

Genetics: The Science of Heredity



Genetics: The Science of Heredity

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Genetics: The Science of Heredity

What is Genetics?

GENETICS - is the science of how traits are inherited. In other words, how characteristics pass from parent to offspring.



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So, what are "genes" anyway?

Genes are:

- "The basic unit of inheritance" (*they are what you get from your parents*).
- Pieces of DNA (more on that later...)
- The recipe for making YOU. (Genes make proteins & proteins make up your cells).
- What make you different from one another. No one else has your exact, unique combination of genes.

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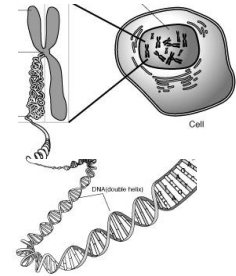
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Where are my "genes"?

- Your **genes** are inside all the cells of your body.
- Inside the nucleus of your cells, are **chromosomes**.
- Chromosomes are made of tightly wound up **DNA** (called chromatin).
- The DNA code makes up your genes.



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Chromosomes?!?!

- **Chromosomes** are tightly wound-up "packages" of DNA.
- Humans have 23 pairs of chromosomes, 46 in all. (*Sperm & Egg cells only have 23 single chromosomes!*)
- Each parent contributes one chromosome to each pair, so you get half your chromosomes from your mom and half from your dad.



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Tell me more about DNA...

DNA stands for:
deoxyribonucleic acid.
Sound it out....
DE – OXY – RYE – BOW –
NEWK – LAY – IC ACID.



DNA is a giant molecule made of certain chemicals.

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The Structure of DNA



DNA looks like a long, twisted ladder called a **DOUBLE HELIX**.

- There are 2 long strands. These are the sugar-phosphate “backbones” of DNA.
- The “steps” of the ladder that connect the strands are base-pairs.

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The Structure of DNA

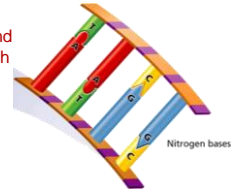
There are only 4 different chemicals that bond the 2 strands together:

ADENINE (A)
THYMINE (T)

Only bond
with each
other!

CYTOSINE (C)
GUANINE (G)

Only bond
with each
other!



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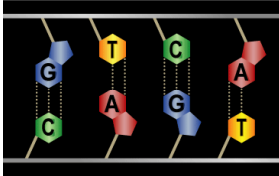
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Order of the Base Pairs = Genetic Code

The order of the base pairs (ACGTGCGATAT) are the recipe for how the proteins will be made...

If you have 1 of the strands, you can build a protein by matching up the missing bases:



*This is how
DNA copies
itself and
makes
proteins!*

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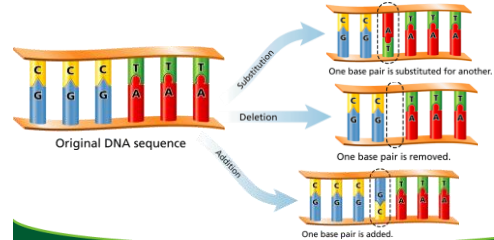
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Mutations

Sometimes, mistakes are made when DNA is copied. These mistakes are called **MUTATIONS**.

There are 3 types: substitution, deletion, addition.



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Effects of Mutations

Some mutations are harmful, some are helpful, and others don't make much of difference. Mutations add **GENETIC VARIETY**. We are all different because mutations have occurred in our genetic code.



Webbed
toes!

End of Slide

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So, how many genes do we have anyway?

The HUMAN GENOME:

- Has 3 billion base pairs of DNA!
- Includes about 35,000 genes!
- 99.9% of your DNA is identical to everyone else's. *All our differences come from that 0.1%!*

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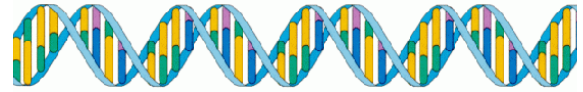
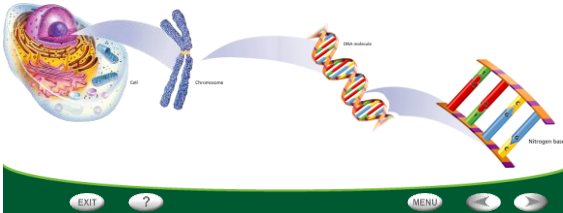
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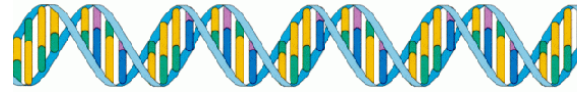

Genetics: The Science of Heredity - The DNA Connection

Review

Inside your cells, you have chromosomes (23 pairs!).
 Chromosomes are made of long strands of DNA.
 DNA has a double helix shape (twisted ladder).
 DNA is made of combinations of nitrogen base-pairs (A-T, C-G).
 These combinations are the recipes for making proteins.




G A A G G T A G A T A E
T E N A G C G C A T T O O G

What is DNA?

- DNA stands for deoxyribonucleic acid.
- DNA is the chemical that makes up our genes.
- Your DNA is your GENETIC CODE - it is the "recipe" or the set of instructions to make YOU!



What does DNA look like?

- It is shaped like a twisted ladder called a "double helix".
- There are 2 long strands - the sugar-phosphate "backbones".
- The "steps" of the ladder are the base-pairs that connect the 2 strands.

What is the Genetic Code?

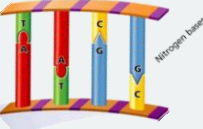
- There are only 4 different chemicals that bond the 2 strands together:

Adenine
Thymine

A only
bonds
with T

Cytosine
Guanine

C only
bonds
with G



What is the Genetic Code?

- The order of the base-pairs is your genetic code!

ATGCTGCATGCCTGAAATAGCTA
TACGACGTACGGACTTTATCGAT

- This code isn't nonsense! It's the recipe for making the proteins that make up YOU!

How does your body "read" this code and know which proteins to make?

- Each body one is made up of bases that at a time. Each group of 3 bases is called a **codon** and codes for a specific protein.

ATG TTCCAAGCCTCATT



Genetic Code-Breaking!

Try using the "codon" key to decode a set of instructions!

Why were there different pictures?

The original code said...

GAC AGA GCA TGG ATT GCA
 ATT CAC CCG ACG AGC GAA
 ATT GCA AAC GAC ATT GCA ATT
 AGA GAA GAC ATT TTC ATA AGC
 CAC ATT ATA AAC ATT GCA ATT
 GCG CCG TGG TTA

DRAW A HOUSE AND A RED FISH IN A BOWL.

But one group had one codon switched...

GAC AGA GCA TGG ATT GCA
 ATT CAC CCG ACG AGC GAA
 ATT GCA AAC GAC ATT GCA ATT
 AGA C **ATG** GAC ATT TTC ATA AGC
 CAC ATT ATA AAC ATT GCA ATT
 GCG CCG TGG TTA

DRAW A MOUSE AND A RED FISH IN A BOWL.

Another group had a codon switched and an extra codon inserted...

GAC AGA GCA TGG ATT GCA
 ATT CAC CCG ACG AGC GAA
 ATT GCA AAC GAC ATT GCA ATT
 AGA GAA GAC ATT TTC ATA
 A **GAC** AC A **GAA** A AAC ATT GCA
 ATT GCG CCG TGG TTA

DRAW A HOUSE AND A DEAD FISH IN A BOWL.

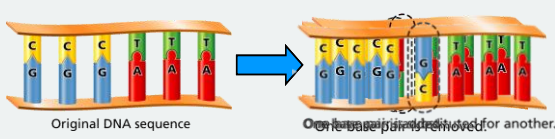
The last group had several codons deleted...

GAC AGA GCA TGG ATT GCA
 ATT CAC CCG ACG AGC GAA
 ATT AAC GAC ATT GCA ATT
 AGA GAA GAC ATT TTC ATA AGC
 CAC AT
 GCG CCG TGG TTA

DRAW A HOUSE AND A RED FISHBOWL.

What happens if there is a mistake in the code?

- Sometimes mistakes are called **MUTATIONS**.
- There are 3 types: **ADDITION**
DELETION **SUBSTITUTION**



What is the effect of a mutation?

- The mutation changes the meaning of the code... It messes up the instructions!
- For example - look at the effect of taking out one letter from this sentence

THE **PAT CAT ATE THE RAT.**

DELETION
Mutation

But remember, codons are read in 3 letter sections, so all the letters move over...

Deleting even 1 base pair can make a big difference!

What is the effect of a mutation?

THE **BAT CAT ATE THE RAT.**

SUBSTITUTION
Mutation

Changing 1 base pair may make a small difference or...

THE **FAT CAT ATE THE RAT.**

ADDITION
Mutation

a big difference!

What is the effect of a mutation?

- Mutations add GENETIC VARIETY. We are all different because mutations have occurred in our genetic code.
- Some mutations are harmful... BUT, some can be helpful, and others don't make much difference.

