

DNA Detectives Teachers Guide.

Through the Glasgow Science Centre, you should have access to the following resources for DNA detectives:

- Activity Slide Deck: DNA Detectives Guide (for use as a PowerPoint)
- DNA Detectives Activity Worksheet (3 versions, double-sided for printing)
 - Version 1.A, Version 1.B and Version 1.C
- DNA Detectives Completion Certificate (printable with 4 copies per page)

In addition, for the activity you will also need:

- Tape measures or a means of measuring height (ideally enough for the class to do this in pairs)
- Colouring pencils
- Printer
- Scissors (for cutting out the certificates only)
- Access to PowerPoint and a projector.

Contained in the resources there are three versions of the worksheet available (V1.A, V1.B, and V1.C), print a mix of the worksheets and give them out in a random order to the class (each pupil should have their own worksheet). Please note, the activity will only work if the class have a mixture of all three worksheets.

Guide the class through the information provided in the DNA detective guide section of the PowerPoint slides. Below there is additional information to help you to deliver the lesson.

Where slides are animated the instructions for the animations will be included within the teaching points for the slide.

Slide 1

Slide overview: Title Slide

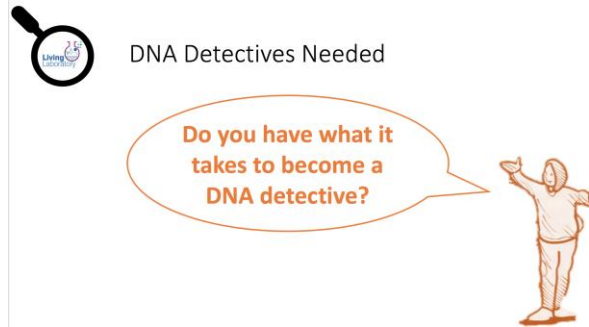


Teaching points:

- Set the scene for what the class will learn from this lesson explaining that:
 - Today we are going to become DNA detectives and understand more about our genetic information which is called DNA.
 - We are also going to look at how doctors can use information in our DNA to help them to decide which treatment could be best for helping to make someone better when they are ill.

Slide 2

Slide overview: Presenting the opportunity to become a DNA detective to the class.



DNA Detectives Needed

Do you have what it takes to become a DNA detective?

Teaching points:

- Explain to the class that they need to complete 4 challenges to become a DNA detective.
- Ask them if they want to take on the challenges.

Slide 3

Slide overview: Title Slide for the DNA detectives guide



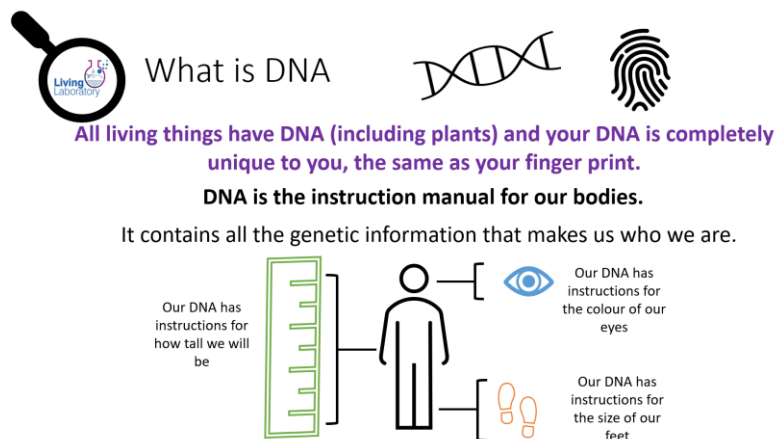
DNA
Detectives
Guide

Teaching points:

- Explain to the class that they have a DNA detectives guide to help them learn everything they need to know in order to become a DNA detective and together you will all work through the guide and complete the challenges on the worksheets.

Slide 4:

Slide overview: Describing DNA - this slide explains the basic concept of what DNA is and how it makes us who we are.



What is DNA

All living things have DNA (including plants) and your DNA is completely unique to you, the same as your finger print.

DNA is the instruction manual for our bodies.

It contains all the genetic information that makes us who we are.

Our DNA has instructions for how tall we will be

Our DNA has instructions for the colour of our eyes

Our DNA has instructions for the size of our feet

Teaching points:

- With the information on the slide explain the following about what DNA is:
 - The DNA is our genetic code and stands for **D**eoxyribo**N**ucleic **A**cid.
 - All living things, including plants, have DNA.
 - DNA is unique for each living thing, in the same way that our fingerprints are unique.
- *Animation* Click to activate the animation and to reveal more information about the DNA describing the following to the class:
 - Our DNA is like an instruction manual for our bodies
- *Animation* Click again for the next animation and then go on to explain:
 - We can think of this in terms of Lego - imagine all the parts of our body are Lego, our DNA is like the Lego instruction book that tell us how to make all the pieces into something useful.
 - Things that we can easily see that are determined by our DNA are our eye colour, height, and shoe size.

Slide 5:

Slide overview: CHALLENGE 1 - Understanding what our DNA tell us about ourselves. Here the class will need a tape measure, or another means of measuring their height.



**DNA Detective
Challenge 1**

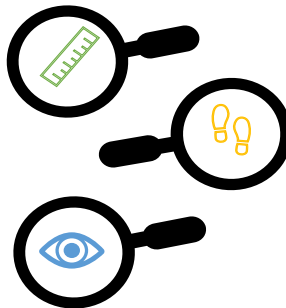
What does your DNA tell us about you:

In pairs find out the following:

What **height** are you

What **size feet** do you have

What colour are your **eyes**



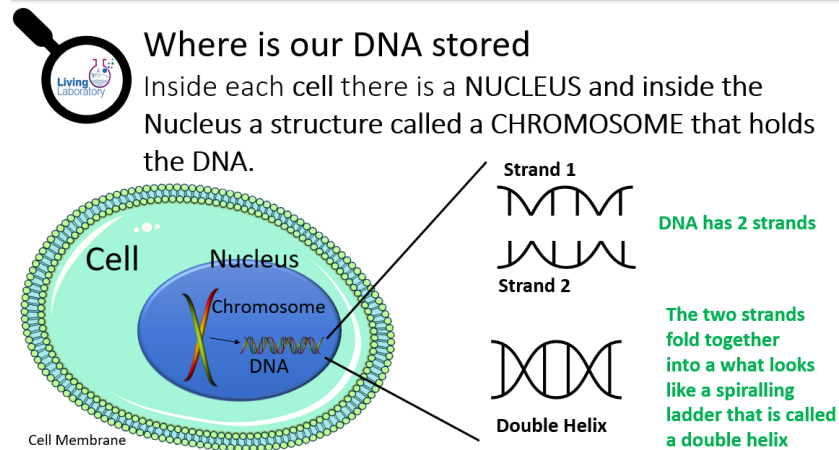
Work together to find out what is the most common eye colour is in your class

Teaching points:

- This is the first challenge for the class and they should work in pairs and record their answers on the worksheets. Explain the following to the class:
 - The first challenge for us, as potential DNA detectives, is to understand more about what our DNA tells us about ourselves.
 - Work in pairs to measure your height, find out your shoe size and find out the colour of your eyes.
 - Record all your answers in the activity worksheet.
- As a class work out what is the most common eye colour.
- If time allows the class can also work together to either line themselves up in height order or they can group themselves based on their shoe size.

Slide 6:

Slide overview: Learning more about our DNA, starting with where it is stored. This slide introduces the concept of a cell being the basic building block for the body and that inside each cell is a nucleus which is the container for the DNA. It also briefly introduces the word chromosome, which is the structure inside the nucleus in which the DNA is stored. The slide then goes on to describe the structure of DNA, it has 2 strands and folds into a spiral called a double helix. The words in bold are key teaching words and when drawing the cell these parts should be labelled (see challenge 2).



Teaching points:

- Explain the following:
 - The next essential thing to understand our DNA is where it is stored.
- *Animation* Click to reveal information about the cell and then explain the following
 - Our bodies are made up of a basic building block called a cell.
 - Around the outside of the cell is a **Cell Membrane**: a coat that keeps everything inside.
- *Animation* Click to reveal information about where the DNA is stored within the cell and then explain the following:
 - Every cell in the body has a copy of our DNA.
 - The container inside the cell that holds all the DNA is called the **Nucleus**.
 - Within the nucleus the DNA is held in X shaped structures called **chromosomes**.
- *Animation* Click to reveal more detailed information about the DNA and then explain the following:
 - The DNA itself is made up of 2 lines of DNA (these are called strands of DNA) that come together to form a shape similar to a spiral ladder that we call a **double helix**.

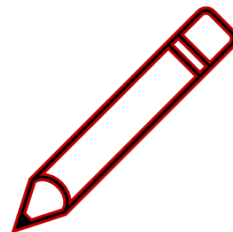
Slide 7

Slide overview: CHALLENGE 2 – Understanding where the DNA is stored. Here the class will draw a cell showing where the DNA is stored. There is space for this challenge on the activity worksheet, therefore it might be helpful to have slide 6 back on the screen when the class are drawing their cells.



DNA Detective Challenge 2

Draw a cell and add as much information as you can.

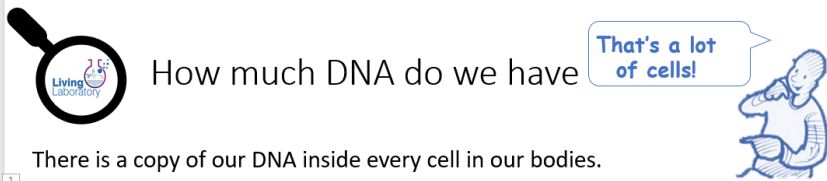


Teaching Points:

- Explain the second challenge to the class:
 - The second challenge for us is to show we understand where the DNA is stored inside our bodies.
 - Draw a picture of the cell showing where the DNA is stored, try to include as much information as possible in the drawing
 - The cell membrane
 - The nucleus
 - A Chromosome
 - The 2 strands of DNA in a spiral (or double helix)

Slide 8:

Slide overview: How much DNA do we have - This slide begins to look at the number of cells in the body, as every cell has a copy of our DNA. To try to comprehend such a large number the slide looks at a series of numbers to help put the term trillion in context.



How much DNA do we have

There is a copy of our DNA inside every cell in our bodies.

And our bodies have over 37.5 Trillion cells
That's over 37.5 Trillion copies of our DNA

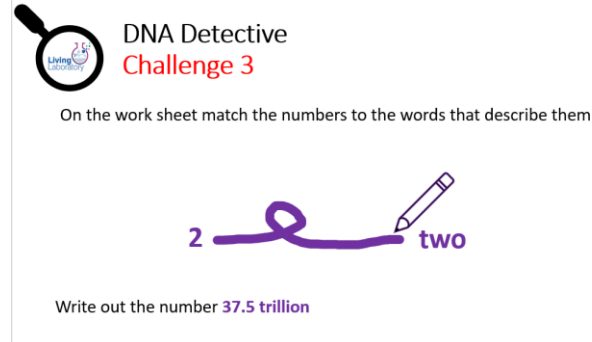
1	1	One
2	1000	A Thousand
3	1,000,000	A Million
4	1,000,000,000	A Billion
5	1,000,000,000,000	A Trillion

Teaching points:

- Using the initial information on the slides explain the following:
 - To understand how much DNA we have, we first need to remember that there is a copy in every cell as we learned a few slides ago.
- Pose the question “how many cells do we have on our body” to the class allowing time for the class to attempt to guess.
- *Animation* Click to reveal the answer given in orange and click again to show the image with the caption “that is a lot of cells”
- Explain the following to the class to reinforce that there is a copy of the DNA in every cell.
 - As there is a copy in every cell that we have in our body that means we have over 37.5 trillion cells in the body.
- Explain to the class that in order to understand such a big number we should look at some other numbers to help to put it into context.
- The next section of the slide tries to put the term trillion into perspective by showing a series of numbers from 1 (one) – 1,000,000,000,000 (one trillion). These are animated so that each number can be discussed in turn. Below are some discussion points for large numbers based around population levels.
- *Animation-* Click to reveal the number 1 and then click again to reveal the number 1000.
 - For 1-1000 think about examples that we see every day like the number of pupils in a school (think about primary school populations vs secondary school populations).
- *Animation-* Click to reveal the number 1 million
 - For 1 million start to think about country populations, for example Scotland has a population of 5 million, whereas the whole of the UK has a population of 67 million
 - If the class are advanced look at how much bigger the UK population is compared to the population of Scotland.
- *Animation-* Click to reveal the number 1 billion
 - For 1 billion start to think about the population of the whole world which is in the region of 7.9 billion.
- *Animation-* Click to reveal the number 1 trillion
 - To get a scale for a trillion you would need to copy the population of the whole world 126 times!


Slide 9:

Slide overview: CHALLENGE 3, understanding how much DNA we have in our bodies. This slide presents the third challenge, matching the number to the word to help reinforce the concept of large numbers, it then asks the class to try to write out the number 37.5 trillion in full (remember that 1 trillion is 1 followed by 12 0's)



DNA Detective
Challenge 3

On the work sheet match the numbers to the words that describe them




Write out the number **37.5 trillion**

Teaching points:

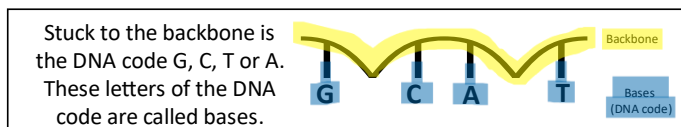
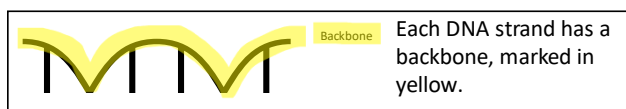
- Present the third challenge to the class explaining the following:
 - We have now arrived at the third challenge in our quest to become DNA detectives.
 - Here our challenge is to understand how many copies of our DNA we have in our bodies and to understand the scale of that number.
 - On the activity sheet match the numbers to the words; for example match the number 1 to the word one.
 - There is also a second part to this challenge where can you write out the full number for 37.5 trillion (37,000,000,000,000)
- The second part of the challenge could be an individual activity or could be led by the teacher for the whole class.

Slide 10:

Slide overview: Understanding the genetic code - This slide starts to explore our genetic code that holds all the information that make us who we are. Here we will introduce 2 parts of the DNA: the backbone and the bases (also known as the DNA code). If you choose to give more detail about the names of the bases, these can be written on a board to show the spelling, alternatively the lesson can be taught by using the letters only.



To be able to understand our DNA and all of the information it can tell us, you first have to understand the DNA code



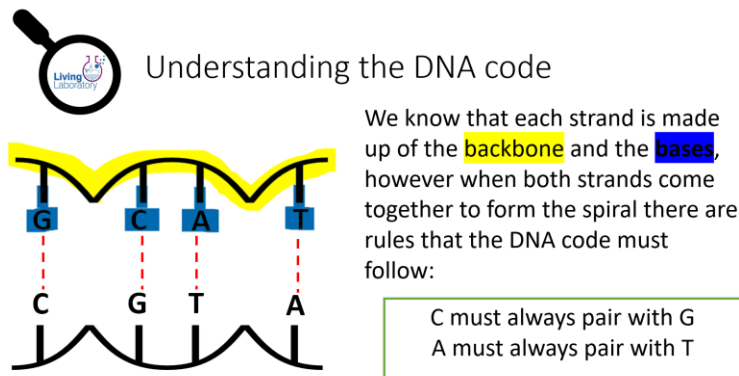
Teaching points:

- Explain the following to the class:
 - Next, to become a DNA detective, we need to understand the messages within the DNA and these are found within the DNA code.
 - Think back to when we looked at where the DNA was stored, and we learned that there are two stands of our DNA that come together to make a spiral shape.
 - Let's look at these strands in more detail.

- *Animation* click to reveal the first box and then explain the following:
 - Each strand has a backbone that is shown in yellow.
- *Animation* click to reveal the second box and then explain the following:
 - Attached to the backbone is one of 4 letters that make up the DNA code (or genetic sequence): these letters are called bases. The bases are G (guanine), C (cytosine), A (adenine) and T (thymine).
 - The names can be added in if you want to include them, however the activity will still work if you want to introduce the bases as G, C, A and T.
 - By understanding the code and learning more about it, we can begin to understand more about our bodies, what sometimes make us sick, and we can also understand ways to make us better again when we are sick.

Slide 11

Slide overview: Understanding the code - this slide sets out the rules that the genetic code must follow, understanding these rules will help to solve challenge 4. The code works on base pairing and whenever first strand has a **C** it will always pair with a **G** on the second strand (and vice versa) and where there is a **T** on the first strand it will it will always pair with an **A** on the second strand (and vice versa).



Understanding the DNA code

We know that each strand is made up of the **backbone** and the **bases**, however when both strands come together to form the spiral there are rules that the DNA code must follow:

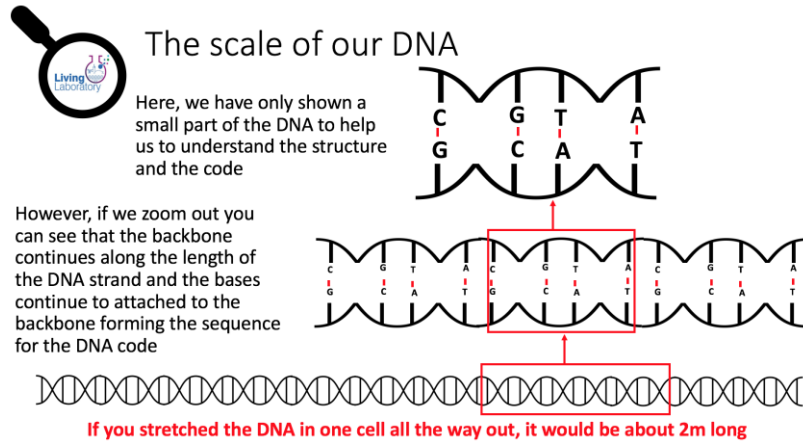
C must always pair with G
A must always pair with T

Teaching points:

- Explain the following to the class:
 - To crack the genetic code and understand more about it, there are some simple rules that we need to learn.
 - Understanding the rules is key to becoming a DNA detective and will help you to solve challenge 4, your biggest challenge yet.
 - We know that each strand is made up of the backbone and the bases, however when both strands come together to form the spiral there are rules that the DNA code must follow:
- *Animation* Click to reveal the green box and explain the following:
 - Each base will only match with one other base, **G** will always pair with **C** and **A** always pairs with **T**.
- *Animation* click reveal all the **G** bases pairing with **C** bases
- *Animation* click again to reveal all the **A** bases pairing with **T** bases
- To help reinforce this concept say a letter to the class and ask them to tell you which of the bases it would pair with. You could try to following order to test the class:
 - Teacher says **C**, the class should say **G**
 - Teacher says **G**, the class should say **C**
 - Teacher says **A**, the class should say **T**
 - Teacher says **T**, the class should say **A**

Slide 12:

Slide overview: Understanding the scale of the DNA inside a cell. This slide starts to explore how much DNA code we have packed into 1 cell, as we have been looking at a small section to learn about it.



The scale of our DNA

Here, we have only shown a small part of the DNA to help us to understand the structure and the code

However, if we zoom out you can see that the backbone continues along the length of the DNA strand and the bases continue to be attached to the backbone forming the sequence for the DNA code


If you stretched the DNA in one cell all the way out, it would be about 2m long

Teaching points:

- Using the initial text on the slide explain the following:
 - Here, we have only shown a small part of the DNA to help us to understand the structure and the code
- *Animation* Click to reveal more text and explain the following:
 - However, if we zoom out you can see that the backbone continues along the length of the DNA strand and the bases continue to be attached to the backbone forming the sequence for the DNA code
- *Animation* Click to reveal a longer segment of the DNA to illustrate the point above.
- To help put the scale of the DNA sequence there are markers on each of the sequences to show how we have zoomed in on a small part of the DNA to explain the code
- *Animation* Click to reveal the red boxes and explain the following:
 - The red boxes show how we have zoomed in on one a small section of the DNA.
- *Animation* Click to reveal last piece of text on the slide and explain the following:
 - If you stretched the DNA in one cell all the way out, it would be about 2m long

Slide 13

Slide overview: What does our body do with the code? This slide will recap what has already been covered (where the DNA is stored, roughly how many copies we have and also what the DNA code looks like) from here it will build on what the DNA does, looking back at the idea of it being an instruction manual.



What Does our body do with the code?

We know that:

- DNA is stored in every cell inside the nucleus on chromosomes.
- We know that the DNA bases make up the DNA code and these have rules for both stands of the DNA to match.
- But what does the code do in the body?

The DNA code as we discussed before is like an instruction manual for the body, the DNA has the instructions to make all the things that the body needs to work properly, and these are called proteins.

When our body needs a protein to do a task in our body, the part of our DNA that has the instructions for that protein become active and allows our body to make the protein.

Teaching points:

- Cover the following recap with the class:
 - We know that DNA is stored in every cell inside the nucleus on chromosomes.

- We know that the DNA bases make up the DNA code and this has rules for both strands of the DNA to match.
- Then pose the following question and allow time for discussion within the class.
 - But what does the code do in the body?
- *Animation* – Click to reveal an explanation as to what the DNA does and describe the following to the class:
 - The DNA code (as we discussed before) is like an instruction manual for the body: the DNA has the instructions to make all the things that the body needs to work properly, and these things are called proteins.
 - When our body needs a protein to do a task in our body, the part of our DNA that has the instructions for that specific protein becomes active allowing our body to make the protein.

Slide 14

Slide overview: Using digestion as an example, this slide will explain how the body can activate parts of the DNA code to produce what it needs for a specific task.

Lets look at an example

When we eat food we need to digest that food.

Lets take a bite of an apple

1 The apple moved down into the stomach and then some blue bubbles appeared, these bubbles are our stomach acid which help us to digest the food.

2 When we eat our bodies know that we will need the cells in our stomach to produce acid, so they will activate the part of the DNA that has the code to make the acid molecules and when we have enough acid that part of the DNA code switches off again.

Signal from the food

3 The stomach cell activates the part of the DNA that has the code to make the stomach acid.

4 Stomach Cell.

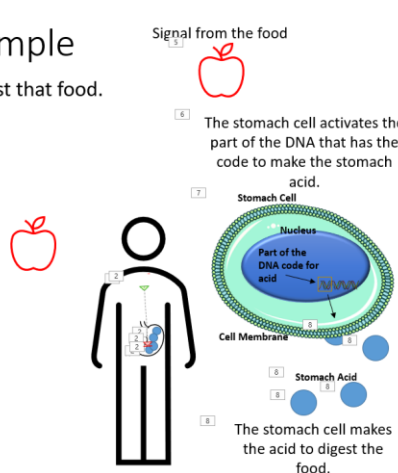
5 Nucleus

6 Part of the DNA code for acid

7 Cell Membrane

8 Stomach Acid

9 The stomach cell makes the acid to digest the food.



Teaching points:

- Explain to the class that you will be looking at digestion as an example of how the body can activate the part of the DNA that has the instructions for a specific task:
 - Let's use digestion as an example of how the body can activate the part of the DNA that has the instructions for a specific task.
- *Animation* - Click to reveal the text "Let's take a bite of an apple" and explain the following to the class:
 - In order to look at digestion we first need to eat something.
- *Animation* - Click to reveal a short animated sequence. The animation will show an apple that moves down into the stomach and is surround by 4 blue bubbles.
- At this point, ask the class what in their stomach would digest food?
 - Discussion will hopefully lead to the answer **acid**.
- *Animation* - Click to reveal the text around the previous short animation, this will also give the answer to the question 'what in the stomach digests the food'. Explain the following to the class:
 - The apple moved down into the stomach and then some blue bubbles appeared, these bubbles are our stomach acid which help us to digest the food.
- *Animation* - Click to reveal the text that will give more information about what is happening in the cells in the stomach and explain the following to the class.
 - When we eat, our bodies know that we will need the cells in our stomach to produce acid, so they activate the part of the DNA that has the code to make acid molecules. When we have enough acid, that part of the DNA code is switched off again.
- *Animation* The next **three** clicks will show this in a series of pictures with added text to help reinforce the concept explained above, these can be read from the slide.

Slide 15

Slide overview: Outlining some useful information that scientists have learned from our DNA – this slide aims to show what scientist have already learned from DNA.



Scientist have been studying our DNA for a very long time. They have learned....

More about how our bodies work and function



About what goes wrong with our bodies when we get sick.



Ways that doctors can help to make us better again when we are sick.



Teaching points:

- Explain the following to the class:
 - Other DNA detectives (scientists) have already cracked some of the genetic code to help them to understand more about the human body and how it works.
 - Work carried out by previous DNA detectives is how we know that parts of the DNA code gives instructions to make the proteins that we need to carry out tasks in our bodies, like we have just learned using digestion as an example.
- *Animation* - Click to reveal the text and images and explain the following:
 - From understanding the genetic code, we now know more about how our bodies work and how we can use this information to keep ourselves fit and healthy.
- *Animation* - Click to reveal the text and images and explain the following:
 - Understanding the genetic code has also helped us to learn more about the changes that happen to our bodies when we get sick.
- *Animation* - Click to reveal the text and images and explain the following:
 - And more importantly it is helping us to understand how we can treat people when they are sick, making them feel better again.

Slide 16

Slide overview: This slide looks at the last point from slide 12 in more detail and starts to think about how we can use the genetic code to help make people who are sick better again. In challenge 1 we looked at what DNA can tell us about ourselves and by looking at the differences throughout the class we can see that everyone's DNA gives them different qualities that make us who we are. Therefore, it is not unexpected that when we get sick there could be differences in our DNA that make one person respond to a certain treatment better than another.



Let's look more at how the doctors can use DNA to help make people who are sick better.

Remember back to challenge 1 when we looked at how our DNA makes us unique

For certain illnesses there can be several treatment options that the doctor can choose from to make people better and because of the differences in our DNA not everyone will respond to the same treatment.

Therefore, how does the doctor know which one would be best?

By understanding the DNA code we can begin to understand more about what treatment might be best for each person



Teaching points:

- Using the slide as a guide explain the following to the class:
 - Remember back to challenge 1 when we looked at how our DNA makes us unique as we are all different height, with different eye colours and different shoe sizes.
 - We as DNA detectives are starting to understand more about how doctors can use the differences in our DNA code to help make people who are sick better again.
- *Animation* - Click to reveal the text and explain the following:
 - For certain illnesses there can be several treatment options that the doctor can choose from to make people better, but due to the differences in our DNA not everyone will respond to the same treatment.
- *Animation* - Click to reveal the text and explain the following:
 - Therefore, how does the doctor know which one would be best?
- *Animation* - Click to reveal the text and explain the following:
 - By understanding the DNA code and looking at the difference in the DNA code from person to person, we can begin to understand more about what treatment might be best for each person.

Slide 17

Slide overview: Setting the scene for challenge 4 - this slide helps to set the scene for the last challenge explaining that the doctors need the help of the DNA detectives.



The Doctors need your help.



There are 3 treatments that the doctor can give, however they need to understand the DNA code before they will know which one to give to each patient.
Can you help them to understand the code and choose the right treatment?

Teaching points:

- Explain the following to the class:
 - The doctors urgently need help to break the DNA code that will help them decide which of the three treatments to give their patients.
 - This will be the final challenge that you need to complete in order to become DNA detectives, however it will be the hardest challenge yet and there are several steps to undertake in order to complete the challenge.
 - Are you ready for the final challenge?

Slide 18

Slide overview: CHALLENGE 4 -this slide gives instructions for each step of the final challenge.



**DNA Detective
Challenge 4**

- 1) Use key 1 to fill in the missing bases on strand 2 of the DNA on your worksheet.
- 2) Then take the bases in groups of three and use key 2 to work out the treatment that is hidden in the DNA.
- 3) Work with the rest of the class to find out the number of each treatment the doctor will need.



Teaching points:

- You can either talk through the steps that need to be undertaken to complete the challenge before the class start or each step can be taken in turn as it is reached.
- Reminder: this challenge will be slightly different in each of the three versions of the worksheet.
- You can work through the mock example on slide 18 as a class before undertaking the challenge on the worksheets. (see slide 18 info)

Step 1:

- The key 1 shows that G-C pair together, and A -T pair together, however it may be useful to remind the class that if there is a G on stand 1, then this would be matched by a C on strand 2 and so on.
- The appendix at the end of the guide will show how the base pairing should work for each of the three worksheets.
- Explain the following to the class:
 - Using the information you have on the worksheet for challenge 4, you now need to break the code.
 - Use Key 1 to fill in the missing bases on strand 2 of the DNA on the work sheets.
 - Remember that you need to follow the rules for the DNA code to match the correct bases on stand 2 to the ones that are shown on strand 1.
 - NOTE: you may not have the same DNA code as the people on either side of you, so don't expect your answers to be the same.

Step 2: Explain the following:

- Every three bases are marked on the work sheet and should correspond to a letter using the key 2.
- Using the key, break the code to spell out a word.
- The word on each of the activity sheets is a colour and the colour represents a treatment. Purple, yellow and orange. The working to decode each word for each of the three worksheets is also shown in the appendix at the end of the guide.

Slide 19

Slide overview: Example of what is on each activity sheet.



Teaching points:

- A mock-up of the challenge (note this is **not** the same as the three worksheets and spells the word GREEN in the end).
- This can be worked through as a group before the class undertake their own challenge.

Slide 20

Slide overview: a copy of the keys (also included on the worksheets)

KEY 1			
	A-T		
	C-G		
KEY 2			
CGT - A	TGC - I	TTG - Q	GCC - Y
AGT - B	TGA - J	CCA - R	ACG - Z
GAT - C	TAG - K	AAC - S	
ATA - D	TAT - L	CAC - T	
GCT - E	CGC - M	TAC - U	
TCG - F	GCG - N	GAG - V	
CCG - G	GGT - O	CAT - W	
TTA - H	CTA - P	AAG - X	

Slide 21

Slide overview: The class results – The slide shows an example of the worksheet where the class can record their findings about treatments that the code revealed and also the number of people who had the same code word.

What are the three different treatments?

_____	_____	_____
Treatment 1	Treatment 2	Treatment 3
_____	_____	_____
Number	Number	Number

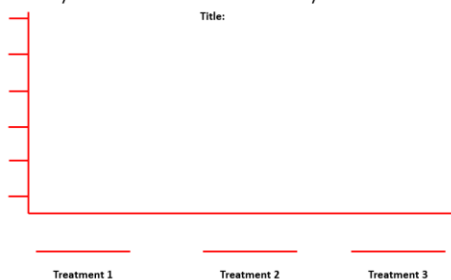
Teaching points:

- With the whole class, work out what the three words are.
- Ask the class to form three groups based on what colour was on their activity sheet.
- Each group should then count how many people are in that group.
 - On this slide there are gaps like those on the activity sheet for the children to fill in. It may be useful to draw this onto a board and write in the answers as a class and they can then be copied into the worksheets.

Slide 22

Slide overview: The last task in the challenge – creating a bar graph to help the doctors understand how many of each treatment they will need. A template for the bar graph has been given in the worksheet. To extend the math component, you can also ask them to represent this in a pie chart. A representative graph has been shown in the appendix at the end of the guide.

Can you create a graph for the doctor telling them how many of each treatment they need.



Teaching points:

- Explain the following:
 - We have almost completed all the challenges to become a DNA detective, however the doctors have just sent word that they have one more challenge.
 - The doctors need us to put our findings into a graph showing the number of treatments that would be needed by the doctors.
 - We need to create a bar graph to show the findings from the class.

Slide 23

Slide overview: Congratulations you are now all DNA detectives! This slide rounds up the activity and introduces the overall concept of precision medicine. The certificates can now be given out to say that each pupil is now a DNA detective. Note: Certificates come as 4 per page and need to be cut into individual certificates once printed.

Congratulations

By understanding the DNA and breaking the code you have helped the doctors give people the right treatment to make them better.



Did you know that by using information about a person, like their DNA, to help find the best treatment for them is called **PRECISION MEDICINE**

Teaching points:

- Congratulate the class and explain the following:
 - The challenges are complete, and the class have all graduated as DNA detectives and will all receive a certificate for their hard work.
 - By understanding the DNA and breaking the code, you have helped the doctors to give their patients the right treatment for them, this is known as **precision medicine**.
 - Another way to describe precision medicine is using information about a person, such as their DNA, to find the best treatment for them.

Slide 24

Slide overview: Copy of the Certificate.

Date:

Certificate



Name:

Has completed all the challenges and is now a



DN




Detective

Teaching points:

We hope you enjoyed the activity and if you have any feedback please contact louise.bennett@glasgow.ac.uk

Appendices

1) Activity Sheet V1.A PURPLE



G A T A T G G G T G A T A T A C G A

 C T A T A C C C A C T A T A T G C T

 P U R P L E

Key 1

Key 2

2) Activity Sheet V1.B YELLOW

C G G C G A A T A A T A C C A G T A

 G C C G C T T A T T A T G G T C A T

 Y E L L O W

3) Activity Sheet V1.B ORANGE

C C A G G T G C A C G C G G C C G A

 G G T C C A C G T G C G C C G G C T

 O R A N G E

4) Example Graph

