a WOW Lab BLUEPRINT

Gel Electrophoresis

Inquiry Approaches

Initial Inquiry

What is gel electrophoresis?

Gel electrophoresis is a laboratory technique used to separate small molecules, such as deoxyribonucleic acid, ribonucleic acid or protein, by applying an electrical charge to a gel matrix.

Explain how the DNA, RNA or protein fragments separate in the gel.

The biological molecules are coated with negative charges that help them travel towards the positive electrode. The molecules are separated by size; smaller fragments move faster through the gel compared to the larger ones. In this activity, food colouring is separated by charge and not size.

Experimental Procedure Inquiry

Why is food colouring used instead of DNA in this activity?

DNA gel electrophoresis uses a microlitre-sized sample and requires a more powerful voltage source. Using this separation technique on food colouring is an affordable and simple alternative to using DNA, while mimicking how DNA gel electrophoresis works.

What is the purpose of using a control sample?

This sample is used to ensure that the activity is running properly. It can also be used at the end of the activity to compare the movement of colours in the other samples and the intensity of the colour to determine the number of drops used in each sample.

How would changing the concentration of the gel affect the movement of the colours?

A higher concentration slows down the movement of the fragments in the gel, which facilitates the separation of small molecules. A lower concentration allows the fragments to travel further in the gel, resulting in better separation of large molecules.

What might be another method of adding the samples to the gel?

Instead of filter paper that has soaked up the sample, the sample can be administered directly into the sample wells with an eye dropper. However, this technique is trickier and requires a steady hand.

Why is it important to set up the sample wells so that they are aligned?

If all the sample wells are aligned then the samples will start moving from the same position. If one sample well is positioned in front of the other wells then this sample will have an advantage and therefore will appear to have travelled further when in reality it has not.

What causes the food colouring molecules to move through the gel?

The food colouring molecules are negatively charged and will travel through the gel toward the positively charged terminal because opposite charges attract.

What is the total voltage of the power source, given that four 9 V batteries are connected in series?

In series, the voltages of the batteries can be added together. This gives a total voltage of 36 V.

In-Depth Inquiry

What is the significance of using a buffer solution?

In gel electrophoresis, buffers establish a pH around 8.0 and provide ions to support conductivity through the gel. Without a charged solution containing ions, there would be no current through the gel and therefore no movement of the charged food colouring ions during the activity.

Why does the positive terminal wire oxidize during the activity?

When attached to the power source, electrons from the positive terminal wire are travelling to the negative terminal wire through the conductive buffer solution. As a result, positive charge accumulates at the positive terminal (where the electrons are leaving) and negative charge accumulates at the negative terminal (where the electrons are arriving). The loss of electrons from the positive terminal results in the oxidization of the stainless steel wire.

If DNA is a long string of nucleic acids, how is it cut into different fragments?

DNA is cut using restriction enzymes. These molecules cut DNA at specific positions and create many differently-sized fragments of DNA. These fragments are then separated in the gel.