

BIOLOGY 12 - RECOMBINANT DNA & GENETIC ENGINEERING

⇒ Part A: Definitions: Define the following terms, **IN YOUR OWN WORDS, IN AS FEW WORDS AS CLARITY ALLOWS.**

i.	recombinant DNA	DNA that contains the DNA from two or more different species.
ii.	genetic engineering	Using technology to alter the natural genetic material of organisms.
iii.	biotechnology products	Medicines, hormones, proteins etc. that are produced using genetic engineering techniques.
iv.	transgenic organisms	Free-living organisms that have had one or more foreign genes inserted into them.
v.	gene therapy	Replacing defective genes with healthy genes or otherwise using genes to treat human diseases and disorders.
vi.	vector	Something that is used to get the DNA from one species into the other species' DNA. e.g. plasmids and retroviruses
vii.	plasmid	A small circular piece of DNA found in some bacteria that are frequently used as vectors in recombinant DNA techniques.
viii.	polymerase chain reaction	a laboratory technique that can "amplify" (make innumerable copies) a small amount of DNA quickly.
ix.	DNA probe	a radioactive piece of DNA used to identify viral infections, genetic disorders, and some cancers.
x.	RFLP Analysis	a laboratory technique used to produce DNA fingerprints that can be used to identify criminals, determine paternal identities, and identify defective genes.

PART B - SHORT ANSWERS

- GENETIC ENGINEERING** is the use of technology to alter the genome of viruses, bacteria, and other cells for medical, agricultural, or medical purposes.
- RECOMBINANT** DNA contains DNA from 2 or more different sources.
- Several uses of recombinant DNA include **CLONING** genes, producing **BIOTECHNOLOGY** products, making **TRANSGENIC** organisms, **GENE** therapy, **DNA** fingerprinting.
- A biotechnology product that are now available include are human **GROWTH** hormone, which used to have to be extracted from the pituitary glands of 50 **CADAVERS** to make a single dose.
- A common vector is the **RETROVIRUS**, which is a virus that has, **RNA**, rather than DNA as its nucleic acid.
- A **VECTOR** is something that can get DNA from one species into the DNA of a second species. Often, this can be a **PLASMID**, a small circular piece of bacterial DNA.
- An example of in vivo gene therapy is grafting **DOPAMINE**-producing cells right onto the brain to treat **PARKINSON'S** disease. Another technique involves using an **ADENOVIRUS** that contains a gene to treat **CYSTIC** fibrosis - the adenovirus is injected into the body in an inhalant spray.
- BACTERIA** are useful monerans that are engineered for numerous duties. For example, some are engineered to produce an **INSECTICIDE** to kill insects. Many are used to clean up messes like garbage dumps and oil spills -- using organisms for this purpose is called **BIOREMEDIATION**. They can also be used to produce **CHEMICALS**, like the phenylalanine used in the production of *Nutrasweet*.
- DNA "fingerprints" are commonly produced using a technique called **RFLP** Analysis. This techniques uses special enzymes called **RESTRICTION** enzymes, which cut up DNA in specific ways.

10. DNA that has been amplified by PCR can be analyzed using a radioactive DNA **PROBE**, which can detect viral infections, and diagnose some genetic disorders and cancers.
11. Ex vivo gene therapy has been used to treat liver cells for people suffering from **HYPERCHOLESTEROLEMIA**, a disorder in which the liver is unable to properly remove **CHOLESTEROL** from the blood.
12. If two organisms have identical DNA, but are not twins, they are said to be **CLONES**. Two animals that have been successfully cloned are **SHEEP** and **GUINEA** pigs.
13. In order to insert a human gene into a bacterial plasmid, first a **RESTRICTION** enzyme is used to cut up the DNA and form "sticky" ends on the gene and the plasmid. Then, the enzyme DNA **LIGASE** is used to seal the human gene into the plasmid. The can now be allowed to reproduce, cloning the DNA, or the bacteria can be caused to **TRANSLATE** the human gene, producing pure human protein.
14. In PCR uses a heat-resistant form of the enzyme DNA **POLYMERASE** and a repeating cycle of heating and cooling to produce massive amounts of DNA from tiny samples (e.g. a single hair from a crime scene).
15. The **HUMAN GENOME** project is a massive project in biochemistry in which every single nucleotide in the human genome is being sequenced.
16. The laboratory technique that is used to make many multiple copies of a single piece of DNA is the **POLYMERASE CHAIN** reaction, which is abbreviated **PCR**.
17. Tissue **PLASMINOGEN ACTIVATOR**, or tPA, is a biotechnology product that is used to dissolve blood **CLOTS**, and tumour necrosis factor is another one used to treat **CANCER**.
18. Today, high quality human **INSULIN** is produced through biotechnology for the treatment of diabetes.
19. **TRANSGENIC** animals are now commonly used in agriculture. One commonly used biotechnology product used in cows is **BOVINE GROWTH HORMONE**, (bGH), which increases milk production by 25%.
20. **TRANSGENIC** plants are widely used in agriculture. For example, there is an engineered **WHEAT** which contains a gene that makes the wheat resistant to the herbicide *Roundup*. These plants can also be engineered to be resistant to temperature extremes, **SALTY** soils, drought, bruising, and spoiling.
21. Treating genetic disorders by replacing defective genes in a person with healthy genes is called **GENE THERAPY**. If the genes are injected into cells that have been first removed from the patient, and then put back in the patient, this is called **EX VIVO** gene therapy. If the genes are introduced right into the bodies of the patients directly, this is called **IN VIVO** gene therapy.
22. Using genetically engineered animals to produce medicines and drugs for human use is called **GENE FARMING**.