DNA, Replication and RNA

The structure of DNA

DNA, or **Deoxyribonucleic Acid**, is the blueprint for building all of life.

**DNA** is a long molecule made up of units called **NUCLEOTIDES**. Each nucleotide is made up of three basic parts:

1. **SUGAR** called **DEOXYRIBOSE**
2. **PHOSPHATE GROUP**
3. **NITROGEN BASE**

Of those nitrogen bases, there are **two** categories, each with two types...

1. **Two rings**
   a. **ADENINE**
   b. **GUANINE**
2. **1 ring**
   a. **CYTOSINE**
   b. **THYMINE**

The **backbone** of DNA is composed of the **sugar** and **phosphate** groups, while the **nitrogen** bases fill the insides like **rungs** on a ladder.

- This structure was discovered by scientists, James Watson and Francis Crick.
  - They named the official shape of DNA – the **DOUBLE HELIX**

In DNA there has to be one **adenine** for every **thymine** and one **guanine** for every **cytosine**.

- **A = T**
- **G = C**

A **cattail**, a **cat** and a **catfish** are all **different** organisms composed of different
proteins. If you look at the DNA of these organisms however, you will see that all of these are made up of the same nucleotides, all with the same four bases, adenine, cytosine, thymine, and guanine.

How can all these organisms be so different if they are made up of the same material?

The difference lies in the four nitrogen bases and how they are arranged along the DNA strands. This sequence of bases forms the unique genetic information of an organism.

For example bases in this order: ATGATT

Would code for different information than bases in this order: ATCATG

The closer two organisms are related to each other the closer the two sequences of bases are.

DNA REPLICATION

Each cell in your body contains a copy of your DNA that was originally found in the fertilized egg at conception.

When we learned about mitosis, we knew that before this could begin, all of the chromosomes must double and turn into the sister chromatids. The process in which this happens is called DNA REPLICATION.

How DNA replicates… DNA MAKES DNA

Each strand of DNA has enough information needed to reconstruct the other half by pairing up the nitrogen bases.

Because each strand can be used to make the other stand, they are said to be COMPLIMENTARY STRANDS.

DNA replication is carried out by a series of enzymes which “unzip” the DNA.
Each side serving as a **template** for making the other end.

Diagram:

When strung together, the **sequence** in which the **nitrogen bases** are arranged writes a **code** to make specific **PROTEINS**.

The role of RNA...

**RNA**, like **DNA** is a long **chain** of **nucleotides** (**sugar**, **phosphate** and **nitrogen bases**). But there are **three** main differences between **RNA** and **DNA**...

1. The sugar is not **deoxyribose**, but instead just **ribose**.
2. **RNA** is **single stranded**.
3. RNA has the nitrogen base **URACIL**, instead of **Thymine**.
   a. Therefore, when matching base pairs in **RNA**...

<table>
<thead>
<tr>
<th>(DNA)</th>
<th>(RNA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenine</td>
<td>Uracil</td>
</tr>
<tr>
<td>Thymine</td>
<td>Adenine</td>
</tr>
<tr>
<td>Guanine</td>
<td>Cytosine</td>
</tr>
<tr>
<td>Cytosine</td>
<td>Guanine</td>
</tr>
</tbody>
</table>

Like workers on an **assembly line**, each doing a different job to complete a whole **product**, **Protein** production, in much the same sense, is **similar**.

In all, there are **three** different types of **RNA**...

1. **Messenger RNA** (mRNA)
a. Brings **instructions** on how to build a **protein** from the **DNA** in the nucleus into the cytoplasm and on to a **ribosome**, where it will be **built**.

2. **Ribosomal RNA (rRNA)**
   a. Binds to the **mRNA** and uses the **instructions** to **assemble** the amino acids in the correct **order**.

3. **Transfer RNA (tRNA)**
   a. Delivers amino acids to the **ribosome** to be **assembled** on the protein.

- **DNA** provides the initial **information** to make the **proteins**.
- **RNA** also helps move the **amino acids** from one place to the next.
- **RNA** helps build the **proteins**.
- **RNA** helps move **amino acids** to the correct building **place**.

Transcription

How does the **information** in DNA, which is found in the **nucleus**, move to the **ribosome**, which is found in the **cytoplasm**?

**Messenger RNA (mRNA)** carries this information through the **nuclear membrane** and to the **ribosome**. In the nucleus, **enzymes** make an **RNA** copy of a portion of the original **DNA** strand. This process is known as **TRANSCRIPTION**.

1. The process starts as an enzyme **unzips** the molecule of **DNA** in the region of the **gene** to be transcribed.

2. Free RNA **nucleotides** found floating in the **nucleus** form **base pairs** with their complimentary **DNA** strand.
   a. **A=U, T=A, G=C, C=G**
   b. A T A G A T A A T G C G A T G A
   c. The **mRNA** nucleotides will **covalently** bond together.

3. The **mRNA** strand breaks away and the **DNA** strands **rejoin**.
   a. The **mRNA** leaves the **nucleus** and enters the cytoplasm on the way
The main difference between DNA replication and RNA transcription is that in RNA trans, a single strand molecule is formed rather than a double strand.