



DNA EXTRACTION

DNA analysis, whether for matching a crime scene sample to a suspect, testing for genetic diseases or identifying a new animal or plant species, first requires the extraction of DNA from the sample of interest. From animals, including humans, DNA samples are often extracted from blood or from skin cells. The easiest way to collect skin cells from humans is to use a cotton swab to brush the inside of the cheek. This is called a **buccal** swab. “Buccal” is a term meaning cheek or mouth. For small animals (i.e., insects) and plants, DNA can be extracted from small tissue samples. In order to analyze DNA, pure DNA is required. As DNA is located in cells, unwanted materials such as membranes and proteins must be separated and removed in order to obtain pure DNA.

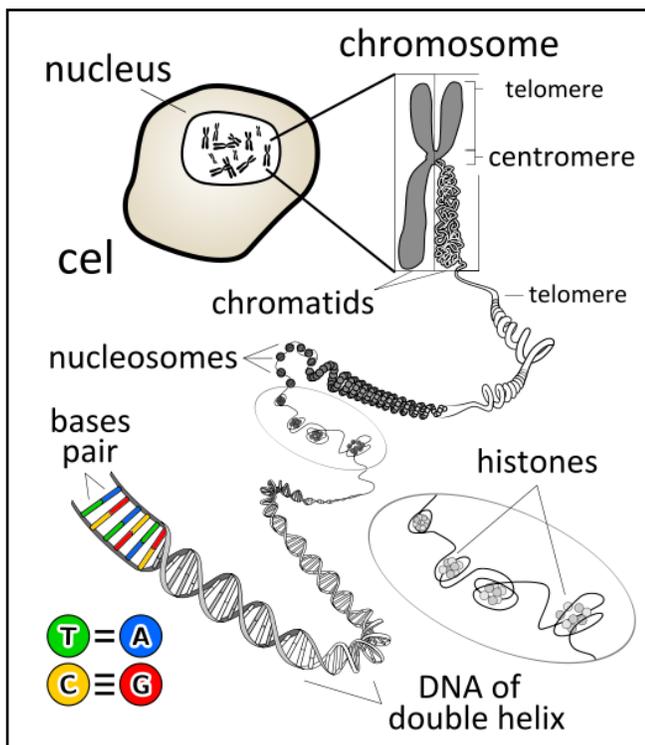


Figure 1: Images magnifying and showing the source of DNA. Source: [Wikimedia commons](https://commons.wikimedia.org/wiki/File:DNA_structure_1.jpg):

The basic steps for extracting DNA are the same no matter what the cell type:

1. Cell Lysis:

The word **lysis** means “to separate.” In a cell, lysis occurs when membranes are broken apart. Cells have an outer membrane – the **cell membrane** as well as an inner membrane which surrounds the DNA called the nucleus. The membranes are made up of two layers of **lipids** (fat molecules) with **proteins** going through them. The cell membrane and nucleus can be broken apart by chemical means, such as by the addition of a detergent, which separates the lipid molecules to break down the membrane. Detergents act to clean dishes in the same manner as they break down cell membranes. Detergents bind to grease (lipids), which allows the grease particles to be washed away with water. Chemical lysis may also be combined with physical lysis such as grinding or high-powered blending which can also break down cellular membranes.

2. Removal of membrane lipids:

After the cell and nuclear membranes are broken down in step 1, the lipid molecules must be removed. Adding a highly concentrated salt solution causes the detergent and other cellular debris, such as proteins, to **precipitate** (to form a solid and come out of the solution). The DNA remains dissolved in the liquid solution and can be removed from the cellular debris by **centrifugation** (spinning at high speed so that precipitate collects as a pellet at the bottom of a tube). The DNA, which is still dissolved in the liquid, can be moved to a new sample tube. Alternatively, the precipitate can be filtered out, such that only the DNA in the liquid solution will come through a filter.



DNA in the nucleus is wrapped around proteins called histones, which helps to organize the DNA into chromosomes. To remove the histone proteins, a protease, which is an enzyme that breaks down proteins, can be added.

3. Precipitation of the DNA:

The DNA now needs to be removed from the liquid solution. While DNA is **soluble** (can be dissolved) in water, it is not soluble in alcohol. So the addition of ethanol or isopropyl alcohol (rubbing alcohol) will cause the DNA to clump and form a visible white precipitate. The precipitate can be collected into a pellet by centrifugation. When the alcohol is removed, relatively pure DNA should remain.