BioPharmaceutical Technology Center
I N S T I T U T E

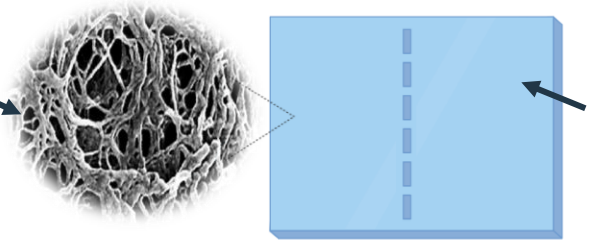
DNA & Principles of Gel Electrophoresis

Field Trip Background HS

Agarose Gel Electrophoresis

Purified agarose is a powder that is insoluble in water (or buffer) at room temperature but melts in boiling water (or buffer). As it cools, agarose undergoes polymerization; the sugar monomers crosslink with each other and cause the solution to "gel", much like JELL-O. Higher concentrations of agarose give firmer gels. If you were inside a gel, it would resemble a very dense spider web.

Scanning electron micrograph of agarose gel; 50,000 x magnification
Anders S. Medin, PhD Thesis, Uppsala University 1995



An agarose gel
(via Biorender.com)

If you were a small fragment of DNA, then you could easily crawl through the spaces between the webs (they are too tough for you to just pull out of the way) but as you increase in length, it gets harder and harder for you to fit through the spaces.

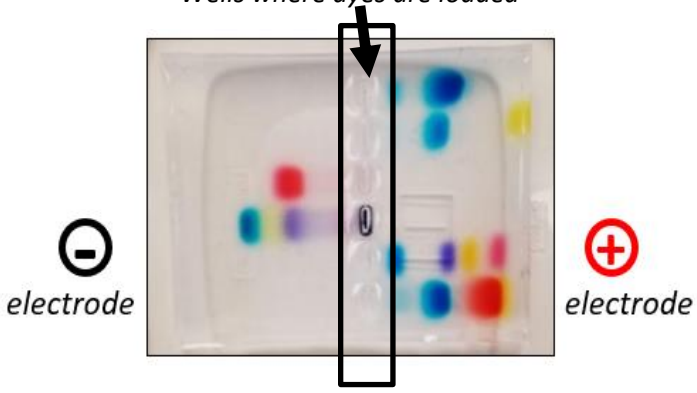
We use a 1% agarose gel in 1x sodium borate buffer for this field trip. The agarose is kept molten at 55°C until the gels are poured. Gels are prepared by pouring the molten agarose into casting trays around a six-well comb and allowing them to solidify. The comb is removed from the solidified gel and the DNA is loaded into the wells left by the comb.

Gel box connected to power supply

The gel box is prepared by pouring buffer into the chambers and placing the gel in the box. Instead of DNA, we will load dye samples into the wells of the agarose gel. Next, the gel box is connected to a power supply and an electrical current is passed through the cell.

The gel "runs" because charged molecules (like DNA or our dyes) are carried through the gel by the electrical current. The difference between the colored bands is based on the size and charge of the dye molecules.

Wells where dyes are loaded



Dye samples after gel electrophoresis

Based on the direction the dyes have traveled, can you tell which are positively charged?

Which molecules are the largest?

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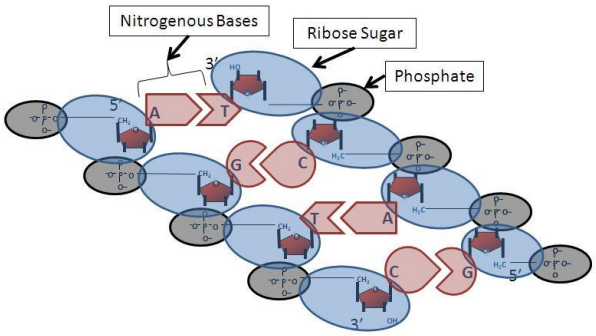
DNA

Deoxyribo**N**ucleic **A**cid (**DNA**) is the genetic determinant and is sometimes called the "Code of Life". DNA is important because it gives a cell the information it needs to make proteins. DNA concepts can be used to help students understand how molecules connect and interact within cells, allowing cells to serve as the building blocks of life.

In the DNA and Principles of Electrophoresis Biotechnology Field Trip, students will explore DNA molecules. By creating a human model, students will learn how sugars, phosphates, and nucleotide bases (A, T, G, C) connect together to give a molecule of DNA its characteristic shape and its function.

Representation of DNA structure

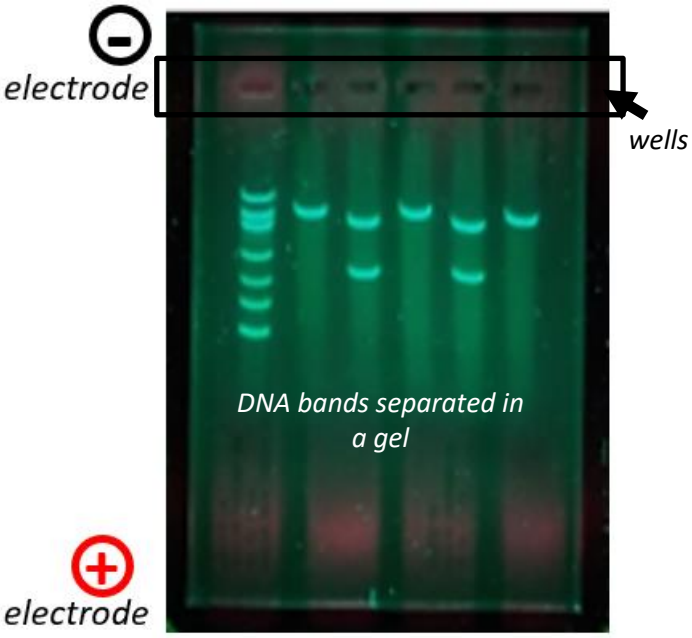


Students will learn that the molecular composition of DNA gives it a negative charge and will use this characteristic to separate DNA pieces of different size from one another using the technique of agarose gel electrophoresis, which is a laboratory technique used to separate charged molecules. Molecules separate by size, with the smaller ones moving more rapidly through the agarose gel matrix than the large ones.

When DNA is loaded into the wells of a gel, fragments of DNA that have different sizes run through the gel at different rates depending on their length.

Special fluorescent dye molecules are attached to the DNA so that it glows when we shine ultraviolet (UV) light through the gel. We take a photograph of the gel so that it is easier to study the banding patterns.

DNA and Principles of Gel Electrophoresis will help students visualize DNA structure and understand how electrophoresis can separate molecules by charge and size.



If you would like more information before you bring your students to the BTC Institute for this field trip, please contact us. We look forward to working with you and your students.

Thank you for your interest in the BTC Institute's Biotechnology Field Trips program!

BTC Institute
www.btci.org

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