

Objective	Introduction	Main Activity	Reflection	Success criteria
1. What is DNA and cloning? (5-10 min)	Review DNA and Genes (~2 slides)	Power point slides with basic introductions and examples of when DNA should be <i>Read</i> (eg. crime scenes, diagnose disease, others) and how copied DNA can be used (eg. for treating disease)	Reflect on differences in the cells in our body (eg eyes vs nails)	Know that DNA makes genes. Know that differences in DNA explain differences across organs and individuals.
	Introduce cloning. Explain that DNA can be taken out of cells and “read & copied”. Explain that cloning (copying) single genes is common and easy. (~2 slides)		Even though DNA is highly conserved, even across species, but there are always differences between individuals.	Understand that “reading” DNA is important and has potential to help.
2. How can DNA be read? (10+10 min)	Explain that DNA is in our cells. Known segments of DNA can be used to read DNA (known/unknown) with PCR technology. (~5 slides)	Power point slides with introduction. ANIMATION: for fishing for DNA (known sequence as the bait for an unknown attached to it)	DNA can be read with the help of DNA and other helping compounds. PCR technology is a versatile, commonly used technique across fields of research and enables scientists to read, copy, change DNA sequences.	Know that PCR technology enables DNA sequencing and DNA copying.
	Introduce gene alterations behind lactose intolerance as an example. (2 slides)	DISCUSS: With a simplified lactose gene on a slide and options for “baits” that could be used to sequence it, ask children which option could be used.	Reflect on why you would want to know if you have lactose intolerance? How can the information help you?	Know that DNA sequencing can reveal mutations in genes.

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3. How can copied DNA be used? (10+10+5 min)	Explain that known segments of DNA can be used to copy genes. The copied human gene can be put into a plasmid (specific for a DNA sequence) which is then put into a little bacteria that can then make the human protein. (~5 slides?) After game, explain how with many bacterial cells the production can be amplified to industrial scale. (1-2 slides)	Power point slides introducing recombinant technology.	Reflect on activity. How many pairs ended up with the same protein production? Use each decoded protein as an example to reflect on why this might be important (haemophilia/coagulant factors, insulin/diabetes, interleukins/cancer)	Understand that DNA can be used to make factory-make proteins for treating disease.
		Introduce game with power point slide example. GAME: In pairs, children randomly pick a plasmid and are given three genes (DNA sequences). Only one of the three genes will match the plasmid they have picked. They decode the sequence and find out what protein they can now mass produce in a bacteria.		
4. Take home messages (5-10 min)	Summarize when and how DNA can be read and how it can even save lives. (1-2 slides) Explain that cloning commonly refers to DNA segments, but that even a sheep has been cloned (not common or easy) (~2 slides)	Summary slides. Discussion on what can DNA be useful for (ask students to recall lesson content)		

Own notes for making PowerPoint slides:

- *If feasible without excess detail, add cutting edge gene editing technology CRISPR as an example*
- *If space: introduce concept of GMO either for next lesson or as content for advanced/older kids*

References:

Liras, A. 2008. Recombinant proteins in therapeutics: haemophilia treatment as an example. Int Arch Med, 1: 4.

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