**ACTIVITY: DNA detective**

**Activity idea**

In this activity, students learn about the collection and processing of DNA evidence and use DNA profiling to solve a crime. The activity is designed for use on an interactive whiteboard with the whole class; it can also be used individually or in small groups at a computer or with a data projector and laptop.

By the end of this activity, students should be able to:

* describe where DNA is found in the body and how DNA may be ‘left behind’ at a crime scene
* describe the basic structure of DNA
* explain the process of DNA profiling.

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**Introduction/background**

For more information about DNA see the article [DNA, chromosomes and gene expression.](https://www.sciencelearn.org.nz/resources/206-dna-chromosomes-and-gene-expression)

Even though we are all unique, most of our DNA is actually identical to other people’s DNA. However, specific regions of our DNA vary highly between people – these regions are called polymorphic, and differences in these variable regions between people are known as polymorphisms. Each of us inherits a unique combination of polymorphisms from our parents. DNA polymorphisms can be analysed to give a DNA profile.

The current technique for DNA profiling uses polymorphisms called short tandem repeats.

Short tandem repeats (or STRs) are regions of non-coding DNA that contain repeats of the same nucleotide sequence. For example, GATAGATAGATAGATAGATAGATA is an STR where the nucleotide sequence GATA is repeated six times. STRs can be shown as bands of different sizes in a DNA profile that resembles a barcode.

STRs are found at different places or genetic loci in a person’s DNA. In New Zealand, the forensic teams at ESR analyse STRs in 15 different loci. The chance of a random match between two individuals using 15 loci has been estimated at less than one in an English billion (1 000 000 000 000).

More information on [DNA profiling](https://www.sciencelearn.org.nz/resources/1980-dna-profiling).

**What you need**

* Access to the interactive [Crime scene DNA](https://www.sciencelearn.org.nz/resources/211-dna-detective) (You will need the [Adobe Flash Player](http://get.adobe.com/flashplayer/) to view this.)
* An interactive whiteboard (IWB) or enough tablets/computers for students to work individually or in small groups – it is possible to run this activity using a laptop and data projector
* A printer if you would like a record of the activity for assessment purposes

**What to do**

1. Start a discussion with your class focused on what they know about forensics. What have they heard/seen in the media? Do they watch shows such as *CSI*, *NCIS* or *Bones*? Who is responsible for using forensics to solve crime in New Zealand?
2. Start the interactive presentation [Crime scene DNA](https://www.sciencelearn.org.nz/resources/211-dna-detective). Work through this with the whole class or facilitate pairs or small groups.
3. Download the zip file to use the interactive offline. Unzip and then view by selecting/opening the html or swf file. The contents of the zip folder must be saved in the same location in order to use the interactive.

**Teacher notes**

The interactive presentation simulates (and simplifies) the process of using DNA to solve a crime.

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| ***Tab 1*** | In New Zealand, scientists from the Institute of Environmental Science and Research (ESR) are called in to attend crime scenes all over the country 24 hours a day, 7 days a week. At the scene, they collect evidence and then analyse this back in the lab to help construct a sequence of events to solve the crime. Some Police officers are also specially trained to collect evidence and lift fingerprints.   * Background information about forensic services in New Zealand is available on the ESR website: [www.esr.cri.nz/our-services/testing/forensic-analysis/](http://www.esr.cri.nz/our-services/testing/forensic-analysis/). * The New Zealand Police website has information about collecting and using fingerprints to solve crimes: [www.police.govt.nz/service/fingerprint/#about](http://www.police.govt.nz/service/fingerprint/#about). |
| ***Tab 2*** | You may like to use the pen tool (on the toolbar on the right-hand side of the screen) to circle or list evidence that students would like to take back to the lab.   * Optional discussion question: Which piece of evidence do you think is the most important and why? |
| ***Tab 3*** | It may be helpful to refer to the [Alternative conceptions about genetics](https://www.sciencelearn.org.nz/resources/216-alternative-conceptions-about-genetics). All of the samples (except the footprint) could be placed in the ‘Contains DNA’ box if students give the appropriate reasoning. For example, the phone obviously does not contain DNA but if there are skin cells present, it may be possible to extract a DNA sample.  There are lots of online articles about unusual sources of DNA samples that have been used to solve crimes. For example:   * Dandruff DNA ‘link’ to attack: [news.bbc.co.uk/2/hi/uk\_news/wales/1658478.stm](http://news.bbc.co.uk/2/hi/uk_news/wales/1658478.stm). * Bandit undone by his dandruff: [www.cbsnews.com/news/bandit-undone-by-his-dandruff](http://www.cbsnews.com/news/bandit-undone-by-his-dandruff). |
| ***Tab 4*** | For more information about DNA, see the article [DNA, chromosomes and gene expression](https://www.sciencelearn.org.nz/resources/206-dna-chromosomes-and-gene-expression). |
| ***Tab 5*** | This is the correct order:   * *Put on protective clothing including gloves to prevent sweat, hair etc. from contaminating the sample.* * *Protect the sample from any external factors including the weather, animals and traffic.* * *Photograph the sample.* * *Carefully swab the sample.* * *Allow the sample to air dry before packaging into a paper bag or collecting into a test tube if liquid.* * *Carefully label and seal the sample bag/container.* * *Provide information that you think may be important, for example, an unusual location or any possible contaminants.* * *Forward to the ESR laboratory as soon as possible.*   Extension activity: Discussion focused on the importance of having a strict procedure around evidence collection. |
| ***Tab 6*** | For more information about how DNA is used to solve crimes, see [introduction/background](#Introduction) notes or the article [DNA profiling](https://www.sciencelearn.org.nz/resources/1980-dna-profiling). |
| ***Tab 7*** | This step is necessary to make sure the samples collected at the scene are not from the residents of the house. |
| ***Tab 8*** | Optional discussion around DNA databank. In some cases (if there are no immediate suspects, for example), investigators may compare the DNA profile from the scene with profiles from New Zealand’s DNA databank. |
| ***Tab 9*** | These probabilities are approximate because different loci have different degrees of variability. Also, some alleles are more common than others. As you increase the number of loci tested in a profile, you exponentially decrease the likelihood of incorrectly identifying an individual. |
| ***Tab 10*** | A matching DNA profile only answers the question of whether a DNA sample from a crime scene matches the profile of an individual. The individual could have been involved in the crime or there could be a legitimate reason their DNA was present.  As a result, DNA is only ever part of the evidence used in court. |

**Extension activity**

Use the [Ethical frameworks](https://www.sciencelearn.org.nz/resources/2363-ethics-thinking-toolkit) to explore the issue of a national DNA databank using a ‘consequentialism’ or ‘rights and responsibilities’ approach.