PROTEIN SYNTHESIS

WHAT IS IT?

HOW DOES IT WORK?

Learning Outcomes

All:

Will be able to describe simple steps in protein synthesis: Transcription and Translation and be able to distinguish between them.

Describe the roles of DNA, mRNA, tRNA, and Ribosomes in the process

Able to 'read' string of mRNA codons and construct a string of corresponding amino acids using a table

Most:

Describe the differences between DNA and RNA

Able to describe the roles of RNA polymerase in the process of protein synthesis and recall where it occurs

Some:

Able to fit the concept of mRNA splicing into the model.

DNA

Some starter questions.....

What does DNA stand for?

What is it made up from?

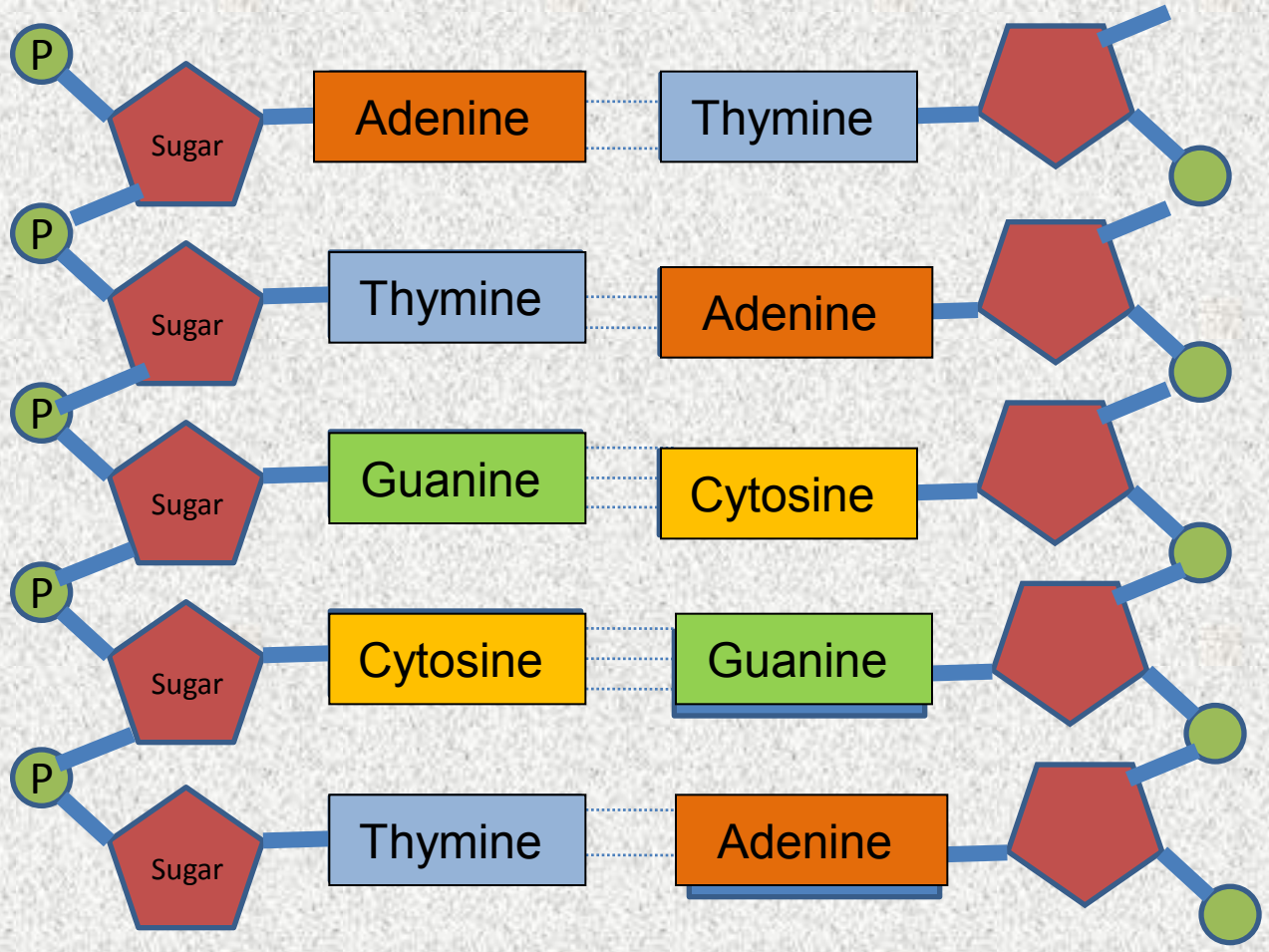
Where is it found?

What does it do?

DNA

- DeoxyriboNucleic acid
- Contain instructions on how to build proteins used in the body.
- Found in cell nucleus.
- Codes for individual Proteins.
- Made up from chain of sugar-phosphates and one of four bases.

DNA


P
Sugar
Adenine
Thymine
P
Sugar
Thymine
Adenine
P
Sugar
Guanine
Cytosine
P
Sugar
Cytosine
Guanine
P
Sugar
Thymine
Adenine

PROTEIN

Some simple starter questions.....

What is a Protein?

What is it made from?

Where are they made?

What can they do?

PROTEIN

- Polymer of units linked by peptide bonds:
- Built up from 20 amino acids
- Created in Ribosomes
- Perform nearly all biological functions:
  - Enzymes
  - Antibodies
  - Structural bodies
  - Hormones
  - etc!

BUT...

If DNA is used to build proteins

Q: HOW IS THIS ACTUALLY ACHIEVED?

DNA cannot escape the nucleus – the molecules are too large, and proteins are manufactured in ribosomes *outside* the nuclear envelope

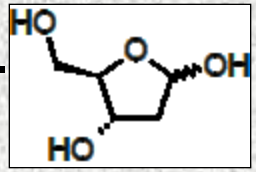
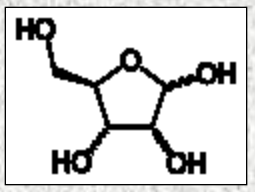
A: DNA uses an intermediary form:

messenger RNA (mRNA)

RNA

RIBOSENUCLEIC ACID

2 key differences between DNA and RNA:

DNA	RNA
Sugar group- Deoxyribose 	 Sugar group- Ribose
4 Bases: Adenine Guanine Thymine Cytosine	4 Bases: Adenine Guanine Uracil Cytosine

From DNA to PROTEIN

2 phases to the process:

TRANSCRIPTION

and

TRANSLATION

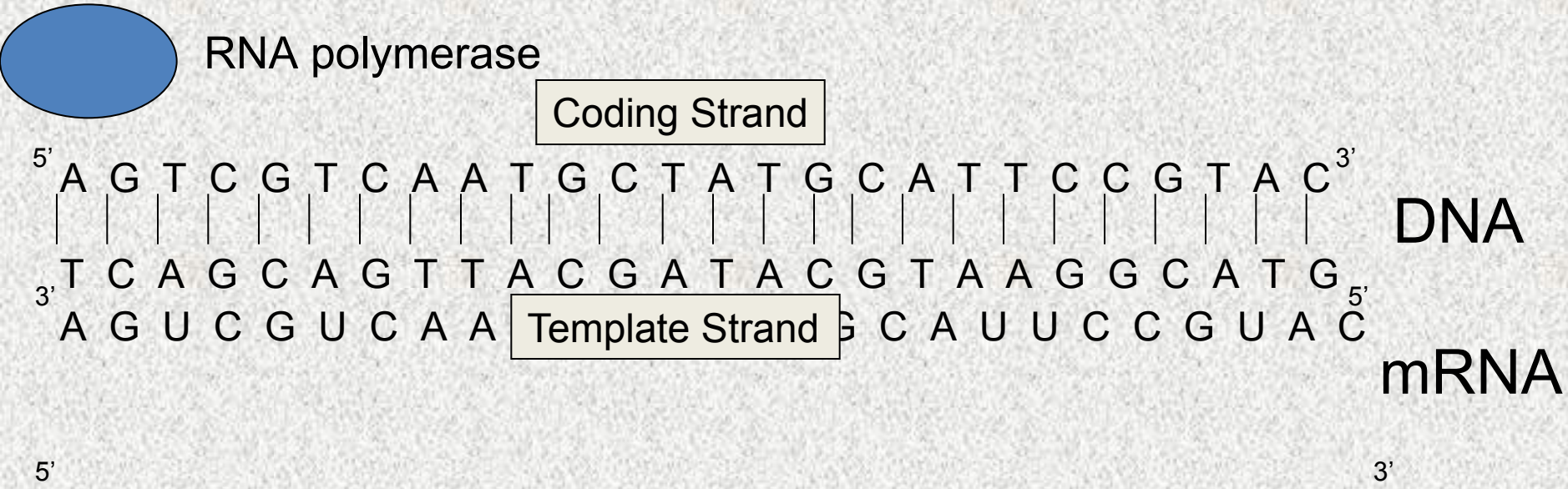
TASK 1

Model a length of DNA by listing at least 21 nucleotide bases

And then build a complementary list of bases to complete the molecule

TRANSCRIPTION

The process by which DNA is ‘read’ to produce a strand of mRNA



TASK 2

Using your model from task 1 build a list of base pairs to from a strand of mRNA

TRANSCRIPTION

Here is a video that shows the process in detail
It is created using simulations of the molecules involved

DNA to
PROTIEN

TRANSCRIPTION

The steps in this part of the process are:

1. RNA polymerase binds to DNA strand and unwinds a short section (about 12 base pairs long)

2. This then travels along the DNA strand building an RNA molecule from the TEMPLATE STRAND

3. Non coding strands of mRNA (**Introns**) are cut out leaving just coding strands (**Exons**) in a process called **SPLICING**

TRANSCRIPTION

This stage is now complete and the mRNA is free to pass through the nuclear envelope and into the cell cytoplasm...

... where it is met by a ribosome and is ready to undergo....

TRANSLATION

TRANSLATION

This is: the process by which mRNA is ‘read’ to produce a strand protein chain

Another type of RNA is involved in this stage; Transfer RNA (tRNA)

These units carry specific, individual, amino acids

Process is carried out in the RIBOSOME

TRANSLATION and tRNA

tRNA is a short strand of RNA with 2 important features:

1: tRNA caries an ANTI CODON

Each tRNA molecule has an area with 3 bare bases: these match up to corresponding bases on the mRNA (called codons)

There are 64 different tRNA molecules for each possible combination of bases

TRANSLATION and tRNA

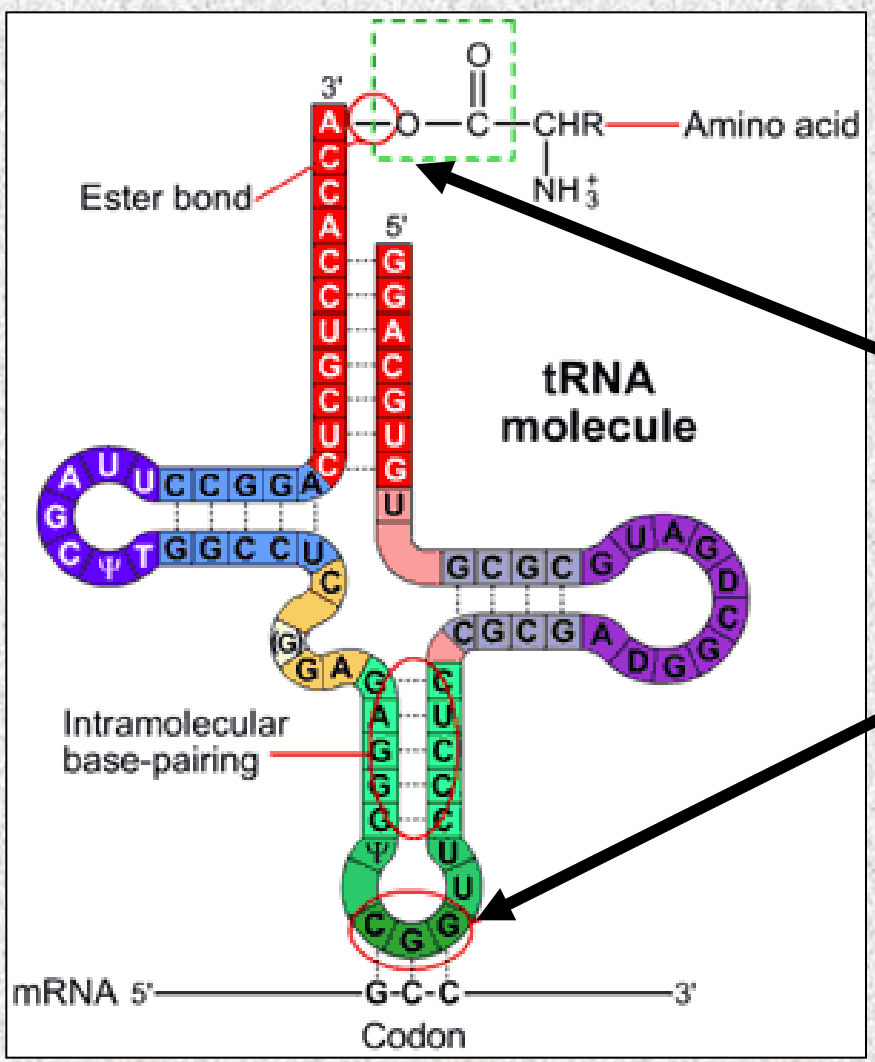
tRNA is a short strand of RNA with 2 important features:

2: tRNA is SPECIFIC

Each type of tRNA carries a SPECIFIC amino acid

Some amino acids are coded for by just a single codon others by several

tRNA



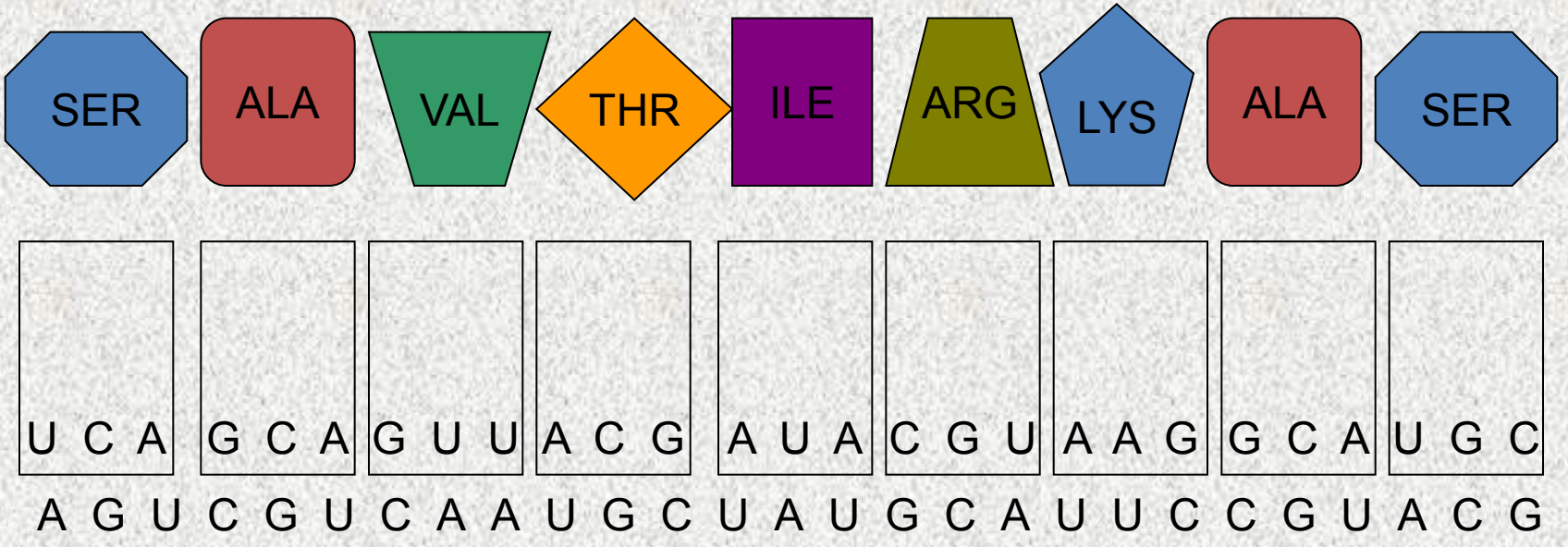
Strand of RNA showing 2 key important areas:

Amino Acid Binding Site

Anticodon

TRANSLATION

Remember our strand of mRNA from before?



TRANSLATION

Now we return to the video…

If that wasn't very clear then here is a slightly more stylised video

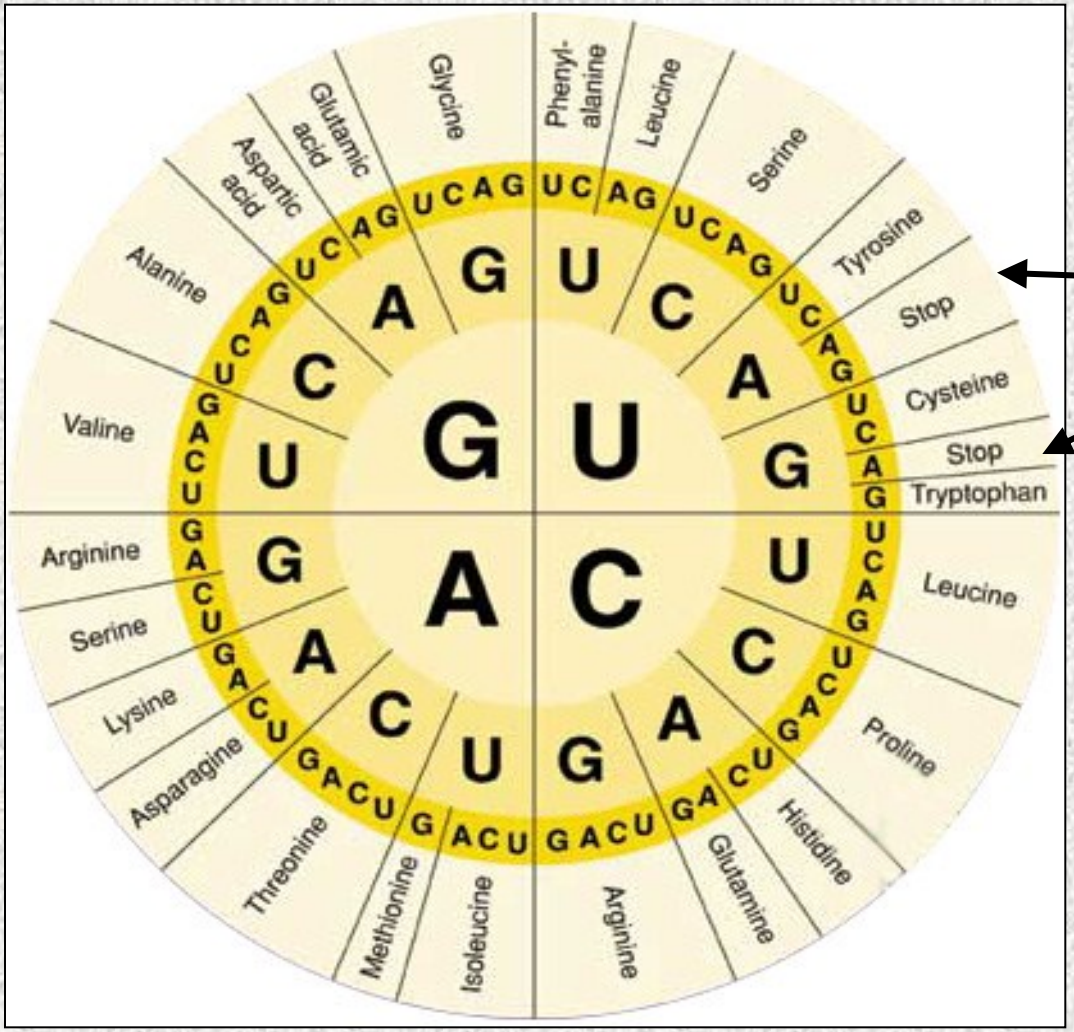
TRANSCRIPTION

TASK 3

Using your model strand of mRNA from Task 2

Now create a chain of amino acids to from your very own protein.

Either use the table in the book, or the "amino acid wheel" on next slide.



These codons indicate where transcription ends

Courtesy of Copernicus Project

http://www.copernicusproject.ucr.edu/

The Genetic Code

DEGENERATE:

More than one codon for most amino acids.

e.g.	AUA, AUC *or* AUU	= Isoleucine
	CCA, CCU , CCG *or* CCC	= Proline
	AAA *or* AAG	= Lysine

NON-OVERLAPPING:

Each set of 3 bases (codons) are read only once.

i.e. AUA|GCU|AAU|CCG|UGG

= ISO| ALA |ASP|PRO|TRY

TASK 4

Using PCs log onto

www.WolframAlpha.com

Enter sequence of bases from your DNA coding strand

Try several different strands with same software.

Who can get the most matches to the human genome?

TASK 5

Create a model of either

TRANSLATION or TRANSCRIPTION

Can be any format e.g.: PowerPoint, Poster, 3D Model