Competition Time!!!

For your chance to **win** a **£50 amazon voucher…**

Design a poster answering the question:

"If you had a DNA sequencer, what would you want to sequence DNA from? And why?"

Work individually or in teams of up to 5!

Make an A1 size poster, either on paper or digitally on PowerPoint and send your entries to us as soon as you can!

You can email us at **engage@wgc.org.uk** or if you would rather post your entry then please email us asking for an address to send them to!

In your poster answer the following:

- *What is DNA sequencing?*
- *If you had a portable DNA sequencer, what would you want to sequence DNA from?*
- *Why would you want to sequence DNA from that?*
- *Do you think it would be a 'good' or 'bad' thing to do?*

All entries will be judged by researchers from our institutes and short listed entries will be displayed at public events during the main LifeLab event on 27th and 28th September 2019. Winning teams will be notified and prizes presented to teams at the public events. All entries must reach us by the 20th September.

Please do ask your teachers for help with this and contact us with any questions you have about the competition.

In the past, we have had entries looking at examples both real and fictional. We have had sequencing of Harry Potter to understand what DNA code gives him his magical abilities, investigating the genetic link between family members who suffer with certain health conditions, searching for alien life, and so much more!

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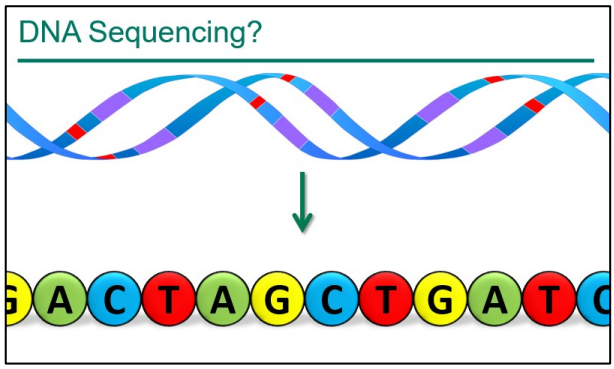
What is DNA Sequencing?

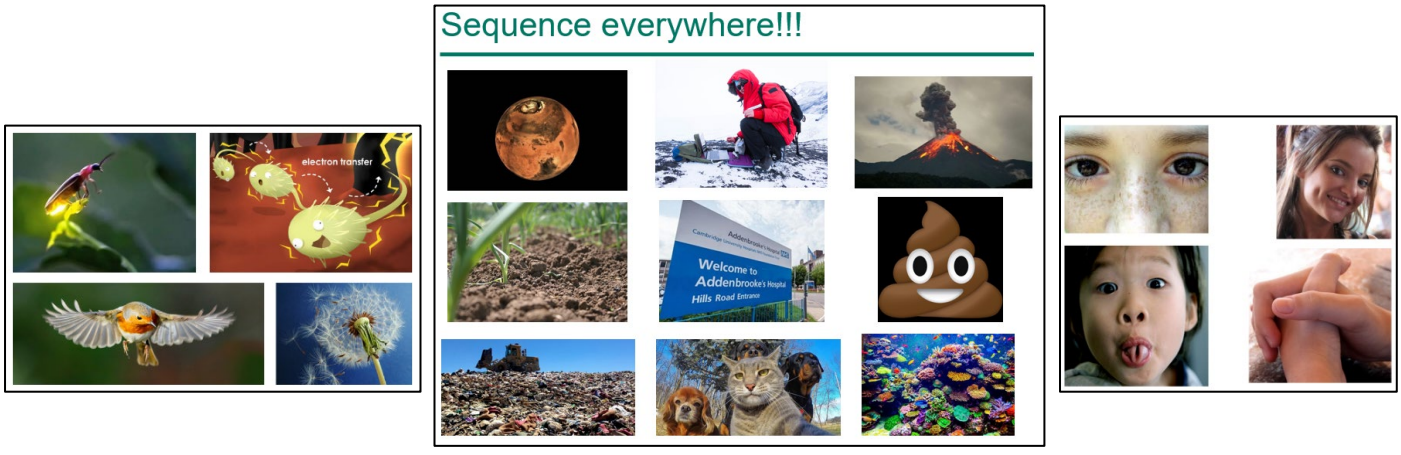
DNA sequencing is the process of taking DNA from an individual and working out the genetic code stored within.

This process has become fast, cheap and portable. The machine in the picture below is a DNA sequencer that plugs into a laptop!



What to Sequence?

All living creatures (animals, humans, plants and microbes) have DNA which is like the instruction manual that tells the individual what characteristics to have. Your DNA sequence tells you how to look, act and even what you can do (e.g. rolling your tongue is a genetic ability!). In movies and TV, most superheroes get their powers from their DNA and aliens look the way they do because of it too! We can now take DNA sequencers anywhere we want – from space and tops of volcanoes, to the bottom of the sea and hospitals. This is letting us discover why creatures are the way they are and can do the things they do in a way we never could before.



Competition Time!!!

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Design a poster answering this question:

"If you could store any information in a DNA time capsule, what would you like to store for the future and why?"

Work individually or in teams of up to 5!

Make an A1 size poster, either on paper or digitally on PowerPoint and send your entries to us as soon as you can!

You can email us at **engage@wgc.org.uk** or if you would rather post your entry then please email us asking for an address to send them to!

In your poster answer the following:

- *What is DNA? What is it composed of, what is its purpose?*
- *How can DNA be used for storing digital information and why are scientists trying to do this?*
- *Why could DNA be a good way to store information? Consider evolution and the stability of DNA - due to its stability DNA has become nature's storage device.*
- *What would you store on DNA code, what would be useful information for future generations? Consider the change in culture, society and technology over time, what do you want to share?*

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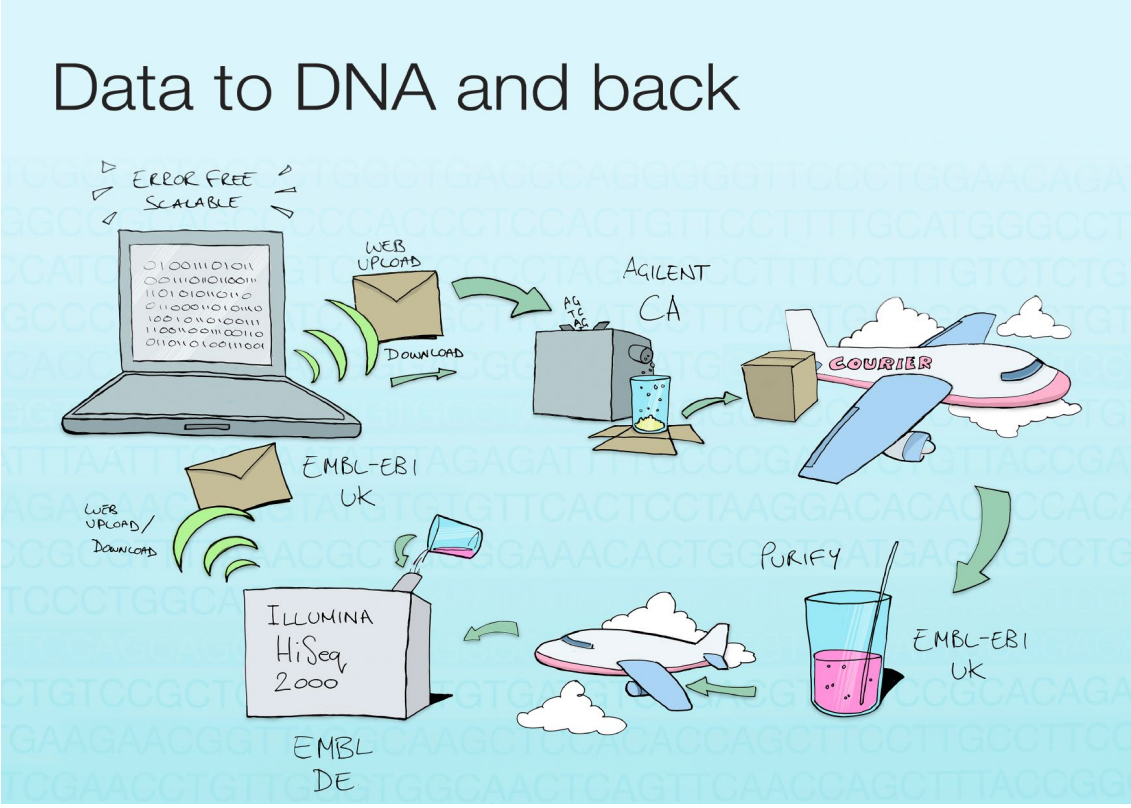
What is DNA?

All living creatures (animals, humans, plants and microbes) have DNA which is like the instruction manual that tells each individual what characteristics to have - how they look, how they behave and what they can do.

DNA stands for deoxyribonucleic acid and it is made up of tiny chemical compounds known as 'bases' - adenine (A), cytosine (C), guanine (G) and thymine (T). DNA can be thought of as a code made up of a series of these four letters.

Storing information in DNA

In 2013, scientists at EMBL-EBI found a way to store digital information in the form of synthetic DNA. All digital information is binary, meaning it's represented as a series of 0s and 1s. Using DNA's four bases - A, C, G and T - they could create a code where, for example, A corresponds to 00, C to 01, G to 10 and T to 11, this allowed them to transform digital information into DNA code and back again.



Why store information on DNA?

Stored correctly DNA can last for tens of thousands of years. We know this because we can still extract DNA from wooly mammoth bones, even though they died out a long, long time ago. A small amount of DNA can store a lot of data - one gram of DNA can store one billion gigabytes of data!

Useful links:

https://www.ebi.ac.uk/research/goldman/dna-storage
https://www.bbc.co.uk/news/science-environment-21145163
https://www.nature.com/articles/nature11875
https://www.nature.com/articles/s41576-019-0125-3
https://youtu.be/tBvd7OSDGgQ
https://youtu.be/a4PiGWNsIEU

Expansion topics:
What else could DNA be used for and why?

- Exploratory research into the use of DNA to create nanomachines; https://www.mdpi.com/1422-0067/19/7/2114/htm

- Developing field of DNA computing – using DNA to solve complex mathematical problems; https://computer.howstuffworks.com/dna-computer1.htm

Are there any other uses you can think of?

Competition Time!!!

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Design a poster answering the question:

If you could edit your genome to maintain your health as you age, what specifically would you target and why?

Work individually or in teams of up to 5!

Make an A1 size poster, either on paper or digitally on PowerPoint and send your entries to us as soon as you can!

You can email us at **pe@babraham.ac.uk** or if you would rather post your entry then please email us asking for an address to send them to!

In your poster answer the following:

- *What is your genome?*
- *Which condition/disease is your target?*
- *Why is this your target?*
- *Who would benefit and how?*
- *What are the positive and negative issues?*

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Studying the biology of ageing to help us live healthier lives

We're all ageing, it's a fact of life. And as we age we often experience many of the signs of ageing; aches, pains, illness, slower mental and physical responses. But do we have to? Is ageing really an essential part of getting older?

Babraham Institute research aims to understand what changes in our body as we age and how that affects our lives. We hope that a deeper understanding of ageing biology could ultimately lead to lifestyle changes, policies and treatments that could help people to stay healthier as they age. By studying how cells in our body specialise, regulate their genes, communicate and defend themselves against illness, we hope to gain insights into why we age, why some of us age faster than others and how we can all take steps to stay healthy for longer.

There are many additional benefits to our work too. Many major illnesses including cancer, diabetes and heart disease become more common with age. Older people are also much more prone to contagious diseases such as flu. By understanding ageing, we can lay the foundations for ways to revitalise ageing systems in our bodies, which could greatly reduce the number of cases of diseases like these and many others.

Some key discoveries:

- The epigenetic clock – We developed a way to study age-linked changes in gene regulation in mice, allowing us to study this process in detail and understand its effects. A very similar mechanism exists in humans.
- Ageing and pregnancy – More women are choosing to have children later in life but this does come with increased risks. Our work in mice showed that it's not just the age of the egg cell that affects this risk but also the age of the womb itself. If the same is true in humans it could be an important consideration for mothers to be.
- Immune system diversity – The immune system produces antibodies in response to infections. Older people often produce a less diverse range of antibodies. Our research suggests an explanation for this.
- Dietary restriction – Controlling diet can affect the rate of ageing thinks to links between cell signalling mechanisms and epigenetic regulation of genes.
- Cell cannibalism – Sometimes cells eat each other in a process called entosis or cell cannibalism. Our work identified an unknown mechanism of entosis that might help to protect us from harmful damaged cells and could slow cancer growth.

Visit www.babraham.ac.uk for more information about our research into healthy ageing.

Competition Time!!!

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Design a poster answering this question:

"If you could investigate a protein inside a living creature to understand how it works, what protein structure would you solve and why?"

Work individually or in teams of up to 5!

Make an A1 size poster, either on paper or digitally on PowerPoint and send your entries to us as soon as you can!

You can email us at **engage@wgc.org.uk** or if you would rather post your entry then please email us asking for an address to send them to!

In your poster answer the following:

- *What are proteins and what do they do? Why is studying the exact 3D shape of a protein important?*
- *What protein would you like to discover the shape of?*
- *What would that information be useful for? What would it allow us to do?*

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Please do ask your teachers for help with this and contact us with any questions you have about the competition.

In previous similar competitions we have had entries looking at both real and fictional possibilities. So whether it's to look at what allows Bruce Banner to transform into the Hulk, to understand what goes wrong in a disease, or to study the proteins involved in making spider webs so that we can make stronger materials, let us know what you want to do!

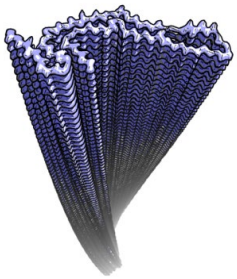
www.camlifelab.co.uk

What are proteins?
Proteins do most of the work in our bodies. This includes digestion of food, movement of muscle, detection of invading bacteria, communicating signals around the body, defence against cancer, producing more proteins, and so much more! Therefore understanding how they work and interact with each other can provide us with a greater insight into how things might go wrong in disease.

Proteins are made from a sequence of amino acids joined together in a chain. The sequence of these is directed by the sequence in our DNA. It is through proteins that our DNA controls things like what we look like and certain things that we can do.

A protein in the brain that Valium binds to.

An electron microscope that is used to study protein structure.



The structure of a tau filament associated with a type of dementia.

Why is the structure of a protein important?
Structure and function are tightly linked. Proteins are long chains of amino acids, but they don't float loosely – they fold up into highly specific structures. It is only by folding into the correct 3D shape that a protein can perform its functions and interact with other proteins in the way that it should. Identifying the precise structure of a protein to atomic detail can allow us to understand exactly how it does its job.

Solving structures to understand how certain proteins do what they do might allow scientists to develop drugs that modify the function of that protein either to stop it from working or to make it work better. This could be used to treat disease or enhance normal bodily processes.

Protein structures could also allow scientists to design and develop artificial molecules that imitate nature, but with different purposes that might be useful for biotechnology, for example through production of biofuels or new types of materials.

Can you think of anything that happens in nature that you'd like to understand better or might like to recreate and improve upon? It's probably driven by proteins, so getting the structures of those proteins might make it possible!

Useful link: https://www2.mrc-lmb.cam.ac.uk/news-and-events/public-engagement/lmb-science-stories/cryo-electron-microscopy/

Competition Time!!!

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Design a poster answering the question:

"Stem cells can be used to model diseases in the lab. If you could only use stem cells to study one disease, which one would you chose and why?"

Work individually or in teams of up to 5!

Make an A1 size poster, either on paper or digitally on PowerPoint and send your entries to us as soon as you can!

You can email us at **engage@wgc.org.uk** or if you would rather post your entry then please email us asking for an address to send them to!

In your poster answer the following:

- *What are stem cells and what makes them different to other cell types?*
- *How might stem cell research lead to significant medical and scientific advances?*
- *Why you have chosen the disease you have?*
- *What should the limits to the use of stem cells in research be?*

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Stem cells

Stem cells have the amazing ability to develop into any type of cell in the body. These stem cells are found in developing embryos and also in adults in tissues including the brain, bone marrow, skin and liver.

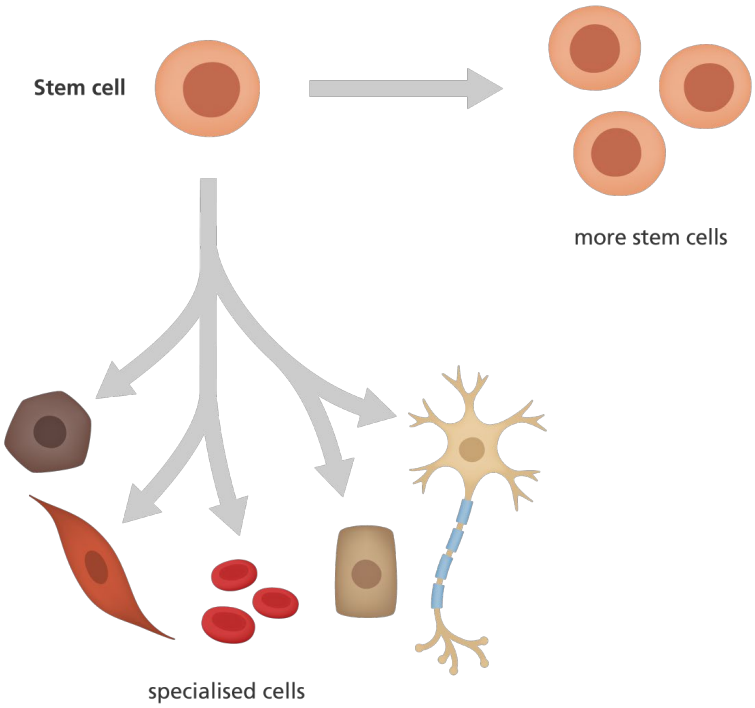

Image credit: Genome Research Limited

Stem cells provide the new cells for our bodies as we grow and replace the cells damaged or lost due to disease. This ability of stem cells to divide again and again and make new specialised cells is the focus of much research in Cambridge and in Universities and Research Institutes across the world. One of the aims of this research is to determine whether stem cell therapies will be able to treat a wide variety of the health challenges, including heart disease and cancer, which we face today.

There are lots of stories in the press which suggest that stem cell therapies will be able to cure many diseases that have previously been thought untreatable. But how close are researchers and clinicians to making the breakthroughs needed to see these treatments available to us in our hospitals? And what are the ethical and social implications of stem cells research that we, as a society, should be considering?

For more information see:
https://www.stemcells.cam.ac.uk/
https://www.stemcells.cam.ac.uk/get-involved
https://www.yourgenome.org/facts/what-is-a-stem-cell
https://www.bbc.co.uk/bitesize/guides/zghqfcw/revision/4
https://www.eurostemcell.org/