DNA, Replication, and RNA

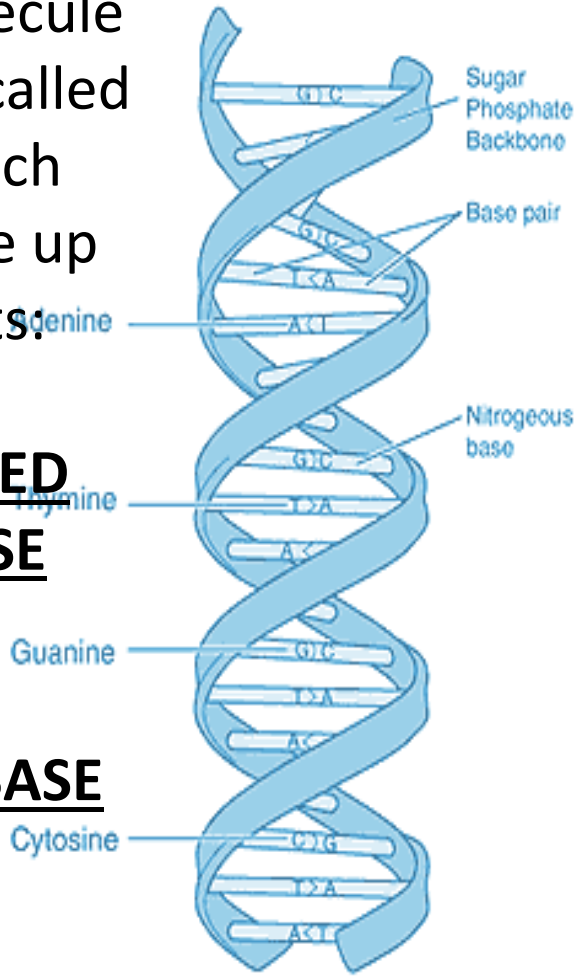
How are traits made?

The Structure of DNA

DNA, or **Deoxyribonucleic Acid**, is the blueprints 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:

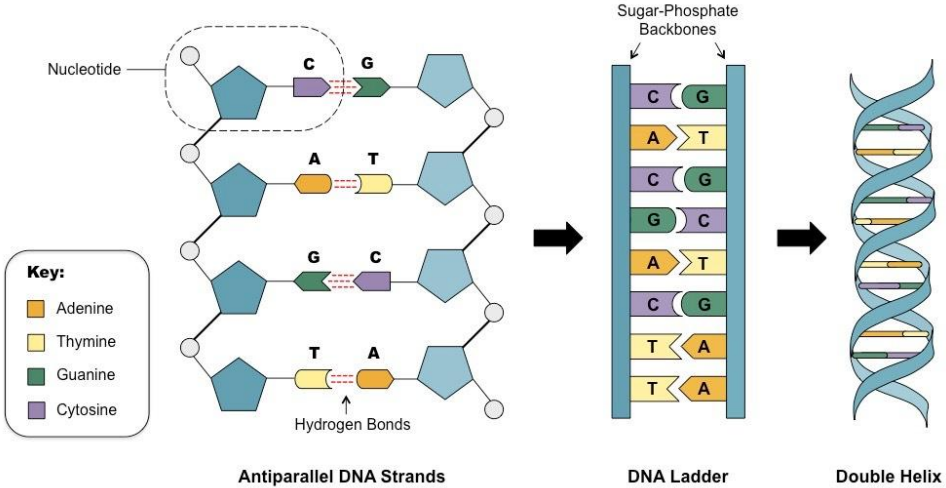
1. **5-CARBON SUGAR CALLED DEOXYRIBOSE**
2. **PHOSPHATE GROUP**
3. **NITROGEN BASE**



There are 4 **nitrogen** bases, they are

a. **ADENINE**
b. **GUANINE**
c. **CYTOSINE**
d. **THYMINE**

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



- 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.

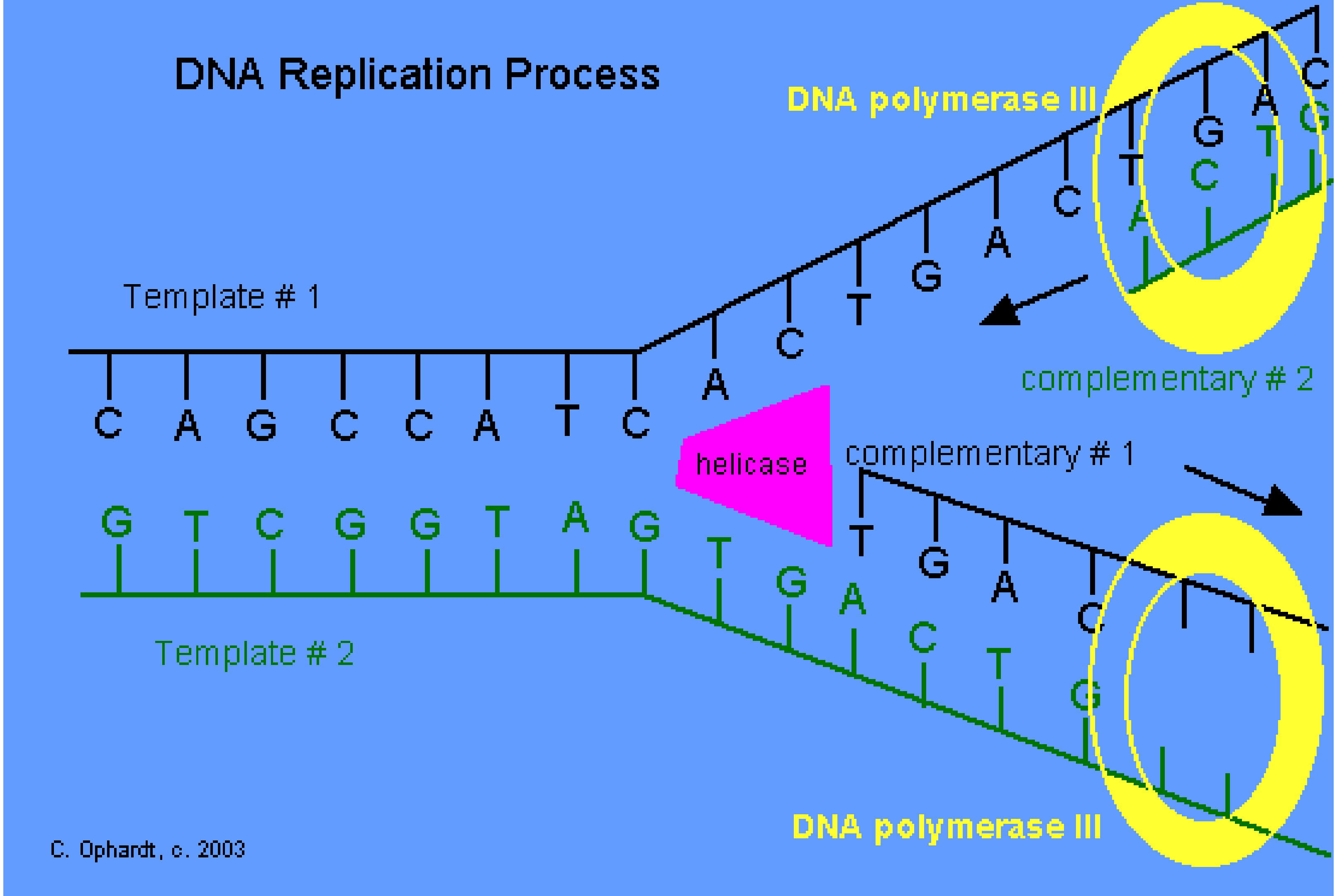
DNA must be passed to new cells, so it must make a copy of itself. The process in which this happens is called **DNA Replication.**

How DNA replicates…

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 **strand**, 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.

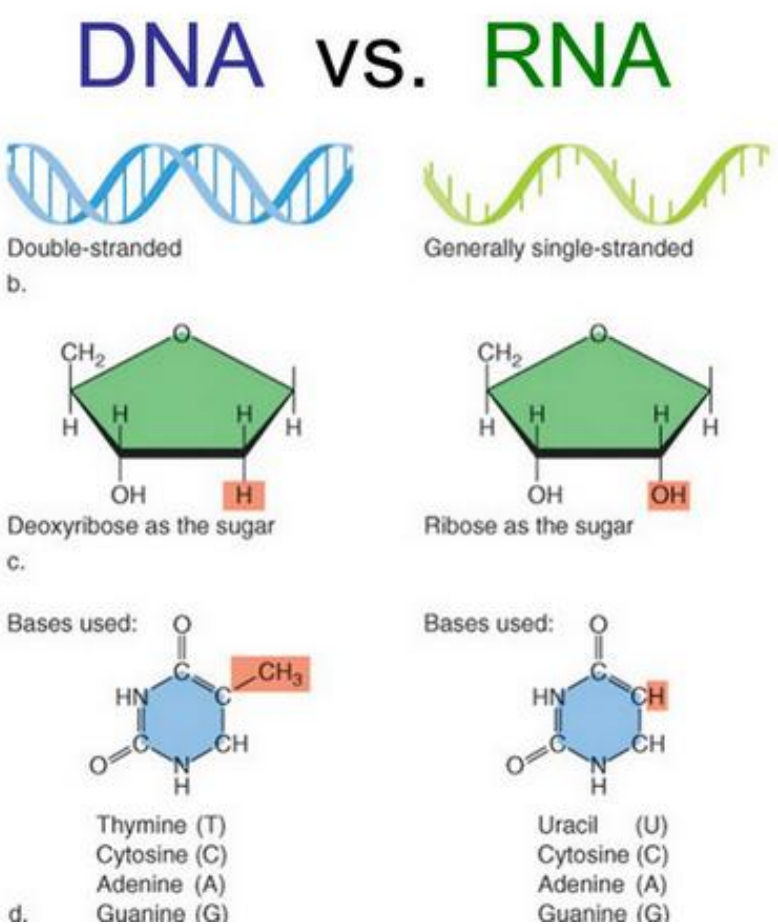

DNA Replication Process
DNA polymerase III
Template # 1
C A G C C A T C
complementary # 2
helicase
complementary # 1
G T C G G T A G
Template # 2
DNA polymerase III
C. Ophardt, c. 2003

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

How do we get Proteins from DNA?

The role of RNA…

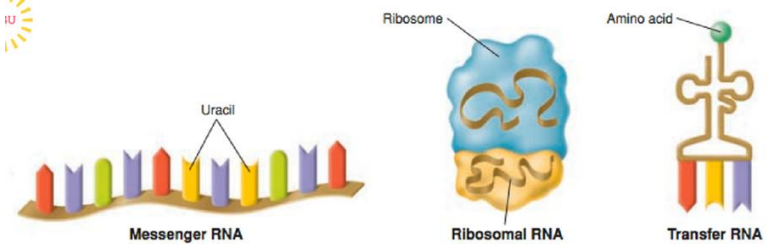
RNA, like DNA is a long **chain** of **nucleotides** (**sugar**, **phosphate** and **nitrogen bases**). But there are **three** main differences between **RNA** and **DNA**…



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**…

(DNA)	(RNA)
Adenine	**Uracil**
Thymine	**Adenine**
Guanine	**Cytosine**
Cytosine	**Guanine**

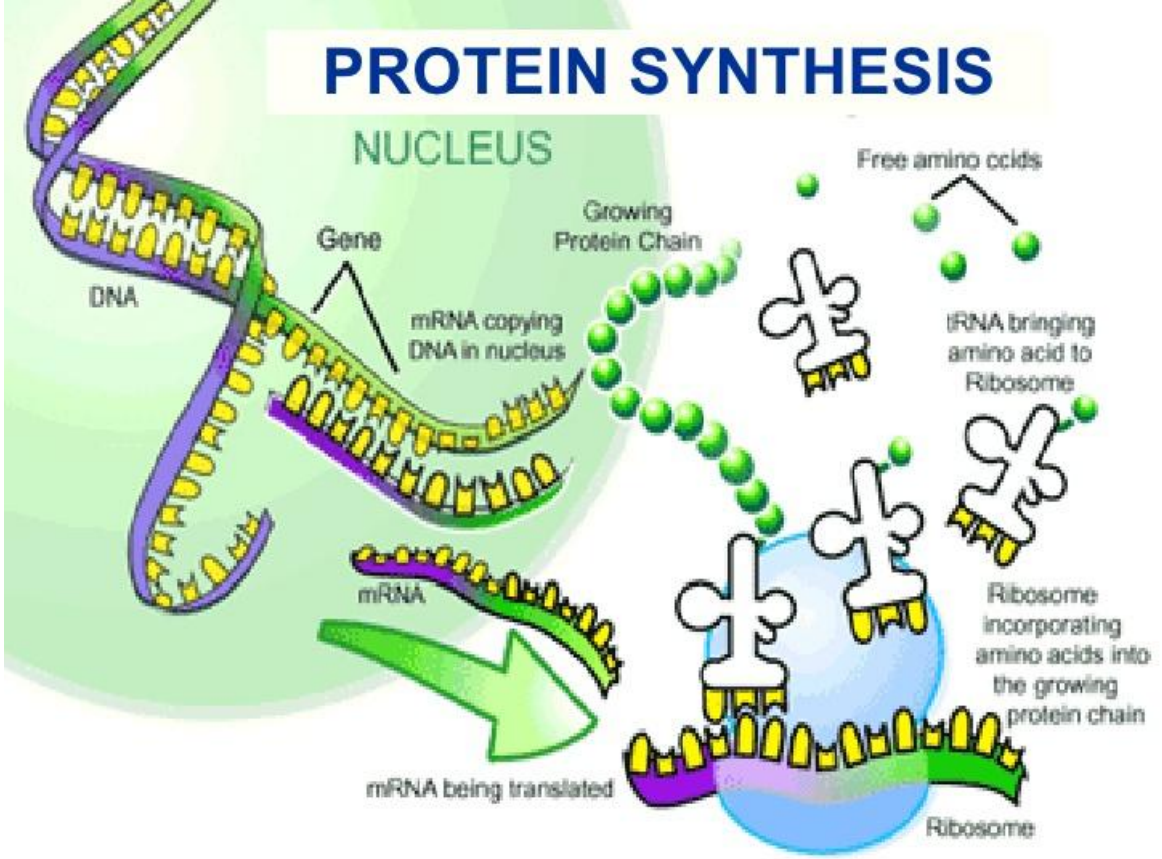
Like workers on an **assembly line**, each doing a different job to complete a whole **product**, **Protein** production, in much the same sense, is **similar**.



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**.

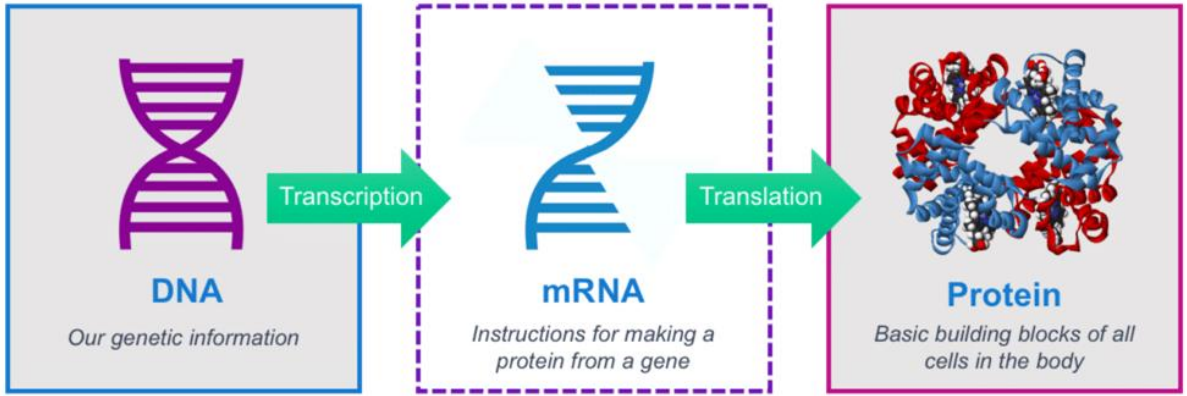


Where do the amino acids to build proteins come from?

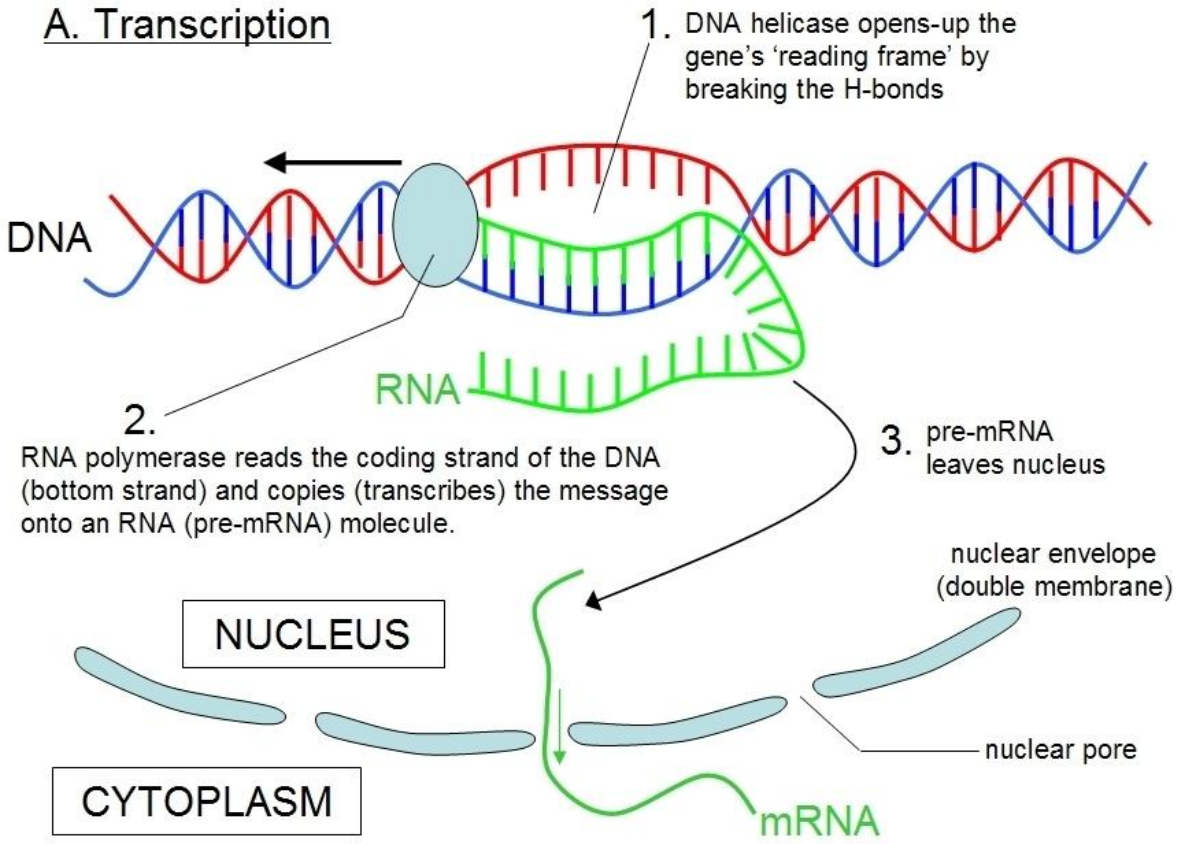
Transcription

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**.



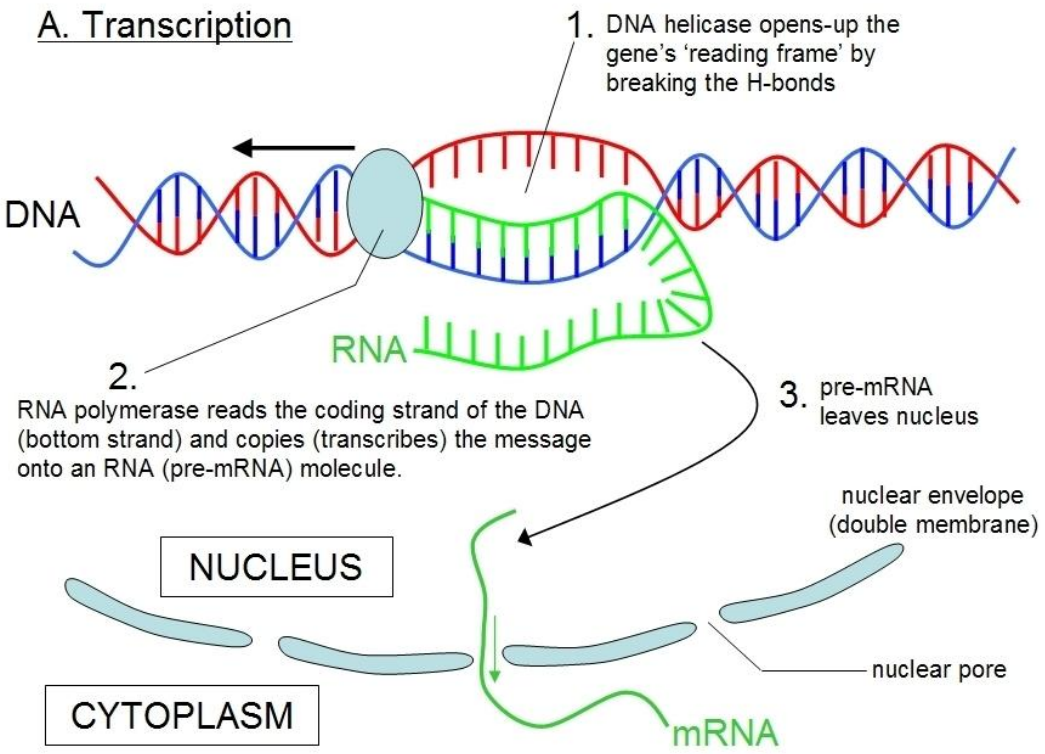
1. The process starts as an enzyme **<u>unzips</u>** the molecule of **<u>DNA</u>** in the region of the **<u>gene</u>** to be transcribed.



2. Free RNA **nucleotides** found floating in the **nucleus** form **base pairs** with their complimentary **DNA** strand.

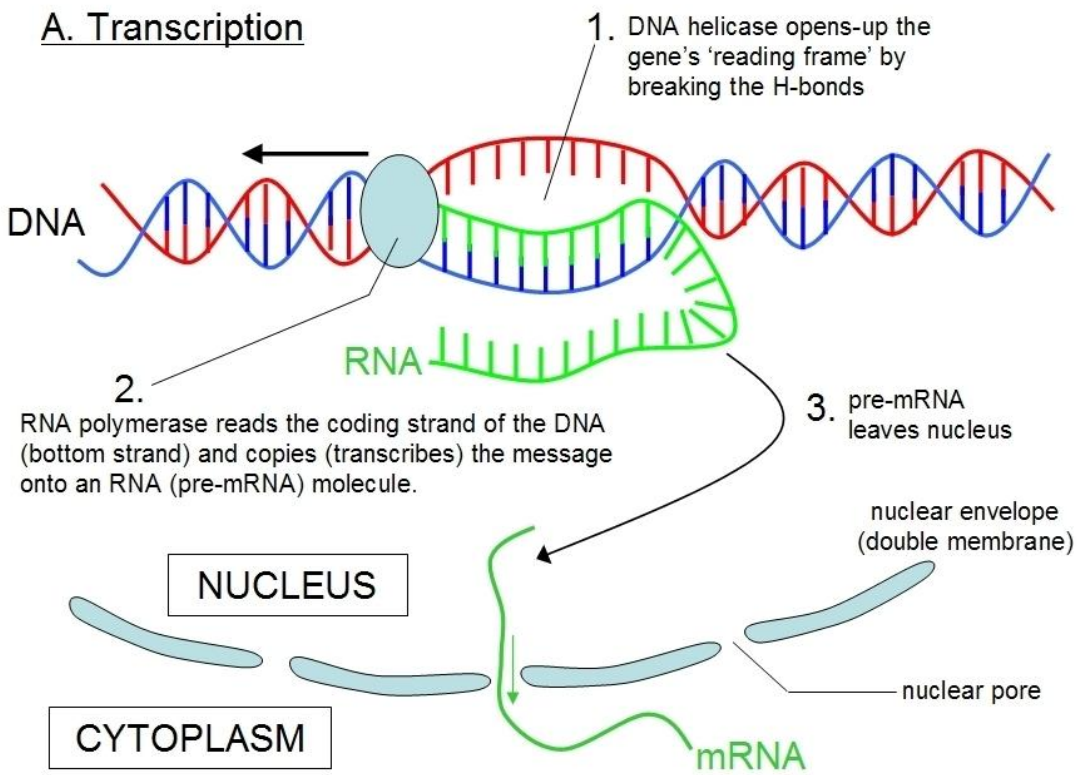
a. **A=U, T=A, G=C, C=G**
b. A T A G A T A A T G C G A T G A

a. The **mRNA** nucleotides will **covalently** bond



3. The **mRNA** strand breaks away and the DNA strands **rejoin**.

   a. The **mRNA** leaves the **nucleus** and enters the cytoplasm on the way to the **ribosome**.



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.