SCIENCE FOUNDATIONS

RNA and protein synthesis

Difficulty level: Advanced

Science Foundations

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Overview of the concept

This is how a gene in your DNA becomes a working protein, like the insulin that controls your blood sugar or the haemoglobin that carries oxygen in your blood. Your DNA stays safe in the nucleus while a messenger copy carries the instructions out to the machines that build the protein. A person with diabetes takes insulin because their own body cannot make enough of that protein. Knowing RNA and protein synthesis tells you how the code in your genes turns into the working parts of your body.

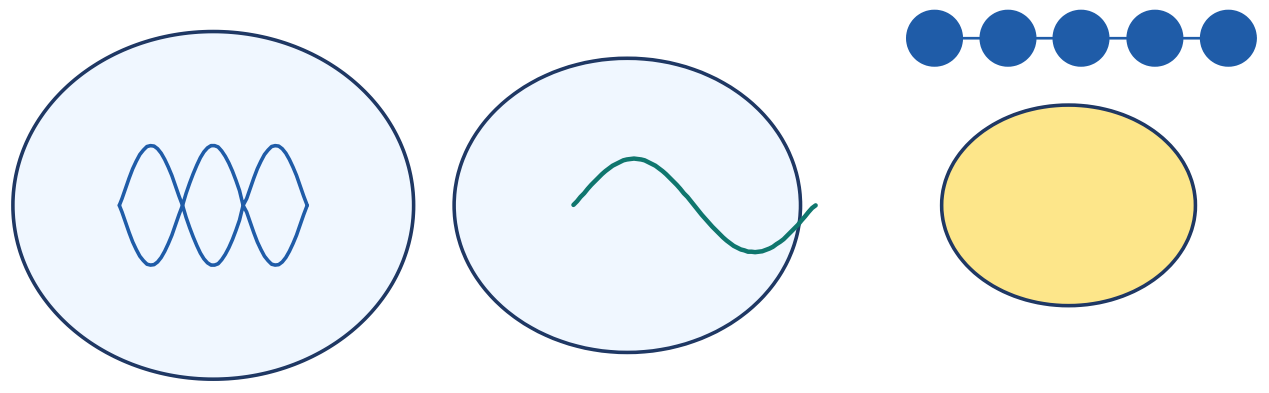


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Worked examples

EXAMPLE 1

Q Trace a gene to a protein in three steps.



SOLUTION

Transcribe: copy the DNA gene into mRNA in the nucleus.

Carry: mRNA leaves the nucleus to a ribosome.

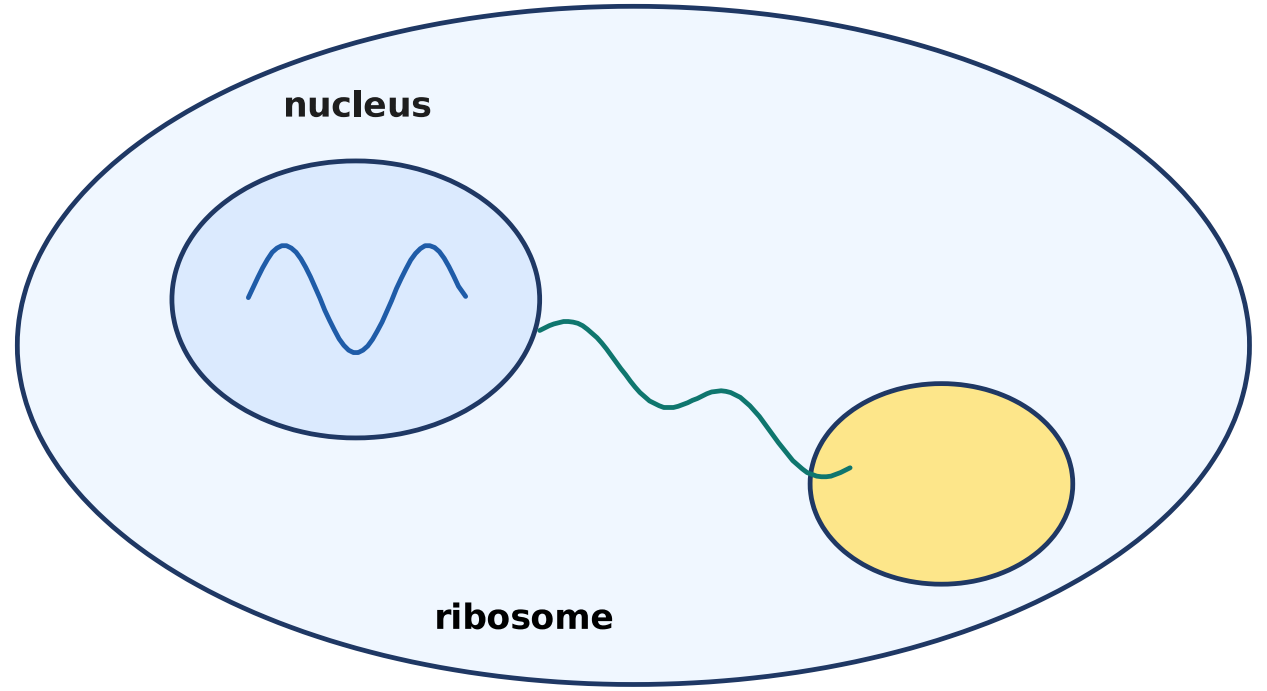
Translate: the ribosome reads mRNA and joins amino acids into protein.

The result is DNA to mRNA to protein.

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EXAMPLE 2

Q Where does each step happen?



SOLUTION

Transcription happens in the nucleus.

Translation happens at a ribosome in the cytoplasm.

The protein then folds and works in the cell.

The result is nucleus for transcription, ribosome for translation.

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Practice questions

1 **A skin cell needs the protein keratin. Trace the keratin gene to the finished protein in three steps, naming what happens at each step.**

- **A** Transcribe the keratin gene into mRNA in the nucleus, carry the mRNA to a ribosome, then translate it into keratin
- **B** Translate the keratin gene into mRNA in the nucleus, then transcribe it at a ribosome
- **C** Copy the keratin gene into DNA in the cytoplasm, then translate it in the nucleus
- **D** Transcribe the keratin gene into mRNA at a ribosome, then translate it in the nucleus

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2

Trace the flow of information from a gene to a working protein, naming the molecule made at each stage.

A. DNA is transcribed to mRNA, and mRNA is translated to protein

B. mRNA is transcribed to DNA, and DNA is translated to protein

C. Protein is transcribed to mRNA, and mRNA is translated to DNA

D. DNA is translated to mRNA, and mRNA is transcribed to protein

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3 **In a muscle cell, the gene for actin is switched on. Where does transcription of the actin gene happen, and where is actin made?**

- **A** Transcription in the nucleus, translation at a ribosome
- **B** Transcription at a ribosome, translation in the nucleus
- **C** Transcription in the cytoplasm, translation in the nucleus
- **D** Both steps in the nucleus

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4 Which step of protein synthesis happens at a ribosome in the cytoplasm?

- A Translation
- B Transcription
- C Replication
- D Mutation

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5 Which happens first in protein synthesis: transcription or translation?

- A Transcription
- B Translation
- C They happen at the same time
- D Translation, then transcription

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6 What does transcription make?

A mRNA

B DNA

C A protein

D tRNA

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7 What does translation make?

A A protein

B mRNA

C DNA

D A gene

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8

What carries the message out of the nucleus?

A mRNA

B DNA

C A protein

D A ribosome

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9

What reads mRNA?

A A ribosome

B The nucleus

C The cytoplasm

D A mitochondrion

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10

Does DNA leave the nucleus?

A No

B Yes

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ANSWER KEY

1. Transcribe the keratin gene into mRNA in the nucleus, carry the mRNA to a ribosome, then translate it into keratin

2. DNA is transcribed to mRNA, and mRNA is translated to protein

3. Transcription in the nucleus, translation at a ribosome

4. Translation

5. Transcription

6. mRNA

7. A protein

8. mRNA

9. A ribosome

10. No

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