What is gel electrophoresis?
Gel electrophoresis is a technique that separates pieces of DNA (or other biological molecules) by size.

Pieces of DNA in a test tube all look the same.

Gel electrophoresis separates pieces of DNA by size so that researchers can further analyze them.

How does gel electrophoresis work?
First a gel is prepared.  Gels are made of agarose, a seaweed extract similar to gelatin. The finished gel has a consistency similar to very firm jello. This consistency offers resistance to the pieces of DNA as they try to move through the gel.

The gel is prepared with wells at one end so that DNA samples can be loaded into the gel.

As the pieces of DNA move through the gel, they will meet with resistance. Larger pieces of DNA will have more difficulty moving through the gel than smaller fragments. Thus, larger fragments will move slower than smaller fragments. This allows separation of all different sizes of DNA fragments.

Here you can see the migration of different fragments of DNA over time. Lane 2 contains a small fragment only, lane 3 a large fragment only, and lane 4 both a small and a large fragment.
Uses of DNA Gel Electrophoresis

Is my DNA still there?
Is my DNA completely cut?

Uses of DNA Gel Electrophoresis

Did I get a PCR product?
Is my PCR product the expected size?

Uses of DNA Gel Electrophoresis

Restriction mapping - where in your DNA do specific enzymes cut relative to one another?

Technical considerations

% agarose

0.7% agarose is used for large pieces of DNA
Southern blots of total genomic DNA fragments of 5 kb or larger.
1.5 - 2% agarose is used for small PCR fragments less than 1 kb
1% agarose is used for sizes in between

Technical Considerations

Type of Agarose

Most DNA gels use standard agarose.
If you plan to recover a fragment from the agarose, you may use low melting point agarose.
If you plan to run RNA on the gel, special Rnase free agarose may be used.
Technical Considerations

Commonly Used Buffers
TBE - Tris Borate EDTA
TAE - Tris Acetate EDTA
Either of these is often stored as a 10x concentrate

Technical Considerations
Loading Dye
Purposes
- give color to sample
- give weight to sample so it will sink into well
- show progress of gel migration
Components
- dyes (xylene cyanol, bromphenol blue, Orange G)
- weight (glycerol or ficoll)

Technical Considerations - Molecular Weight Markers
A mixture of different pieces of DNA of known size. Used to determine size of fragments in your sample.

Lambda HindIII digest
- 0.56 kb to 23 kb cheaper
- 100 bp ladder
  - 100 bp increments
  - more expensive
  - used for smaller fragments
- 1 kb ladder
  - 1000 bp increments
  - more expensive
Note - sizes refer to linear fragments.

Staining
DNA in the gel is invisible.
To visualize DNA, gels are stained with ethidium bromide.
A UV light is then used to visualize the EtBr.

CAUTIONS
Ethidium Bromide is a carcinogen.
- wear gloves
- correct disposal
UV light damages eyes
- wear goggles
- use photoimaging system

Ethidium bromide has a ring structure similar to the ring structure in DNA bases.
Ethidium bromide intercalates between the bases.
Shining UV light on ethidium bromide will cause it to fluoresce at visible wavelengths.