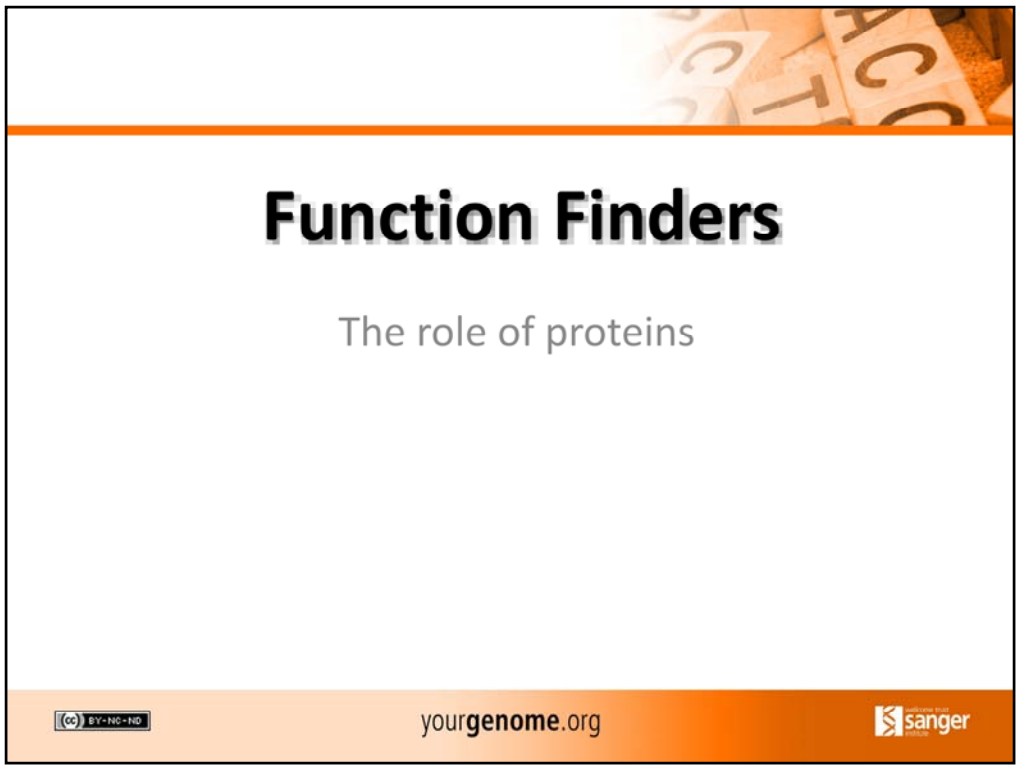
Function Finders
The role of proteins
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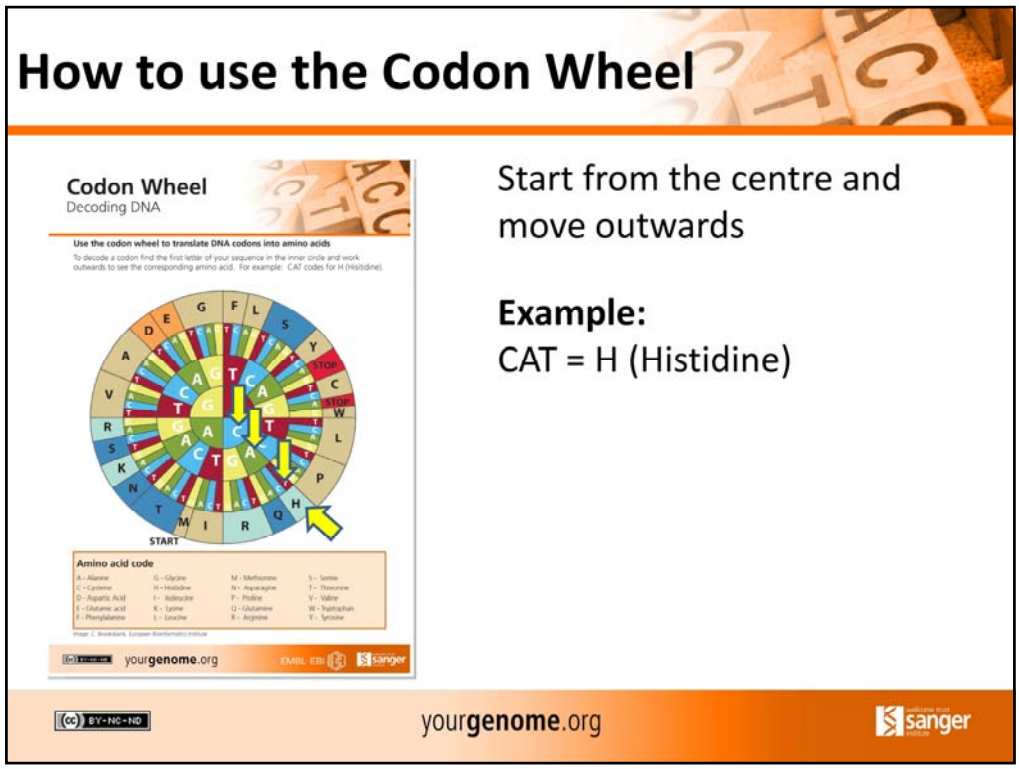
sanger

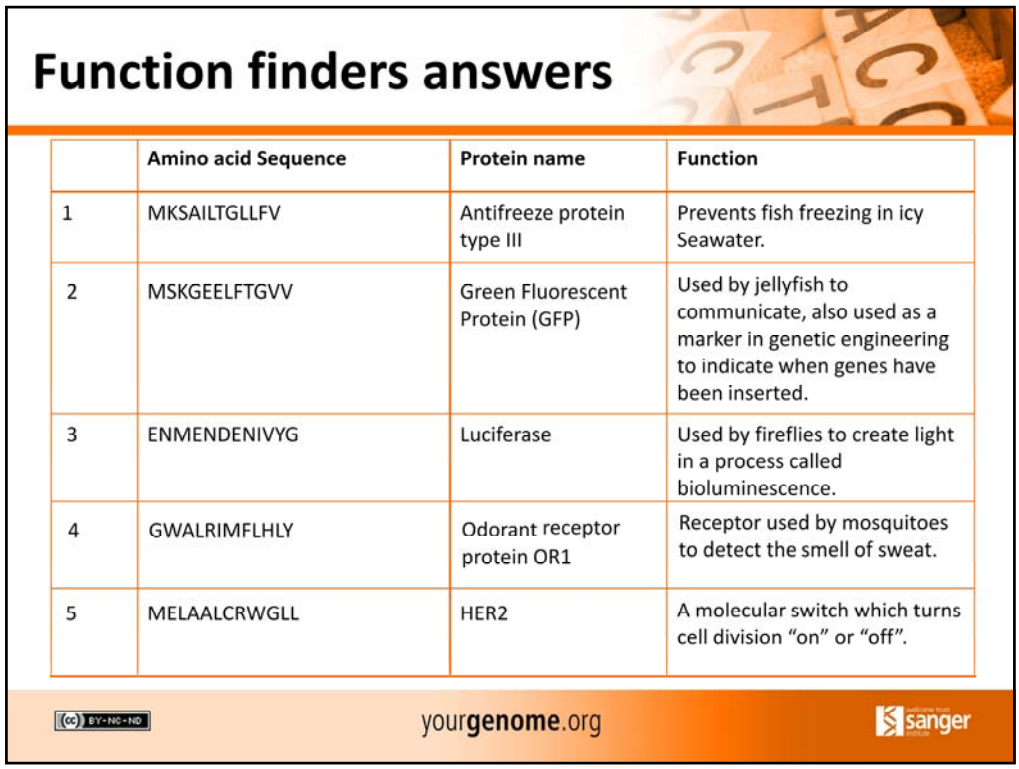


A series of three bases is called a codon which translates into an amino acid. A series of amino acids make a protein.

The codon wheel is central to this activity as it translates the DNA sequence into amino acids.

To use the wheel you must work from the inside circle out to the outer circle.

For example if the first triplet of the sequence is CAT, the amino acid it codes for is Histidine (H).

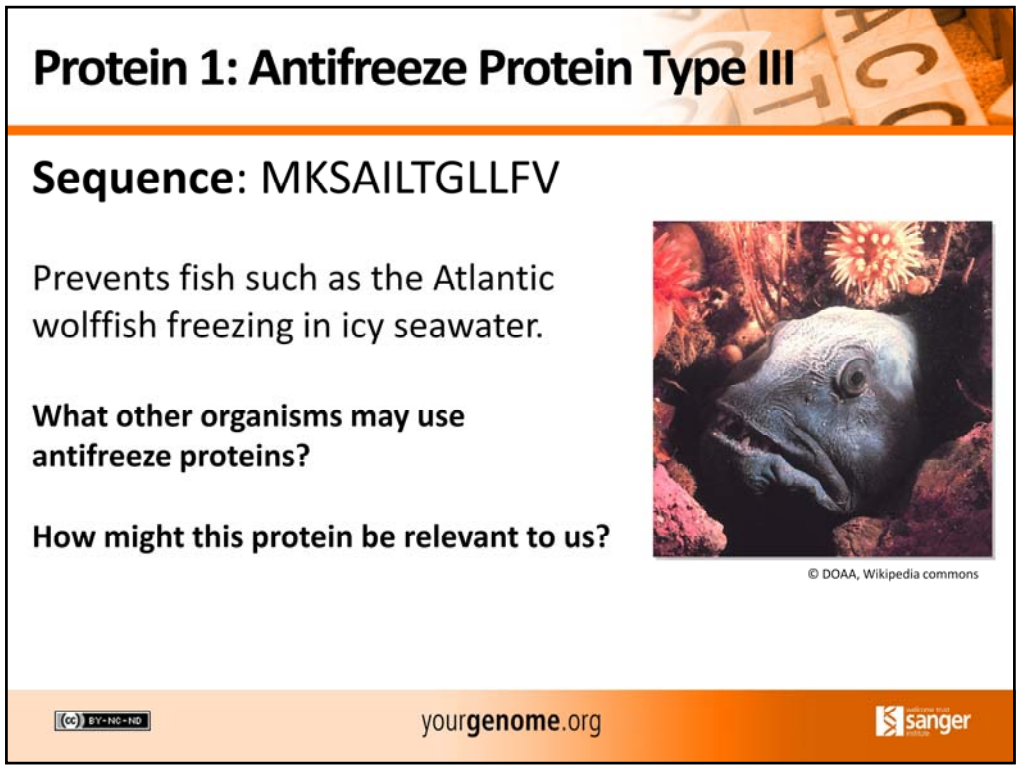


Stress to the students that the amino acid sequence is not the entire amino acid sequence, but a region that we can use to search online databases. Normally, amino acid sequences can be comprised of hundreds of amino acids.

By following the link to the Uniprot website at the bottom of the protein profile students will be able to see the full sequence of the protein (if time).

Function finders answers

	Amino acid Sequence	Protein name	Function
6	PGENLCYRKMWC	Alpha-bungarotoxin	Snake venom.
7	PREIQTAVRLLL	Histone H2B	Use to wind up DNA so it can be condensed into chromosomes. http://www.wehi.edu.au/wehi-tv/dna/movies/Chromosome_Coil.mov.gz
8	PGGEKETSATQR	Mucin-1	Forms a protective film on the surface of cells in our bodies e.g. those lining the intestines and throat.
9	EKRKLFIRSM	Caspase 1	Destroys cellular proteins which leads to cell death (apoptosis).
10	MSSDSEMAIF	Myosin 1	Makes muscles move.



Before discussing the results, stress to the students that the amino acid sequence is not the entire amino acid sequence, but a region that we can use to search online databases. Normally, amino acid sequences can be comprised of hundreds of amino acids.

By following the link to the Uniprot website at the bottom of the protein profile students will be able to see the full sequence of the protein (if time).

The antifreeze protein is essential to prevent organisms like the wolf fish from freezing in icy conditions.

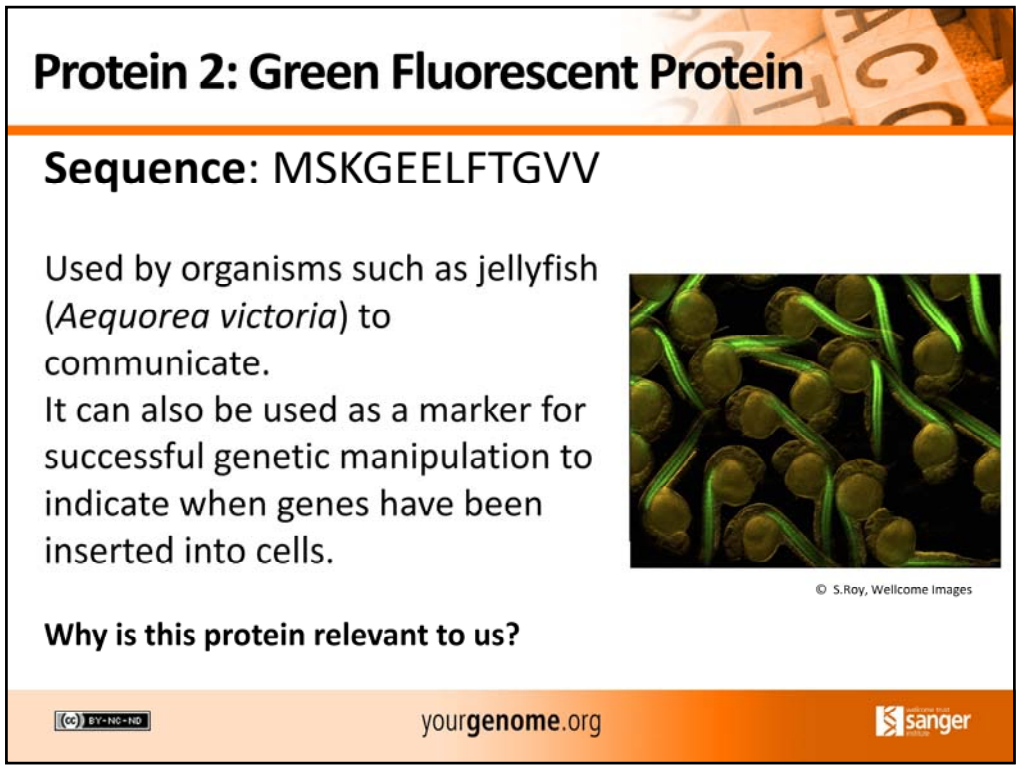
Q. Is this just exclusive to this one species / what other species may use antifreeze proteins?

Antifreeze proteins are found in other organisms including invertebrates such as the “Snow flea” or springtail, as well as species of plant and some bacteria.

Q. How might this protein be relevant to us?

Understanding the structure and function of antifreeze proteins can help better preserve donor organs.

It can also have applications in food science, for example preventing ice crystallisation in ice cream, to create smoother, creamier ice cream.

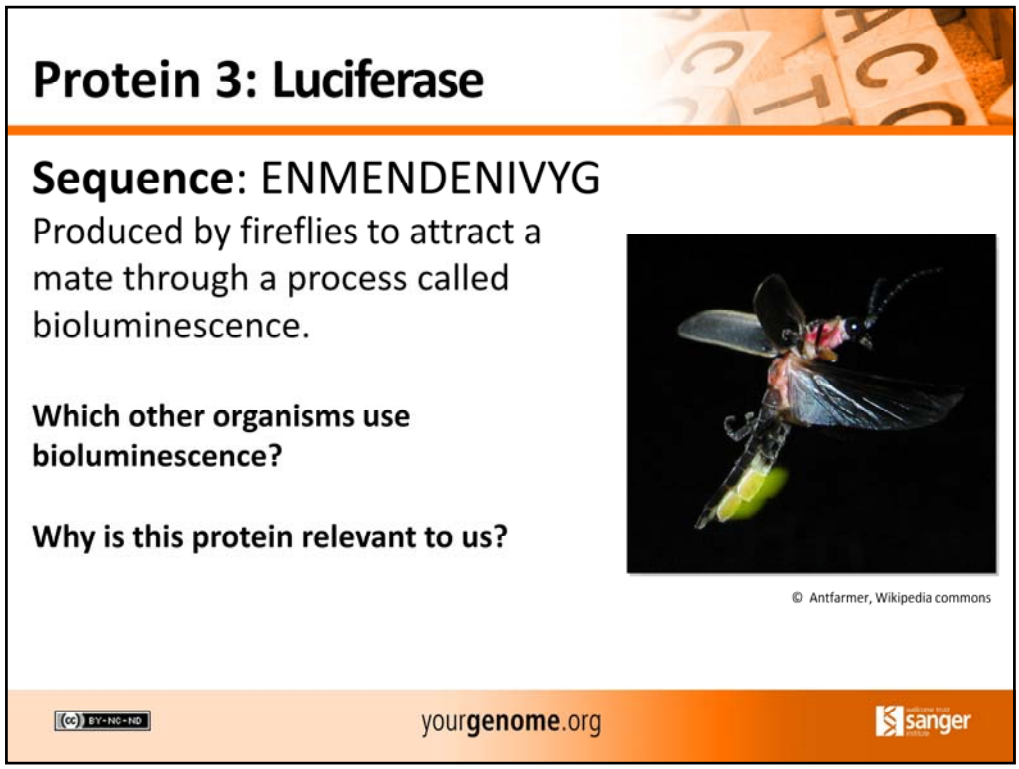


Green Fluorescent Protein (GFP) is used by organisms such as jellyfish *(Aequorea victoria)* to communicate. It can also be used as a marker for successful genetic manipulation, when the GFP gene is coupled with a gene of interest which is to be inserted into a cell. If the gene insertion has been successful, the modified cell(s) will glow green under a specific light wavelength. Other fluorescent proteins exist and are also used as genetic markers.

Q. Why is this protein relevant to us?

These genetic markers are important for developmental studies. They help us better understand the impact of specific genes in the embryonic development process and can be used to investigate human disease.

The image on the profile and presentation slide shows transgenic zebrafish embryos expressing GFP in muscle precursor cells (myotomes). The green fluorescence arises due to expression of an alpha-actin-GFP transgene in these one day old embryos.



Luciferase is a protein used by fireflies to attract a mate using a process called bioluminescence.

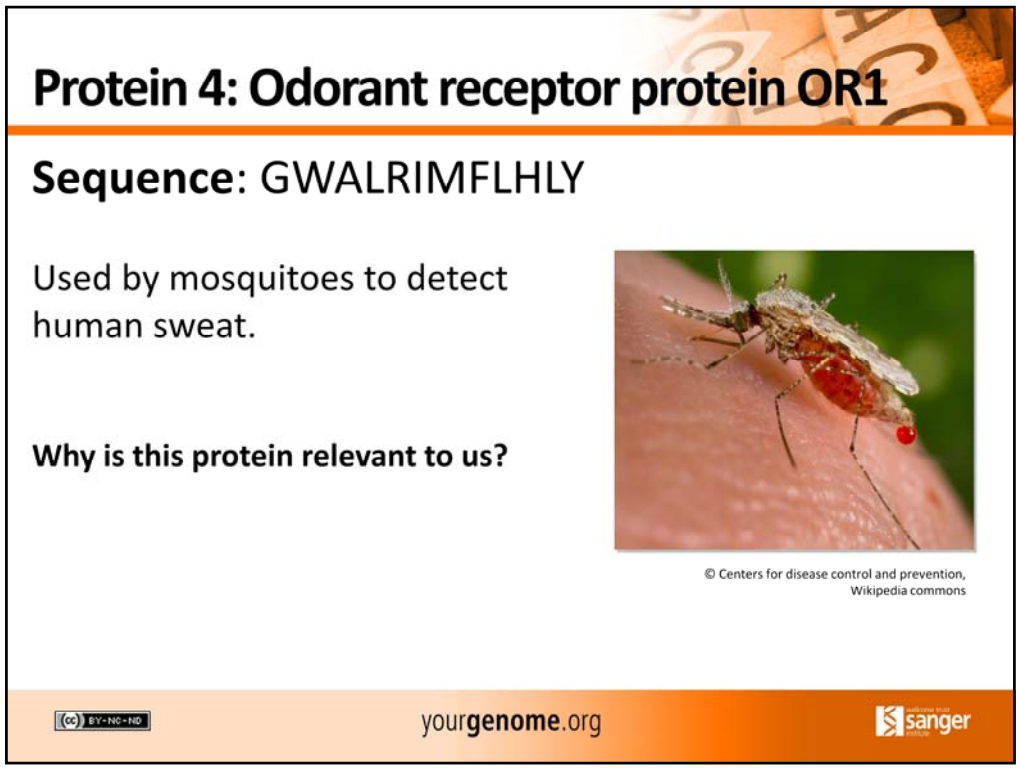
Bioluminescence is the production and emission of light by a living organism as the result of a chemical reaction in which chemical energy is converted to light energy.

Q. What organisms use bioluminescence?

A large range of organisms use bioluminescence including microscopic plankton, insects like the fireflies, some fungi and several bacterial species.

Q. Why is this protein relevant to us?

Luciferase systems are widely used in the field of genetic engineering as reporter genes, much like GFP.



This odour receptor protein allows the *Anopheles* mosquito to identify human sweat and therefore locate the source of a blood meal.

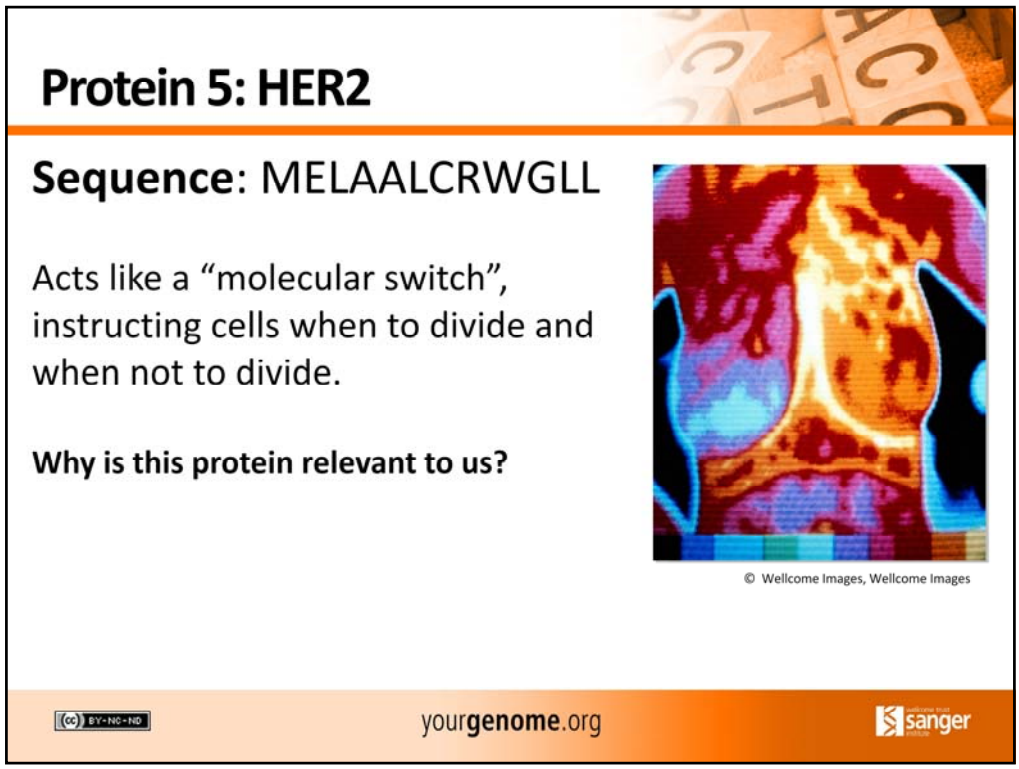
Odour receptor proteins allow organisms to detect specific chemical odours in their local environment which can help them locate and identify food or a potential mate.

Q. Why do you think animals have evolved so many odour receptors?

Odour receptors can help an animal identify multiple food sources, find a mate and find out about other animals in the area, particularly in species which scent mark territories. Multiple odour receptors provide a system for discriminating between as many different odours as possible. Each odour receptor does not detect a single odour chemical, instead it binds to a number of similar odourant structures.

Q. Why is this protein relevant?

Malaria is a major global disease killing 1.5 – 2.7 million people every year, most of whom are children under the age of five. Understanding this protein and the odour compound it recognises could be used in developing solutions to help with the battle against the disease.

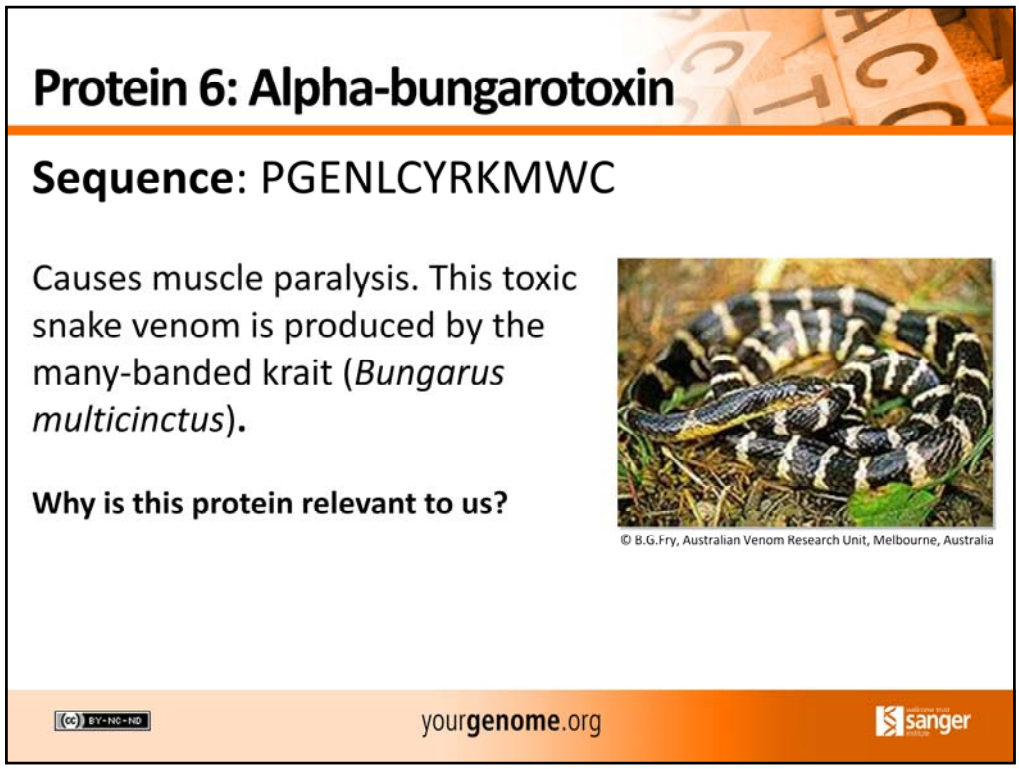


HER2 is a cell membrane surface-bound receptor normally involved in the signal transduction pathways leading to cell growth and differentiation. It acts as a molecular switch, which can turn pathways influencing cell division and growth on and off.

Q. Why is it relevant to us?

HER2 is associated with breast cancers in which the *HER2* gene is over-expressed, giving the cell more HER2 protein receptors and leading to increased and uncontrolled cell growth.

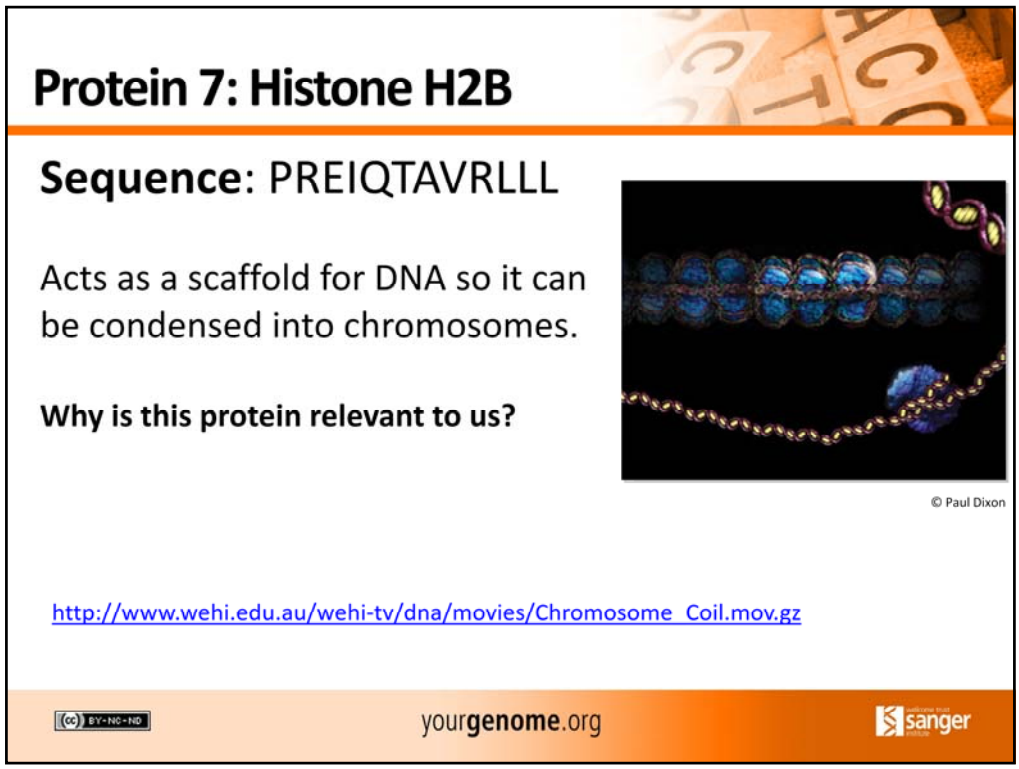
Understanding the role of the gene and the protein in uncontrolled cell growth aids diagnosis and treatment of cancers involving the altered gene. Herceptin is an anti-cancer drug that specifically targets HER2 receptors and can be highly effective where mutations in *HER2* are present. Research programmes such as the Cancer Genome Project at the Wellcome Trust Sanger Institute are identifying and cataloguing mutations such as those found in HER2. This type of data can be used to inform the design of clinical trials of new cancer drugs.



Alpha-bungarotoxin is one of the components of the venom of the elapid snake, the Taiwanese many-banded krait *(Bungarus multicinctus).* It binds irreversibly to the acetylcholine receptor, which is found at junctions between nerves and muscles, causing paralysis, respiratory failure and eventually death in the victim.

Q. Why is this protein relevant?

Understanding how the protein works is very important in developing anti-venoms, which can save many lives. However, it can have other uses in the medical field. Alpha-bungarotoxin is also a selective antagonist (specific blocker) of the alpha 7 nicotinic acetylcholine receptor in the brain; an ion channel which mediates fast signal transmission at the synapses. The blocking effect of alpha-bungarotoxin is being investigated as a way of altering nervous activity in schizophrenia and epilepsy.



Histones play an important role in all cells by providing a structure around which DNA can wrap to create coils which form the basis of the chromosomes. This coiling mechanism significantly reduces the space required in the nucleus to store DNA. If you imagine the histone complex as a reel of cotton. The histone protein is the reel around which the DNA 'cotton' is wrapped.

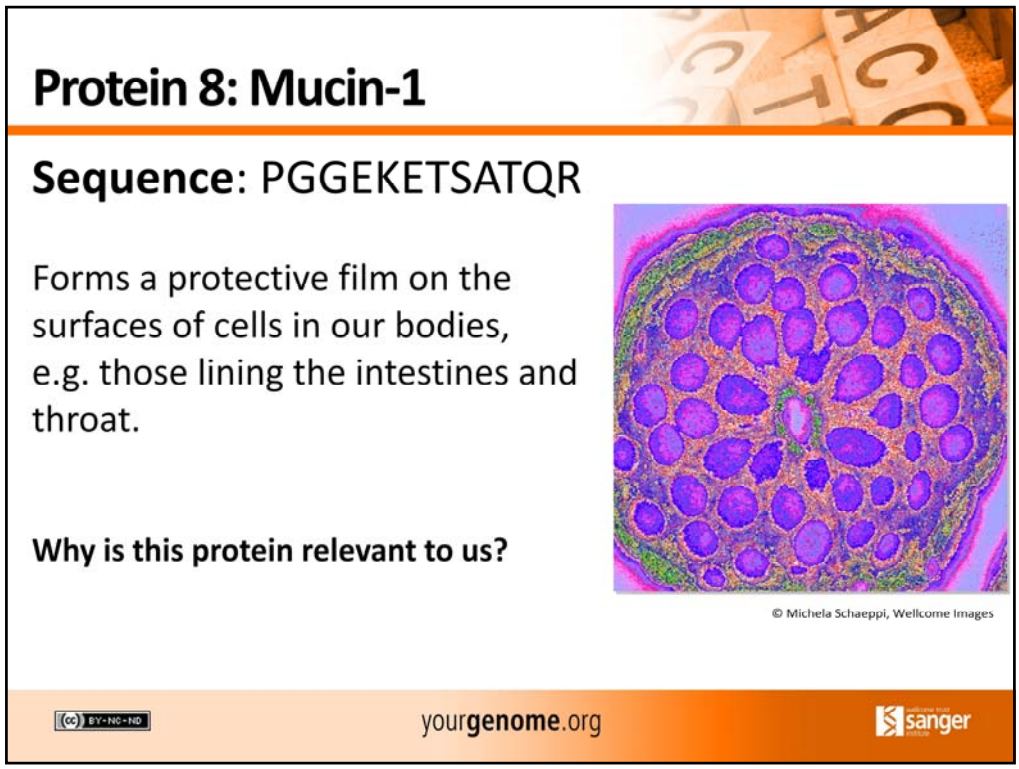
If using link to animation, choose 'Body code' video and play from 01:20 – 02:53

Q. Why is this protein relevant to us?

Histones are essential to life. Not only do they give structure to our chromosomes but they have an important role in the control of genes. We probably couldn't survive without them - when researchers remove histone proteins like H2B from yeast cells, these cells die.

Histones can undergo modifications that can lead to the DNA wrapped around them being bound tighter or more loosely and this can have an impact on gene expression. Some modifications can lead to the formation of heterochromatin; a tightly packed form of DNA which has limited transcription properties which results in gene silencing.

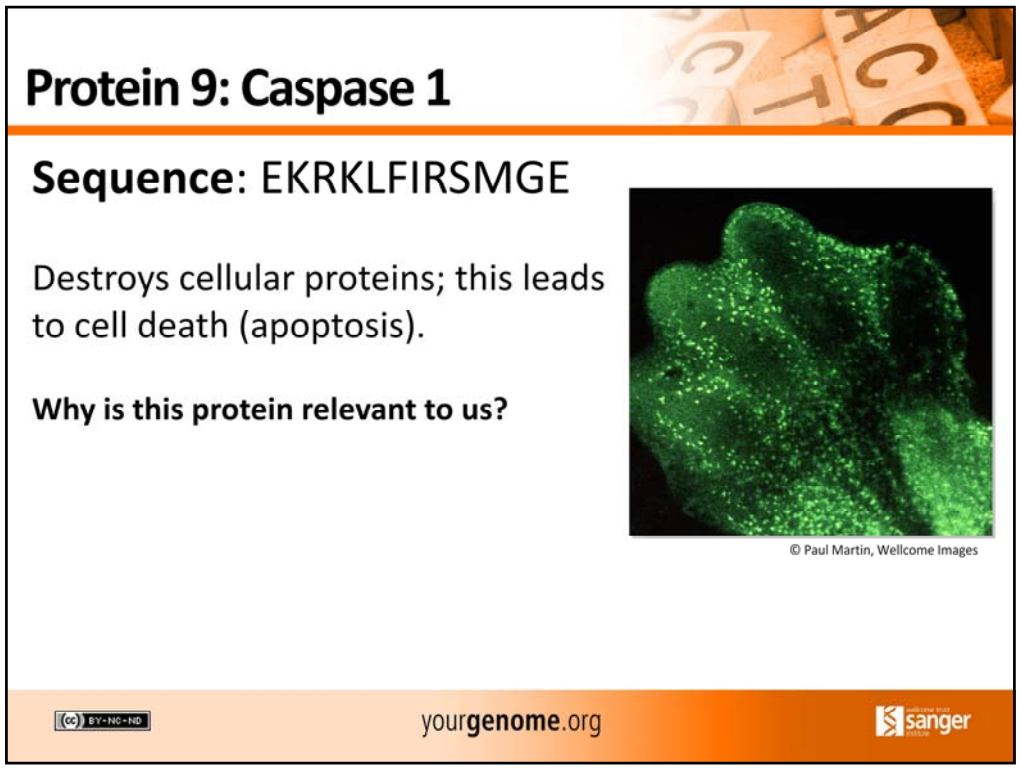
Research has indicated that modifications to histones can be associated with the development of some cancers, including leukemia and breast and ovarian cancers.



Mucins are proteins that form protective films on the surfaces of cells. This protein is anchored to the apical surface (the outward facing or exposed surface) of the epithelial cells which line cavities throughout the body. It serves a protective function by providing a physical barrier to pathogens that could damage the cells.

Q. Why is this protein relevant?

Excessive levels of mucins can be associated with breast and ovarian cancers, because mucins can reduce the amount of P53 protein produced. P53 slows cell growth and division, so lower levels result in cells dividing more rapidly, which can lead to cancer.

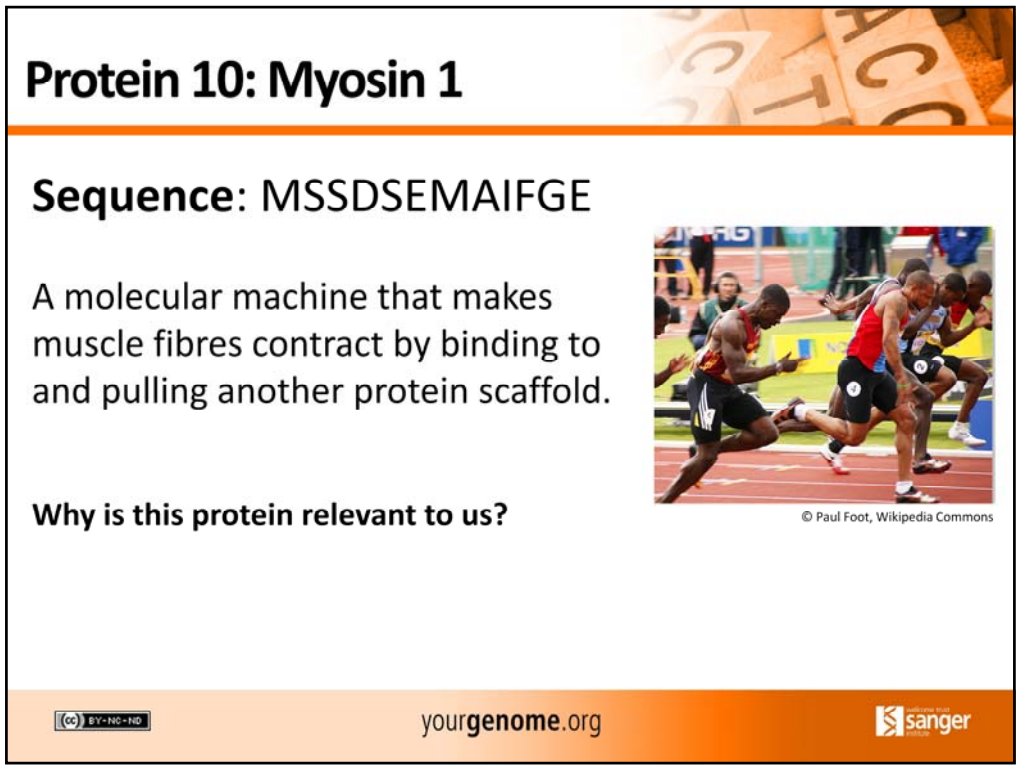


Caspase 1 is an enzyme that destroys cellular proteins leading to apoptosis or programmed cell death.

Q. Why is this protein relevant?

In order for us to develop correctly some of our cells must die, for example in the formation of our fingers and toes caspases mediate the development of gaps between the digits.

The image shows a light microscope image of the developing foot of a mouse embryo showing areas of dying cells between the digits. The limb starts off as a paddle shape, but areas of programmed cell death (apoptosis) appear between the regions where the digits will form. The dead cells are removed by scavenging cells called macrophages (stained green).



Myosin is a key protein found in muscle fibres and is essential for making muscles move.

Q. Why is this relevant to us?

Without myosin we couldn't move. It is attached to the end of the muscle fibres and makes them contract by binding to, and pulling on, another protein called actin. This pulling mechanism is powered by energy generated from the breakdown of a molecule called adenosine triphophate (ATP).

Myosin molecules generate force in skeletal muscle through a "power stroke" mechanism fuelled by the energy released from ATP hydrolysis. The power stroke occurs at the release of the products of ATP hydrolysis - ADP and phosphate - when myosin is tightly bound to actin. The effect of this release is a conformational change in the molecule that pulls against the actin. The combined effect of the myriad power strokes throughout muscle fibres causes the muscle to contract. The power strokes can be likened to watching a rowing boat from above with the myosin molecules moving forward and back causing the muscle to move.