

Certificate of Analysis & Product Manual



Triple Repeat Disorders Genotyping

Fragile X, Myotonic Dystrophy, Friedreich's Ataxia, Huntington's disease

Fluorescent Probes, siRNA, Hybridization and Detection Reagents

Fragile X CGG Repeat Genotyping GScan™ V2 Kits

Fragile X CGG triple repeat fluorescent genotyping

Catalog No. 40-2004-15XX

Storage Condition: See Material Supplied List

For Research Use Only. Not for use in diagnostic procedures for clinical purposes

Important Information

Fragile X GScan™ Version 2 kit components are not compatible with earlier version kit components.

All Gene Link products are for research use only.

Not for use in diagnostic procedures for clinical purposes.

Genotyping using this kit requires use of the appropriate fluorescent genetic analyzer instrument and software capable of detection of fluorescently labeled fragments of varying lengths.

Product to be used by experienced researchers appropriately trained in performing molecular biology techniques following established safety procedures. Additional qualification and certification is required for interpretation of results.



Material Supplied

Fragile X CGG Repeat Genotyping GScan™ V2 Kits

Fragile X GScan™ Version 2 kit components are not compatible with earlier version kit components.

Fragile X CGG Repeat Genotyping GScan™ V2 Kits			
Kit	Catalog No.	Description	Size
<input type="checkbox"/>	40-2004-15FM	Fragile X CGG Repeat Genotyping GScan™ V2 6-Fam Kit. 100 X 25 µL rxns.	100 rxns
<input type="checkbox"/>	40-2004-15FMS	Fragile X CGG Repeat Genotyping GScan™ V2 6-Fam Kit. 20 X 25 µL rxns.	20 rxns

Fragile X Genotyping GScan™ V2 Kit 100 Reactions Components			
Content	Catalog No.	Description	Size
<input type="checkbox"/>	40-2004-15LFM	Fragile X GScan™ V2 6-Fam Component L	450 µL
<input type="checkbox"/>	40-2004-15E	Fragile X GScan™ V2 Component E	1.2 mL
<input type="checkbox"/>	40-2004-15D	Fragile X GScan™ V2 Component D	300 µL
<input type="checkbox"/>	40-2004-15P	Fragile X GScan™ 6-Fam amplified 29/85 CGG Repeats control	10 µL

Fragile X Genotyping GScan™ V2 Kit 20 Reactions Components			
Content	Catalog No.	Description	Size
<input type="checkbox"/>	40-2004-15LFMS	Fragile X GScan™ V2 6-Fam Component L	90 µL
<input type="checkbox"/>	40-2004-15ES	Fragile X GScan™ V2 Component E	250 µL
<input type="checkbox"/>	40-2004-15DS	Fragile X GScan™ V2 Component D	60 µL
<input type="checkbox"/>	40-2004-15PS	Fragile X GScan™ 6-Fam amplified 29/85 CGG Repeats control	5 µL

Storage Condition

Store at -20°C


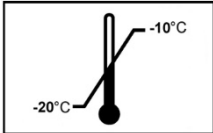

Certificate of Analysis & Product Specifications




The Fragile X GScan™ V2 kit components supplied have been validated to amplify the CGG triple repeat spanning region of the FMR-1 gene. The length of CGG triple repeat amplification routinely obtained by using standard Taq polymerase is greater than 120 CGG repeats.

Manufacturing lot numbers are stated on the label of each product and accompanying packing slip.

Product Label Information

REF	Catalog No.	Description	Size
	40-2004-15FM	Fragile X CGG Repeat Genotyping GScan™ V2 6-Fam Kit. 100 X 25 µL rxns.	100 rxns
	40-2004-15FMS	Fragile X CGG Repeat Genotyping GScan™ V2 6-Fam Kit. 20 X 25 µL rxns.	20 rxns

		
Research Use Only	Storage Store at -20°C to -10°C	Lot Number Stated on product tube and packing slip

		
Expiry One year from Date of Shipment	Instructions Consult product manual	QR Code Visit Gene Link website for product details

GeneProber™ Related Product Ordering Information

The GeneProber™ product line is based on the chemiluminescent Southern blot detection method. Gene Link's non-radioactive detection systems for genotyping of triple repeat disorders are rapid, reliable and as sensitive as the ³²P labeled southern blots. No more decayed probes and radioactive exposure. Kits are available for reliable genotyping of the Fragile X, Huntington's Disease, Myotonic dystrophy and other triple repeat mutation group disorders.

Unlabeled GeneProber™ probes are also available for radio labeling and radioactive based detection. Gene Link strongly recommends the use of non-radioactive gene detection systems. Consider switching to Gene Link's product line of non-radioactive detection systems.

Product	Unit Size	Catalog No.
Fragile X GeneProber™ GLFX1 Probe unlabeled	500 ng	40-2004-40
Fragile X GeneProber™ GLFXDig1 Probe Digoxigenin labeled	110 µL	40-2004-41
FRAXE/FMR2/AFF2 GeneProber™ AFF2-AJ31Dig1	110 µL	40-2054-41
Huntington's Disease GeneProber™ GLHD14 Probe unlabeled	500 ng	40-2025-40
Huntington's Disease GeneProber™ GLHDDig2X Probe Digoxigenin labeled	110 µL	40-2025-41
Myotonic Dystrophy GeneProber™ GLDM1 Probe unlabeled	500 ng	40-2026-40
Myotonic Dystrophy GeneProber™ GLDMDig2 Probe Digoxigenin labeled	110 µL	40-2026-41
Friedreich's Ataxia GeneProber™ GLFRDA21 Probe unlabeled	500 ng	40-2027-40
Friedreich's Ataxia GeneProber™ GLFRDADig21 Probe Digoxigenin labeled	110 µL	40-2027-41
Mitochondrial DNA deletion GeneProber™ GL557 Digoxigenin labeled	110 µL	40-2055-41

GScan™ Related Product Ordering Information

Gene Link's GScan™ gene detection products are safe, convenient and sensitive, and afford automated compilation of data. Kits are available for reliable genotyping of the Fragile X, Huntington's Disease, Myotonic dystrophy and other triple repeat mutation group disorders. The kits contain optimized PCR amplification reagents and a wide array of fluorescent-labeled primers for genotyping after PCR using fluorescent genetic analyzer instrument. Included in these kits are ready-to-run control samples of various repeats of the triple repeat disorder kit. These control samples are for calibration with the molecular weight markers for accurate size determination of the amplified fragments.

The GScan™ kits are simple and robust for routine triple-repeat detection of greater than 100 repeats of all triple repeat disorders listed.

Product	Unit Size	Catalog No.
Fragile X GScan™ V2 Kit for fluorescent detection; 100 reactions kit	1 kit	40-2004-15XX
Fragile X GScan™ V2 Kit for fluorescent detection; 20 reactions kit	1 kit	40-2004-15FMS
FRAXE/FMR2/AFF2 GScan™ Kit for fluorescent detection; 100 reactions kit	1 kit	40-2054-15FM
FRAXE/FMR2/AFF2 GScan™ Kit for fluorescent detection; 20 reactions kit	1 kit	40-2054-15FMS
Huntington's Disease GScan™ V2 Kit for fluorescent detection; 100 reactions kit	1 kit	40-2025-15XX
Huntington's Disease GScan™ V2 Kit for fluorescent detection; 20 reactions kit	1 kit	40-2025-15FMS
Myotonic Dystrophy GScan™ Kit for fluorescent detection; 100 reactions kit	1 kit	40-2026-15XX
Myotonic Dystrophy GScan™ Kit for fluorescent detection; 20 reactions kit	1 kit	40-2026-15FMS
Friedreich's Ataxia GScan™ Kit for fluorescent detection; 100 reactions kit	1 kit	40-2027-15XX
Friedreich's Ataxia GScan™ Kit for fluorescent detection; 20 reactions kit	1 kit	40-2027-15FMS

All Gene Link products are for research use only

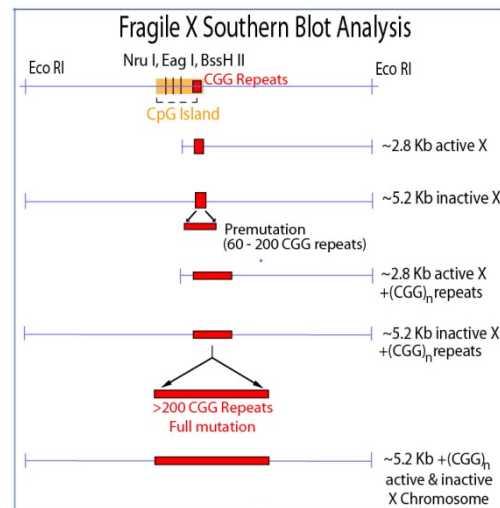
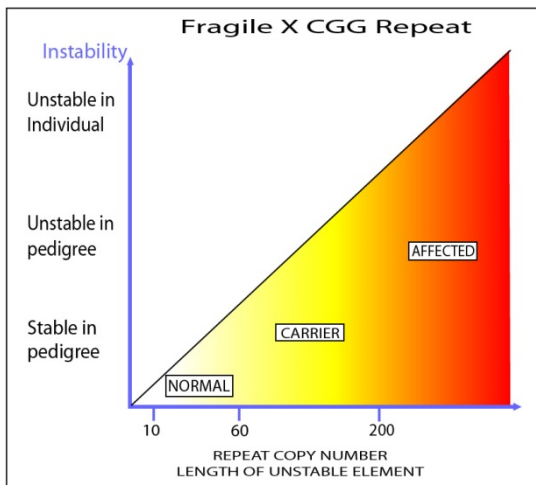
Current pricing are posted at <http://www.genelink.com/>

Fragile X Genotyping

Background

Fragile X syndrome is the most common form of inherited mental retardation. It affects approximately 1 in 1200 males and 1 in 2500 females. As suggested by the name, it is associated with a fragile site under specific cytogenetic laboratory conditions at position Xq27.3 (1).

The inheritance patterns of fragile X puzzled geneticists, as it did not follow a clear X linked pattern. Approximately 20% of males who are carriers based on pedigree analysis do not manifest any clinical symptoms and are thus termed as Normal Transmitting Males (NTM), mental retardation is rare among the daughters of male carriers. Approximately 35% of female carriers have some mental impairment. Based on the above it has been proposed that there are two states of the mutation, one mutation range in which there is no clinical expression (premutation), which could change to the disease causing state predominantly when transmitted by a female (full mutation)(2).



The fragile X syndrome gene (FMR-1, fragile X mental retardation) was cloned in 1991 simultaneously by three groups (3-6). Soon the peculiar genetic mode of transmission was established and a new class of mutation came into existence- Trinucleotide repeats amplification. This explained the clinical state of 'premutation' and 'full mutation' as well as 'anticipation'. The fragile X syndrome is caused by the amplification of CGG repeats, which is located in the 5' region of the cDNA. The most common allele in the normal population consists of 29 repeats, the range varying from 6 to 54 repeats. Premutations in fragile X families showing no phenotypic effect range in size from 52 to over 200 repeats. All alleles with greater than 52 repeats are meiotically unstable with a mutation frequency of one. In general repeats up to 45 are considered normal; repeats above 50 to 200 are considered as premutation and above 200 as full mutation (3-7). The range between 40-55 is considered even by most experienced clinical geneticists and molecular geneticists very difficult to interpret and is considered as a 'gray zone' with interpretations made on a case-by-case basis (8).

Trinucleotide Repeats

To date, trinucleotide repeats expansion has been shown to be responsible for at least 15 different neurodegenerative disorders in humans. Table 1 lists these disorders. All share the instability of the repeats above a particular threshold. Once this threshold is exceeded the trinucleotide repeats become meiotically unstable and upon expansion exhibit the onset of disease symptoms.

Table 1. Trinucleotide Repeats in Human Genetic Disease

Disease	Repeat ^a	Normal Length ^b	Intermediate Length (Premutation) ^{a,b}	Full Disease Length ^b
Fragile XA (FRAXA)	(CGG) _n	6-52	59-230	230-2,000
Fragile XE (FRAXE)	(CCG) _n	4-39	? (31-61)	200-900
Fragile XF (FRAXF)	(CGG) _n	7-40	?	306-1,008
FRA16A	(CCG) _n	16-49	?	1,000-1,900
Jacobsen Syndrome (FRA11B)	(CGC) _n	11	80	100-1,000
Kennedy Syndrome (SMBA)	(CAG) _n	14-32	?	40-55
Myotonic Dystrophy (DM)	(CTG) _n	5-37	50-80	80-1,000; congenital, 2,000-3,000
Huntington disease (HD)	(CAG) _n	10-34	36-39	40-121
Spinocerebellar ataxia 1 (SCA1)	(CAG) _n	6-39	None Reported	40-81
Spinocerebellar ataxia 2 (SCA2)	(CAG) _n	14-31	None Reported	34-59
Spinocerebellar ataxia 3 (SCA3)/Machado Joseph disease (MJD)	(CAG) _n	13-44	None Reported	60-84
Spinocerebellar ataxia 6 (SCA6)	(CAG) _n	4-18	None Reported	21-28
Spinocerebellar ataxia 7 (SCA7)	(CAG) _n	7-17	28-35	38-130
Haw River syndrome (HRS; also DRPLA))	(CAG) _n	7-25	?	49-75
Friedreich ataxia (FRDA)	(GAA) _n	6-29	? (>34-40)	200-900

^a Typically, repeats tracts contain sequence interruptions. See Pearson and Sinden (1998a) for a discussion of the sequence interruptions.

^b No. of triplet repeats.

^c A question mark (?) indicates potential mutagenic intermediate length, and an ellipsis (...) indicates none. Not all diseases are associated with a premutation length repeats tract or premutation disease condition.

Molecular Analysis

Fragile X genotyping can be done by direct PCR amplification of the CGG trinucleotide repeats region and confirmed by Southern blot analysis. In most cases both methods are used to complement the results. Full mutations usually cannot be identified by PCR by most investigators and southern analysis is the preferred method to distinguish full mutations. The FMR-1 gene region containing the CGG trinucleotide repeats is flanked by Eco RI sites; and an Eag I and Nru I site in the CpG region. Full mutation has been shown to methylate the active gene too and thus it prevents Nru I and Eag I restriction of DNA. Hybridization of southern blots of Eco RI and Nru I or Eag I double digested DNA clearly can distinguish between normal, premutation and full mutation genotypes.

The size of the CGG repeats can be determined by PCR analysis and sizing preferably on sequencing gel. The PCR products can be labeled fluorescently by using fluorescently labeled primers or the with ³⁵S or ³²P followed by

Fragile X GScan V2™ Kits. Fragile X CGG triple repeat fluorescent genotyping

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autoradiography. Another attractive alternative is to run a cold PCR reaction followed by blotting and hybridization with an alkaline phosphatase conjugated probe for non-radioactive detection.

Table 2. CGG Trinucleotide repeats and fragment size*													
CGG	bp	Size	%		CGG	bp	Size	%		CGG	bp	Size	%
1	3	223			36	108	328	1.05		71	213	433	
2	6	226			37	111	331	0.35		72	216	436	
3	9	229			38	114	334	0.53		73	219	439	
4	12	232			39	117	337	1.23		74	222	442	
5	15	235			40	120	340	1.23		75	225	445	
6	18	238			41	123	343	0.35		76	228	448	
7	21	241			42	126	346	0.7		77	231	451	
8	24	244			43	129	349	0.7		78	234	454	
9	27	247			44	132	352	0.18		79	237	457	
10	30	250			45	135	355			80	240	460	
11	33	253			46	138	358			81	243	463	
12	36	256	0.18		47	141	361	0.18		82	246	466	
13	39	259			48	144	364	0.18		83	249	469	
14	42	262			49	147	367	0.18		84	252	472	
15	45	265	0.18		50	150	370			85	255	475	
16	48	268	0.35		51	153	373			90	270	490	
17	51	271			52	156	376	0.35		95	285	505	
18	54	274			53	159	379			100	300	520	
19	57	277			54	162	382			105	315	535	
20	60	280	6.32		55	165	385			110	330	550	
21	63	283	0.18		56	168	388			115	345	565	
22	66	286	0.88		57	171	391			120	360	580	
23	69	289	6.14		58	174	394			130	390	610	
24	72	292	2.63		59	177	397			140	420	640	
25	75	295	0.88		60	180	400			150	450	670	
26	78	298	1.4		61	183	403			160	480	700	
27	81	301	0.88		62	186	406			170	510	730	
28	84	304	2.28		63	189	409			180	540	760	
29	87	307	18.8		64	192	412			190	570	790	
30	90	310	38.8		65	195	415			200	600	820	
31	93	313	7.02		66	198	418			210	630	850	
32	96	316	3.51		67	201	421			220	660	880	
33	99	319	1.23		68	204	424			230	690	910	
34	102	322	0.53		69	207	427			240	720	940	
35	105	325	0.7		70	210	430			250	750	970	

*Fragment sizes based on Gene Link Fragile X Genemer™ & GScan genotyping products.

Fragile X GScan V2™ Kits. Fragile X CGG triple repeat fluorescent genotyping

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Gene Link offers safe and reliable chemiluminescent detection methods as an alternate to radioactive based detection methods. PCR-Prober™, GScan™ and GeneProber™ line of products replaces radioactive based methods. Gene Link's GScan Ver2 kit is for PCR amplification followed by fluorescent detection of the specific triple repeat fragment size and routinely detects greater than 120 CGG repeats.

Genemer™ Kit Agarose Gel Analysis

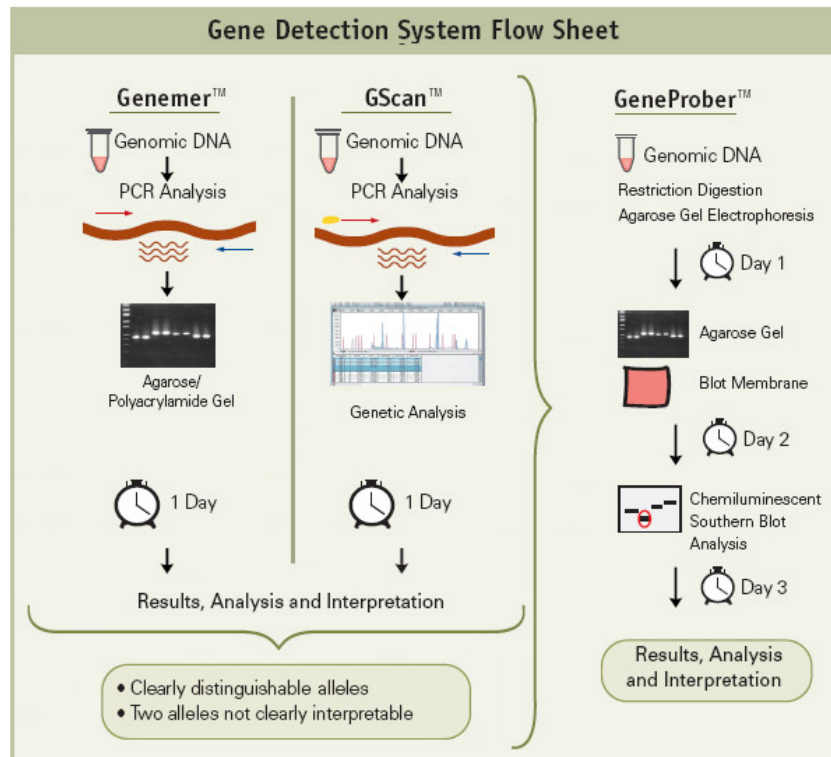
Optimized fragile X Genemer™ kit with components for PCR amplification of up to 130 CGG repeats using standard Taq polymerase. Amplified samples are resolved by agarose gel electrophoresis. This Genemer™ method or GScan™ fluorescent detection is recommended for initial screening of all samples.

GScan™ Kit

Optimized fragile X GScan™ kit with components for PCR amplification of up to 100 CGG repeats using standard Taq polymerase. Amplified samples are resolved by genetic analyzers capable of fluorescent detection or agarose gel electrophoresis. This Genemer™ Kit or GScan™ kit for fluorescent detection is recommended for initial screening of all samples.

GeneProber™ Probes for Southern Blot Analysis

Digoxigenin labelled probes for chemiluminescent Southern blot detection method or unlabeled probe for end user to perform radioactive label. Gene Link offers safe and reliable chemiluminescent detection methods as an alternate to radioactive based detection methods.



Procedure

Fragile X GScan™ Version 2 kit components are not compatible with earlier version kit components.

Important Information

Genotyping using this kit requires use of the appropriate fluorescent genetic analyzer instrument and software capable of detection of fluorescently labeled fragments of varying lengths. This kit has been optimized for ABI3100 genetic analyzer.

Procedure: Fragile X CGG Repeats Analysis by PCR

PCR Premix Preparation

Thaw individual components. Promptly store at -20°C after use. Prepare *fresh* before use enough PCR premix for the number of reactions to be performed. Prepare 10% more for pipetting allowance. Prepare premix following the volumes given below. Follow the same ratio for preparing other final volumes.

PCR Thermal Cycler Files

Program two PCR thermal cycler files as follows

Hot Start File		
Step	Time and Temperature	Cycles
Denaturation	5 minutes at 98°C	1
Hold	Hold for infinity at 62°C	Hold
Add Taq enzyme mix (EM) while on hold.		

Fragile X CGG Amplification File		
Step	Time and Temperature	Cycles
Denaturation	2 minutes at 94°C	1
Denaturation	30 seconds at 94°C	30
Annealing	30 seconds at 60°C	
Extension	3 minutes at 72°C	
Fill up	7 minutes at 72°C	1
Hold	Hold for infinity at 4°C	Hold

Protocol: PCR Amplification**A. Example: PCR premix for 20 µL reaction. Label tube as “PP” (PCR premix).**

Given below is a protocol for preparing a PCR premix for one and ten 20 µL reaction. This can be scaled up or down as required. Prepare 10% more for pipetting loss.

PCR Premix Preparation-PP			
Component	Volume/20 µL rxn.	11X 20 µL rxns.*	Worksheet
Sterile water	5 µL	55 µL	
GLFX GScan™ Component L	4 µL	44 µL	
GLFX Gscan™ Component E	10 µL	110 µL	
GLFX Gscan™ Component D	2 µL	22 µL	
Total	21 µL	231 µL	

*Preparation of 10% more to account for pipetting loss.

B. Enzyme premix (for 10 reactions). Label tube as “EM” (Enzyme mix).

Enzyme Mix Preparation-EM			
Component	Volume/20 µL rxn.	11X 20 µL rxns.	Worksheet
PCR premix (from above)	2 µL	22 µL	
Taq. Polymerase*	0.25 µL	2.5 µL	
Total	2.25 µL	24.5 µL	

*The kit is optimized for regular Taq Polymerase. Any good quality Taq polymerase that is regularly used in the laboratory can be used. Hi Fidelity and long template Taq polymerase will perform better.

C. Initial Denaturation. ‘Hot Start’ PCR

For each sample add the following.

Hot Start PCR	
Component	Volume
PCR premix-PP (from step A above)	18 µL
DNA Template (~100ng for chromosomal DNA)	1 µL
Total	19 µL

Transfer all sample tubes to thermal cycler and start “Hot Start” file.

D. PCR Amplification.

After initial denaturation while thermal cycler is ‘holding’ at 60°C add Enzyme Mix-EM as follows.

PCR Amplification	
Component	Volume
Hot Start PCR tubes (from step C above)	19 µL
Add Enzyme Premix-EM (from step B above)	2 µL
Total Volume*	21 µL

*Reaction volume can vary by 5-10% and still obtain reliable amplification.
Component concentration should not vary by more than 12%.

Start FX CGG amplification PCR file.

E. Post PCR Processing

Process sample for **Omni-Clean** purification of amplified products. This purification method is preferred over Sephadex G-50 spin column chromatography or ethanol precipitation as it is the most effective way to reduce the fluorescent primer and primer dimers if present. **Omni-Clean Kit** is available from Gene Link, catalog number 40-4130-10 or 40-4140-10.

OR

Process sample for Sephadex G-50 spin column chromatography. G-50 columns should be equilibrated with sterile water.

OR

Process sample for ethanol precipitation.

Dissolve purified fragments in 20 µL water. Ready for fragment analysis.

F. Fragment Analysis

Follow genetic analyzer manufacturer's instructions. The amplified fragments are labelled with 6-Fam as the fluorophore. Use appropriate filter set for detection of 6-Fam emission. Molecular weight markers preferable should be 500 Liz or other compatible dye set for particular instrument type.

Run two aliquots of sample at different concentrations. A brief protocol is given below for ABI3100 instrument.

1. Add 0.5 µL of appropriate size standards.
2. Add 2 & 4 µL of sample in duplicate tubes.
3. Add 12 µL of formamide loading buffer.
4. Mix and heat denature at 95°C for 5 minutes.
5. Transfer to ice.
6. Samples ready to load on instrument.

G. Prerun Control Sample Analysis

A fragile X ready to load sample is provided in the kit. This is an aliquot of a GScan V2 kit amplified genomic DNA sample containing 29/85 CGG repeats. The control genomic DNA is derived from cell culture of an established Fragile X carrier obtained from Coriell Cell Repositories/ NIGMS Human Genetic Cell Repository, Catalog ID: [NA06907/GM06907](#). This amplified sample can be run as a control to yield the appropriate size fragment. We recommend that 2 and 4 µL of this sample be loaded with appropriate molecular weight markers. The sample is provided in water. Follow genetic analyzer manufacturer's instructions relating to running samples, data recovery and interpretation.

Gene Link recommends the end user to amplify sufficient reactions of a known genotype to be used as internal control and to include known controls genomic DNA in all amplification batches.

Results and Interpretation

The GScan™ fragile X gene detection system is optimized to give results. Fragile X PCR based genotyping is considered difficult due to the extensive stretch of CGG repeats in fragile X mutation that causes a strong secondary structure in the DNA. This secondary structure prevents DNA polymerases, even Taq polymerase used at elevated temperature, from replicating the CGG repeat region. The GScan™ kit includes PCR additives and enhancers to reduce the secondary structure and increase the length of the CGG repeats that the Taq polymerase can replicate. The GScan™ system can reliably detect up to 120 CGG repeats. Detection of more than ~130 repeats is not reliable. A DNA sample that does not yield a PCR product on duplicate analysis indicates either a failure of the PCR reaction, or a DNA sample with extensive CGG expansion. In the latter case, we recommend Southern analysis using the GeneProber™ Fragile X Detection System to clearly determine the genotype.

Using the reagents provided, the GScan™ kit will yield an amplified Fragile X CGG triple repeat spanning PCR product with 30 CGG repeats of ~310 base pairs. All other repeats can be tabulated based on this size. Please refer Table 2 of this manual. Note that the amplified product can only be resolved on a suitable genetic analyzer. The mobility of the amplified samples cannot be exactly correlated to the size markers due to the extensive CGG repeats. Based on sequenced CGG repeat DNA samples, we observe that the amplified CGG repeat fragments runs slower and is thus, when compared to the molecular weight markers run on genetic analyzers is approximately 3 base or one CGG repeat shorter. Example, a 29 CGG repeat fragment is 307 bp and travels as a 304 bp fragment when compared to commercially available genotyping molecular weight markers. It is advisable to run several control samples of known CGG repeats to ascertain the approximate size by comparison.

All normal samples except female homozygous samples will yield interpretable results. The normal pattern is one amplified fragment with CGG repeat size below 45 from male DNA samples and two amplified fragments with CGG repeat size below 45 from female DNA samples. Keep in mind that more than 40% of the population is homozygous for the 29-30 CGG allele and thus may give only one overlapping amplified fragment band from female DNA in PCR results but are actually normal.

From our experience, less than 5% of the samples referred for Fragile X are actually Fx cases. PCR amplification and detection is a way to ascertain genotype of almost 90% of the samples. *It is essential to perform Southern blot analysis for ALL samples that does not give NORMAL results in duplicate PCR analysis.* PCR analysis is to screen bulk of the samples and then perform Southern blot analysis only on those samples that do not yield 'normal' amplification pattern.

You should perform Southern blot analysis for the following sample types

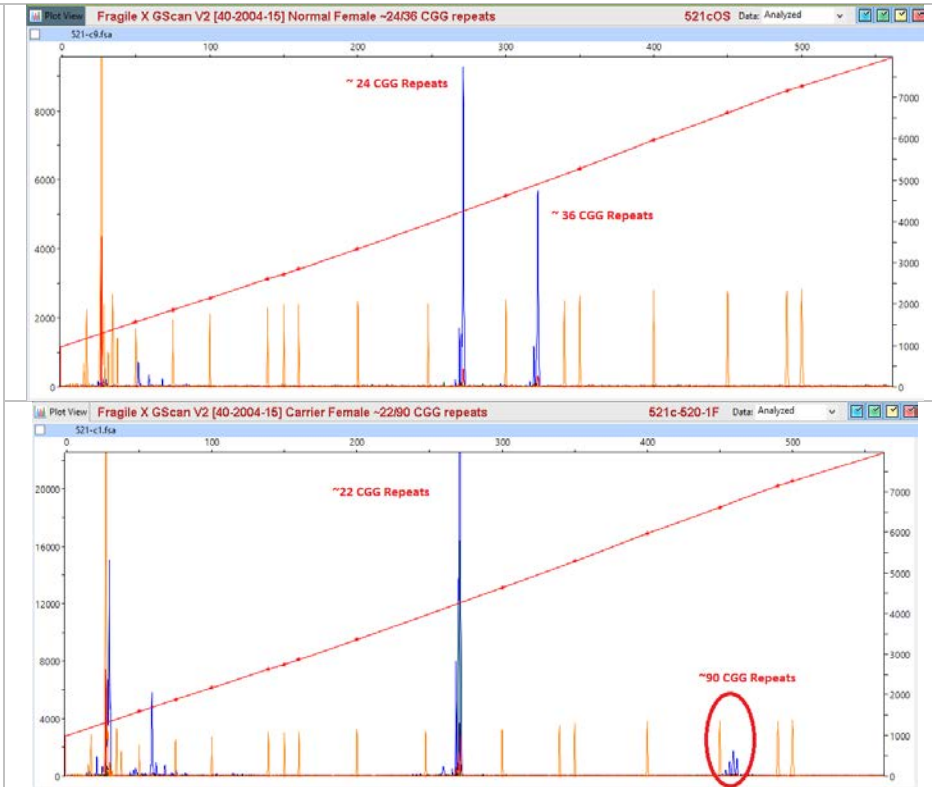
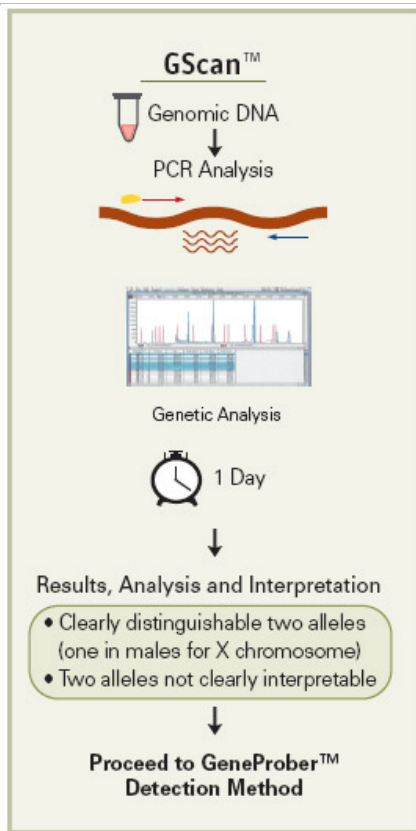
- a. Only one fragment amplified for female samples. Realize that more than 40% of the population is homozygous for the 29-30 CGG allele and thus may give only one fragment in PCR results but are actually normal with two alleles.
- b. No amplification products on duplicate amplification.
- c. Samples with amplification over ~45 CGG repeats.

GScan™ results should be easy to interpret based on the size of the fragment amplified, a guideline is provided in Table 3.

Table 3. Fragile X Molecular Analysis Results Interpretation

Clinical Category	Normal (male/female)	Female Carrier with small amplification	Female carrier with significant amplification	Female carrier with Large amplification	Carrier male with premutation (NTM)	Full Mutation (Male/Female)	Carrier with Fragile X Mosaicism
Risk mutation will become full mutation in next generation	0%	moderate	significant	high	0%	moderate to high	can vary from 0-100%
Number of CGG repeats	6-45	46-69	70-86	87-200	40-200	>200	40-200/ >200
Size of CGG repeats; bp	18-135	138-207	210-258	260-600	120-600	>600	120-600/ >600
Total Fragment Size; bp	221-338	341-410	413-461	464-803	323-803	>803	323-803/ >803

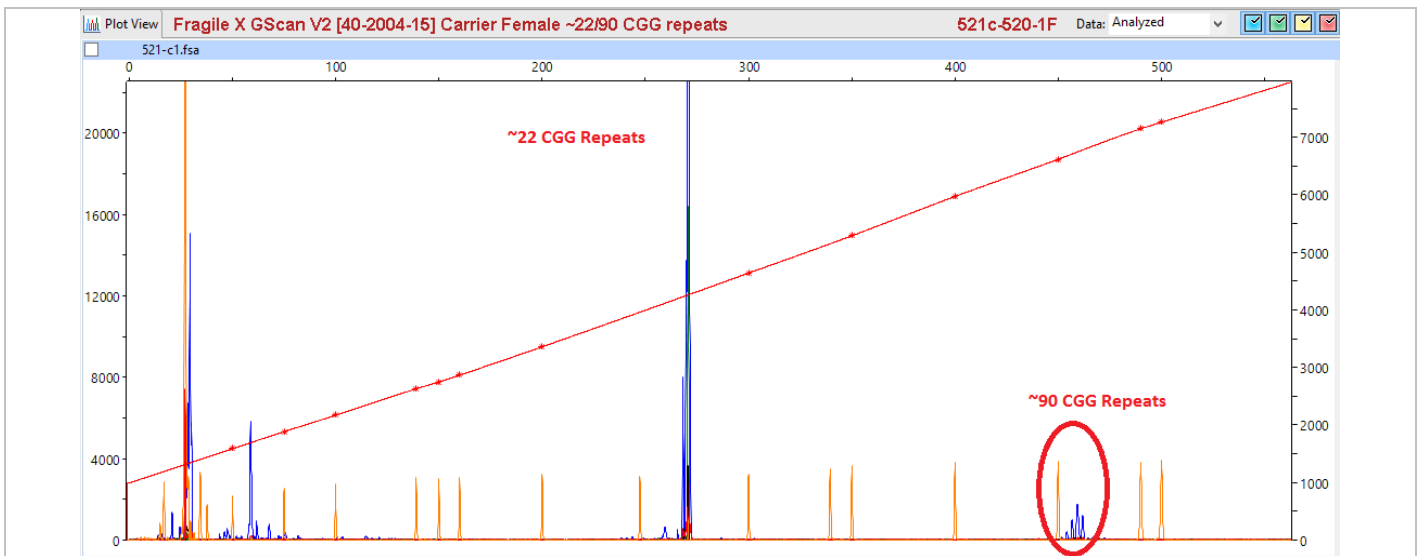
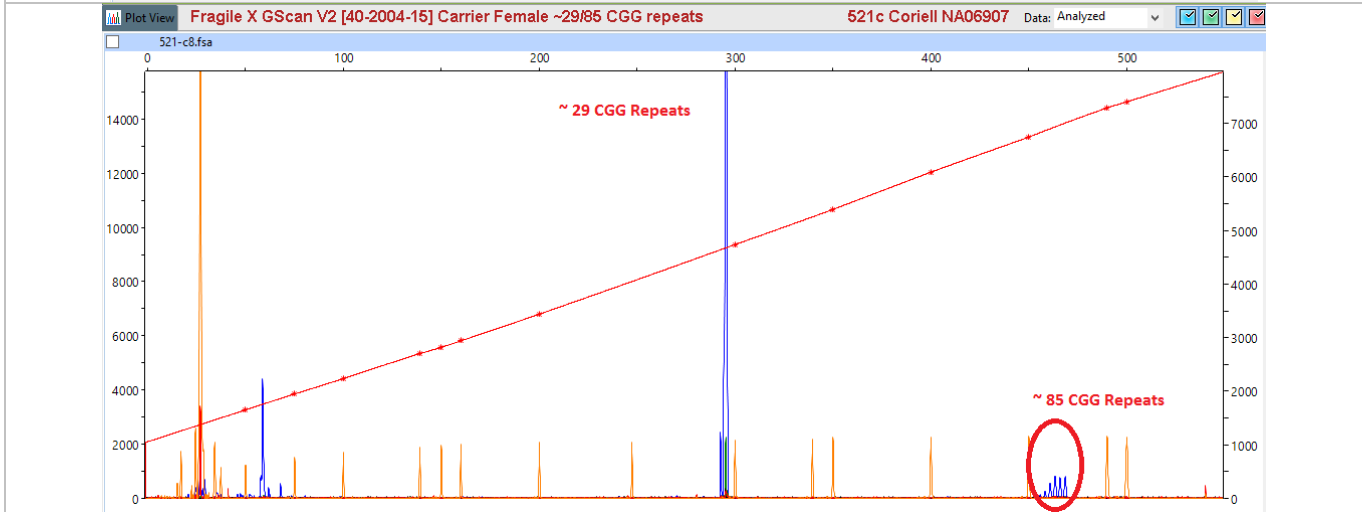
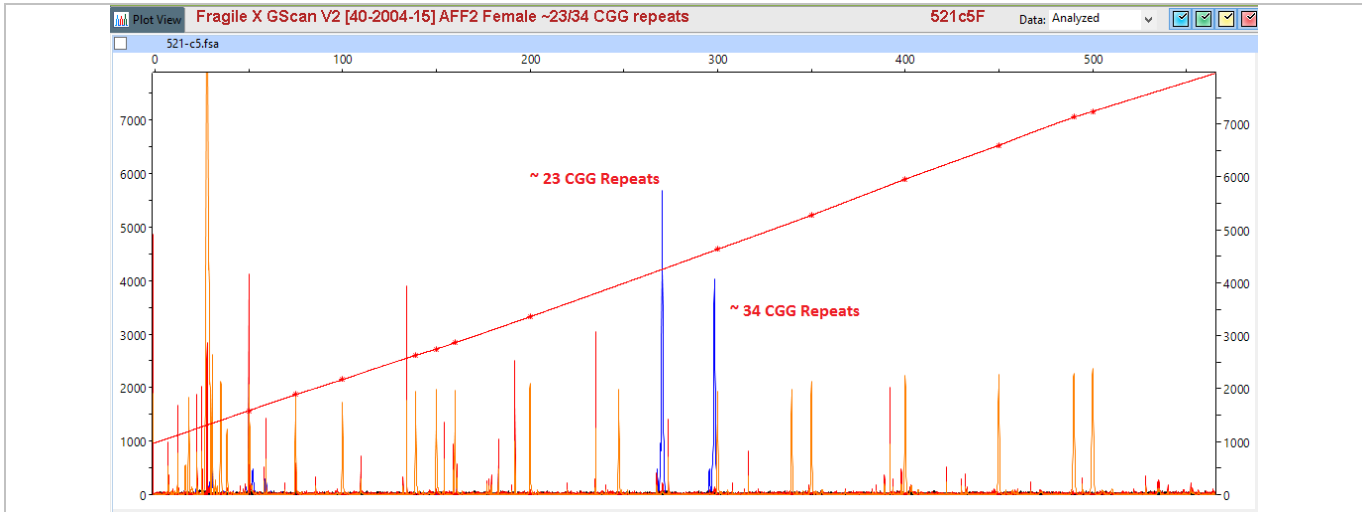
Fragile X GScan™ V2 Kit [40-2004-15] PCR Amplification & Fluorescent Detection



Fragile X GScan™ V2 [40-2004-15FM] Kit was used to amplify human genomic samples representing various CGG triple length pre-mutations, full mutations and normal Fragile X genotype. Fragment analysis results are shown, each panel denotes the fragile X CGG repeat genotype

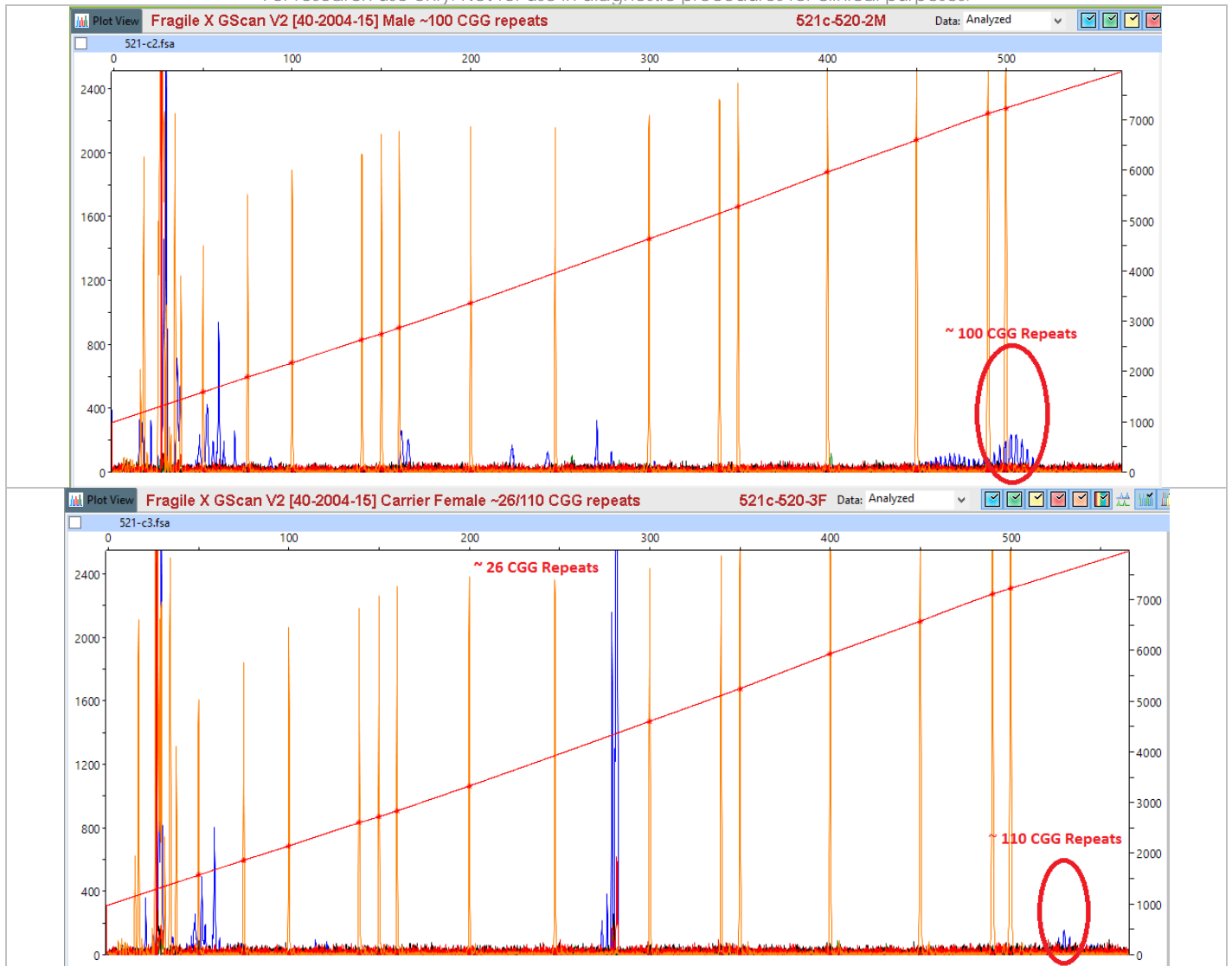
Fragile X GScan V2™ Kits. Fragile X CGG triple repeat fluorescent genotyping

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Fragile X GScan V2™ Kits. Fragile X CGG triple repeat fluorescent genotyping

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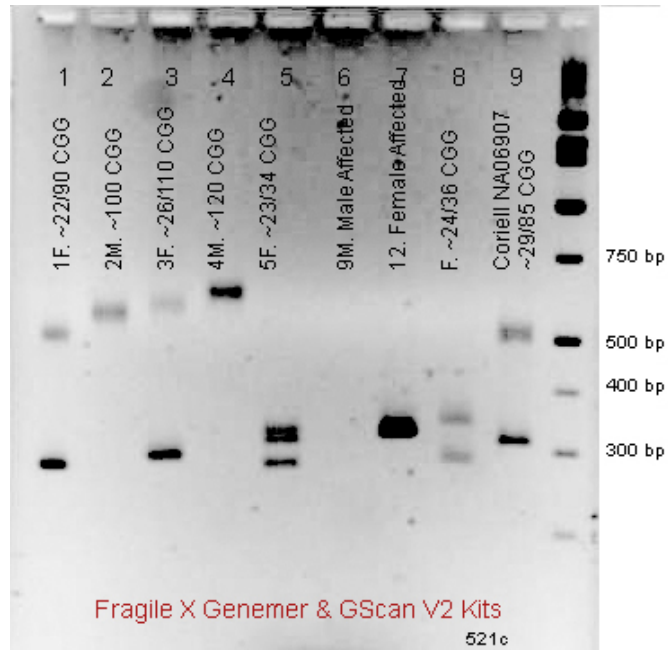
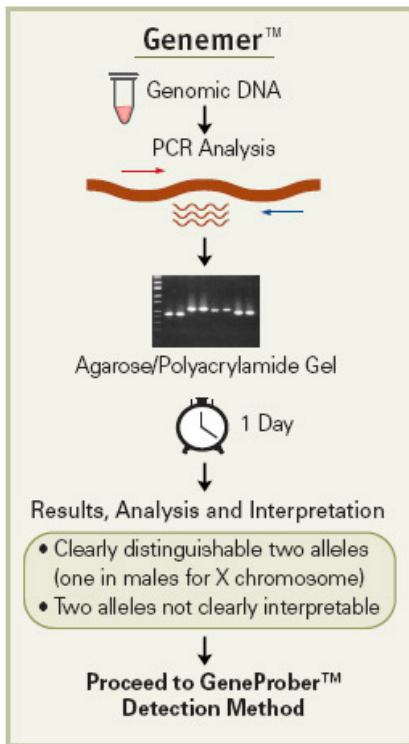


Recommendation for Southern Blot Analysis

Southern blot analysis can be performed using the non-radioactive digoxigenin labeled GeneProber™ probe (Catalog Number 40-2004-41) or for radioactive based detection use the unlabeled GeneProber™ (Catalog Number 40-2004-40). These probes are specific and deliver reliable results.

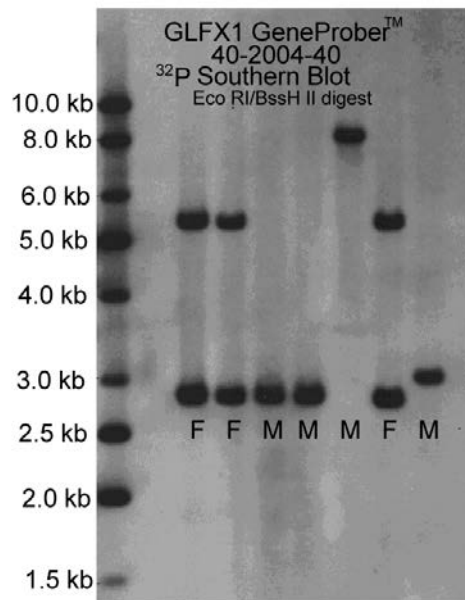
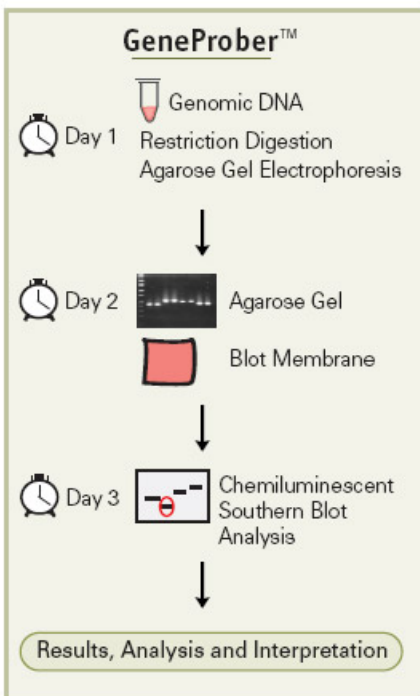
The GeneProber™ Fragile X gene detection system is for Southern blot genotyping based on size of the 2.8kb and 5.2 kb Eco RI/Eag I digests (or other appropriate restriction enzymes) of genomic DNA. This is similar to the radioactive blot which we are all used to, instead of having to label the probe with ³²P every week and the associated hazards. In the GeneProber™ system the probe is simply replaced with the non-radioactive GLFXDig1 digoxigenin labeled probe. All manipulations can thus be carried safely on the bench top. After washing, the detection system requires an added step of incubation with anti-Dig alkaline phosphatase for 30 minutes and after a few wash, detection using CSPD star as the chemiluminescent substrate. The blot is exposed to X-ray film from 2 hrs and onwards depending on the signal achieved. For a Southern blot using 5µg genomic DNA a 2hr exposure is normally sufficient.

Fragile X Genemer™ V2 Kit [40-2004-11] PCR Amplification & Agarose Gel Detection



Fragile X GScan™ V2 [40-2004-15FM] and Genemer™ V2 Kit [40-2004-11] was used to amplify human genomic samples representing various CGG triple length pre-mutations, full mutations and normal Fragile X genotype. After PCR 10 µL samples were applied to a 2.5 agarose gel for electrophoresis. Gel picture is of an ethidium bromide stained gel. Gel lanes denote briefly the fragile X CGG repeat genotype.

Fragile X GeneProber™ [40-2004-41] Southern Blot & Chemiluminescent Detection



Fragile X southern blot analysis. Genomic DNA digested with Eco RI/BssH II and GLFX1 GeneProber [40-2004-40] labeled with ³²P as the probe. Normal pattern expected is as follows. Female: 5.2 kb and 2.7kb; Males; 2.7kb

Fragile X Frequently Asked Questions/Troubleshooting

1. **General Comment.** Fragile X genotyping is not easy. Fragile X PCR based genotyping is difficult due to the extensive stretch of CGG. Even Taq polymerase at elevated temperature cannot replicate the long stretch of CGG repeats. Our kit is optimized to give results for up to at least 120 CGG repeats. A few initial rounds of optimization may be required. Once the investigator is experienced with all the manipulations, getting good results should be routine.

2. **Reliable Detection.** The system will be able to detect reliably the CGG repeats greater than 120 repeats. Detection beyond this is dependent on the PCR conditions and is NOT reliable. Any DNA sample which does not give a reliable CGG repeat analysis on this system clearly indicates either a failure of the PCR reaction or a DNA with extensive CGG repeats. A particular DNA sample not yielding a PCR product on duplicate analysis clearly indicates the possibility of long CGG repeats. In cases like these we suggest that Southern analysis should be done using the Fragile X GeneProber™ [40-2004-41] gene detection system to clearly determine the genotype. Southern analysis is also strongly advised when both the alleles are not reliably genotyped.

References

1. Nelson, D.L. (1993) Growth Genetics and Hormone. 9:1-4.
2. Rousseau, F. et al. (1991) NEJM 325:1673-1681.
3. Verkerk, A. et al. (1991) Cell 65:905-914
4. Fu, Y.H et al. (1991) Cell 67:1047-1058.
5. Oberle, I. et al. (1991) Science 252:1097-1102.
6. Yu, S. et al. (1991) Science 252: 1179-1181.
7. Nelson, D.L. (1996) Growth Gen. and Hormone. 12:1-4.
8. Richards, R and Sutherland, G.R (1992) TIG 8: 249-255.

Appendix: Protocols

Genomic DNA Purification

Genomic DNA is usually extracted from blood. A simple procedure is given below that purifies ~10 µg DNA from 300 µl blood using a 30 minute procedure.

Omni-Pure™ Genomic DNA Purification System Catalog Number: 40-4010-01

A. Initial Preparation

1. Label two sets of 1.5 ml tubes per sample.
2. Add 900 µl GD-1 solution (RBC Lysis Solution) to one tube for each sample.
3. Add 300 µl Isopropanol (2-propanol) to one tube for each sample. Cap the tubes.

B. Cell Lysis

1. To the tube containing 900 µl GD-1 solution (RBC Lysis Solution) using a filter tip pipet transfer 300 µl whole blood. Cap and gently mix by inversion. Incubate for 1-3 minutes at room temperature. Mix by inversion a few times during this incubation period. Incubate longer for fresh blood cells as they are intact and not lysed already.
2. Centrifuge at 3 K rpm for 20 seconds to pellet the white blood cells. A reddish white pellet should be clearly visible. Decant and discard supernatant leaving behind the last few droplets. Do not totally remove the supernatant.
3. Completely resuspend the white blood cell pellet by vigorously vortexing the tube. Ensure that the pellet is completely resuspended.
4. To the resuspended cells add 300 µl GD-2 solution (Cell Lysis Solution). Mix by gentle vortexing. You will notice release of DNA by the thickening of the liquid in the sample. Samples may be stored at this stage for processing later. It has been shown that the samples are stable in Cell Lysis Solution for at least 2 years at room temperature.

C. Protein Precipitation

1. Add 100 µl GD-3 solution (Protein Precipitation Solution) to the sample in cell lysis solution.
2. Vortex vigorously for 20 seconds. Small particles of brown color will appear and be visible at this stage.
3. Centrifuge at 5 K rpm for 1 minute to pellet the precipitated proteins. A clearly visible brown pellet containing proteins should be collected at the bottom of the tube.

D. DNA Precipitation

1. Decant the supernatant containing the DNA to a new appropriately labeled tube (see initial preparation above) containing 300 µl 100% Isopropanol (2-propanol).
2. Mix the sample by inversion until a visible white floating DNA strand-particle is identified. Mixing by inversion 30-40 is usually sufficient.
3. Centrifuge at 6 K rpm for 1 minute to collect the DNA as a pellet. A white DNA pellet should be clearly visible.
4. Decant supernatant and place tube inverted on a clean Kimwipe™ tissue paper to drain the remaining supernatant.
5. To remove residual salts, add 300 µl of 70% ethanol. Vortex gently.
6. Centrifuge at 6 K rpm for 1 minute to collect the DNA as a pellet. Gently take out the tubes so that the pellet is not dislodged. While holding the tube, rotate tube so that you can watch the pellet. Now carefully decant the ethanol, keeping an eye on the pellet so that it does not flow away.
7. Place tube inverted on a clean Kimwipe™ tissue paper to drain the remaining ethanol.
8. Air dry the DNA pellet. Do not use vacuum.

E. DNA Reconstitution & Use

1. Add 100 µl of GD-4 solution (DNA Reconstitution Solution). Vortex gently. Incubate at 60°C for 5 minutes to facilitate dissolution or keep overnight at room temperature.
2. Store DNA at 4 °C. For long-term storage, place sample at -20 °C or -80 °C.
3. Average yield of 10 µg is expected from 300 µl blood DNA. The range is between 5 µg to 15 µg.
4. The 100 µl of purified DNA obtained will have an average concentration of ~ 100 ng/µl.
5. For PCR amplification use 1-2 µl.
6. Use 100 µl for restriction digestion followed by Southern blot analysis.
7. It is convenient to perform multiple 300 µl blood DNA purification instead of scaling up the procedure.

Fragile X Genotyping Product Ordering Information

Product	Unit Size	Catalog No.
Fragile X Genemer™ Kit for gel based detection. Kit for performing PCR amplification and gel based detection.	1 Kit [100 rxns]	40-2004-11
Fragile X GScan™ Kits for fluorescent detection Kit for performing fluorescent PCR amplification based detection. Various dye kits. XX=FM for 6-Fam; HX for Hex; TT for Tet; C3 for Cy3 and C5 for Cy5.	1 Kit [100 rxns]	40-2004-15XX
Fragile X GeneProber™ GLFX1 Probe unlabeled Probe for radioactive labelling and Southern blot analysis	500 ng	40-2004-40
Fragile X GeneProber™ GLFX1 Probe Digoxigenin labeled Probe for non-radioactive chemiluminescent Southern blot analysis	110 µL	40-2004-41
Fragile X Genemer™ Primer pair Primers for amplification of CGG triple repeat spanning region. The quantity supplied is sufficient for 400 regular 50 µL PCR reactions.	10 nmols	40-2004-10
Fragile X PCRProber™ AP labeled probe Alkaline phosphatase labeled probe	12 µL	40-2004-31
Fragile X PCRProber™ Kit for chemiluminescent detection Kit for performing PCR amplification and chemiluminescent based detection.	5 blots [50 rxns]	40-2004-32

FRAXE/FMR2/AFF2 Genotyping Product Ordering Information

Product	Unit Size	Catalog No.
FRAXE/FMR2/AFF2 GeneProber™ AFF2-AJ31Dig1 Probe Digoxigenin labeled Probe for non-radioactive chemiluminescent Southern blot analysis	110 µL	40-2054-41
FRAXE/FMR2/AFF2 Genemer™ Kit for gel based detection Kit for performing PCR amplification & gel based detection	1 Kit [100 rxns]	40-2054-11
FRAXE/FMR2/AFF2 GScan™ Kits for fluorescent detection Kit for performing fluorescent PCR amplification based detection, Fam labeled	1 Kit [100 rxns]	40-2054-15FM

Genemer™ control DNA Cloned fragment of the mutation region of a particular gene. These control DNA's are ideal genotyping templates for optimizing and performing control amplification with unknown DNA. The size of the triple repeats has been determined by sequencing and gel electrophoresis. The stability of size repeats upon cloning and amplification has NOT been determined. Thus, the size should be considered approximate and there is no claim for each fragment to contain the exact number of triple repeats. These control DNA's are sold with the express condition that these NOT be used for exact triple repeat size determination of DNA of unknown genotype. The control DNA should be used for determining the performance of specific Genemer™ and PCRProber™ Gene Link products.

Fragile X ~16 CGG repeat Genemer Control DNA	500 ng	40-2004-01
Fragile X ~29 CGG repeat Genemer Control DNA	500 ng	40-2004-02
Fragile X ~40 CGG repeat Genemer Control DNA	500 ng	40-2004-03
Fragile X ~60 CGG repeat Genemer Control DNA	500 ng	40-2004-04
Fragile X ~90 CGG repeat Genemer Control DNA	500 ng	40-2004-05

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Fragile X GScan V2™ Kits. Fragile X CGG triple repeat fluorescent genotyping

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Southern Blot Buffers & Reagents

Product	Catalog No.	Unit Size
Agarose Tablets, 0.5 gm each; 100 tablets	40-3011-10	100 tablets
Agarose LE Molecular Biology Grade; 100 g	40-3010-10	100 g
Agarose LE Molecular Biology Grade; 500 g	40-3010-50	500 g
Hybwash A, Hybridization Wash Solution (20X SSC); 200 mL	40-5020-20	200 mL
Hybwash B, Hybridization Wash Solution (10% SDS); 100 mL	40-5021-10	100 mL
TAE Buffer; 50 X Concentrate; 100 mL	40-3007-01	100 mL
TAE Buffer; 50 X Concentrate; 1 L	40-3007-10	1 L
TBE Buffer; 5 X Concentrate; 1 L	40-3008-10	1 L
Buffer M 10X (Maleic Acid buffer); 100 mL	40-5025-10	100 mL
10% Blocking solution; 100 mL	40-5026-10	100 mL
Loading Buffer 2X BPB/XC Denaturing for Sequencing; 1 mL	40-5027-10	1 mL
10x AP Detection buffer (alkaline phosphatase detection buffer); 100 mL	40-5031-10	100 mL
Lumisol™ I Hybridization Solution; contains formamide; 200 mL	40-5022-20	200 mL
Lumisol™ II Hybridization Solution; for non-toxic hybridizations; 200 mL	40-5023-20	200 mL
Lumisol™ III Hybridization Solution; for oligo probes; 200 mL	40-5024-20	200 mL
CDP-Star® Substrate; Ready-to-Use 0.25 mM in spray bottle; 10 mL	40-5010-10	10 mL

Loading Buffers

Product	Catalog No.	Size
Gel Loading Buffer 5X BPB/XC non-denaturing; 1 mL	40-3002-10	1 mL
Gel Loading Buffer 5X BPB/XC non-denaturing; 15 mL	40-3002-15	15 mL
Gel Loading Buffer 10X BPB/XC non-denaturing; 1 mL	40-3003-10	1 mL
Gel Loading Buffer 10X BPB/XC non-denaturing; 15 mL	40-3003-15	15 mL
Gel Loading Buffer 5X Orange G/XC non-denaturing; 1 mL	40-3004-10	1 mL
Gel Loading Buffer 5X Orange G/XC non-denaturing; 15 mL	40-3004-15	15 mL
Gel Loading Buffer 2X BPB/XC Denaturing for Sequencing; 1 mL	40-5027-10	1 mL
Gel Loading Buffer 2X BPB/XC Denaturing for Sequencing; 15 mL	40-5027-15	15 mL
DNA SDS Gel Loading Buffer 5X BPB/XC DNA binding protein denaturing buffer ; 1 mL	40-5028-10	1 mL
DNA SDS Gel Loading Buffer 5X BPB/XC DNA binding protein denaturing buffer; 15 mL	40-5028-15	15 mL
RNA Gel Loading Buffer 2X BPB/XC with ethidium bromide; 1 mL	40-5029-10	1 mL
RNA Gel Loading Buffer 2X BPB/XC with ethidium bromide; 15 mL	40-5029-15	15 mL
RNA Gel Loading Buffer 2X BPB/XC without ethidium bromide ; 1 mL	40-5030-10	1 mL
RNA Gel Loading Buffer 2X BPB/XC without ethidium bromide; 15 mL	40-5030-15	15 mL

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Related Products Ordering Information

Omni-Pure™ DNA & RNA Purification Systems

Product	Catalog No.	Unit Size*(Purifications)
Omni-Pure™ Blood DNA Purification System	40-4010-01	100
Omni-Pure™ Blood DNA Purification System	40-4010-05	500
Omni-Pure™ Blood DNA Purification System	40-4010-10	1000
Omni-Pure™ Tissue DNA Purification System	40-4050-01	100
Omni-Pure™ Tissue DNA Purification System	40-4050-05	500
Omni-Pure™ Tissue DNA Purification System	40-4050-10	1000
Omni-Pure™ Plant DNA Purification System	40-4060-01	100
Omni-Pure™ Plant DNA Purification System	40-4060-05	500
Omni-Pure™ Plant DNA Purification System	40-4060-10	1000
Omni-Pure™ Viral DNA Purification System	40-3720-01	100
Omni-Pure™ Viral DNA Purification System	40-3720-05	500
Omni-Pure™ Microbial DNA Purification System	40-3700-01	100
Omni-Pure™ Microbial DNA Purification System	40-3700-05	500
Omni-Pure™ Viral RNA Purification System	40-3650-01	100
Omni-Pure™ Viral RNA Purification System	40-3650-05	500

*Sample volume for each purification system varies. Each purification yields sufficient quantity for desired applications.

Omni-Clean™ Gel DNA Purification and Concentration Systems

Product	Catalog No.	Unit Size*(Purifications)
Omni-Clean™ Gel DNA Beads Purification System	40-4110-10	100
Omni-Clean™ Gel DNA Beads Purification System	40-4110-50	500
Omni-Clean™ Gel DNA Spin Column Purification System	40-4120-10	100
Omni-Clean™ Gel DNA Spin Column Purification System	40-4120-50	500
Omni-Clean™ DNA Beads Concentration System	40-4130-10	100
Omni-Clean™ DNA Beads Concentration System	40-4130-50	500
Omni-Clean™ DNA Spin Column Concentration System	40-4140-10	100
Omni-Clean™ DNA Spin Column Concentration System	40-4140-50	500

*Sample volume for each purification system varies. Each purification yields sufficient quantity for desired applications.

Omni-Pure™ Plasmid DNA Purification Systems

Product	Catalog No.	Unit Size*(Purifications)
Omni-Pure™ Plasmid DNA Purification System	40-4020-01	100
Omni-Pure™ Plasmid DNA Purification System	40-4020-05	500

*Sample volume for each purification system varies. Each purification yields sufficient quantity for desired applications.

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