teachers guide

Proteins 4: Making proteins

Components

	NAME	DESCRIPTION	AUDIENCE
	*Making proteins* teachers guide	This guide shows how to use a learning object to build students' understanding of protein synthesis.	teachers
	*How are proteins made?* learning object	This interactive learning object explains how proteins are made. It leads students through an animation about protein synthesis and an activity where students 'build' part of the protein insulin.	students
	*Protein synthesis* worksheet	Students use this worksheet as they work through the learning object, *How are proteins made?*	students
	*Protein synthesis summary* fact sheet	This fact sheet summarises two stages of protein synthesis: transcription and translation.	students

Purpose

Students watch an animation of protein synthesis. They are guided through the processes of transcription and translation using a section of the insulin gene.

Outcomes

Students understand that:

- a strand of DNA is transcribed to make mRNA, which is translated to form a strand of amino acids;
- nucleotide order on an mRNA strand is determined by nucleotide order of a strand of DNA;
- nucleotides are read in groups of three, called a codon; and
- the order of amino acids in a strand is determined by the order of nucleotides on an mRNA strand.

Activity summary

ACTIVITY	POSSIBLE STRATEGY
Students watch an animation at the start of the learning object, *How are proteins made?* to introduce cellular processes of transcription and translation.	whole class, individually or in pairs
Students work through the remainder of the interactive learning object, *How are proteins made?* to understand and practice building proteins. The fact sheet, *Protein synthesis*, summarises key concepts presented in the learning object.	individually or in pairs
Students answer questions in the worksheet, *Protein synthesis*.	individually

Technical requirements

The learning object requires Adobe Flash Player version 8 or later (this is a free download from www.adobe.com). It can be placed on a web or file-server and run either locally or remotely in a web browser. The teachers guide, worksheet and data sheet require Adobe Reader (version 5 or later), which is a free download from www.adobe.com. The worksheet is also available in Microsoft Word format.

Acknowledgements

learning object, *How are proteins made?*

Image of insulin: Timofeev, V.I., Chuprov-Netochin, R.N., Samigina, V.R., Bezulglov, V.V., Miroshnikov, K. A. & Kranova, I.P. (2010). X-ray investigation of gene-engineered human insulin crystallized from a solution containing polysialic acid. *Acta Crystallogr., Sect. F 66*, 259-263, created with Jmol: an open-source Java viewer for chemical structures in 3D (jmol.sourceforge.net).

Image of insulin hexamer: Yonemoto, I., (2006). Insulin Hexamer. Modified image from Chang, X., Jorgensen, A. M., Bardrum, P. & Led, J.J. (1997) Solution structures of the R6 human insulin hexamer. *Biochemistry 36*, 9409-9422, created with Jmol: an open-source Java viewer for chemical structures in 3D (jmol.sourceforge.net).

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SPICE resources and copyright

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Associated SPICE resources

Proteins 4: Making proteins may be used in conjunction with related SPICE resources to teach the topic of proteins.

DESCRIPTION	LEARNING PURPOSE
Proteins (overview) This learning pathway shows how a number of SPICE resources can be combined to teach the topic of proteins.	
Proteins 1: The importance of proteins A video highlights the essential role played by proteins in living organisms.	**Engage**
Proteins 2: Looking at proteins Students complete a practical activity to isolate and visualise proteins in tissue samples, using gel electrophoresis.	**Explore**
Proteins 3: Protein molecules Students work through an interactive learning object that explains the molecular structure of proteins.	**Explain**
Proteins 4: Making proteins Students work through an interactive learning object that explains how proteins are made by living organisms. A fact sheet summarises the main stages of transcription and translation.	**Explain**
Proteins 5: Defective proteins What happens when the process of protein formation goes wrong? A case study about Kuro disease explains some implications.	**Elaborate**