

## 5. Appendix



### Contents

General Guidelines for Preparation and Storage of Buffers and Solutions	89
Commonly Used Buffers and Solutions	90
Spectrophotometric Measurement of Nucleic Acid Concentration	91
Bacterial Culture Media and Buffers	92
Agarose Gel Electrophoresis Buffers for Analysis of DNA	93
Commonly Used DNA Markers in Agarose Gel Electrophoresis	93
Southern Transfer Buffers and Solutions	94
Formaldehyde Agarose Gel Electrophoresis Buffers for Analysis of RNA	94
Northern Transfer Solution	95
Colony-Blot Solutions	95
SDS-PAGE Buffers and Solutions for Analysis of Proteins	96

continues overleaf

## 5. Appendix



### Contents

Continued

Coomassie Staining Solutions	97
Western Transfer Buffers and Solutions	97
Protein Dot-Blot Preparation Buffers	98
Immunodetection Buffers	98
Chromogenic Substrates for Immunoblotting Procedures	99
Coating and Assay Buffers and Solutions for ELISA Procedures	99
Substrates and Solutions for Protein Assay Procedures	100
QIAGEN Literature	101
QIAGEN on the World Wide Web — <a href="http://www.qiagen.com">www.qiagen.com</a>	102
QIAGEN Technical Support	103
Trademarks and Disclaimers	103

This Appendix provides recipes for the media, buffers, and solutions that are used with the protocols described in the previous chapters. Please be aware that different versions of the same medium, buffer, or solution may exist, so the recipes described here may differ slightly from those in other molecular biology manuals. The recipes described here are those used by the scientists at QIAGEN, and provide optimal results. This Appendix also contains additional useful information for analysis of nucleic acids and proteins, as well as information about different technical resources offered by QIAGEN.

## General Guidelines for Preparation and Storage of Buffers and Solutions

### Preparing buffers and solutions

The following guidelines should be followed when preparing buffers and solutions for use in the procedures described in this Bench Guide.

1. It is generally easier to start by weighing dry components. Carefully weigh out the desired amount of each component.

**Tip** Large amounts of components can be weighed directly into the vessel in which they will be dissolved, e.g., measuring cylinder or beaker.

**Tip** For smaller amounts, use weighing boats and add each component sequentially once the correct amount has been weighed out. Rinse weighing boats with distilled water over the buffer vessel to ensure that all the substance weighed out has been added.

2. Measure liquid components using a measuring cylinder and add to the dry components. Rinse the measuring cylinder with a small amount of distilled water and empty into the vessel.
3. Add distilled water (or the appropriate solvent) to approximately 90% of the desired volume.

▶▶▶ continues overleaf



4. Stir the solution using a stir bar and a magnetic stirrer, and adjust the pH with the appropriate acid or base to the desired value using a calibrated pH meter.

**Tip** Add acid or base dropwise and allow the pH to stabilize before adding further acid or base.

**Tip** Buffer pH changes with temperature. If you will be working with buffers at a specific temperature, e.g., 4°C, prepare buffers using water at 4°C. Ensure that your pH meter is adjusted to compensate for the change in temperature.

5. Add distilled water to the desired volume.
6. Filter-sterilize buffer through a 0.45 µm filter, or autoclave.

**Tip** Do not autoclave solutions that will be used in experiments that are sensitive to bacterial endotoxins. Filter-sterilize such solutions instead.

### Storing buffers and solutions

In general, buffers and solutions should be stored at 2–8°C. Solutions containing unstable compounds (e.g., antibiotics) should be stored in aliquots at –20°C. Bottles should be clearly labeled with the name of the buffer/solution, the pH, the components and their concentration, and the date of preparation. When preparing buffers from stock solutions, check and, if necessary, adjust the pH before adjusting the buffer to the final volume.

## Commonly Used Buffers and Solutions

Buffer	Components per liter	
20x SSC	NaCl	175.3 g
	Sodium citrate·2H <sub>2</sub> O	88.2 g
	<i>Adjust pH to 7.0 with NaOH</i>	
0.5 M EDTA, pH 8.0	Ethylenediaminetetraacetic acid (EDTA)·2H <sub>2</sub> O	186.1 g
	NaOH	~20 g
	<i>Adjust pH to 8.0 with NaOH</i> <i>EDTA will not go into solution until the pH is about 8.0</i>	
1 M Tris-Cl	Tris base	121.1 g
<i>Adjust to desired pH with HCl</i>		
TE, pH 7.4	1 M Tris-Cl, pH 7.4	10 ml
	0.5 M EDTA, pH 8.0	2 ml
10% SDS	Sodium dodecyl sulfate (SDS)	100 g
<i>Adjust pH to 7.2 with HCl</i>		
<i>There is no need to sterilize 10% SDS</i>		



## Spectrophotometric Measurement of Nucleic Acid Concentration

Spectrophotometric conversions for calculating the concentration of nucleic acids from their absorbance at 260 nm ( $A_{260}$ ) are given in Table 1.

**Table 1. Spectrophotometric conversions**

1 $A_{260}$ unit	Concentration ( $\mu\text{g/ml}$ )*
dsDNA	50
ssDNA	33
RNA	40
Oligonucleotides	20–30

Adapted from reference 1.

\* This relationship is only valid for measurements made at neutral pH, and is based on a standard 1 cm path length.

An example of the calculation involved in RNA quantification is shown below:

Volume of RNA sample = 100  $\mu\text{l}$

Dilution = 10  $\mu\text{l}$  of RNA sample + 490  $\mu\text{l}$  distilled water (1/50 dilution).

Measure absorbance of diluted sample in a quartz cuvette.

$$A_{260} = 0.23$$

$$\begin{aligned} \text{Concentration of RNA sample} &= \text{Spectrophotometric conversion} \times A_{260} \times \text{dilution factor} \\ &= 40 \times 0.23 \times 50 \\ &= 460 \mu\text{g/ml} \end{aligned}$$

$$\begin{aligned} \text{Total yield} &= \text{concentration} \times \text{volume of sample in milliliters} \\ &= 460 \mu\text{g/ml} \times 0.1 \text{ ml} \\ &= 46 \mu\text{g} \end{aligned}$$

**Tip** Spectrophotometric measurements must be taken using a quartz cuvette. If you use more than one cuvette to measure multiple samples, they must be matched.

**Tip** To ensure readings fall within the linear range, values should lie between 0.1 and 1.0.

**Tip** Dilute samples in a low-salt buffer with neutral pH (e.g., 10 mM Tris-Cl, pH 7.0) when making spectrophotometric measurements for determining nucleic acid concentration.

**Tip** Spectrophotometric quantification of DNA is accurate only when the sample is not contaminated with RNA, and vice versa.

**Tip** Phenol has an absorbance maximum of 270–275 nm, which is close to that of DNA and RNA. Phenol contamination mimics both higher yields and higher purity because of an upward shift in the  $A_{260}$  value.



## Bacterial Culture Media and Buffers

### Media

Medium	Components per liter		Medium	Components per liter	
<b>LB</b>	Tryptone	10 g	<b>SOC</b>	Tryptone	20 g
	Yeast extract	5 g		Yeast extract	5 g
	NaCl	10 g		NaCl	0.5 g
<i>Autoclave</i>		<i>Dissolve, then add:</i>			
<b>LB agar*</b>	Tryptone	10 g		250 mM KCl	10 ml
	Yeast extract	5 g		2 M MgCl <sub>2</sub>	5 ml
	NaCl	10 g		<i>Autoclave, cool, then add:</i>	
	Agar: for 1.5% LB agar	15 g		1 M sterile glucose <sup>†</sup>	20 ml
	for 0.7% LB agar	7 g			
	<i>Autoclave</i>				

\* For details on preparing LB-agar plates, see "Preparation of LB-agar plates", page 5.

<sup>†</sup> Do not sterilize by autoclaving! Filter the solution through a 0.2 µm filter instead.

### Buffers for preparing competent *E. coli*

Buffer	Composition of working solutions	Components per liter	
<b>TFB1</b>	100 mM RbCl	RbCl	12.1 g
	50 mM MnCl <sub>2</sub>	MnCl <sub>2</sub> ·4H <sub>2</sub> O	9.9 g
	30 mM potassium acetate	Potassium acetate	2.9 g
	10 mM CaCl <sub>2</sub>	CaCl <sub>2</sub>	1.1 g
	15% glycerol	Glycerol	15 ml
	pH 5.8	<i>Adjust pH to 5.8</i>	
		<i>Sterilize by filtration</i>	
<b>TFB2</b>	10 mM MOPS	MOPS	2.1 g
	10 mM RbCl	RbCl	1.2 g
	75 mM CaCl <sub>2</sub>	CaCl <sub>2</sub>	8.3 g
	15% glycerol	Glycerol	15 ml
	pH 6.8	<i>Adjust pH to 6.8 with KOH</i>	
		<i>Sterilize by filtration</i>	



## Agarose Gel Electrophoresis Buffers for Analysis of DNA

Buffer	Composition of working solution	Components
<b>Stock solution components per liter</b>		
<b>TAE</b>	<b>1x</b> 40 mM Tris-acetate 1 mM EDTA	<b>50x</b> Tris base 242 g Glacial acetic acid 57.1 ml 0.5 M EDTA, pH 8.0 100 ml
<b>TBE</b>	<b>0.5x</b> 45 mM Tris-borate 1 mM EDTA	<b>5x</b> Tris base 54 g Boric acid 27.5 g 0.5 M EDTA, pH 8.0 20 ml
<b>Components per 10 ml</b>		
<b>Gel loading buffer</b>	<b>6x</b> 0.25% bromophenol blue 0.25% xylene cyanol FF 40% (w/v) sucrose*	Bromophenol blue 25 mg Xylene cyanol FF 25 mg Sucrose* 4 g

\* 15% Ficoll (Type 400) or 30% glycerol can be used instead of sucrose.

## Commonly Used DNA Markers in Agarose Gel Electrophoresis

$\lambda$ HindIII	$\lambda$ HindIII-EcoRI	$\lambda$ EcoRI	$\Phi$ X174 HaeIII	100 bp ladder <sup>†</sup>	1 kb ladder <sup>‡</sup>
23,130	21,226	21,226	1,353	2,072	12,216
9,416	5,148	7,421	1,078	1,500	11,198
6,557	4,973	5,804	872	1,400	10,180
4,361	4,268	5,643	603	1,300	9,162
2,322	3,530	4,878	310	1,200	8,144
2,027	2,027	3,530	281	1,100	7,126
564	1,904		271	1,000	6,108
125	1,584		234	900	5,090
	1,375		194	800	4,072
	947		118	700	3,054
	831		72	600	2,036
	564			500	1,636
	125			400	1,018
				300	517
				200	506
				100	396
					344
					298
					220
					201
					154
					134
					75

Sizes in base pairs

<sup>†</sup> Invitrogen, cat. no. 15628-019.

<sup>‡</sup> Invitrogen, cat. no. 15615-0116.



## Southern Transfer Buffers and Solutions

Buffer	Composition of working solution	Components per liter	
<b>Denaturation buffer</b>	1.5 M NaCl	NaCl	87.7 g
	0.5 M NaOH	NaOH	20 g
<b>Neutralization buffer</b>	1 M Tris·Cl	Tris base	121.1 g
	1.5 M NaCl	NaCl	87.7 g
	pH 7.4	Adjust pH to 7.4 with HCl	
<b>20x SSC</b>	3 M NaCl	NaCl	175.3 g
	0.3 M sodium citrate	Sodium citrate·2H <sub>2</sub> O	88.2 g
		Adjust pH to 7.0 with NaOH	

## Formaldehyde Agarose Gel Electrophoresis Buffers for Analysis of RNA

Buffer	Composition of working solution	Components	
<b>Stock solution components per liter</b>			
<b>FA gel buffer*</b>	<b>1x</b> 20 mM MOPS 5 mM sodium acetate 1 mM EDTA pH 7.0	<b>10x</b> MOPS, free acid	41.9 g
		Sodium acetate·H <sub>2</sub> O	6.8 g <sup>†</sup>
		0.5 M EDTA, pH 8.0	20 ml
		Adjust pH to 7.0 with NaOH	
<b>Components per liter</b>			
<b>FA gel running buffer</b>	<b>1x</b> 1x FA gel buffer 2.5 M formaldehyde <sup>‡</sup>	10x FA gel buffer	100 ml
		37% (12.3 M) formaldehyde	20 ml
		RNase-free water <sup>§</sup>	880 ml
<b>Components per 10 ml</b>			
<b>RNA loading buffer</b>	<b>5x</b> 0.25% bromophenol blue 4 mM EDTA 0.9 M formaldehyde <sup>‡</sup> 20% glycerol 30.1% formamide 4x FA gel buffer	Bromophenol blue	25 mg <sup>¶</sup>
		0.5 M EDTA, pH 8.0	80 µl
		37% (12.3 M) formaldehyde	750 µl
		Glycerol	2 ml
		Formamide	3.084 ml
		10x FA gel buffer	4 ml
		Stable for ≈ 3 months at 2–8°C	

\* FA gel buffer turns yellow during autoclaving. This has no effect on gel electrophoresis. <sup>†</sup> Alternatively, 4.1 g anhydrous sodium acetate

<sup>‡</sup> Toxic and/or mutagenic. Take appropriate safety measures. <sup>§</sup> See page 48.

<sup>¶</sup> Alternatively, use 16 µl of a saturated aqueous bromophenol blue solution instead of 25 mg powder. To make this solution, add solid bromophenol blue to distilled water, mix, and continue to add more bromophenol blue until no more will dissolve. Centrifuge to pellet the undissolved powder, and carefully pipet the saturated supernatant.



## Northern Transfer Solution

Buffer	Composition of working solution	Components per liter	
<b>20x SSC</b>	3 M NaCl	NaCl	175.3 g
	0.3 M sodium citrate	Sodium citrate·2H <sub>2</sub> O	88.2 g
		<i>Adjust pH to 7.0 with NaOH</i>	

## Colony-Blot Solutions

Solution	Composition of working solution	Components per liter	
<b>10% SDS</b>	10% (w/v) SDS	SDS	100 g
		<i>Adjust pH to 7.2 with HCl</i>	
<b>Denaturing solution</b>	0.5 M NaOH	NaOH	20 g
	1.5 M NaCl	NaCl	87.7 g
<b>Neutralization solution</b>	1.5 M NaCl	NaCl	87.7 g
	0.5 M Tris·Cl	Tris base	60.6 g
	pH 7.4	<i>Adjust pH to 7.4 with HCl</i>	
<b>20x SSC</b>	3 M NaCl	NaCl	175.3 g
	0.3 M sodium citrate	Sodium citrate·2H <sub>2</sub> O	88.2 g
		<i>Adjust pH to 7.0 with HCl</i>	



## SDS-PAGE Buffers and Solutions for Analysis of Proteins

Solution	Composition of working solution	Components	
		Components per liter	
<b>30% acrylamide/ 0.8% bis-acrylamide stock solution*</b>	30% acrylamide	Acrylamide	300 g
	0.8% bis-acrylamide ( <i>N,N'</i> -methylene-bis-acrylamide)	Bis-acrylamide	8 g
<b>2.5x separating gel buffer</b>	1.875 M Tris-Cl	Tris base	227.1 g
	0.25% SDS pH 8.9	SDS <i>Adjust pH to 8.9 with HCl</i>	2.5 g
<b>5x stacking gel buffer</b>	0.3 M Tris-phosphate	Tris base	36.3 g
	0.5% SDS pH 6.7	SDS <i>Adjust pH to 6.7 with phosphoric acid</i>	5 g
<b>5x electrophoresis buffer</b>	0.5 M Tris base	Tris base	60.6 g
	1.92 M glycine 0.5% SDS	Glycine SDS <i>pH should be 8.8 without adjustment</i>	144.1 g 5 g

		Components per 10 ml	
<b>5x SDS-PAGE sample buffer</b>	0.225 M Tris-Cl, pH 6.8	1 M Tris-Cl, pH 6.8	2.25 ml
	50% glycerol	Glycerol	5 ml
	5% SDS	SDS	0.5 g
	0.05% bromophenol blue	Bromophenol blue	5 mg
	0.25 M dithiothreitol (DTT) <sup>†</sup>	1 M DTT	2.5 ml

\* Can be purchased as a ready-to-use solution from several companies, e.g., Rotiphorese® Gel 30 (Roth, cat. no. 3029.1) or Bio-Rad® 30% Acrylamide/Bis Solution (Bio-Rad, cat. no. 161-0158). Acrylamide is a potent neurotoxin and is absorbed through the skin. Take appropriate safety measures particularly when weighing solid acrylamide/bisacrylamide, and also when working with solutions and gels.

<sup>†</sup> Do not autoclave solutions containing DTT.



## Coomassie® Staining Solutions

Solution	Composition of working solution	Components per 100 ml	
<b>Coomassie staining solution</b>	0.05% (w/v) Coomassie Brilliant Blue R-250	Coomassie Brilliant Blue R-250*	50 mg
	40% (v/v) ethanol	Ethanol	40 ml
	10% (v/v) glacial acetic acid	<i>Dissolve, then add:</i> Glacial acetic acid	10 ml
	50% (v/v) water	Water	50 ml
		<i>Filter before use</i>	
<b>Destaining solution</b>	40% (v/v) ethanol	Ethanol	40 ml
	10% (v/v) glacial acetic acid	Glacial acetic acid	10 ml
	50% (v/v) water	Water	50 ml

\* e.g., SIGMA, cat. no. B 0149.

## Western Transfer Buffers and Solutions

Solution	Composition of working solution	Components	
		Components per liter	
<b>Semi-dry transfer buffer</b>	25 mM Tris base	Tris base	3.0 g
	150 mM glycine	Glycine	11.3 g
	10% (v/v) methanol	Methanol	100 ml
		<i>pH should be 8.3 without adjustment</i>	
<b>Tank-blotting transfer buffer</b>	25 mM Tris base	Tris base	3.0 g
	150 mM glycine	Glycine	11.3 g
	20% (v/v) methanol	Methanol	200 ml
		<i>pH should be 8.3 without adjustment</i>	
		Components per 100 ml	
<b>Ponceau S staining solution</b>	0.5% (w/v) Ponceau S	Ponceau S	0.5 g
	1% (v/v) glacial acetic acid	Glacial acetic acid	1 ml



## Protein Dot-Blot Preparation Buffers

Solution	Composition of working solution	Components per liter	
<b>Dilution buffer for denaturing conditions</b>	8 M urea	Urea	480.5 g
	100 mM NaH <sub>2</sub> PO <sub>4</sub>	NaH <sub>2</sub> PO <sub>4</sub> ·H <sub>2</sub> O	13.8 g
	10 mM Tris·Cl	Tris base	1.2 g
	pH 8.0	<i>Adjust pH to 8.0 with HCl</i>	
<b>Dilution buffer for native conditions</b>	50 mM NaH <sub>2</sub> PO <sub>4</sub>	NaH <sub>2</sub> PO <sub>4</sub> ·H <sub>2</sub> O	17.5 g
	300 mM NaCl	NaCl	6.9 g
	pH 8.0	<i>Adjust pH to 8.0 with NaOH</i>	

## Immunodetection Buffers

Buffer*	Composition of working solution	Components per liter	
<b>TBS buffer</b>	10 mM Tris·Cl	Tris base	8.8 g
	150 mM NaCl	NaCl	1.2 g
	pH 7.5	<i>Adjust pH to 7.5 with HCl</i>	
<b>TBS-Tween®/Triton® buffer</b>	20 mM Tris·Cl	Tris base	2.4 g
	500 mM NaCl	NaCl	29.2 g
	0.05% (v/v) Tween 20	Tween 20	500 µl
	0.2% (v/v) Triton X-100†	Triton X-100	2 ml
	pH 7.5	<i>Adjust pH to 7.5 with HCl</i>	
<b>Blocking buffer</b>	3% (w/v) BSA in TBS buffer	BSA‡	30 g
		<i>Dissolve in TBS buffer</i>	
	<i>Alternative:</i> 1% (w/v) alkali-soluble casein in TBS buffer	Alkali-soluble casein§	10 g
	<i>Dissolve in TBS buffer</i>		
<b>Secondary antibody dilution buffer</b>	10% (w/v) nonfat dried milk powder in TBS buffer	Nonfat dried milk powder	100 g
		<i>Dissolve in TBS buffer</i>	
	<i>Alternative:</i> 1% (w/v) alkali-soluble casein in TBS buffer	Alkali-soluble casein§	10 g
	<i>Dissolve in TBS buffer</i>		

\* Buffers containing BSA or milk powder should be prepared freshly each time they are required. Store other buffers at 2–8°C to avoid microbial spoilage. Do not use azide as a bactericide as this will inhibit the peroxidase detection reaction.

† SIGMA, cat. no. x-100 ‡ SIGMA, cat. no. A7906. § Merck, cat. no. 1.02241.



## Chromogenic Substrates for Immunoblotting Procedures

Chromogenic substrate*	Abbreviation	Reaction product
<b>Peroxidase substrates</b>		
3,3'-Diaminobenzidine	DAB	Brown, insoluble
3-Amino-9-ethylcarbazole	AEC	Red, insoluble
4-Chloro-1-naphthol	4C1N	Blue, insoluble
<b>Alkaline phosphatase substrate</b>		
5-Bromo-4-chloro-3-indolyl phosphate/Nitro blue tetrazolium	BCIP/NBT	Blue, insoluble

\* Prepare solutions for alkaline phosphatase or horseradish-peroxidase reaction immediately before use.

## Coating and Assay Buffers and Solutions for ELISA Procedures

Solution	Composition of working solution	Components per liter	
<b>PBS</b>	50 mM potassium phosphate 150 mM NaCl pH 7.2	0.5 M $K_2HPO_4$ 0.5 M $KH_2PO_4$ NaCl <i>pH should be 7.2 without adjustment</i>	71.7 ml 28.3 ml 8.8 g
<b>50 mM sodium carbonate, pH 9.6</b>	50 mM $Na_2CO_3$ pH 9.6	$Na_2CO_3 \cdot H_2O$ <i>Adjust pH to 9.6 with NaOH</i>	6.2 g
<b>50 mM sodium carbonate, pH 10.6</b>	50 mM $Na_2CO_3$ pH 10.6	$Na_2CO_3 \cdot H_2O$ <i>Adjust pH to 10.6 with NaOH</i>	6.2 g
<b>PBS/BSA<sup>†</sup></b>	0.2% BSA in PBS	BSA <i>Dissolve in PBS buffer</i>	2 g
<b>Microplate blocking buffer<sup>†</sup></b>	2.0% sucrose 0.1% BSA 0.9% NaCl	Sucrose BSA NaCl	20 g 1 g 9 g

<sup>†</sup> Buffers containing BSA or milk powder should be prepared freshly each time they are required.



## Substrates and Solutions for Protein Assay Procedures

Substrate*/Solution	Components	
Phosphate–citrate buffer, pH 5.0	0.2 M Na <sub>2</sub> HPO <sub>4</sub>	51.5 ml
	0.1 M citric acid	48.5 ml
<b>Substrate for alkaline phosphatase</b>		
p-Nitrophenyl Phosphate (pNPP)	pNPP	50 mg
	1 M diethanol-amine; 0.01% MgCl <sub>2</sub> ·6 H <sub>2</sub> O, pH 9.8	10 ml
<b>Substrate for horseradish peroxidase</b>		
2,2'-Azino-bis[3-Ethylbenz-thiazoline-6-Sulfonic Acid] (ABTS®)	ABTS	10 mg
	Phosphate–citrate buffer	10 ml
	<i>Immediately before use add</i> 30% H <sub>2</sub> O <sub>2</sub>	2 µl

Alternative substrates for horseradish peroxidase <sup>†</sup>		
o-Phenylenediamine (OPD)	OPD	10 mg
	Phosphate–citrate buffer	10 ml
	<i>Immediately before use add</i> 30% H <sub>2</sub> O <sub>2</sub>	2 µl
3,3',5,5'-Tetramethylbenzidine (TMB)	TMB	1 mg
	DMSO	1 ml
	<i>Dissolve then add</i> Phosphate–citrate buffer	9 ml

\* Prepare substrates immediately before use.

† These substrates will yield higher sensitivity, but depending on the antibody systems used, they can also lead to increased background signals.

### Details of substrates for protein assay procedures

Substrate	Wavelength for monitoring color development	Stopping reagent <sup>‡</sup>	Wavelength for determining stopped product
pNPP	405 nm	3 M NaOH	405 nm
ABTS	415 nm	1% SDS	415 nm
OPD	450 nm	3 M HCl or 3 M H <sub>2</sub> SO <sub>4</sub>	492 nm
TMB	370 nm or 650 nm	2 M H <sub>2</sub> SO <sub>4</sub>	450 nm

‡ If the reaction is stopped, the signal will increase slightly, depending on the substrate used, and the color will be stable for a period of time.

Further information about buffers and solutions for molecular biology can be found in commonly used manuals (e.g., 1,2).



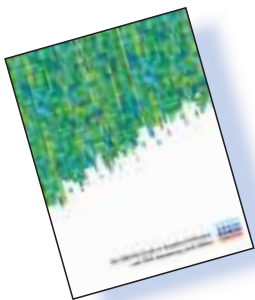
## QIAGEN Literature

It is beyond the scope of this Bench Guide to give detailed information on all methods and applications used in molecular biology. However, QIAGEN offers a wide range of technical literature for specific applications to help you plan and carry out your research. These guides include:



### **Critical Factors for Successful PCR and the QIAGEN PCR and RT-PCR Application Guide**

*Critical Factors for Successful PCR* provides practical guidelines for using QIAGEN products in standard and specialized PCR applications. Useful information is presented on topics such as primer design, use and design of degenerate primers, amplification of longer PCR products, hot-start PCR, and much more. The *QIAGEN PCR and RT-PCR Application Guide* presents a wide range of PCR applications, from standard PCR and RT-PCR to more specialized techniques such as methylation-specific PCR, RAPD-PCR, and differential display.

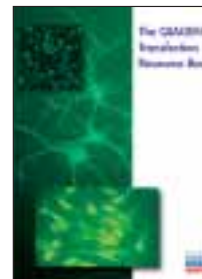


### **The QIAGEN Guide to Template Purification and DNA Sequencing**

Useful to both experts and novices, this guide includes sequencing-related protocols, applications, and strategies, as well as technical information and helpful troubleshooting tips.

### **The QIAGEN Transfection Resource Book**

This book is a valuable reference that includes helpful information on transfection, such as optimization and troubleshooting, as well as general cell culture protocols and background information.



### **Plant Nucleic Acid Purification**

This application guide gives an overview of the techniques used for plant nucleic acid purification and provides useful guidelines for successful results..



This literature, as well as many other resources published by QIAGEN, is available to download or view in a convenient PDF format 24 hours a day at [www.qiagen.com/literature/litrequest.asp](http://www.qiagen.com/literature/litrequest.asp) (see page 102). Literature in printed format can also be requested online, or through your local Sales Representative or distributor (see back cover for contact information).



## QIAGEN on the World Wide Web — [www.qiagen.com](http://www.qiagen.com)

No matter where you are in the world, you can visit the QIAGEN web site anytime to find technical information, details about our products and services, and lots more! An overview of some of the things you can find on the QIAGEN web site is provided below. To find specific information quickly, try the QIAGEN search form at [www.qiagen.com/search/search.asp](http://www.qiagen.com/search/search.asp).

### Technical Resources

- ▶ **Literature and protocols** — download or view PDF files of QIAGEN handbooks, protocols, and other resources, or request printed literature at [www.qiagen.com/literature/](http://www.qiagen.com/literature/).
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