BIOTECHNO ACTIVITY BOOK

Compiled by :

EduHeal Foundation
New Delhi

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Preface

Biotechno Activities book is a small step torwards encouraging school students to take up biotechnology. We at EduHeal Foundation still need lot of help and encouragement from school teachers and Principal in accomplishment of our goal. It is you who form the vital link between EduHeal Foundation and students as you can further encourage students to know about biotechnology on a day to day basics. We would also not sit idle but make efforts to increase interest :

- By publishing books like Biotechno Activities Books.
- Create awareness by conducting Nationwide Biotechnology Olympiad.
- Teacher Tranining Programme in basics of genetics and Biotechnology.
- Career Development Workshop for Students.
- Virtual Genetic Lab.
- Networking to enhance school/Govt./ Industry Interface.

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With best wishes

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CLASS - X

S. No.	Topic	Page No.
1.	The First Step to Being a Genetic Engineer	05
2.	Introduction to Biotechnology	12
3.	DNA Fingerprinting	20
4.	Human Cloning and Genetic Engineering	22
6.	Genetic Engineering in Crop Modification	30
7.	Major Applications of Genetic Engineering	33
8.	Biodiesel	34
9.	Environmental Clean up by Plants	38
10.	Adleman And Discovery of DNA Computer	40
11.	Biotechnology & Biodiversity	44
12.	Sample Questions	53

The First Step to Being a Genetic Engineer

All this talk about genetic engineering and cloning sounds so impressive that most people are intimidated by the subject and would never consider themselves clever enough to seek a career in such a complex field. While there is no doubt that genetics and molecular biology are challenging career paths, they are certainly within your reach. If you find genetic engineering interesting and exciting, then half the battle is won.

The next thing you will need to do, is find out more about it, and that's as easy as reading a magazine, surfing the Net, or visiting a good bookstore/library. Also you can talk to the career counsellor on EduHeal Foundation helpline number : 09350232518. The first thing an aspiring genetic engineer will have to master, is a clear understanding of that wirey stuff called deoxyribonucleic acid (DNA) and why it is so important.

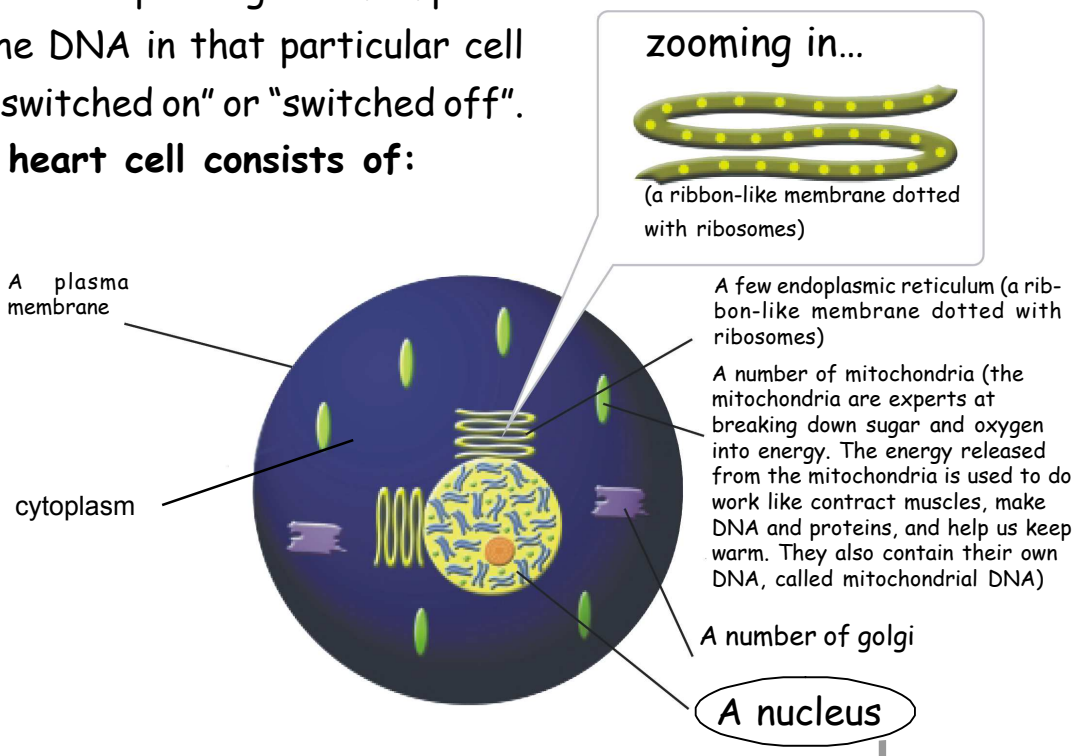
In the next few pages is a step-by-step guide to the basics of DNA. We will start by looking at its place in a cell and then gradually zoom in until we can see what it consists of and how it functions. To keep things simple, we will be looking at an animal heart cell, but it is important to remember that genetic engineering is not just about humans and animals. A lot of very important genetics work is being done in plants as well.

The (Animal Heart) Cell

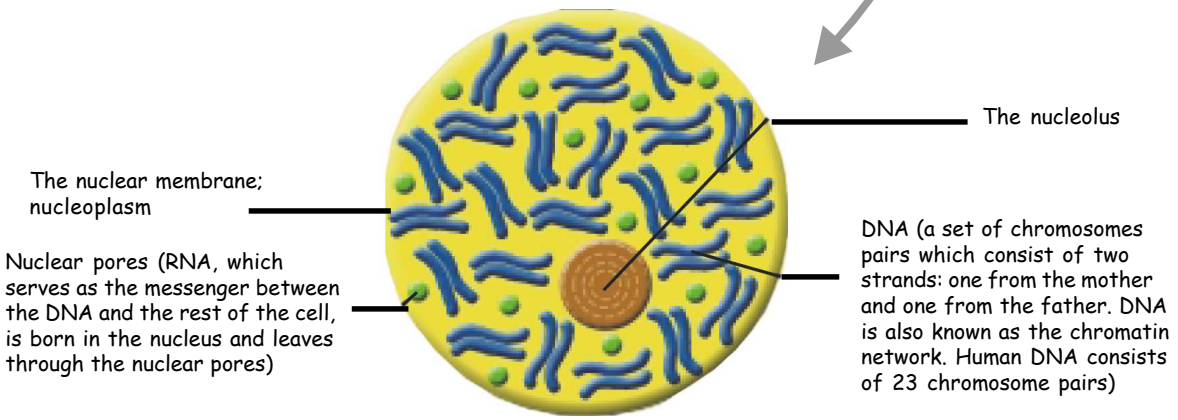
All the cells in an organism, such as a person, contain the same DNA, but the cells do not all look the same and will differ according to the functions that they have. Cells will take on different shapes and

functions depending on which parts of the DNA in that particular cell are "switched on" or "switched off".

The heart cell consists of:



The nucleus of a cell is where most of the DNA is stored. DNA is the most significant part of the cell as it carries the genes that ensure that we have all the right body parts, as well as the genes that set each one of us apart as individuals. If our genes were the same, we would all look the same! The nucleus consists of:



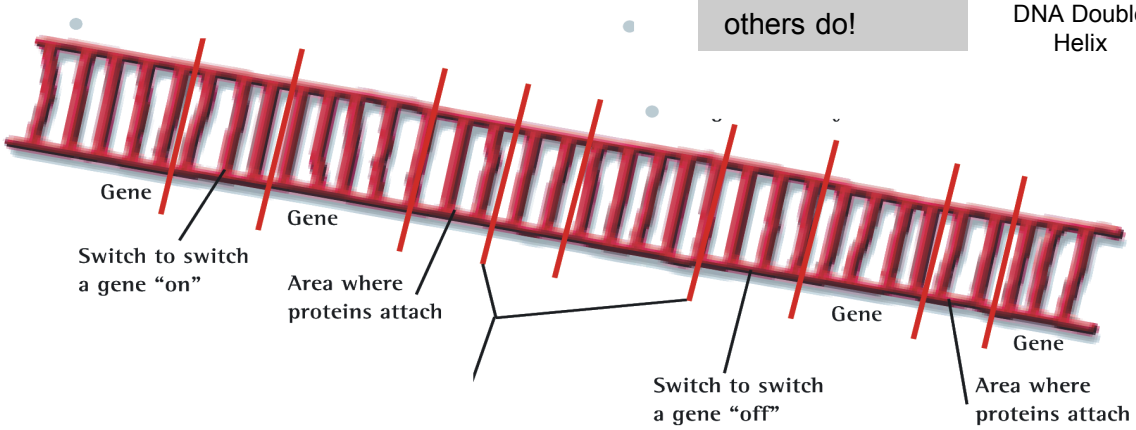
DNA

DNA is a long fibre, like a hair, that is made from two chromosome strands stuck together with a slight twist. DNA is organised into:

- segments of genes;
- segments where proteins attach to the DNA when it needs to coil into chromosomes (this usually happens when the cell is getting ready to divide);
- segments that turn a gene "on"; and
- segments that turn a gene "off".

DNA Double Helix

Only 80% of our DNA codes for proteins or regulate genes. Scientists don't know what the others do!



Genes and their functions

Genes, which are segments of DNA scattered along the length of the strands, carry the instructions for making all the thousands of proteins that are found in a cell. They also determine how the different cells are arranged.

- Each gene has only one job to do, and that is to construct a single protein such as insulin, haemoglobin, skin cells, etc.
- If a gene is faulty it can cause disease.

Closer look at a chromosome Pair

As uptil now you must know that a chromosome pair is two strands of DNA which have coiled up together as a result of proteins that attach to them. These are made up of nucleotides.

Nucleotides are made of:

- a base;
- a sugar; and
- a phosphate

There are four types of bases, namely:

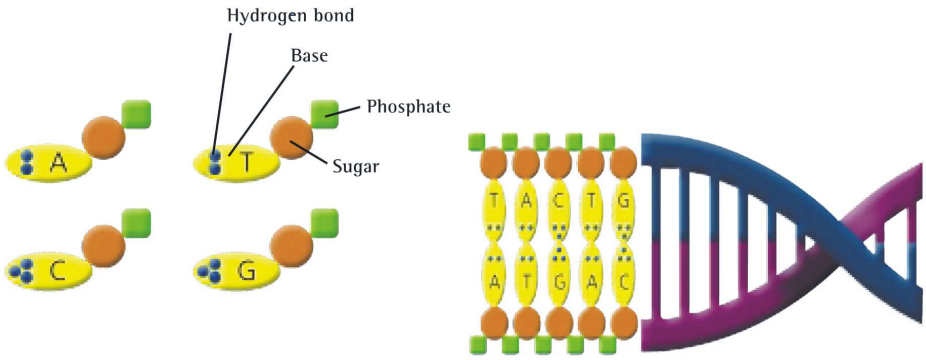
C – Cytosine (three hydrogen bonds);

G – Guanine (three hydrogen bonds);

A – Adenine (two hydrogen bonds); and

T – Thymine (two hydrogen bonds).

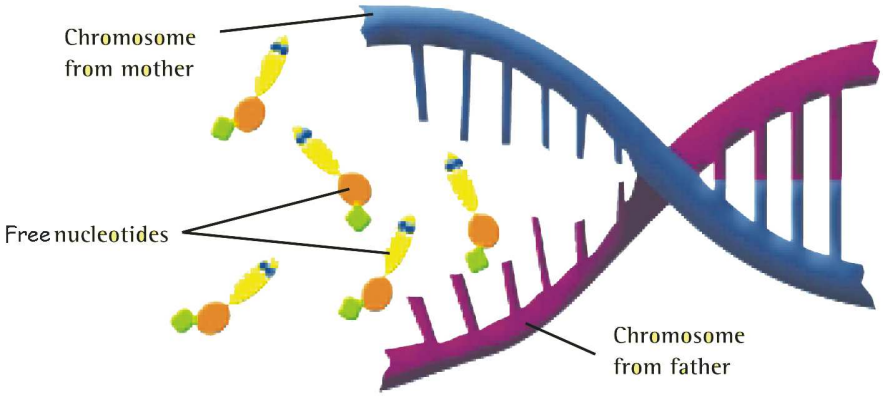
The number of hydrogen bonds that each base has determines which bases will stick together when they come into contact with one another. Therefore, A and T go together and C and G go together.



DID YOU KNOW: All the DNA in one human nucleus contains 5 billion nucleotides, which would explain why the Human Genome Project has taken so long.
Human genome project was the project to map the complete genome of human. It was started in year 1990 in US and finished in year 2003. Lot of countries participated in it. Unfortunately India was not part of it. Hence India needs to make strong efforts in field of Biotechnology to keep up with the world. Eduheal Foundation through its biotechnology for school's initiative is taking a small step in this direction. It will be conducting a spectrum of school programmes including nationwide biotechnology olympiad, Teachers training programme, students workshop, virtual Labs, Biotechno activity books etc.

Disclosing the path of DNA replication

Making a copy of a chromosome pair can be compared to making two zips out of one. In order to make a replica, an enzyme (which is a type



of protein) called DNA Polymerase is needed.

Here's how it works:

1. A small section of the old chromosome pair unwinds and pulls apart by breaking the hydrogen bonds.
2. Free nucleotides float in and attach onto a partner with the same hydrogen bond (ie, A pairs with T and C pairs with G).
3. Once this pulled-apart section is filled with new partners,

WHAT IS RNA AND WHY IS IT IMPORTANT?

While our DNA contains our genetic coding and therefore is the most important part of a cell, it would be useless if there wasn't a way for it to transfer that information to the rest of the cell.
Luckily, RNA acts as DNA's "right-hand man" by making sure that instructions from the DNA are carried out in the cell. But how does it do this?
As we mentioned before, each gene (which is a stretch of DNA) is coded to make a particular protein. But, in order for a protein to be made the "switch" that controls when that particular protein should be made and when it shouldn't, needs to be "on".
For example, the cells in your pancreas are mainly there to make insulin. If you have just eaten something, your body needs to make insulin in order to properly digest the food.
Once the DNA in the cells of the pancreas have registered that there is food that needs digesting, the switch which allows for insulin to be made, turns "on".
While RNA is smaller, it looks more or less the same as DNA, as it is also made up of nucleotides. However, one of the bases in the RNA is different. Instead of Thymine, RNA has Uracil.

another section of the DNA gets pulled apart and the process continues.

4. When the process is complete, there are two brand new chromosome pairs that are exact replicas of one another. Each has a strand from the original DNA and a new strand constructed by free nucleotides and DNA Polymerase.

DNA RHYME

Morning all" said Ms Fahey
"I hope you're feeling well.
Would you like to learn more science?"
"Yes, please" her students yell!

"We've already learned about the cells
which make up all of us*
and we know that inside each
there is the boss-like nucleus.

This powerful little nucleus
is not an empty ball.
It contains small things called chromosomes,
some twenty-three pairs in all,

Half come from mum and half from dad
they total forty-six.
They're shaped like an X
(except for one!)
To make a very special mix...
YOU!

Boys have one Y shaped chromosome
while girls have only Xs.
That's what makes the difference
Between Alex and Alexis!

These chromosomes that come in pairs
are made of stuff that's hard to say -

* see class (VIII)