The Biotechnology Education Company®



Principles and EDVO-Kit # Practice of Agarose Gel Electrophoresis

Storage: Store the entire experiment at room temperature

EXPERIMENT OBJECTIVE:

The objective of this experiment is to develop a basic understanding of electrophoretic theory, and gain "hands-on" familiarity with the procedures involved in agarose gel electrophoresis to separate biological molecules.

> All components are intended for educational research only. They are not to be used for diagnostic or drug purposes, nor administered to or consumed by humans or animals.

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EDVO-Kit # 101 Principles and Practice of Agarose Gel Electrophoresis

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EDVO-Kit # 101 Principles and Practice of Agarose Gel Electrophoresis

Experiment Components

ELECTROPHORESIS SAMPLES

- Ready-to-Load[™] Dye samples
 - A Orange
 - B Purple
 - C Red
 - D Blue 1
 - E Dye Mixture
 - F Blue Dye Mixture (Blue 1 + Blue 2)

REAGENTS & SUPPLIES:

- Practice Gel Loading Solution
- UltraSpec-Agarose[™] powder
- Concentrated electrophoresis buffer
- 1 ml pipet
- 100 ml graduated cylinder (packaging for samples)
- Microtipped Transfer Pipets

THIS EXPERIMENT DOES NOT CONTAIN HUMAN DNA.

Requirements

- Horizontal gel electrophoresis apparatus
- D.C. power supply
- Automatic micropipets with tips
- Balance
- Microwave, hot plate or burner
- Pipet pumps or bulbs
- 250 ml flasks or beakers
- Hot gloves, vinyl gloves and safety goggles
- DNA visualization system (white light)
- Distilled or deionized water

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Storage: Store entire experiment at room temperature

Agarose gel electrophoresis is a widely used procedure in various areas of biotechnology. This simple, but precise, analytical procedure is used in research, biomedical and forensic laboratories. Of the various types of electrophoresis, agarose gel electrophoresis is one of the most common and widely used methods. It is a powerful separation method frequently used to analyze DNA fragments generated by restriction enzymes, and it is a convenient analytical method for determining the size of DNA molecules in the range of 500 to 30,000 base pairs. It can also be used to separate other charged biomolecules such as dyes, RNA and proteins.

The centerpiece and "workhorse" of agarose gel electrophoresis is the horizontal gel electrophoresis apparatus. There are many types of electrophoresis units, but the horizontal electrophoresis unit is the most commonly used unit for separating DNA molecules on agarose gels. Other types, such as protein (or vertical) electrophoresis, may utilize an apparatus which is shaped differently and utilizes polyacrylamide gels. The horizontal electrophoresis apparatus is essentially a sophisticated rectangular-shaped "box" with electrodes at each end. All EDVOTEK electrophoresis units, as well as all units found in research laboratories, contain platinum electrodes because of platinum's superior electrical conductivity and permanency. Because platinum electrodes are both expensive and fragile, care should be taken when handling electrophoresis is equipment.

The separation medium is a gel made from agarose, which is a polysaccharide derivative of agar. Originating from seaweed, agarose is highly purified to remove impurities and charge. It is derived from the same seaweed as bacterial agar used in microbiology, as well as a food product called agar agar, which is used to prepare a gelatin-like dessert in Asian cuisine. Because agarose comes from the same source as the food product agar agar, it is a non-toxic substance. However, the gel contains buffer for conductivity, and as with any laboratory materials, it should not be eaten.

In EDVOTEK experiments, the agarose is mixed with hydrocolloids which makes the gel clearer, more resilient and less prone to breakage. This resulting mixture, called UltraSpec Agarose[™], is prepared and used in the same manner as regular agarose, but with superior results. UltraSpec-Agarose[™] is particularly well-suited for separating DNA molecules in the range of 500 to 30,000 base pairs. Gels cast with UltraSpec-Agarose[™] are



sturdier and more resilient, and consequently are less prone to breakage than conventional agarose. The enhanced resolving power and translucent quality of UltraSpec-Agarose[™] results in greater visual clarity and definition of separated DNA fragments after staining.

The gel is made by dissolving agarose powder in boiling buffer solution. The solution is then cooled to approximately 55°C and poured into a casting tray which serves as a mold. A well-former template (often called a comb) is placed across the end of the casting tray to form wells when the gel solution solidifies.

After the gel solidifies, the gel is submerged in a buffer-filled electrophoresis chamber which contains a positive electrode at one end, and a negative electrode at the other. Samples are prepared for electrophoresis by mixing them with components, such as glycerol or sucrose, that will give the sample density. This makes the samples sink through the buffer and remain in the wells. These samples are delivered to the sample wells with a micropipet or transfer pipet.

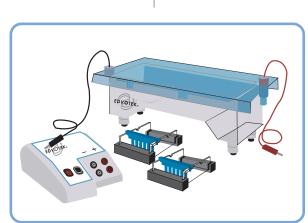
A Direct Current (D.C.) power source is connected to the electrophoresis apparatus and electrical current is applied. Charged molecules in the sample enter the gel through the walls of the wells. Molecules having a net negative charge migrate towards the positive electrode (anode)

while net positively charged molecules migrate towards the negative electrode (cathode). Within a range, the higher the applied voltage, the faster the samples migrate. The buffer serves as a conductor of electricity and to control the pH, which is important to the charge and stability of biological molecules. Since DNA has a strong negative charge at neutral pH, it migrates through the gel towards the positive electrode during electrophoresis.

If electrophoresis is conducted using dye samples, the migration of the various colored molecules can be visualized directly in the gel during electrophoresis and do not require staining. Because of the small size of the dye molecules, electrophoresis is fairly rapid. However,

the small size of the dye molecules also makes them susceptible to diffusion out of the gel. Thus, the results of dye electrophoresis experiments must be viewed immediately when the separation is complete. The gels cannot be saved.





On the other hand, gels separating DNA require staining in order to be visualized. Although DNA samples that are prepared for electrophoresis typically appear bluish-purple, the DNA itself does not have color. The color comes from a dye in a gel loading solution that is added at the end of typical DNA reactions, such as restriction enzyme digestion, or amplification by polymerase chain reaction. The gel loading solution stops the reaction. It also contains glycerol, which provides density to the sample so it will sink into the well during gel loading. The bluish-purple dye allows for visual tracking of sample migration during the electrophoresis. In general, most DNA samples follow behind the tracking dye during electrophoresis. Thus, it is important that electrophoresis is terminated before the tracking dye runs off the end of the gel.

The most commonly used stains for visualizing DNA contain either ethidium bromide or methylene blue. Ethidium bromide is a mutagen and must be handled and disposed according to strict local and/or state guidelines. Visualization also requires a short wave ultraviolet light source (transilluminator). Stains containing methylene blue are considered safer than ethdium bromide, but should still be handled and disposed with care. EDVOTEK has developed a quick and easy method of staining DNA, which is safer and minimizes the disposal of chemical waste, called InstaStain®.

Agarose gel electrophoresis possesses great resolving power, yet is relatively simple and straightforward to perform. The agarose gel consists of microscopic pores that act as a molecular sieve which separates molecules based upon charge, size and shape. These characteristics, together with buffer conditions, gel concentrations and voltage, affect the mobility of molecules in gels.

The sieving properties of the agarose gel influence the rate at which a molecule migrates. The charge to mass ratio is the same for different sized DNA molecules. The reason for this is inherent in the structure of the molecule. The nucleotides in DNA are linked together by negatively charged phosphodiester groups. For **every** base pair (average molecular weight of approximately 660) there are two charged phosphate groups. Therefore, every charge is accompanied by approximately the same mass. The absolute amount of charge on the molecule is not a critical factor in the separation process.



The separation occurs because smaller molecules pass through the pores of the gel more easily than larger ones, i.e., the gel is sensitive to the physical size of the molecule. If the size of two fragments are similar or identical, they will migrate together in the gel. If chromosomal DNA is cleaved many times, the wide range of fragments produced will appear as a smear after electrophoresis.

Molecules can have the same molecular weight and charge but different shapes, as in the case of plasmid DNAs. Molecules having a more compact shape (a sphere is more compact than a rod) can move more easily through the pores. The migration rate of linear fragments of DNA is inversely proportional to the log $_{10}$ of their size in base pairs. This means that the smaller the linear fragment, the faster it migrates through the gel.

Given two molecules of the same molecular weight and shape, the one with the greater amount of charge will migrate faster. In addition, different molecules can interact with agarose to varying degrees. Molecules that bind more strongly to the agarose will migrate more slowly.

The mobility of molecules during electrophoresis is also influenced by gel concentration, and the volume of the agarose gel solution depends upon the size of the casting tray. Higher percentage gels, as well as thicker gels, are sturdier and easier to handle. However, the mobility of molecules and staining (where applicable) will take longer because of the tighter matrix of the gel.

In EDVOTEK experiments, the most common agarose gel concentration for separating dyes or DNA fragments is 0.8%. However, some experiments require agarose gels with a higher percentage, such as 1% or 1.5%. Because of such variability, it is important to read experiment instructions carefully to ensure that the gel is prepared with the proper concentration and volume to maximize successful experimental results.

The fundamental procedures of agarose gel electrophoresis, including gel casting, sample loading and separation are covered in this experiment. The separation of the dyes will be clearly visible during the electrophoresis process, so staining is not required. In this experiment, several different dye samples will be separated by agarose gel electrophoresis and their rate and direction of migration will be observed. Dyes A (Orange), B (Purple), C (Red) and D (Blue) are all negatively charged at neutral pH. Dye E is a mixture of dyes. Dye F (blue mixture) contains a dye with a net positive charge.



Numerous equipment models are available for conducting horizontal agarose gel electrophoresis. The instructions in this document specifically address the use of EDVOTEK electrophoresis equipment, but can be adapted to equipment made by other manufacturers.

Familiarize yourself with the equipment you will be using before starting any experiment.

The equipment requirements for conducting agarose gel electrophoresis start with three basic items:

- 1) Horizontal gel electrophoresis apparatus
- 2) Direct Current (D.C.) power source
- 3) Sample delivery instrument (automatic micropipet)

Dye electrophoresis experiments do not require additional equipment, although a visible light source (light box) will enhance visualization of the bands in the gel.



HORIZONTAL GEL ELECTROPHORESIS APPARATUS

The horizontal electrophoresis apparatus chamber contains electrodes at each end. All EDVOTEK electrophoresis units (and units used in research laboratories) contain platinum electrodes because of platinum's superior electrical conductivity and permanency. Because platinum electrodes

are both expensive and fragile, care should be taken when handling electrophoresis equipment. By convention, the positive electrode (anode) is color-coded red, while the negative electrode (cathode) is black.

EDVOTEK electrophoresis apparatus models include removable gel casting trays with rubber end caps (dams) to close off the ends of the tray during gel casting. Other models may require the use of tape to close off the ends. Well-former templates (combs) form the wells into which samples are loaded for electrophoretic separation.

After the agarose gel is cast, the gel (on the tray) is placed in the buffer-filled apparatus chamber for sample loading and electrophoresis. During electrophoresis, molecules with a net negative

charge will migrate towards the postive electrode, while molecules with a net postive charge will migrate towards the negative electrode. Because experiment #101 includes dye samples with a net negative or net postive charge, the experiment requires a gel with wells in the middle of the gel.



Black

Sample wells

Experiment #101 requires a gel with wells in the middle of the gel.

Red

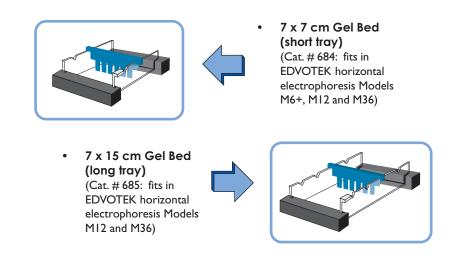
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GEL CASTING TRAYS

EDVOTEK injection-molded casting trays (also called gel beds) are available in two sizes, providing flexibility for a variety of experimental options. The rubber end caps fit tightly onto the ends of the gel casting tray. This feature eliminates the problem of leaking agarose solution associated with casting trays that require the ends of the gel bed to be closed with tape.



WELL-FORMER TEMPLATES (COMBS)

Two different well former templates (combs) are available for EDVOTEK injection-molded electrophoresis units (Models M6+, M12 and M36). The standard 6-tooth comb and the Double comb 8/10 provide flexibility for a variety of experimental options.

• 6-Tooth Comb (Cat. # 680)

Injection-molded polycarbonate comb for casting 6 wells that accommodate up to 38-40 μl of sample



 Double Comb 8/10 (Cat. # 683)

> Injection-molded polycarbonate comb for increasing the number of wells per gel. Capacity of wells:

- -- 8-tooth wells up to 30 μ l
- -- 10-tooth wells up to 20 µl



Comb size will impact the amount of sample that can be loaded into the sample wells. For equipment that is not manufactured by EDVOTEK, it may be necessary to pour thicker gels so the wells can accommodate enough sample for optimal results.

DIRECT CURRENT POWER SOURCE

Electrical current is applied to the electrophoresis apparatus using a Direct Current (D.C.) power source. There are numerous power sources available, with a variety of features. In general, whether you use constant voltage or variable voltage power sources, or even batteries, the higher the voltage applied the faster the samples migrate. However, the maximum amount of voltage that can be applied depends upon the design of the electrophoresis apparatus and should not exceed manufacturer's recommendations. Voltage that is too high can melt the agarose gel

during electrophoresis and cause distortion of results. For EDVOTEK injection-molded electrophoresis units, maximum voltage should not exceed 125 volts.





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Background Information

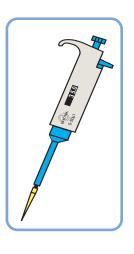
SAMPLE DELIVERY INSTRUMENTS

Although the variable automatic micropipet is the preferred instrument for delivering accurate, reproducible volumes of sample, other less expensive equipment alternatives include fixed volume micropipets or disposable transfer pipets.

Variable Automatic Micropipets:

An automatic micropipet is used to deliver accurate, reproducible volumes of sample.

- For the electrophoresis of dyes, load the well with 35-38 microliters of sample.
- Use a clean micropipet tip for loading each sample.





Fixed Volume Micropipets:

Accurate sample delivery can also be achieved using fixed volume micropipets. These types of micropipets are pre-set to a specific volume. Although the volume can not be changed, these types of micropipets operate similarly to the variable automatic micropipets. Most fixed volume pipets do not have ejector buttons, so the tips must be removed manually.

Transfer Pipets:

With EDVOTEK electrophoresis systems, an alternative sample delivery method can be used if you do not have automatic micropipets. Disposable plastic transfer pipets can be used, but

they are not precise. Because their volumes cannot be accurately controlled, their use can result in significant sample waste.

To help control the delivery of small sample volumes with transfer pipets, gently squeeze the pipet stem, instead of the bulb. When using transfer pipets for sample delivery, load each sample well until it is full.



Clean by flushing the transfer pipet with distilled water several times after delivering each sample and before loading a new sample.

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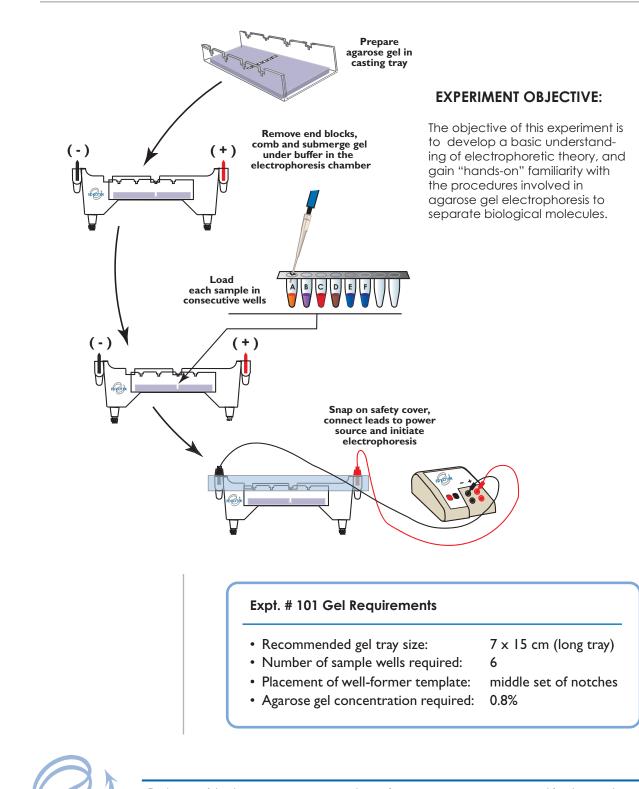


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Experiment Overview

EDVOTEK_®





Agarose Gel Preparation

LABORATORY SAFETY

Wear gloves and safety

goggles

- Gloves and goggles should be worn routinely as good laboratory practice.
- 2. Exercise extreme caution when working with equipment that is used in conjunction with the heating and/or melting of reagents.
- 3. DO NOT MOUTH PIPET REAGENTS USE PIPET PUMPS.
- 4. Exercise caution when using any electrical equipment in the laboratory.
- 5. Always wash hands thoroughly with soap and water after handling reagents or biological materials in the laboratory.

PREPARING THE GEL BED

- 1. Close off the open ends of a clean and dry gel bed (casting tray) by using rubber dams or tape.
 - A. Using Rubber dams:
 - Place a rubber dam on each end of the bed. Make sure the rubber dam fits firmly in contact with the sides and bottom of the bed.
 - B. Taping with labeling or masking tape:
 - With 3/4 inch wide tape, extend the tape over the sides and bottom edge of the bed.
 - Fold the extended edges of the tape back onto the sides and bottom. Press contact points firmly to form a good seal.
 - 2. Place a well-former template (comb) in the middle set of notches. Make sure the comb sits firmly and evenly across the bed.



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Important note:

Most experiments require that the wellformer template be placed in notches at the end of the tray.

Expt. # 101 is unique the well-former template is placed in set of notches in the **middle** of the tray.

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Experiment Procedures

Agarose Gel Preparation

CASTING AGAROSE GELS

- 3. Use a 250 ml flask to prepare the gel solution. Add the following components to the flask as specified for your experiment (refer to Table A).
 - Buffer concentrate
 - Distilled water
 - Agarose powder

Table AIndividual 0.8% UltraSpec-Agarose™ GelElectrophoresis of Dyes								
Size of EDVOTEK Casting Tray (cm)	Amt of Agarose (gm)	Concentrated + Buffer (50x) · (ml)	Distilled + Water ⁼ (ml)	Total = Volume (ml)				
7 x 7	0.24	0.6	29.4	30				
7 × 15	0.48	1.2	58.8	60				

- 4. Swirl the mixture to disperse clumps of agarose powder.
- 5. With a marking pen, indicate the level of the solution volume on the outside of the flask.
- 6. Heat the mixture to dissolve the agarose powder. The final solution should appear clear (like water) without any undissolved particles.
 - A. Microwave method:
 - Cover the flask with plastic wrap to minimize evaporation.
 - Heat the mixture on High for 1 minute.
 - Swirl the mixture and heat on High in bursts of 25 seconds until all the agarose is completely dissolved.
 - B. Hot plate method:
 - Cover the flask with aluminum foil to prevent excess evaporation.
 - Heat the mixture to boiling over a burner with occasional swirling. Boil until all the agarose is completely dissolved.

Check the solution carefully. If you see "crystal" particles, the agarose is not completely dissolved.



At high altitudes, it is

microwave oven to

reach boiling temperatures.

recommended to use a

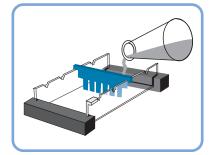
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Agarose Gel Preparation

 Cool the agarose solution to 55°C with careful swirling to promote even dissipation of heat. If detectable evaporation has occurred, add distilled water to bring the solution up to the original volume as marked on the flask in step 5.



Cool the agarose to 55°C DO NOT POUR BOILING HOT AGAROSE INTO THE GEL BED. Hot agarose solution may irreversibly warp the bed.

After the gel is cooled to 55°C:

If you are using rubber dams, go to step 9. If you are using tape, continue with step 8.

- 8. Seal the interface of the gel bed and tape to prevent the agarose solution from leaking.
 - Use a transfer pipet to deposit a small amount of cooled agarose to both inside ends of the bed.
 - Wait approximately 1 minute for the agarose to solidify.
- 9. Pour the cooled agarose solution into the bed. Make sure the bed is on a level surface.
- 10. Allow the gel to completely solidify. It will become firm and cool to the touch after approximately 20 minutes.



Agarose Gel Preparation

PREPARING THE GEL FOR ELECTROPHORESIS

11. After the gel is completely solidified, carefully and slowly remove the rubber dams or tape from the gel bed.

Be especially careful not to damage or tear the gel wells when removing the rubber dams. A thin plastic knife, spatula or pipet tip can be inserted between the gel and the dams to break possible surface tension.

- 12. Remove the comb by slowly pulling straight up. Do this carefully and evenly to prevent tearing the sample wells.
- 13. Place the gel (on its bed) into the electrophoresis chamber, properly oriented, centered and level on the platform.
- 14. Fill the electrophoresis apparatus chamber with the required volume of diluted buffer for the specific unit you are using (see guidelines in Table B).

For DNA analysis, the same EDVOTEK 50x Electrophoresis Buffer is used for preparing both the agarose gel buffer and the chamber buffer. The formula for diluting EDVOTEK (50x) concentrated buffer is 1 volume of buffer concentrate to every 49 volumes of distilled or deionized water.

The electrophoresis (chamber) buffer recommended is Trisacetate-EDTA (20 mM Tris, 6 mM sodium acetate, 1 mM disodium ethylenediamine tetraacetic acid) pH 7.8. Prepare the buffer as required for your electrophoresis apparatus.

Table B	Dilution of Electrophoresis (Chamber) Buffer									
EDVOTEK Model #	Concentrated Buffer (50x) + (ml)	Distilled Water [:] (ml)	Total = Volume (ml)							
M6+	6	294	300							
MI2	8	392	400							
M36 (blue)	10	490	500							
M36 (clear)	20	980	1000							

15. Make sure the gel is completely covered with buffer.

16. Proceed to loading the samples and conducting electrophoresis.



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Experiment Procedures

Sample Delivery (Gel Loading)



Accurate sample delivery technique ensures the best possible gel results. Pipeting mistakes can cause the sample to become diluted with buffer, or cause damage to the wells with the pipet tip while loading the gel.

If you are unfamiliar with loading samples in agarose gels, it is recommended that you practice sample delivery techniques before conducting the actual experiment. EDVOTEK electrophoresis experiments contain a tube of practice gel loading solution for this purpose. Casting of a separate practice gel is highly recommended. One suggested activity is outlined below:

- 1. Cast a gel with the maximum number of wells possible.
- 2. After the gel solidifies, place it under buffer in an electrophoresis apparatus chamber.

Alternatively, your teacher may have cut the gel in sections between the rows of wells. Place a gel section with wells into a small, shallow tray and submerge it under buffer or water.

Note: The agarose gel is sometimes called a "submarine gel" because it is submerged under buffer for sample loading and electrophoretic separation.

- 3. Practice delivering the practice gel loading solution to the sample wells. Take care not to damage or puncture the wells with the pipet tip.
 - For electrophoresis of dyes, load the sample well with 35-38 microliters of sample.
 - If using transfer pipets for sample delivery, load each sample well until it is full.
 - 4. If you need more practice, remove the practice gel loading solution by squirting buffer into the wells with a transfer pipet.
 - 5. Replace the practice gel with a fresh gel for the actual experiment.

Note: If practice gel loading is performed in the electrophoresis chamber, the practice gel loading solution will become diluted in the buffer in the apparatus. A small amount of practice gel loading solution (filling up to 12 wells) will not interfere with the experiment, so it is not necessary to prepare fresh buffer.

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See the following page for specific instructions regarding the operation of an automatic micropipet.

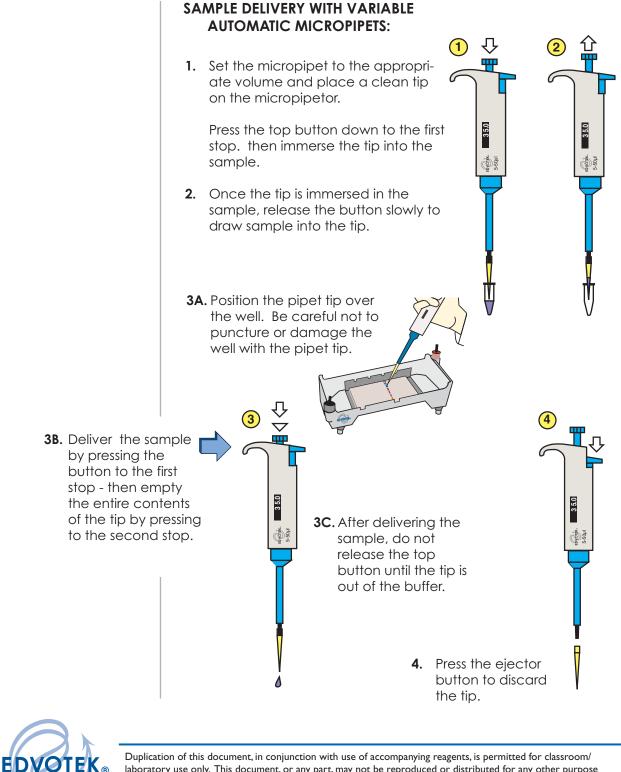
If you are using transfer pipets, gently squeeze

the pipet stem, instead of the bulb to help control the delivery of small sample volumes. 17



Sample Delivery (Gel Loading)





Conducting Agarose Gel Electrophoresis

ELECTROPHORESIS SAMPLES

Samples in EDVOTEK Series 100 and Sci-On® Series electrophoresis experiments are packaged in one of two different formats:

- Pre-aliquoted QuickStrip[™] connected tubes (new format)
- Individual 1.5 ml or 0.5 ml microtest tubes

Pre-aliguoted QuickStrip[™] connected tubes

- Each set of QuickStrip[™] connected tubes contains pre-aliquoted readyto-load samples for one gel. A protective overlay covers the strip of QuickStrip[™] sample tubes.
- Check the sample volume. Sometimes a small amount of sample will cling to the walls of the tubes. Make sure the entire volume of sample is at the the bottom of the tubes before starting to load the gel.
- Tap the overlay cover on top of the strip, or tap the entire QuickStrip™ on the table to make samples fall to the bottom of the tubes

Individual 1.5 ml or 0.5 ml microtest tubes

- Your instructor may have aliquoted samples into a set of tubes for each lab group. Alternatively, you may be required to withdraw the appropriate amount of sample from the experiment stock tubes.

IMPROVED

EDVOTEK

BCD

QuickStrips™

QuickStrips

patent pending

FEATURE

- Check the sample volume. Sometimes a small amount of sample will cling to the walls of the tubes. Make sure the entire volume of sample is at the the bottom of the tubes before starting to load the gel.
- Briefly centrifuge the sample tubes, or tap each tube on the tabletop to get all the sample to the bottom of the tube.

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Experiment Procedures

Conducting Agarose Gel Electrophoresis

QuickStrip[™] Samples

Successful Pipetting with Micropipets

 Do not disturb the samples in the QuickStrip[™]. Gently tap the QuickStrip[™] tubes on the lab bench to ensure that samples are at the bottom of the tubes. Delivering QuickStrip[™] Samples with Transfer Pipets:

If using disposable transfer pipets for sample delivery, pierce the protective overlay with a paper clip before inserting the transfer pipet to withdraw the sample.

2. Stabilize the QuickStrip[™] by firmly anchoring it on the lab bench.

* If a sample becomes displaced while inserting the pipet tip in the tube, gently tap the QuickStrip™ on the lab bench to concentrate the sample to the bottom of the tube. With the pipet plunger depressed to the first stop, re-insert the tip into the sample and raise the micropipet plunger to withdraw the sample.

- 3. Gently pierce the printed protective overlay with the pipet tip attached to a micropipet. Depress the micropipet plunger to the first stop before the tip is placed in contact with the sample.
- 4. With the pipet plunger depressed to the first stop, insert the tip into the sample.
- 5. Raise the plunger of the micropipet to withdraw the sample.
- 6. Load the sample into the appropriate well of the gel. Discard the tip.
- 7. Repeat steps 3-6 for each sample.



LOAD THE SAMPLES

For either QuickStrip $^{\rm TM}$ or individual microtest tube format, samples should be loaded into the wells of the gel in consecutive order.

Load the DNA samples in tubes A - F into the wells in consecutive order. The amount of sample that should be loaded is $35-38 \ \mu$ l.

Lane	Label	Sample
1 2 3 4 5 6	A B C D E F	Orange Purple Red Blue 1 Dye Mixture Blue Dye Mixture



Conducting Agarose Gel Electrophoresis

*The EDVOTEK Model #M6 should not

70 volts.

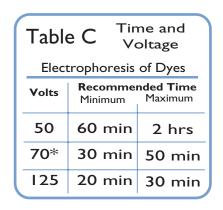
be run at higher than

RUNNING THE GEL

1. After the samples are loaded, carefully snap the cover down onto the electrode terminals.

Make sure that the negative and positive color-coded indicators on the cover and apparatus chamber are properly oriented.

- 2. Insert the plug of the black wire into the black input of the power source (negative input). Insert the plug of the red wire into the red input of the power source (positive input).
- 3. Set the power source at the required voltage and conduct electrophoresis for the length of time determined by your instructor. General guidelines are presented in Table C.
- 4. Check to see that current is flowing properly you should see bubbles forming on the two platinum electrodes.
- 5. After approximately 10 minutes, you will begin to see separation of the colored dyes.



- 6. After the electrophoresis is completed, turn off the power, unplug the power source, disconnect the leads and remove the cover.
- 7. Document the gel results.

A variety of documentation methods can be used, including drawing a picture of the gel, taking a photograph, or scanning an image of the gel on a flatbed scanner.

Staining is not required for Experiment # 101, but results must be analyzed upon completion of the electrophoretic separation. Because dye molecules are extremely small they will diffuse out of the gel. Thus, the gel cannot be saved.



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Experiment Results and Study Questions

EXPERIMENT RESULTS - LABORATORY NOTEBOOK RECORDINGS:

Address and record the following in your laboratory notebook or on a separate worksheet.

Before starting the experiment:

- Write a hypothesis that reflects the experiment.
- Predict experimental outcomes.

During the Experiment:

• Record (draw) your observations, or photograph the results.

Following the Experiment:

- Formulate an explanation from the results.
- Determine what could be changed in the experiment if the experiment were repeated.
- Write a hypothesis that would reflect this change.

STUDY QUESTIONS

Answer the following study questions in your laboratory notebook or on a separate worksheet.

- 1. On what basis does agarose gel electrophoresis separate molecules?
- 2. Explain migration according to charge.
- 3. What conclusion can be drawn from the results of sample F?
- 4. Why is glycerol added to the solutions before they are loaded into the wells?
- 5. What would happen if distilled water were substituted for buffer in either the chamber solution or the gel solution?



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Hazardous Components [Specific Chemical dentity: Common Name(s)] OSHA PEL ACGIH TLV Precommended % (Optional) This product contains no hazardous materials as defined by the OSHA Hazard Communication Standard. CAS # 62625-28-9 Modelal Conditions Generally Aggravated by Exposure Rinse contacted areas with copious amounts of water Section III - Physical/Chemical Characteristics Steps to be Taken in case Material is Released for Spilled Weare ye and skin protection and mop/wipe spill area. Rinse with water. Vapor Pressure (mm Hg.) No data Metting Point N/A Vapor Density (AIR = 1) No data Evaporation Rate (Butyl Acetate = 1) No data Solubile Solubile Vapor and skin contact Vate Disposal Method Can be disposed in the trash or down the sink Precautions for Jake No data Flammable Limits LEL No data Vect Vect Yean d skin contact Section IV - Physical/Chemical Characteristics Flammable Limits LEL No data Vect None Flash Point (Method Used) N/A Ventilation Local Exhaust No Special None Special Fire Fighting Procedures N/A Ventilation Local Exhaust No Special None Unusual Fire and Explosion Hazards None Yest Eye Protection Splas	IDENTITY (As Used on Label and List) Bromophenol Blu Section I Manufacturer's Name EDVOTEK, Inc. Address (Number, Street, City, State, 14676 Rothgeb Drive	e	CFR 1910.1200 Standard mu: specific requirements.	e not permitted. If attorn is available, nat. (301) 2 nation (301) 2 3	any item is not the space must 251-5990	Incompatibility Hazardous Decomposition or E Hazardous Polymerization Section VI - Health F Route(s) of Entry: Health Hazards (Acute and Carcinogenicity: None	Byproducts Sulf May Occur Will Not Occur lazard Data Inhalatior Chronic) A NTP? No o	None ur oxide X n? No cute ey	es and Conditi /e con IAR	d bromides tions to Avoid None Skin? Y, ntact: may	i 'es y cause irrit	tation OSHA Regulation?
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Instruction Instruction Special Fire Fighting Procedures N/A V/A Protective Gloves Yes Eye Protection Splash prof goggles Other Protective Clothing or Equipment None	IDENTITY (As Used on Label and List) Bromophenol Blu Section I Manufacturer's Name EDVOTEK, Inc. Address (Number, Street, City, State, 14676 Rothgeb Drive Rockville, MD 20850 Section II - Hazardous Ingred Hazardous Components [Specific Chemical Identity; Common Name(s)] This product contains no hazard Communication Standard. CAS Section III - Physical/Chemic Boiling Point Vapor Pressure (mm Hg.) Vapor Density (AIR = 1) Solubility in Water Solubility in Water Solubility in Water Elash Point (Method Used)	E Zip Code) E E E Zip Code) E E E E E E E E E E E E E E E E E E E	CFR 1910.1200 Standard mu: specific requirements.	e not permitted. If e not permitted. If fattion is available, nat. (301) 2 nation (301) 2 3 3 nation (301) 2 3 3 hall) httpr://www.commended HA Hazard	any item is not the space must 251-5990 251-5990 % (Optional) % (Optional) No data N/A No data	Incompatibility Hazardous Decomposition or E Hazardous Polymerization Section VI - Health F Route(s) of Entry: Health Hazards (Acute and Carcinogenicity: None Signs and Symptoms of Exi Medical Conditions Genera Emergency First Aid Proce Section VII - Precaut Steps to be Taken in case M Weat eye and ski Waste Disposal Method Can be disposed Precautions to be Taken in Avoid eye and sk Other Precautions Nor Section VIII - Control	Byproducts Sulf May Occur Will Not Occur Iazard Data Inhalatior Chronic) A NTP? No of posure NTP? No of posure NTP? No of posure NTP? No of posure NTP? No of posure NTP? No of posure Chronic) A Rinse con in second in selease in protection of the trash or Handling and Stor chronic contact ne I Measures	None IV oxida X I? No cute ey data Exposure tacted Handl down t ring	re con IAR areas ing ar bywipe he sink	d bromides tions to Avoid None Skin? Y. htact: may RC Monograp No data May cc None re swith copi nd Use e spill area k	i es y cause irrit phs? ause skin or eported ious amour i. Rinse witt	tation OSHA Regulation? No r eye irritation nts of water
V/A Protective Gloves Yes Eye Protection Splash prof goggles Unusual Fire and Explosion Hazards None Other Protective Clothing or Equipment None required	IDENTITY (As Used on Label and List) Bromophenol Blu Section I Manufacturer's Name EDVOTEK, Inc. Address (Number, Street, City, State, 14676 Rothgeb Drive Rockville, MD 20850 Section II - Hazardous Ingred Hazardous Components [Specific Chemical Identity, Common Name(s)] This product contains no hazard Communication Standard. CAS Section III - Physical/Chemic Boiling Point Vapor Pressure (mm Hg.) Vapor Density (AIR = 1) Solubility in Water Solubil Appearance and Odor Blue co Section IV - Physical/Chemic Flash Point (Method Used) No dat	E Zip Code) E E E Zip Code) E E E E E E E E E E E E E E E E E E E	CFR 1910.1200 Standard mu: specific requirements.	e not permitted. If e not permitted. If fattion is available, nat. (301) 2 nation (301) 2 3 3 nation (301) 2 3 3 hall) httpr://www.commended HA Hazard	any item is not the space must 251-5990 251-5990 % (Optional) % (Optional) No data N/A No data	Incompatibility Hazardous Decomposition or E Hazardous Decomposition or E Hazardous Polymerization Section VI - Health F Route(s) of Entry: Health Hazards (Acute and Carcinogenicity: None Signs and Symptoms of Exp Medical Conditions Genera Emergency First Aid Proce Emergency First Aid Proce Section VII - Precaut Steps to be Taken in case M Wear eye and sk Waste Disposal Method Can be disposed Precautions to be Taken in Avoid eye and sk Other Precautions Nor Section VIII - Control Respiratory Protection (Spe	Byproducts Sulf May Occur Will Not Occur Iazard Data Inhalatior Chronic) A NTP? No of posure Illy Aggravated by dures Rinse con ions for Safe Material is Release in protection au in the trash or Handling and Stor in contact ne I Measures ecity Type) NII	None IV oxida X I? No cute ey data Exposure tacted Handl down t ring	es and Conditi (e con IAR areas areas ing ar illed be sink he sink he sink	d bromides tions to Avoid None Skin? Y, ntact: may RC Monograp No data May cc None rr s with copi nd Use e spill area k	es y cause irrit phs? ause skin or eported ious amour ious amour ious amour ious amour ious amour ious amour ious amour	tation OSHA Regulation? No r eye irritation hts of water h water.
Unusual Fire and Explosion Hazards None None None None None None None None	IDENTITY (As Used on Label and List) Bromophenol Blu Section I Manufacturer's Name EDVOTEK, Inc. Address (Number, Street, City, State, 14676 Rothgeb Drive Rockville, MD 20850 Section II - Hazardous Ingred Hazardous Components [Specific Chemical Identity; Common Name(s)] This product contains no hazard Communication Standard. CAS Section III - Physical/Chemic Boiling Point Vapor Pressure (mm Hg.) Vapor Density (AIR = 1) Solubility in Water Solubi Appearance and Odor Blue co Section IV - Physical/Chemic Flash Point (Method Used) No dat Extinguishing Media N/A	E Zip Code) E E E Zip Code) E E E E E E E E E E E E E E E E E E E	CFR 1910.1200 Standard mu: specific requirements.	e not permitted. If e not permitted. If fattion is available, nat. (301) 2 nation (301) 2 3 3 nation (301) 2 3 3 hall) httpr://www.commended HA Hazard	any item is not the space must 251-5990 251-5990 % (Optional) % (Optional) No data N/A No data	Incompatibility Hazardous Decomposition or E Hazardous Decomposition or E Hazardous Polymerization Section VI - Health F Route(s) of Entry: Health Hazards (Acute and Carcinogenicity: None Signs and Symptoms of Exp Medical Conditions Genera Emergency First Aid Proce Emergency First Aid Proce Section VII - Precaut Steps to be Taken in case M Wear eye and sk Waste Disposal Method Can be disposed Precautions to be Taken in Avoid eye and sk Other Precautions Nor Section VIII - Control Respiratory Protection (Spe	Byproducts Sulf May Occur Will Not Occur Iazard Data Inhalatior Chronic) A NTP? No of posure Ully Aggravated by dures Rinse con ions for Safe Waterial is Release in protection of Handling and Stor cin contact ne I Measures ecify Type) NII Local Exhaust	None IN ONE None IN No Cute ey Cute ey Cut	re con IAR areas ing ar illed b/wipe he sink	d bromides tions to Avoid None Skin? Y. htact: may RC Monogran No data May cc None re swith copi nd Use e spill area k	i es y cause irrit phs? ause skin or eported ious amour ious amour ious amour ious amour jorator special	tation OSHA Regulation? No r eye irritation nts of water h water. None
None	IDENTITY (As Used on Label and List) Bromophenol Blu Section I Manufacturer's Name EDVOTEK, Inc. Address (Number, Street, City, State, 14676 Rothgeb Drive Rockville, MD 20850 Section II - Hazardous Ingred Hazardous Components [Specific Chemical Identity; Common Name(s)] This product contains no hazard Communication Standard. CAS Section III - Physical/Chemic Boiling Point Vapor Pressure (mm Hg.) Vapor Pressure (mm Hg.) Vapor Density (AIR = 1) Solubility in Water Solubi Appearance and Odor Blue co Section IV - Physical/Chemic Flash Point (Method Used) No dat Extinguishing Media N/A Special Fire Fighting Procedures	E Zip Code) E E Zip Code) E E E E E E E E E E E E E E E E E E E	CFR 1910.1200 Standard mu: specific requirements.	e not permitted. If e not permitted. If fattion is available, nat. (301) 2 nation (301) 2 3 3 nation (301) 2 3 3 hall) httpr://www.commended HA Hazard	any item is not the space must 251-5990 251-5990 % (Optional) % (Optional) No data N/A No data	Incompatibility Hazardous Decomposition or E Hazardous Polymerization Section VI - Health F Route(s) of Entry: Health Hazards (Acute and Carcinogenicity: None Signs and Symptoms of Exi, Medical Conditions Genera Emergency First Aid Proce Section VII - Precaut Steps to be Taken in case M Wear eye and ski Waste Disposal Method Can be disposed Precautions to be Taken in Avoid eye and ski Other Precautions Nor Section VIII - Control Respiratory Protection (Spe Ventilation	Byproducts Sulf May Occur Will Not Occur Hazard Data Inhalatior Chronic) A NTP? No c posure Illy Aggravated by dures Rinse con ions for Safe Material is Release in protection of Handling and Stor cin contact I me Handling and Stor cin contact ne I Measures ecify Type) Nit Local Exhaust Mechanical (Ger	None IN ONE None IN No Cute ey Cute ey Cut	re con IAR areas ing ar illed b/wipe he sink	d bromides tions to Avoid None Skin? Y. Intact: may RC Monograp No data May cc None re swith copi nd Use e spill area k	es y cause irrii phs? ause skin or eported ious amour i. Rinse with i. Rinse with inse with spirator Special Other	tation OSHA Regulation? No r eye irritation nts of water h water. None None
	IDENTITY (As Used on Label and List) Bromophenol Blu Section I Manufacturer's Name EDVOTEK, Inc. Address (Number, Street, City, State, 14676 Rothgeb Drive Rockville, MD 20850 Section II - Hazardous Ingred Hazardous Components [Specific Chemical Identity: Common Name(s)] This product contains no hazard Communication Standard. CAS Section III - Physical/Chemic Boiling Point Vapor Pressure (mm Hg.) Vapor Density (AIR = 1) Solubility in Water Solubil Appearance and Odor Blue co Section IV - Physical/Chemic Flash Point (Method Used) No dat Extinguishing Media N/A Special Fire Fighting Procedures N/	E Zip Code) E E E Zip Code) E E E E E E E E E E E E E E E E E E E	CFR 1910.1200 Standard mu: specific requirements.	e not permitted. If e not permitted. If fattion is available, nat. (301) 2 nation (301) 2 3 3 nation (301) 2 3 3 hall) httpr://www.commended HA Hazard	any item is not the space must 251-5990 251-5990 % (Optional) % (Optional) No data N/A No data	Incompatibility Hazardous Decomposition or E Hazardous Decomposition or E Section VI - Health F Route(s) of Entry: Health Hazards (Acute and Carcinogenicity: None Signs and Symptoms of Exp Medical Conditions Genera Emergency First Aid Proce Section VII - Precaut Steps to be Taken in case M Wear eye and ski Waste Disposal Method Can be disposed Precautions to be Taken in Avoid eye and ski Other Precautions Nor Section VIII - Control Respiratory Protection (Spe Ventilation Protective Gloves	Byproducts Sulf May Occur Will Not Occur Hazard Data Inhalatior Chronic) A NTP? No of posure Illy Aggravated by dures Rinse con ions for Safe Material is Release in protection ca l in the trash or Handling and Stor in contact ne I Measures ecify Type) NII Local Exhaust Mechanical (Ger Yes	None None None No Cute ey data Exposure tacted Handl down t ing OSH/MS	es and Conditi Ve con IAR areas ing ar illed b/wipe he sink	d bromides tions to Avoid None Skin? Y, ntact: may RC Monogran No data May co None ra s with copi nd Use e spill area k k	es y cause irrii phs? ause skin or eported ious amour i. Rinse with i. Rinse with inse with spirator Special Other	tation OSHA Regulation? No r eye irritation nts of water h water. None None

					Section V - Reactivit	ty Data						
		Material Safety Data	Sheet		Stability	Unstable		Conditi	ons to Avoid			
EDVOTEK.	May be us	ed to comply with OSHA's Haz 29 CFR 1910.1200 Standard r	ard Communicat	ion 1 for	,	Stable	Х		Unknown			
		specific requirements			Incompatibility		None	e				
IDENTITY (As Used on Label and Lis Phenol Red	it)	Note: Blank spaces applicable, or no info	ormation is available	If any item is not e, the space must	Hazardous Decomposition or	Byproducts Su	ulfur oxio	des anc	d bromide	s		
Section I		be marked to indicat	e that.		Hazardous Polymerization	May Occur		Condit	tions to Avoid	ł		
Manufacturer's Name		Emergency Telephone	Number (301)	251-5990	Section VI - Health	Will Not Occur Hazard Data	х		None			
EDVOTEK, Inc.		Telephone Number for info	ormation		- Route(s) of Entry:		ion? No)	Skin?	'es	Inges	stion? Yes
Address (Number, Street, City, Stat		Date Prepared	, ,	251-5990	Health Hazards (Acute and	Health Hazards (Acute and Chronic) Acute eye contact: may cause irritation						
14676 Rothgeb Drive Rockville, MD 20850		07/01/			Carcinogenicity:	NTP'		IAF	RC Monogra	iphs?	OSHA Re	gulation?
		Signature of Preparer (opt	ionai)		None Signs and Symptoms of E		o data		No data		No	
Section II - Hazardous Ingre		entify Information			May cause skin or eye irritation						non	
Hazardous Components [Specific Chemical Identity; Common Name(s	s)] OSI	HA PEL ACGIH TLV	Other Limits Recommended	% (Optional)	Medical Conditions Generally Aggravated by Exposure None reported						
This product contains no haza Communication Standard. C			OSHA Hazard		Emergency First Aid Procedures Rinse contacted areas with copious amounts of water					ter		
					Section VII - Precau	tions for Sat	e Han	dling a	nd Use			
Section III - Physical/Chem	ical Chara	cteristics			Steps to be Taken in case							
Boiling Point	No dat	G Specific Gravity (H ₂ 0 =	= 1)	No data		kin protection	and mo	op/wipe	e spill area	ı. Rinse w	vith water.	
Vapor Pressure (mm Hg.)	No dat	Eveneration Date		N/A	Waste Disposal Method Can be disposed	d in the trash o	or down	the sin	k			
Vapor Density (AIR = 1)	No dat	(Butyl Acetate = 1)		No data	Precautions to be Taken in	-	toring					
- 300	Solubility in Water Soluble					skin contact						
Appearance and Odor Red					Other Precautions	one						
Section IV - Physical/Chemical Characteristics Elash Point (Method Used) Elammable Limits LEL UEL				1	Section VIII - Contro	ol Measures						
Flash Point (Method Used) No d	ata	Flammable Limits	No data	UEL No data	Respiratory Protection (Sp	pecify Type)	NIOSH/N	/ISHA - a	approved rea	spirator		
Extinguishing Media N/A	Extinguishing Media N/A					Ventilation Local Exhaust No Special None Mechanical (General) No Other None						
Special Fire Fighting Procedures	N/A				Protective Gloves	Mechanical (G	ieneral)	IN	Eye Prote	Other ction	None	
Linucual Fire and Evaluation Hararda					Other Protective Clothing of	Yes or Equipment	Nono	roquiro	-	5	Splash prof (Joggies
Unusual Fire and Explosion Hazards None					Work/Hygienic Practices	Avoid ey		required				
					Section V - Reactivity	í						
EDVØTEK.	May be used	aterial Safety Data S to comply with OSHA's Hazar	d Communicatior		Stability Unstable Conditions to Avoid Stable X Unknown							
ED VOTEK.	Standard, 29	CFR 1910.1200 Standard mu specific requirements.	st be consulted to	or	Incompatibility None							
DENTITY (As Used on Label and List)		Note: Blank spaces an applicable, or no inform	e not permitted. If	any item is not	Hazardous Decomposition or E	Byproducts Sul	lfur oxid	les and	bromides	;		
Xylene Cyanol Section I		be marked to indicate t	hat.		Hazardous	May Occur		Conditi	ons to Avoid			
Manufacturer's Name		Emergency Telephone Nu	mber (201) a	51 5000	Polymerization Section VI - Health H	Will Not Occur	Х		None			
EDVOTEK, Inc.		Telephone Number for inform		51-5990	Route(s) of Entry:	Inhalatio	n? No		Skin? Y	es	Inges	stion? Yes
Address (Number, Street, City, State,	Zip Code)	Date Prepared		51-5990	Health Hazards (Acute and	<u> </u>		ye con	tact: ma	y cause ir		
14676 Rothgeb Drive Rockville, MD 20850		07/01/0			Carcinogenicity:	NTP?		IAR	C Monogra	phs?	OSHA Re	gulation?
100kviiić, mb 20000		Signature of Preparer (option	nal)		None Signs and Symptoms of Exp		data		No data		No	
Section II - Hazardous Ingred	ents/Iden	tify Information							May co	juse skin	or eye irrita	ition
Hazardous Components [Specific Chemical Identity; Common Name(s)]	OSHA	PEL ACGIH TLV Re	other Limits ecommended	% (Optional)	Medical Conditions General	,	y Exposu	Ire	None r	eported		
This product contains no hazarda Communication Standard. CAS			HA Hazard		Emergency First Aid Proce		ntacted	d areas	with copi	ous amo	ounts of wat	rer
o .:					Section VII - Precaut	ions for Safe	Hand	ling ar	nd Use			
Section III - Physical/Chemica					Steps to be Taken in case M							
Boiling Point	No data	Specific Gravity ($H_20 = 1$)	No data	Wear eye and ski Waste Disposal Method	in protection o	and mo	p/wipe	spill area	. Rinse w	ith water.	
Vapor Pressure (mm Hg.)	No data	Melting Point Evaporation Rate		N/A	Can be disposed	in the trash o	r down	the sink	:			
Vapor Density (AIR = 1)	No data	(Butyl Acetate = 1)		No data	Precautions to be Taken in I Avoid eye and sk	-	oring					
Solubility in Water Soluble	<u>)</u>				Other Precautions							
Appearance and Odor		, liquid, no odor			Nor	ne						
Section IV - Physical/Chemic Flash Point (Method Used)		Flammable Limits	LEL	UEL	Section VIII - Control							
No date	ב		No data	No data	Respiratory Protection (Spe		IOSH/M	SHA - aj	pproved res	-		
Extinguishing Media N/A					Ventilation	Local Exhaust Mechanical (Ge	neral)	No No		Special Other	None None	
Special Fire Fighting Procedures N/	A				Protective Gloves	Yes			Eye Protec	tion St	plash prof g	goggles
Unusual Fire and Explosion Hazards					Other Protective Clothing or	Equipment	None re	equired				
None				Work/Hygienic Practices Avoid eye and skin contact								

					Section V - Reactivity	y Data				
		aterial Safety Data Sh			Stability	Unstable		Conditions to Avoid		
EDVOTEK.		to comply with OSHA's Hazard CFR 1910.1200 Standard musi				Stable	Х	Unknown		
		specific requirements.			Incompatibility None					
IDENTITY (As Used on Label and List) Methylene Blue		Note: Blank spaces are applicable, or no informa	tion is available.	any item is not the space must	Hazardous Decomposition or Byproducts Sulfur oxides and bromides					
. ,		be marked to indicate the	at.		Hazardous	May Occur		Conditions to Avoid	i	
Section I		Encourse Talanhana Num			Polymerization	Will Not Occur	X	None		
Manufacturer's Name		Emergency Telephone Number (301) 251-5990			Section VI - Health Hazard Data					
EDVOTEK, Inc. Address (Number, Street, City, State,	Zip Code)	Telephone Number for informa		251-5990	Route(s) of Entry:	Inhalation? No Skin? Yes Ingestion? Ye				Ingestion? Yes
14676 Rothgeb Drive	, <i>,</i>	Date Prepared 07/01/03	()	.51-5550	Health Hazards (Acute and	Chronic)	Acute ey	/e contact: ma	y cause irrit	ation
Rockville, MD 20850					Carcinogenicity:	NTP?		IARC Monogra	phs?	OSHA Regulation?
		Signature of Preparer (optiona	al)		None		data	No data		No
					Signs and Symptoms of Exp	posure		May co	ause skin or	eye irritation
Section II - Hazardous Ingred		<u> </u>			Medical Conditions Genera	llv Aggravated b		re		
				% (Optional)						
	This product contains no hazardous materials as defined by the OSHA Hazard				Emergency First Aid Proce		ntacted	areas with cop	ious amour	uts of water
Communication Standard. CAS	5 # /220-/9-	3					macroa			
					Section VII - Precaut	ions for Safe	e Hand	ing and Use		
Section III - Physical/Chemic	al Charact	eristics			Steps to be Taken in case M	Material is Releas	sed for Sp	oilled		
Boiling Point	No data	Specific Gravity (H20 = 1)		No data	Wear eye and ski	in protection o	and mop	o/wipe spill area	ı. Rinse with	ı water.
Vapor Pressure (mm Hg.)	No data	Melting Point		N/A	Waste Disposal Method					
Vapor Density (AIR = 1)	No data	Evaporation Rate (Butyl Acetate = 1)		No data	Can be disposed in the trash or down the sink					
Solubility in Water		(Duty) Acetate = 1)			Precautions to be Taken in Handling and Storing Avoid eye and skin contact					
Solubility in Water Solubi	е				Avoid eye drid sk	Incontact				
Appearance and Odor Blue co	olor, liquid, ı	no odor			Other Precautions	ne				
Section IV - Physical/Chemic	al Charao	toristics								
Flash Point (Method Used)		Flammable Limits	LEL	UEL	Section VIII - Control					
No dat	a		No data	No data	Respiratory Protection (Spe	ecify Type) N	IOSH/MS	SHA - approved res	pirator	
Extinguishing Media N/A					Ventilation	Local Exhaust		No		None
						Mechanical (Ge	eneral)	No	Other	None
Special Fire Fighting Procedures N	/A				Protective Gloves	Yes		Eye Protec	ction Spla	ash prof goggles
Unusual Fire and Explosion Hazards					Other Protective Clothing or	r Equipment	None re	quired		
	None				Work/Hygienic Practices	Avoid eye	e and sk	in contact		

ED VOTEK.	May be used	to com CFR 19	al Safety Data bly with OSHA's Ha 10.1200 Standard pecific requirements	zard Communicati must be consulted	
IDENTITY (As Used on Label and List) Practice Gel Loa		on		s are not permitted. formation is available ite that.	
Section I					
Manufacturer's Name		Emer	gency Telephone	Number (201)	251-5990
EDVOTEK, Inc.		Talaal	hone Number for in	. ,	201-0990
Address (Number, Street, City, State,	Zip Code)	Telep	Ione Number for In		251-5990
14676 Rothgeb Drive Rockville, MD 20850		Prepared 07/0)1/03		
Section II - Hazardous Ingred	lients/Iden	Ŭ		,	
Hazardous Components [Specific Chemical Identity; Common Name(s)]	OSHA	PEL	ACGIH TLV	Other Limits Recommended	% (Optional)
This product contains no hazardous a Standard.	materials as de	fined b	y the OSHA Haza	rd Communication	on
Section III - Physical/Chemic	al Charact	eristi	cs		
Boiling Point	No data	Spe	cific Gravity (H ₂ 0	= 1)	No data
Vapor Pressure (mm Hg.)	No data	Mel	ting Point		No data
Vapor Density (AIR = 1)	No data		poration Rate tyl Acetate = 1)		No data
Solubility in Water Soluble					
Appearance and Odor Blue lique	uid, no odor				
Section IV - Physical/Chemic	al Charac	teristi	cs		
Flash Point (Method Used) No data	ı –	Flam	mable Limits	LEL No data	UEL No data
Extinguishing Media Dry chemical	, carbon dioxi	ie, wate	er spray or foam		
Special Fire Fighting Procedures Us breathing hazardous sulfur oxides an	-		• •	g fire. Keep upw	vind, avoid
Unusual Fire and Explosion Hazards	Unknown				

Section V - Reactivity	y Data				
Stability	Unstable		Conditions to Avoid	d	
	Stable	Х	None		
Incompatibility Nor	ne				
Hazardous Decomposition or E	Byproducts Sulfu	ır oxides	, and bromides		
Hazardous	May Occur		Conditions to Avo	id	
Polymerization	Will Not Occur	Х	None		
Section VI - Health H	lazard Data				
Route(s) of Entry:	Inhalatio	n? Y	es Skin?	Yes	Ingestion? Yes
Health Hazards (Acute and		te eye co r routes.	ontact: May cause	irritation. 1	No data available for
Carcinogenicity: No data availab	le NTP?		IARC Monogr	aphs?	OSHA Regulation?
Signs and Symptoms of Exp	posure May c	ause skir	n or eye irritation		
Medical Conditions Genera	lly Aggravated by	Exposu	re None report	ed	
Emergency First Aid Proce	Treat		matically and supp amounts of water.		inse contacted area
Section VII - Precaut	ions for Safe	Hand	ling and Use		
Steps to be Taken in case N					
Wear eye and skin prote	ection and mop sp	oill area.	Rinse with water.		
Waste Disposal Method Observe all federal, stat	e, and local regul	ations.			
Precautions to be Taken in	Handling and Sto	rina			
Avoid eye and skin con	tact.	0			
Other Precautions None					
Section VIII - Control	Measures				
Respiratory Protection (Spe	ecify Type)				
Ventilation	Local Exhaust		Yes	Special	None
	Mechanical (Ge	neral)	Yes	Other	None
Protective Gloves	les		Eye Prote	ection	Splash proof goggles
Other Protective Clothing or	Equipment	None re	quired		
Work/Hygienic Practices		Avoid e	ye and skin contac	rt	

EDVOTEK.	May be used	to comp CFR 19	Il Safety Data SI bly with OSHA's Hazard 10.1200 Standard mus becific requirements.	Communication	
IDENTITY (As Used on Label and List) Agarose			Note: Blank spaces are applicable, or no informa be marked to indicate th	ation is available,	any item is not the space must
Section I					
Manufacturer's Name		Emer	gency Telephone Nur	nber (201) 2	51-5990
EDVOTEK, Inc.		Tologi	none Number for inform	. ,	51-5990
Address (Number, Street, City, State, Zip Code)					51-5990
14676 Rothgeb Drive		Date I	Prepared 07/01/03	3	
Rockville, MD 20850	Signat	ure of Preparer (option	al)		
Section II - Hazardous Ingred	lients/Iden	tify Ir	formation		
Hazardous Components [Specific Chemical Identity; Common Name(s)]	OSHA	PEL		ther Limits commended	% (Optional)
This product contains no hazardous in Standard.	materials as de	efined b	y the OSHA Hazard (Communicatio	n
CAS #9012-36-6	-1.01				
Section III - Physical/Chemic	al Charact	eristi	cs		
Boiling Point For 1% solution	194° F	Spe	cific Gravity (H ₂ 0 = 1)		No data
Vapor Pressure (mm Hg.)	No data	Mel	ing Point		No data
Vapor Density (AIR = 1)	No data		poration Rate yl Acetate = 1)		No data
Solubility in Water Insoluble - cold	l				
Appearance and Odor White p	owder, no odd	or			
Section IV - Physical/Chemic	al Charac	teristi	cs N.D. = No dat	ta	
Flash Point (Method Used) No data	1	Flam	mable Limits	LEL N.D.	UEL N.D.
Extinguishing Media Water spray, dr	y chemical, ca	urbon di	oxide, halon or stand	ard foam	
Special Fire Fighting Procedures Possible fire ha	zard when exp	posed to	heat or flame		
Unusual Fire and Explosion Hazards	None				

Stability	Unstable		Conditions to Avoid	
	Stable	Х	None	
Incompatibility No	data available			
Hazardous Decomposition	or Byproducts			
Hazardous	May Occur	1	Conditions to Avoid	
Polymerization	Will Not Occur	· x	None	
Section VI - Health	h Hazard Data	-		
Route(s) of Entry:	Inhalati	ion? Yes	Skin? Yes	Ingestion? Yes
Health Hazards (Acute a			* *	
Carcinogenicity:	ion: No data availa NTP?		Ingestion: Large amoun IARC Monographs?	
ouronogeniony.	NIP	1	iAnd worldgraphs?	OSHA Regulation?
Signs and Symptoms of	Exposure No da	ta availab	le	
Medical Conditions Gen	erally Aggravated t	oy Exposi	Ife No data available	
		, , , , , ,	No data available	
Emergency First Aid Pro	ocedures Treat s	vmntome	tically and supportively	
	rieat s	ymptoma	ucany and supportively	
Section VII - Preca	utions for Saf	o Hand	lling and Llee	
Steps to be Taken in cas				
stope to be runor in bac			suitable container for disp	osal
	Sweep up and	a piace in	surance container for disp	
Waste Disposal Method				
	Normal solid	waste dis	posal	
Precautions to be Taken	in Handling and S	toring		
	None	-		
Other Dressutions				
Other Precautions	None			
	TONE			
Section VIII - Cont	rol Measures			
Respiratory Protection (Specify Type) C	hemical c	artridge respirator with ful	Il facepiece.
Ventilation	Local Exhaust		Specia	al
	Mechanical (G	eneral)Ge	n. dilution ventilationOthe	er
Protective Gloves Y	'es		Eye Protection	Splash proof goggles
Other Protective Clothing	g or Equipment	Imporuio	s alothing to provent skin	aontaat
		mpervio	us clothing to prevent skin	Contact
Work/Hygienic Practices	6	None		

					Section V - Reactivity	y Data				
		aterial Safety Data			Stability	Unstable	Co	nditions to Avoid		
EDVOTEK.		to comply with OSHA's Ha CFR 1910.1200 Standard				Stable	Х	None		
	olandara. 20	specific requirement			Incompatibility	Strong oxidizin	g agents			
IDENTITY (As Used on Label and List)	D (7	applicable, or no in	s are not permitted. If formation is available,	f any item is not the space must	Hazardous Decomposition or Byproducts Carbon monoxide, Carbon dioxide					
50x Electrophoresis	випег	be marked to indic	ate that.		Hazardous	May Occur	Co	onditions to Avoid		
Section I			N.L		Polymerization	Will Not Occur	Х	None		
Manufacturer's Name		Emergency Telephone	(301) 2	251-5990	Section VI - Health H	lazard Data				
EDVOTEK, Inc.			Route(s) of Entry:	Inhalation	Yes	Skin? Ye	s	Ingestion?		
Address (Number, Street, City, State,	Zip Code)			251-5990	Health Hazards (Acute and	Chronic)			-	
14676 Rothgeb Drive Date Prepared 07/01/03		3		None None						
Rockville, MD 20850		Signature of Preparer (or	otional)		Carcinogenicity: None iden	ntified NTP?		IARC Monograph	is?	OSHA Regulation?
					Signs and Symptoms of Ex	posure Irritation	to upper r	espiratory tract, sl	in, eyes	
Section II - Hazardous Ingred		tify Information			Medical Conditions Genera	Illy Aggravated by F	vnosure		-	
Hazardous Components [Specific Chemical Identity; Common Name(s)]	OSHA	PEL ACGIH TLV	Other Limits Recommended	% (Optional)			-	None		
This product contains no hazardo	ous materials a	is defined by the OSHA	Hazard		Emergency First Aid Proce	dures Ingestion:	If consci	ous, give large an	ounts of wa	.ter
Communication Standard.					Eyes: Flush with water			air Skin: Wash	vith soap an	d water
Section III - Physical/Chemic	al Charact	ariatiaa			Section VII - Precaut	ions for Safe I	landlin	g and Use		
Section III - Physical/Chemic	ai Charact				Steps to be Taken in case N					0 1 1 1
Boiling Point	No data	Specific Gravity (H20	= 1)	No data					*	e absorptive material.
Vapor Pressure (mm Hg.)	No data	Melting Point		No data		Dispose in accorda enviromental regul		Il applicable feder	al, state, an	d local
Vapor Density (AIR = 1)	No data	Evaporation Rate (Butyl Acetate = 1)		No data	Precautions to be Taken in	Handling and Stori	ng			
Solubility in Water Appreciable, (greater than 1	1%)				Avoid eye and skin	aantaat			
	greater than 1	5.70)			Other Precautions	Avoid eye and skii	i contact.			
Appearance and Odor Clear, liquid, s	light vinegar	odor			Other Frecautions					
Castien IV Rhusiaal/Ohamia		aviation ND	= No data			None				
Section IV - Physical/Chemic Flash Point (Method Used)	al Charac	1	LEL	UEL	Section VIII - Contro					
Plash Point (Method Used) No d	ata	Flammable Limits	N.D.	N.D.	Respiratory Protection (Sp	ecify Type)				
Extinguishing Media	Jse extinguish	ing media appropriate fo	r surrounding fire.		Ventilation	Local Exhaust	Yes		pecial	None
Special Fire Fighting Procedures		e				Mechanical (Gene	eral) Ye	s	Other	None
		e equipment and SCBA vitive pressure mode.	with full facepiece		Protective Gloves Yes			Eye Protecti	on Safe	ety goggles
Unusual Fire and Explosion Hazards		•			Other Protective Clothing of	r Equipment No	ne			
	None identified	1			Work/Hygienic Practices	No	ne			