1. Antifreeze Protein Type III

The Antifreeze protein (AFP) is essential to prevent organisms like the wolf fish from freezing in extremely cold conditions.

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

AFPs are also found in some species of plants, bacteria and invertebrates, such as the Snow flea.

Q. How can this protein be relevant to us?

Understanding the structure and function of AFPs can help improve the preservation of donor organs. Currently it is not possible to freeze organs harvested for transplant operations as the freezing process irreversibly damages the tissue. However scientists are studying AFPs to see if they can be used to successfully freeze, thaw and transplant organs such as hearts and kidneys.

Antifreeze proteins also have applications in food science, for example preventing ice crystallisation in ice cream, creating smoother creamier ice cream.

2. Green Fluorescent Protein (GFP)

Green fluorescent proteins are used to communicate by organisms such as jellyfish (*Aequorea victoria*). It can also be used as a reporter gene to identify if genetic modification has been successful or to see where in an organism a particular protein is being produced. Other fluorescent proteins exist and are used as reporter genes.

Q. Why is this protein relevant to us?

Reporter genes such as GFP are important for development studies. GFPs can be used to track proteins in developing embryos to get a better understanding of the location and function of the protein products of specific genes.

3. Luciferase

Luciferase is a protein used by fireflies to attract a mate. Luciferase catalyses a chemical reaction where chemical energy is converted to light energy. This process of light production by a living organism is called bioluminescence.

Q. What organisms use bioluminescence

A range of organisms use bioluminescence including plankton, fungi, bacteria and insects, such as fireflies and glow worms.

Q. Why is this protein relevant to us?

Like GFPs, luciferase systems are widely used as reporter genes in molecular biology techniques used in the lab.

4. Odorant receptor protein 1 (OR1)

Odorant receptor protein 1 enables Anopheles mosquitoes to identify human sweat and find a source of a blood meal. Odorant receptor proteins allow organisms to detect chemical compounds in their local environment, which can help them locate and identify food or a potential mate. There are a wide range of different odorant receptors, with as many as 1,000 odorant receptor genes in the human genome. Not all of these genes are expressed or produce a functional protein.

Q. Why is this protein relevant?

Malaria is a major global disease killing around one million people every year, mostly children under the age of 5 years old. Understanding this protein and the odour compound it recognises could be used to develop solutions to help with the battle against the disease.

5. HER2

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 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.

6. Alpha-bungarotoxin

Alpha-bungarotoxin is a component in the venom of a type of snake called the Taiwanese banded krait (*Bungarus multicinctus*). Alpha-bungarotoxin binds irreversibly to the receptor of the neurotransmitter acetylcholine in the victim, causing paralysis, respiratory failure and death.

Q. Why is this protein relevant?

Understanding how the alpha-bungarotoxin protein works helps in the development of antivenoms that can save many lives. It can also have other uses in the medical field. The blocking effect of alpha-bungarotoxin on acetylcholine receptors in the brain is being investigated as a way of altering nervous activity in schizophrenia and epilepsy.

7. Histone H2B

Histone proteins play an important role in the packaging of DNA in chromosomes within cells. DNA wraps around histone proteins to form coils, which significantly reduces the space required in the nucleus to store DNA. If you imagine the DNA-histone complex as a reel of cotton, the histone protein is the reel around which the DNA 'cotton' is wrapped.

Q. Why is this protein relevant to us?

Histone proteins are essential to life. When histone proteins like H2B are removed from yeast cells they die. Not only do histone proteins give structure to our chromosomes but they have an important role in controlling the expression of genes. Modifications to histone proteins affect how tightly or loosely wrapped the DNA is and consequently whether genes are expressed or not.
Heterochromatin is a tightly packed form of DNA which means the transcription machinery cannot get to the DNA and the genes cannot be expressed. They are silenced.
Modifications to histones are associated with the development of some cancers, including leukaemias, breast cancers and ovarian cancers.

8. Mucin-1

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.

9. Caspase 1

Caspase 1 is an enzyme that destroys proteins in cells leading to programmed cell death (apoptosis).

Q. Why is this protein relevant?

For us to develop correctly some of our cells must die. One example is during the formation of our fingers and toes where the cells that make up the tissues between the digits die.

10. Myosin 1

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 'power strokes' throughout muscle fibres causes the muscle to contract. The 'power stroke' can be likened to watching a rowing boat from above with the myosin molecules moving forward and back causing the muscle to move.