life and the diversification and adaptation of life forms over time

h. subunits of DNA

The polymerase chain reaction (PCR) is a technique used to make numerous copies of a specific segment of DNA quickly and accurately. The polymerase chain reaction enables investigators to obtain the large quantities of DNA that are required for various experiments and procedures in **molecular biology*** [1], **forensic analysis*** [2], **evolutionary biology*** [3], and **medical diagnostics*** [4].

The PCR technique is based on the natural processes a cell uses to replicate a new DNA strand. Only a few biological ingredients are needed for PCR. The integral component is the **template DNA*** [5]. The only information needed for this fragment to be replicated is the sequence of two short regions of **nucleotides*** [6] at either end of the region of interest. These two short template sequences must be known so that two **primers*** [7] can be synthesized. The primers bind, or anneal, to the template at their complementary sites and serve as the starting point for copying. DNA synthesis at one primer is directed toward the other, resulting in replication of the desired intervening sequence. Also needed are free nucleotides used to build the new DNA strands and a **DNA polymerase*** [8].

PCR is a three-step process that is carried out in repeated cycles. The initial step is the denaturation, or separation, of the two strands of the DNA molecule. This is accomplished by heating the starting material to temperatures of about 95 °C (203 °F). Each strand is a template on which a new strand is built. In the second step, the temperature is reduced to about 55 °C (131 °F) so that the primers can anneal to the template. In the third step, the temperature is raised to about 72 °C (162 °F), and the DNA polymerase begins adding nucleotides onto the ends of the annealed primers. At the end of the cycle, which lasts about five minutes, the temperature is raised and the process begins again. The number of copies doubles after each cycle. 25 to 30 cycles usually produce a sufficient amount of DNA.

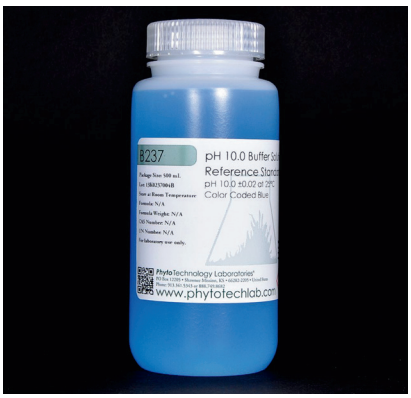
2. GEL ELECTROPHORESIS

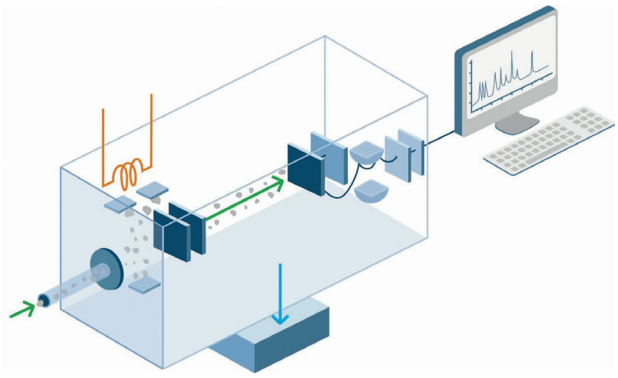
2 *Write the right caption under the pictures below choosing from the phrases in bold in the following passage* Gel electrophoresis.

Gel electrophoresis includes several techniques used to separate molecules of DNA, RNA, or protein on the basis of their size or electric charge. Gel electrophoresis has a variety of applications; for example, it is used in **DNA fingerprinting** and the detection of genetic variants and proteins involved in health and disease as well as in the detection and purification of nucleic acids and proteins for research. It is also used to aid in the detection of pathogens that may be present in blood or other tissues or in sources such as food. In many instances, nucleic acids or proteins that are detected and purified with gel electrophoresis are investigated further by means of **DNA sequencing** or **mass spectrometry**.

The gel electrophoresis apparatus consists of a gel, which is often made from agar or polyacrylamide, and an **electrophoretic chamber** with a **cathode** at one end **and an anode** at the opposite end. The gel, which contains a series of wells at the cathode end, is placed inside the chamber and covered with a **buffer solution**. The samples are then loaded into the **wells with a pipette**. The chamber is connected to a power supply that, when turned on, applies an **electric field** to the buffer. The electric field causes negatively-charged molecules to migrate through the gel toward the anode. The molecules' movement is influenced by the porous gel matrix so that larger, heavier molecules move relatively slowly, whereas smaller, lighter molecules move more quickly. The density of pores and the type of substance used to make the gel further influence the rate of molecule migration.

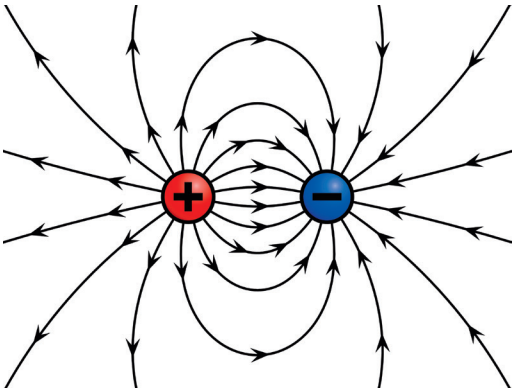
(Adapted from: *https://www.britannica.com/science/gel-electrophoresis)*



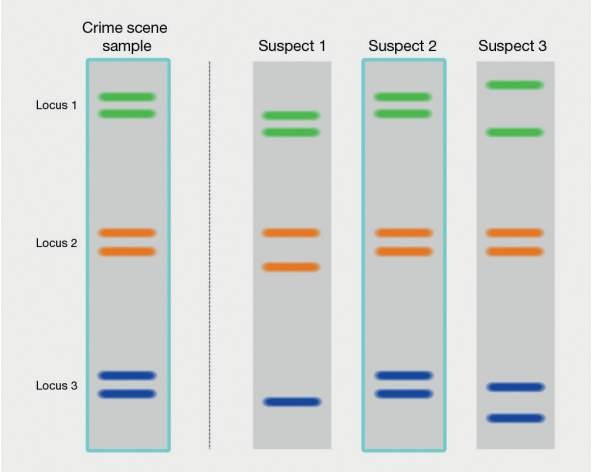


1. .....

2. .....

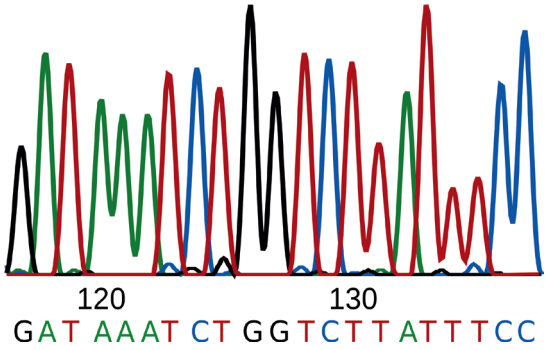


3. .....

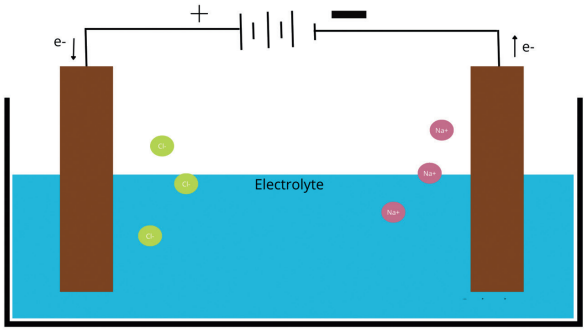


4. .....

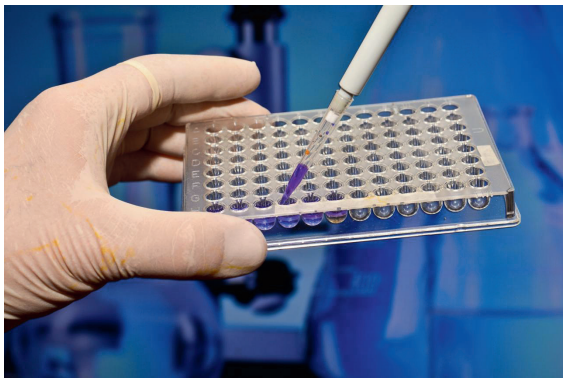
5. .....



6. .....



7. .....



8. .....