Table 8: **gp120**

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(2-10 IIIB)	gp120(2-10)	RVKEKYQHL	HIV-1 infection	human(B8)	[Sipsas97]
	NOTES: • HIV IIIB proteins were used to define the range of CTL epitopes recognized by 3 lab workers accidentally infected with HIV-1 IIIB • Type-specific epitope, unique to the LAI and IIIB because of a deletion of three amino acids that are present in all other subtype B HIV-1s • RVKGIRKNYQHL, a variant found in JRCSF, was not recognized • This epitope is in the signal sequence of gp120				
gp160(30-39 WEAU)	gp120(30-39)	AENLWVTVYY	HIV-1 infection	human(B44)	[Borrow97, Goulder97e]
	NOTES: • Two CTL lines from the patient WEAU were studied – one had an optimal peptide of (A)AENLWVTVYY, and the other (A)AENLWVTVY, and both responded equally well with one or two N-term Alanines • Rapidly post-infection, a strong immunodominant response was observed against this epitope • The naturally occurring forms of the peptide found in WEAU were tested as targets for early WEAU CTLs – the form TENLWVTVY was as reactive as the wild type AENLWVTVY – but the forms AKNLWVTVY, AGNLWVTVY, AANLWVTVY did not serve as targets • The glutamic acid in the second position is a B44 anchor residue • [Goulder97e] is a review of immune escape that summarizes this study in the context of CTL escape to fixation				
gp120(32-56 LAI)	gp120(30-54)	TEKLWVTVYYGVPVWKE-ATTTLFCA	gp160 vaccinia vaccine	human(B18)	[Johnson94c]
	NOTES: • HLA restricted CTL response to epitope in HIV-1 vaccinia-env vaccinees				
gp120(32-56 LAI)	gp120(30-54)	TEKLWVTVYYGVPVWKE-ATTTLFCA	gp160 vaccinia vaccine	human(B18)	[Hammond95]
	NOTES: • This peptide can be processed for HLA-B18 presentation in a TAP-1/2 independent pathway				
gp120(32-41 LAI)	gp120(32-41)	KLWVTVYYGV	MN rec gp160	human(A2)	[Dupuis95]
	NOTES: • CTL from HLA-A2 positive subject react with this peptide				

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(25-46 BRU)	gp120(33-54)	LWVTVYYGVPVWKEATT-TLFCA	HIV-1 infection	human(A2)	[Dadaglio91]
	NOTES: • Defined through peptide blocking of CTL activity, and Env deletions				
gp120(env 48)	gp120(35-45)	VTVYYGVPVWK	HIV-1 infection	human(A11 and A*6801)	[Threlkeld97]
	NOTES: • Study of the fine specificity of an A3-like-HLA-super-type epitope (the A3-super-type includes A*0301, A*1101, A*3101, A*3301, and A*6801) • The A3 super-type is characterized as a hydrophobic or hydroxyl containing anchor residue at position 2, and a positive charge in the C-term position • While most lines were specific, a promiscuous cloned CTL line was derived from an HIV+ donor that could recognize this epitope presented by either A11 or A*6801				
gp120(37-46 LAI)	gp120(36-45)	TVYYGVPVWK	gp160 vaccinia vaccine	human(A3.1)	[Johnson94]
	NOTES: • Multiple CTL clones obtained from two vaccinees				
gp120(38-41 LAI)	gp120(36-45)	TVYYGVPVWK	gp160 vaccinia vaccine	human(A3.1)	[Johnson94c]
	NOTES: • Highly conserved epitope recognized by multiple CTL clones from vaccinee				
gp120(37-46 LAI)	gp120(36-45)	TVYYGVPVWK	gp160 vaccinia vaccine	human(A3.1)	[Hammond95]
	NOTES: • This peptide can be processed for HLA-A3.1 presentation in a TAP-1/2 independent pathway				
gp120(37-46 LAI)	gp120(36-45)	TVYYGVPVWK	HIV-1 infection	human(A3)	[Goulder97, Goulder97e]
	NOTES: • Identical twin hemophiliac brothers were both infected with the same batch of factor VIII • One had a response to this epitope, the other did not • [Goulder97e] is a review of immune escape that summarizes this study				

HIV CTL Epitopes

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(42-51 PV22)	gp120(41-50)	VPVWKEATTT	HIV-1 infection	human(B55)	[Brander95a]
	NOTES: • P. Johnson, unpublished				
gp120(42-52 PV22)	gp120(41-51)	VPVWKEATTTL	HIV-1 infection	human(B35)	[Cao97]
	NOTES: • VPVWKEATTTL is the consensus sequence for clades B and D • VPVWKDAETTL is the consensus sequence for clade A and it is cross-reactive • VPVWKEADTTL is the consensus sequence for clade C and it is cross-reactive • VPVWKEADTTL is the consensus sequence for clade E and even with three substitutions still retains some cross-reactivity				
gp120(49-68)	gp120(41-60)	VPVWKEATTTLFCASDAKAY	HIV infection	human	[Lieberman95]
	NOTES: • HIV-specific CTL lines developed by *ex vivo* stimulation with peptide				
gp120(49-68 SF2)	gp120(41-60)	VPVWKEATTTLFCASDAKAY	HIV infection	human	[Lieberman97]
	NOTES: • Of 25 patients, most had CTL specific for more than 1 HIV-1 protein • 11 subjects had CTL that could recognize vaccinia expressed LAI gp160 • Three of these 11 had CTL response to this peptide • The responding subjects were HLA-A2, A3, B8, B62; HLA-A3, A24, B7, B38				
gp120(49-68 SF2)	gp120(41-60)	VPVWKEATTTLFCASDAKAY	HIV-1 infection	human	[Lieberman97b]
	NOTES: • CTL expanded *ex vivo* were later infused into HIV-1 infected patients				
gp120(59-78)	gp120(51-70)	LFCASDAKAYDTEVHINVWAT	HIV infection	human	[Lieberman95]
	NOTES: • HIV-specific CTL lines developed by *ex vivo* stimulation with peptide				

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(59-78 SF2)	gp120(51-70)	LFCASDAKAYDTEVHINVWAT	HIV infection	human	[Lieberman97]
	NOTES: • Of 25 patients, most had CTL specific for more than 1 HIV-1 protein • 11 subjects had CTL that could recognize vaccinia expressed LAI gp160 • One of these 11 had CTL response to this peptide • The responding subject was HLA-A2 and B-21				
gp120(59-68 HXB2)	gp120(51-60)	LFCASDAKAY	HIV-1 infection	human	[Lieberman92]
	NOTES: • CTL epitope defined by T cell line and peptide mapping				
gp120(53-62 LAI)	gp120(51-60)	LFCASCAKAY	HIV-1 infection	human(B38)	[Shankar96]
	NOTES: • Uncertain whether optimal, binds A24 as well				
gp120(69-88 SF2)	gp120(61-79)	DTEVHNVWATHACVPTDPN	HIV-1 infection	human	[Lieberman97]
	NOTES: • Of 25 patients, most had CTL specific for more than 1 HIV-1 protein • 11 subjects had CTL that could recognize vaccinia expressed LAI gp160 • One of these 11 had CTL response to this peptide • The responding subject was HLA-A2 and B-21				
gp120(77-85)	gp120(77-85)	DPNPQEVVL	HIV-1 infection	human(B*3501)	[Ogg98]
	NOTES: • This epitope was included to illustrate the specificity of HIV-tetrameric staining, in a cross-sectional study correlating HLA A*0201 CTL effector cells and low viral load				
gp120(77-85 SF2)	gp120(77-85)	DPNPQEVVL	HIV-1 infection	human(B35,B51)	[Shiga96]
	NOTES: • Binds HLA-B*3501 and B*5101 – binds and kills gp120-vaccinia virus infected cells carrying B35 or B51				

HIV CTL Epitopes

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(77-85 SF2)	gp120(77-85)	DPNPQEVVL	HIV-1 infection	human(B*3501)	[Tomiyama97]
	NOTES: • A CTL clone responsive to this epitope was obtained • 2/7 B35 positive individuals have a CTL response to this epitope • This epitope is highly variable • The substitutions: 1N, 3S and 7I, 7L and 9M, 8I, 8K all abrogate specific CTL lysis, while only 8K reduces binding to B*3501 • The substitution 8V to 8E does not reduce specific CTL activity				
gp120(111-126 IIIB)	gp120(103-118)	MQEDIISLWDQSLKPC	primary *in vitro* response to peptide	human	[Macatonia91]
	NOTES: • Primary CTL response with cells from non-infected donors stimulated by the peptide				
gp120(112-124 IIIB)	gp120(104-116)	HEDIISLWDQSLK	HIV-1 infection	human(A2)	[Clerici91]
	NOTES: • Helper and cytotoxic T cells can be stimulated by this peptide (T2)				
gp120(MN)	gp120(104-116)	HEDIISLWDQSLK	HIV-1 infection	chimpanzee	[Lubeck97]
	NOTES: • No epitope-specific CTL were detected in chimpanzees immunized with adenovirus-HIV-1 MN gp160 recombinant despite a response to peptides P18 and T1 • Helper and cytotoxic T cells have been found to be stimulated by this peptide (T2)				
gp120(112-124 IIIB)	gp120(104-116)	HEDIISLWDQSLK	HIV exposure	human	[Pinto95]
	NOTES: • CTL and T helper cell reactivity in healthcare workers exposed to HIV				
gp120(119-139 SF2)	gp120(111-129)	WDQSLKPCVKLTPLCVSLK	HIV-1 infection	human	[Lieberman97]
	NOTES: • Of 25 patients, most had CTL specific for more than 1 HIV-1 protein • 11 subjects had CTL that could recognize vaccinia expressed LAI gp160 • One of these 11 had CTL response to this peptide • The responding subject was HLA-A2 and B-21				

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(120-128 LAI)	gp120(120-128)	KLTPLCVTL	MN rec gp160	human(A2)	[Dupuis95]
	NOTES: • CTL from HLA-A2 positive subject react with this peptide				
gp120(120-128)	gp120(120-128)	KLTPLCVTL	HIV-1 infection	human(A2)	[Kundu98]
	NOTES: • Allogeneic dendritic cells (DCs) were obtained from HLA-identical siblings, pulsed with rgp160 MN or A2 restricted HIV-1 epitope peptides, and infused monthly into six HIV-infected patients • 1/6 showed increased env-specific CTL and increased lymphoproliferative responses, 2/6 showed increase only in proliferative responses, and 3/6 showed no change – pulsed DCs were well tolerated • KLTPLCVTL is a conserved HLA-A2 epitope included in this study – all six patients had this sequence as their HIV direct sequence, and a detectable CTL response • CTL demonstrated against peptide-coated target, epitope is naturally processed and enhancible with vaccine				
gp120(120-128)	gp120(120-128)	KLTPLCVTL	HIV-1 infection	human(A2)	[Kmieciak98]
	NOTES: • Increased CTL response to cells expressing a VV construct ΔV3 mutant compared with a full-length env gene product				
gp120(156-165 IIIB)	gp120(160-169)	NCSFNISTSI	HIV-1 infection	human(Cw8)	[Sipsas97]
	NOTES: • HIV IIIB proteins were used to define the range of CTL epitopes recognized by 3 lab workers accidentally infected with HIV-1 IIIB • NCSFNITTSI, a variant found in HIV-1 MN, was not recognized, thus this epitope was type-specific • NCSFNISTSI contains two potential N-linked glycosylation sites and cysteine residue, possibly related to the requirement for a high sensitizing dose of peptide for CTL activity				
gp120(193-212 BRU)	gp120(192-211)	TTSYTLTSCNTSVITQACPK	HIV-1 infection	human(A2)	[Dadaglio91]
	NOTES: • Defined through blocking CTL activity, and Env deletions				

HIV CTL Epitopes

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(199-219 SF2)	gp120(196-215)	SLTSCNTSVITQACPKVSFE	HIV-1 infection	human	[Lieberman97]
	NOTES: • Of 25 patients, most had CTL specific for more than 1 HIV-1 protein • 11 subjects had CTL that could recognize vaccinia expressed LAI gp160 • One of these 11 had CTL response to this peptide • The responding subject was HLA-A2, -B21				
gp120(192-199 HXB2R)	gp120(196-204)	KLTSCNTSV	HIV-1 infection	human(A2)	[Brander95]
	NOTES: • Epitope predicted on HLA binding motif, and studied in the context of inclusion in a synthetic vaccine				
gp120(197-205)	gp120(196-204)	TLTSCNTSV	no CTL shown	human(A2)	[Garboczi92]
	NOTES: • Crystallization of HLA-A2 molecules complexed with antigenic peptides – refers to Dadaglio et al 1991				
gp120(199-207)	gp120(196-204)	TLTSCNTSV	peptide immunization and HIV-1 infection	human(A2.1)	[Brander96b]
	NOTES: • This epitope was recognized by PBMC from 6/14 HIV+ asymptomatic patients • This epitope was used along with pol CTL epitope ALQDSGLEV and a tetanus toxin T helper epitope for a synthetic vaccine • This vaccine failed to induce a CTL response, although a helper response was evident				
gp120(201-225 LAI)	gp120(205-229)	ITQACPKVSFEPIPHYC-APAGFAI	gp160 vaccinia vaccine	human(CD4+ CTL)	[Johnson94, Johnson94c]
	NOTES: • CD4+ CTL isolated from LAI IIIB gp160 vaccinees				
gp120(209-228)	gp120(206-225)	TQACPKVSFEPIPIHYCAPA	HIV infection	human	[Lieberman95]
	NOTES: • HIV-specific CTL lines developed by *ex vivo* stimulation with peptide				

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(209-228 SF2)	gp120(206-225)	TQACPKVSFEPIPIHYCAPA	HIV infection	human	[Lieberman97]
	NOTES: • Of 25 patients, most had CTL specific for more than 1 HIV-1 protein • 11 subjects had CTL that could recognize vaccinia expressed LAI gp160 • One of these 11 had CTL response to this peptide				
gp120(209-228 SF2)	gp120(206-225)	TQACPKVSFEPIPIHYCAPA	HIV-1 infection	human	[Lieberman97b]
	NOTES: • CTL expanded *ex vivo* were later infused into HIV-1 infected patients				
gp120(219-238 HXB2)	gp120(216-235)	PIPIHYCAPAGFAILKCNNK	HIV-1 infection	human	[Lieberman92]
	NOTES: • CTL epitope defined by T cell line and peptide mapping				
gp120(219-238)	gp120(216-235)	PIPIHYCAPAGFAILKCNNK	HIV infection	human	[Lieberman95]
	NOTES: • HIV-specific CTL lines developed by *ex vivo* stimulation with peptide				
gp120(241-249 LAI)	gp120(243-251)	CTNVSTVQC	HIV-1 infection	human(Cw8)	[Sipsas97]
	NOTES: • HIV IIIB proteins were used to define the range of CTL epitopes recognized by 3 lab workers accidentally infected with HIV-1 IIIB • CTNVSTVQC contains a potential N-linked glycosylation site and cysteine residues, possibly related to a requirement for a high sensitizing dose of peptide for CTL activity				
gp120(249-268)	gp120(246-265)	VSTVQCTHGIRPVVSTQLLL	HIV infection	human	[Lieberman95]
	NOTES: • HIV-specific CTL lines developed by *ex vivo* stimulation with peptide				

HIV CTL Epitopes

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(249-268 SF2)	gp120(246-265)	VSTVQCTHGIRPVVSTQLLL	HIV infection	human	[Lieberman97]
	NOTES: • Of 25 patients, most had CTL specific for more than 1 HIV-1 protein • 11 subjects had CTL that could recognize vaccinia expressed LAI gp160 • One of these 11 had CTL response to this peptide • The responding subject was HLA-2, -B21				
gp120(249-268)	gp120(246-265)	VSTVQCTHGIRPVVSTQLLL	HIV-1 infection	human	[Lieberman97b]
	NOTES: • CTL expanded *ex vivo* were later infused into HIV-1 infected patients				
gp120(256-275 LAI)	gp120(256-275)	RPVVSTQLLLNGSLAEEEVV	HIV-1 infection	human(B7)	[Shankar96]
gp120(255-263 SF2)	gp120(256-264)	RPIVSTQLL	HIV-1 infection	human(B35)	[Shiga96]
	NOTES: • Binds HLA-B*3501				
gp120(255-263 SF2)	gp120(256-264)	RPIVSTQLL	HIV-1 infection	human(B*3501)	[Tomiyama97]
	NOTES: • A CTL clone responsive to this epitope was obtained • Only 1/7 B35 positive individuals had a CTL response to this epitope • An I to V substitution at position 3 reduces specific lysis, but not binding to B*3501 • A Q to H substitution at position 7 abrogates specific lysis, but not binding to B*3501				
gp120(295-312 BRU)	gp120(295-311)	SVEINCTRPNNNTRKSI	HIV-1 infection	human(A2)	[Dadaglio91]
	NOTES: • Defined through blocking CTL activity, and Env deletions				
gp120(302-312 HXB2)	gp120(302-311)	RPNNNTRKSI	HIV-1 infection	human(B7)	[Safrit94b]
	NOTES: • CTL from two acute seroconversion cases				

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(302-312 HXB2)	gp120(302-311)	RPNNNTRKSI	HIV-1 infection	human(B7)	[Hammond95]
	NOTES: • Peptide processed by a TAP-1/2-dependent pathway only • CTL from an acute seroconverter				
gp120(302-312 HXB2)	gp120(302-311)	RPNNNTRKSI	HIV infection	human(B7)	[Wolinsky96]
	NOTES: • Longitudinal study of epitope variation *in vivo*				
gp120(303-312 IIIB)	gp120(302-311)	RPNNNTRKSI	HIV-1 infection	human(?B7)	[Walkerpercom96]
	NOTES: • Epitope defined in the context of the Pediatric AIDS Foundation ARIEL Project, a mother-infant HIV transmission study • RPNNNTRKDI and RPNNNTRKGI, naturally occurring variants, were found in non-transmitting mother – ability to recognize these variants has not yet been determined				
gp120(310-318 SF2)	gp120(309-317)	IYIGPGRAF	HIV-1 infection	human(A*2402)	[IkedaMoore97]
	NOTES: • Defined using reverse immunogenetics – 59 HLA-A*2402 binding peptides were predicted by searching for A*2402 anchors in HIV proteins, (Tyr at 2, and Phe, Leu or Ile at the C term) – 53 of the 59 peptides bound A*2402 • This peptide induced CTL in 1/4 HIV-1+ people tested • IYIGPGRAF bound to A*2402 strongly, the epitope can be processed in a vaccinia construct and presented – no specific CTL clones were obtained				
gp120(V3)	gp120(307-324)	TRKSIHIGPGRAFYTTGE	Gag/Env VLP	murine(Balb/C)	[Luo98]
	NOTES: • Intramuscular injection of chimeric gag-env virus like particles (VLPs) containing V3 loop sequences into Balb/c mice induce V3 specific CTL – TRKSIHIGPGRAFYTTGE is a B subtype consensus that stimulated a cross-reactive CTL response				
gp120(V3 loop HXB2)	gp120(310-324)	RIQRGPGRAFVTIGK	gag-V3 fusion	murine(H-2^d)	[Griffiths93]
	NOTES: • Gag-V3 fusion protein immunization elicited V3 CTL response in mice				
gp120(V3 loop HXB2)	gp120(310-324)	RIQRGPGRAFVTIGK	Pr55^{gag}-env VLPs	murine(H-2^d)	[Deml97]
	NOTES: • Env bound to virus like particles (VLPs) can elicit a CTL response that is dependent on the amount of Env presented on the VLP				

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(315-329 IIIB)	gp120(310-324)	RIQRGPGRAFVTIGK	Intranasal peptide with cholera toxin as a mucosal adjuvant	murine(H-2D^d)	[Porgador97]
	NOTES: • IIIB peptide referred to as R15K • Peptide-specific CTLs were induced after *in vitro* restimulation with peptide-pulsed targets • R15K was superior at inducing CTL compared to the RGPGRAFVTI, in contrast to the findings of Nehete *et al.* • Memory CTL responses were induced				
gp120(313-327 MN)	gp120(310-324)	RIHIGPGRAFYTTKN	DNA immunization	murine BALB/c (H-2^d)	[Fomsgaard98]
	NOTES: • Enhanced B and CTL responses to the V3 region occur following epidermal inoculation by gene gun with a chimeric DNA vaccine of V3-hepatitis B surface antigen relative to a gp160 plasmid vaccine				
gp120(V3 loop many strains)	gp120(310-324)	RIHIGPGRAFYTTKN	V3 loop peptides	murine(H-2D^d)	[Casement95]
	NOTES: • V3 peptides from MN and SC induce murine CTL that are cross-reactive with diverse strains				
gp120(313-327 MN)	gp120(310-324)	RIHIGPGRAFYTTKN	MN rgp120 with QS-21 adjuvant	murine(H-2D^d)	[Newman97]
	NOTES: • MN vaccine induced CTL reactive with MN, IIIB and RF vaccinia expressed Env, but not this peptide				
gp120(315-329 IIIB)	gp120(310-324)	RIQRGPGRAFVTIGK	IIIB rgp120 with QS-21 adjuvant	murine(H-2D^d)	[Newman97]
	NOTES: • IIIB vaccine induced IIIB type-specific CTL to this peptide (P18), and an additional Env CTL response that was cross-reactive				

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(313-327 MN)	gp120(310-324)	RIHIGPGRAFYTTKN	peptide vaccine	murine BALB/c (H-2^d)	[Ahlers96, Ahlers97]
	NOTES: • Vaccine constructs containing helper, antibody and CTL peptide epitopes induce strong Th1, CTL and NAb responses against the autologous HIV-1 virus • The peptide CTL response was as cross-reactive as one elicited by a vaccinia construct expressing rgp160 MN • GM-CSF and IL-12 were the two cytokines most effective for inducing and boosting CTLs				
gp120(MN)	gp120(310-324)	RIHIGPGRAFYTTKN	HIV-1 infection	chimpanzee	[Lubeck97]
	NOTES: • Epitope-specific CTL detected in chimpanzees immunized with adenovirus-HIV-1 MN gp160 recombinant • CTL response may account for protection against subsequent HIV-1 SF2 challenge in a chimpanzee lacking neutralizing antibodies				
gp120(315-329 IIIB)	gp120(310-324)	RIQRGPGRAFVTIGK	HIV exposure	human	[Pinto95]
	NOTES: • CTL and T helper cell reactivity in healthcare workers exposed to HIV				
gp120(315-329)	gp120(310-324)	RIQRGPGRAFVTIGK	vaccinia IIIB gp160	murine(H-2D^d)	[Takahashi88]
	NOTES: • V3 loop CTL response in mice vaccinated with gp160				
gp120(315-329 IIIB)	gp120(310-324)	RIQRGPGRAFVTIGK	IIIB peptide	murine(D^d)	[Takahashi89a]
	NOTES: • R(8) F(10) MHC/peptide interaction				
gp120(315-329 IIIB)	gp120(310-324)	RIQRGPGRAFVTIGK	IIIB peptide	murine(D^d)	[Sastry92]
	NOTES: • Free peptide injected into the footpad of a mouse could stimulate specific CTL				
gp120(315-329 BRU)	gp120(310-324)	RIQRGPGRAFVTIGK	HIV-1 infection	human(A2)	[Dadaglio91]
	NOTES: • Defined through blocking CTL activity, and Env deletions				

HIV CTL Epitopes

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(315-329 IIIB)	gp120(310-324)	RIQRGPGRAFVTIGK	HIV-1 infection	human(A2)	[Clerici91]
	NOTES: • Helper and cytotoxic T cells can be stimulated by this peptide (P18)				
gp120(315-329 IIIB)	gp120(310-324)	RIQRGPGRAFVTIGK	rec vaccinia gp160	murine(H-2D^{d,p,q}, H-2^{u})	[Shirai96]
	NOTES: • Multiple murine MHC can cross-present this epitope (P18) and HP53, DRVIEVVQGAYRAIR, to specific CTL				
gp120(315-329 IIIB)	gp120(310-324)	RIQRGPGRAFVTIGK	V3:Ty-Virus-like particles	murine(H-2^{d})	[Layton93]
	NOTES: • V3-Ty-Virus-like particles can induce type-specific CTL in mice in the absence of adjuvant				
gp120(315-329 IIIB)	gp120(310-324)	RIQRGPGRAFVTIGK	vaccinia IIIB gp160	human(A11)	[Achour94]
	NOTES: • One of 3 HLA type restrictions associated with this peptide				
gp120(315-329 IIIB)	gp120(310-324)	RIQRGPGRAFVTIGK	gp160 vaccinia	human(A2,A3)	[Achour93]
	NOTES: • Two of 3 HLA type restrictions associated with this peptide				
gp120(313-327 MN)	gp120(310-324)	RIHIGPGRAFYTTKN	MN gp160 vaccinia	murine(D^{d})	[Takahashi89b]
	NOTES: • Y(11 MN) exchange with V(11 IIIB) interchanges specificities				
gp120(313-327 MN)	gp120(310-324)	RIHIGPGRAFYTTKN	HIV exposure	human	[Pinto95]
	NOTES: • CTL and T helper cell reactivity in healthcare workers exposed to HIV				
gp120(313-327 IIIB, MN, RF)	gp120(310-324)	SITKGPGRVIYATGQ	RF gp160 vaccinia	murine(D^{d})	[Takahashi92]
	NOTES: • Comparison of MN, IIIB, and RF specificities, position 11 is critical				

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(315-329 IIIB)	gp120(310-324)	RIQRGPGRAFVTIGK	peptide immunization	murine(D^d)	[Ahlers97a]
	NOTES: • PCLUS 3-18MN synthetic peptide vaccine construct contained T1 helper epitope covalently linked to truncated P18 CTL epitope • A substitution in the T1 peptide stimulated an enhanced Th response and class II binding specificity, which in turn enhanced CTL induction by vaccine • Construct PCLUS 3-18MN is currently in a phase I vaccine clinical trial				
gp120(315-329 IIIB)	gp120(310-324)	RIQRGPGRAFVTIGK	vaccinia IIIB gp160	murine(H-$2^{d,p,u,q}$)	[Shirai92, Shirai93]
	NOTES: • In a murine system multiple class I molecules can present this peptide, called P18, to CTL, including H-2D^d, H-2D^p, H-2D^q, H-2L^q • The MHC class I molecule D^d as well as H-$2^{u,p,q}$, were found to present peptides P18 and HP53 • The V-β usage in T cells showing cross-reaction between these two peptides was conserved for H-$2^{d,u,p}$, but not in H-2^q				
gp120(V3 loop SF2)	gp120(313-321)	IGPGRAFHT	gp120(SF2) DNA vaccine, rgp120 protein boost	murine(H-2D^d)	[Barnett97]
	NOTES: • CTL were induced by vaccine, and restimulated *in vitro* with V3 peptide • DNA vaccine with protein boost stimulated both CTL and antibodies • Strains SF2 (IGPGRAFHT), US4 (IGPGRAFYA), and CM235 (IGPGQVFYR) were tested				
gp120(V3 loop MN)	gp120(313-322)	IGPGRAFYTT	*B. abortus*-peptide conjugate	murine(H-2D^d)	[Lapham96]
	NOTES: • *B. abortus*-peptide conjugate induced a virus-specific CTL response in CD4+ lymphocyte depleted mice				
gp160(318-327) IIIB	gp120(313-322)	RGPGRAFVTI	DNA gp160 plasmid + peptide boost	Macaca fuscata	[Okuda97]
	NOTES: • Murine BALB/c (H-2^d) and macaque both showed highest level of CTL vaccine response when a DNA vaccine was boosted with a peptide including four peptide subtypes of the V3 region, HPG-30 and a fragment of the CD4 binding region				

HIV CTL Epitopes

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp160	gp120(313-322)	RGPGRAFVTI	Epitopes expressed in modified virus Ankara (MVA) DNA vectors	murine(H-2^d17)	[Hanke98b]
	NOTES: • MVA is an attenuated vaccinia that can not replicate in mammalian cells – strings of CTL epitopes were delivered and expressed in a MVA DNA vector • γ IFN and CTL activity were induced after a single vaccination • An MVA boost enhanced the response				
gp120(318-327)	gp120(313-322)	RGPGRAFVTI	HIV-1 infection	human	[Kmieciak98]
	NOTES: • Increased CTL response to cells expressing a VV construct ΔV3 mutant compared with a full-length env gene product • This epitope doesn't have A2 anchors, but has features that confer promiscuous A2 binding, which may relate to the inhibitory effect seen in this paper				
gp160(318-327 IIIB)	gp120(313-322)	RGPGRAFVTI	IIIB peptide	murine(D^d)	[Takahashi93]
	NOTES: • Successful priming with vaccination of peptide pulsed splenic dendritic cells				
gp120	gp120(313-322)	RGPGRAFVTI	Multi-epitope gene in VVA	murine (H-2^d)	[Hanke98c, Hanke98b]
	NOTES: • This murine epitope was incorporated into a vaccine of CTL epitopes expressed together including 20 HIV epitopes recognized by humans from 12 HLA types, one murine HIV epitope and three macaque HIV epitopes, delivered in a vaccinia virus Ankara (VVA) construct • The murine vaccination was more effective at generating CTL when given i.v. rather than i.m.				
gp160(318-327 IIIB)	gp120(313-322)	RGPGRAFVTI	IIIB peptide	murine(D^d)	[Takahashi96]
	NOTES: • Exposure of CD8+ CTL to free peptide corresponding to the epitope results in strong inhibition of the CTL response to targets presensitized with the same peptide • The authors propose this is due to a "self-veto", where the CTL is inactivated by a CD8+ cell carrying the appropriate peptide-MHC complex				

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp160(318-327 IIIB)	gp120(313-322)	RGPGRAFVTI	A rapidly degraded form of Env	murine(L^d)	[Tobery97]
	NOTES: • An HIV-1 Env vaccine was targeted for rapid cytoplasmic degradation • The rapidly degraded form rapidly stimulated CTL to this peptide, faster than the normal vaccinia-env • The rapidly degraded form also stimulated greater specific CTL lysis and higher CTLp frequencies than normal Env • Similar results were obtained for a Nef protein designed for rapid degradation				
gp160(318-327 IIIB)	gp120(313-322)	RGPGRAFVTI	Combination peptide vaccine	murine BALB/c (H-2^d)	[Hamajima97]
	NOTES: • B cell epitope HGP-30 also serves as a CTL epitope • Vaccine combined HGP-30, V3 loop peptide variants, and CD4 binding site peptide • IL-12 expression plasmid included with the vaccination enhanced the CTL response				
gp160(318-327 IIIB)	gp120(313-322)	RGPGRAFVTI	IIIB peptide	murine(D)	[Nehete95]
	NOTES: • RGPGRAFVTI was defined as the optimal peptide for vaccination, out of RIQRGPGRAFVTIGK • This peptide, in a carrier-free form in Freund's adjuvant, could stimulate Env specific CTL in BALB/c mice				
gp160(318-327 IIIB)	gp120(313-322)	RGPGRAFVTI	CTL line from HIV-donor	human(A2.1)	[Alexander-Miller96]
	NOTES: • This immunogenic peptide does not have the known binding motif for A2.1 • The same optimal peptide for this human HLA-A2.1 epitope was observed for a murine H-2 D^d epitope				
gp120(V3 loop MN)	gp120(313-322)	IGPGRAFYTT	*B. abortus*-peptide conjugate	murine(H-2D^d)	[Lapham96]
	NOTES: • *B. abortus*-peptide conjugate induced a virus-specific CTL response in CD4+ lymphocyte depleted mice				
gp160(318-327) IIIB	gp120(313-322)	RGPGRAFVTI	peptide	murine(H-2D^d)	[Takeshita95]
	NOTES: • XGPXRXXXXI are critical for binding, consistent with H-2D^d motif XGPX(RKH)XXX(X)(LIF)				

HIV CTL Epitopes

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(312-320 SF2)	gp120(313-321)	IGPGRAFHT	DNA gp120-plasmid immunization	murine(D^d)	[Selby97]
	NOTES: • Murine CTL response to peptide observed after immunization with DNA plasmid containing HIV-1 (SF2) gp120 gene regulated by bacteriophage T7 promoter • CTL response required coadministration of rec vaccinia virus expressing T7 RNA polymerase or T7 RNA polymerase soluble protein				
gp160(318-327 IIIB)	gp120(313-322)	RGPGRAFVTI	vaccinia IIIB gp160	human(A2)	[Achour96]
	NOTES: • Individual was immunized with rec vaccinia gp160 IIIB and boosted with purified gp160 • Lysis only occurs with IIIB P18 peptide pulsed onto autologous targets, MN, RF, SIMI P18 peptides fail to stimulate CTL • Restimulating immune cells from gp160 IIIB vaccinees with MN, RF, or SIMI P18 did not enhance the MN, RF, or SIMI specific CTL response				
gp160(318-327 SIMI)	gp120(313-322)	MGPKRAFYAT	vaccinia SIMI gp160	human(A2)	[Achour96]
	NOTES: • Individual was immunized with rec vaccinia gp160 SIMI and boosted with purified recombinant gp160 SIMI • P18 MN and RF peptides were able to stimulate the HIV specific CTL that arose in response to the SIMI vaccination, thus the P18 MN peptide (IGPGRAFYTT) and the P18 RF peptide (KGPGRVIYAT) could cross-react • The P18 IIIB peptide does not cross-react (RGPGRAFVTI in the epitope region) • gp160 SIMI primed immune cells could generate a significantly broader specificity when stimulated with P18 MN or P18RF peptides, but not P18 IIIB				
gp120(318-327 IIIB)	gp120(313-322)	RGPGRAFVTI	vaccinia IIIB gp160	murine(H-$2^{d,p,u}$)	[Shirai97]
	NOTES: • Three class I MHC, H-$2^{d,p,u}$, that differ in sequence and serology, cross-present this peptide to T-cells of each of the other haplotypes • The amino acids R, F, and I are each critical for strong CTL activity with all three MHC molecules				

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(318-327 IIIB)	gp120(313-322)	RGPGRAFVTI	rec vaccinia-gp160	murine(H-2^d)	[Goletz97]
	NOTES: • Anthrax lethal toxin can deliver proteins to the cytosol of eukaryotic cells • A fusion protein linking the delivery domain of the anthrax protein to gp120 achieved cellular uptake, and gp120 was processed allowing presentation of this V3 epitope to CTL *in vitro*				
gp120(314-322)	gp120(316-324)	GRAFVTIGK	no CTL shown	human(B27)	[Jardetzky91]
	NOTES: • Study of peptide binding to HLA-B27				
gp120(337-368 LAI)	gp120(340-364)	KWNNTLKQIDSKLREQF-GNNKTIIF	gp160 vaccinia vaccine	human(CD4+ CTL)	[Johnson94c]
	NOTES: • CD4+ CTL clones were obtained from an HIV-1 vaccinia-env vaccinee				
gp120(339-361 LAI)	gp120(342-359)	NNTLKQIDSKLREQFG	gp160 vaccinia	human(CD4+ CTL)	[Johnson94]
	NOTES: • CD4+ CTL isolated from LAI IIIB gp160 vaccinees				
gp120(374-380 BRU)	gp120(373-379)	PEIVTHS	HIV-1 infection	human(A2)	[Dadaglio91]
	NOTES: • Defined through blocking CTL activity, and Env deletions				
gp120(376-383 PV22)	gp120(379-387)	SFNCGGEFF	HIV-1 infection	human(Cw4)	[Johnson93]
	NOTES: • Conserved epitope				

HIV CTL Epitopes

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(376-383 PV22)	gp120(379-387)	SFNCGGEFF	CTL not shown	human(Cw4)	[Wolinsky96]
	NOTES: • Longitudinal study of epitope variation *in vivo*				
gp120(375-383 IIIB)	gp120(379-387)	SFNCGGEFF	HIV-1 infection	human(B15)	[Wilson97]
	NOTES: • This is the optimal peptide for two CTL clones that recognize this epitope in the context of two different HLA molecules, Cw4 and B15 • Predominant form in proviral DNA of the individual with B15 restricted CTL was SFTCGGEFF and this was recognized • Recognition of a minor autologous variant (SFNCRGEFF) from the B15 donor was greatly reduced				
gp120(375-383 IIIB)	gp120(379-387)	SFNCGGEFF	HIV-1 infection	human(Cw4)	[Wilson97]
	NOTES: • This is the optimal peptide for two CTL clones that recognize this epitope in the context of two different HLA molecules, Cw4 and B15 • Only one form (TFNCGGEFF) was found in the Cw4 donor and this form reacted with the CTL line similarly to the IIIB peptide				
gp120(376-384 IIIB)	gp120(380-388)	FNCGGEFFY	HIV-1 infection	human(A29)	[Wilson97]
	NOTES: • This is the optimal peptide for two CTL clones derived from two different donors • FNCRGEFFY and FNCRGGFFY are major and minor autologous variants in one of the donors, and showed reduced or no stimulatory activity for CTL from the host • The IIIB form and the form FNCAGEFFY were present in the other donor, and the CTL line had reduced activity with the FNCAGEFFY form relative to the index peptide				
gp120(376-384 LAI)	gp120(380-388)	FNCGGEFFY	HIV-1 infection	human(A29)	[Brander96]
	NOTES: • C. Wilson, in press in J. Virol.				

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(381-392 BRU)	gp120(380-391)	KNCGGEFFYCNS	HIV-1 infection	human(A2)	[Dadaglio91]
	NOTES: • Defined through blocking CTL activity, and Env deletions				
gp120(385-393)	gp120(387-395))	FYCNTTQLF	HIV-1 infection	human(A*2402)	[IkedaMoore97]
	NOTES: • Defined using reverse immunogenetics – 59 HLA-A*2402 binding peptides were predicted by searching for A*2402 anchors in HIV proteins, (Tyr at 2, and Phe, Leu or Ile at the C term) – 53 of the 59 peptides bound A*2402 • This peptide induced CTL in 1/4 HIV-1+ people tested • FYCNTTQLF bound to A*2402 strongly, the epitope can be processed in a vaccinia construct and presented – two specific CTL clones were obtained				
gp120(377-387)	gp120(381-391)	NSGGEFFYSNS		human(A2)	[Hickling90]
	NOTES: • Peptides recognized by class I restricted CTL can bind to class II				
gp120(421-440 LAI)	gp120(417-436)	LPCRIKQFINMWQEVGKAMY	HIV-1 infection	human(A2)	[Dadaglio91]
	NOTES: • Defined through blocking CTL activity, and Env deletions				
gp120(410-429 H3DCG)	gp120(417-430)	LPCRIKQFINMWQE	HIV-1 infection	human(DR4 CD4+)	[Siliciano88]
	NOTES: • CD4+ CTL restricted by class II HLA-DR4, targets primed by CD4 mediated uptake of gp120				
gp120(424-432 HXB2)	gp120(420-428)	RIKQIINMW		human(A32)	[Harrer96b]
gp120(424-432 LAI)	gp120(420-428)	RIKQFINMW	HIV-1 infection	human(A32)	[Ray98]
	NOTES: • Autologous virus was used to detect CTL in two individuals, and in both cases strain-specific autologous CTL were found • The autologous epitope sequence was RIKQIINMW, MN and RF were KIKQFINMW and RIKQFVNMW respectively, and all were reactive with CTL clones				

HIV CTL Epitopes

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(428-443 IIIB)	gp120(422-437)	KQIINMWQEVGKAMYA	vaccinia IIIB gp160	murine(H-$2^{a,b,f}$)	[Shirai92]
	NOTES: • In a murine system multiple class I molecules can present to CTL				
gp120(428-443 IIIB)	gp120(422-437)	KQIINMWQEVGKAMYA	HIV exposure	human	[Pinto95]
	NOTES: • CTL and T helper cell reactivity in healthcare workers exposed to HIV				
gp120(MN)	gp120(422-437)	KQIINMWQEVGKAMYA	HIV-1 infection	chimpanzee	[Lubeck97]
	NOTES: • Epitope-specific CTL detected in chimpanzees immunized with adenovirus-HIV-1 MN gp160 recombinant • CTL response may account for protection against subsequent HIV-1 SF2 challenge in a chimpanzee lacking neutralizing antibodies • Helper and cytotoxic T cells can be stimulated by this peptide (T1)				
gp120(421-440 LAI)	gp120(422-436)	KQFINMWQEVGKAMY	HIV-1 infection	human(A2)	[Dadaglio91]
	NOTES: • Defined through blocking CTL activity, and Env deletions				
gp120(428-443 IIIB)	gp120(422-437)	KQIINMWQEVGKAMYA	HIV-1 infection	human(A2)	[Clerici91]
	NOTES: • Helper and cytotoxic T cells can be stimulated by this peptide (T1)				
gp120(428-443 IIIB)	gp120(422-437)	KQIINMWQEVGKAMYA	HIV-1 infection	human(A2)	[Cease87]
	NOTES: • Helper and cytotoxic T cells can be stimulated by this peptide (T1)				

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(439-458 IIIB)	gp120(433-452)	KAMYAPPISGQIRCSSNITG	HIV-1 Pr55gag VLP with gp120 or V3+CD4 linear domains	Macaca mulatta	[Wagner98]
	NOTES: • A VLP is a non-infectious virus like particle self-assembled from HIV Pr55 gag – macaques were immunized with VLPs bound to either gp120 or V3+CD4 linear domains – gag and env specific CTL were stimulated in each case, and Ab response to gag and gp120 and was elicited, but the gp120 neutralizing response occurred only with whole gp120, not V3+CD4 – despite the CTL and Ab response, immunized macaques were infected by intervenous challenge with SHIV chimeric challenge stock • CTL specific for this epitope could be found both before and after SHIV challenge				
gp120(431-440)	gp120(435-444)	MYAPPIGGQI	synthetic peptide	murine(H-2K^d)	[Duarte96]
	NOTES: • Tolerization of CTL response with continued administration of soluble peptide				
gp120(494-513 BRU)	gp120(491-510)	VKIEPLGVAPTKAKRRVVQR	HIV-1 infection	human(A2)	[Dadaglio91]
	NOTES: • Defined through blocking CTL activity, and Env deletions				
gp120(IIIB)	gp120		gp120 or gp160 DNA vaccine	Rhesus monkeys	[Shiver97]
	NOTES: • DNA vaccinations of Rhesus monkeys with a gp120 or gp160 DNA vaccine elicited a strong CD8 cytotoxic T cell response				
gp160	gp120	polyclonal	HIV-1 infection	Macaca nemestrina	[Kent97b]
	NOTES: • Macaques can be infected with HIV, and clear the infection within 6 months, so it is of interest to examine their initial immune response • A strong CTL response against env, pol and gag antigens can be detected • The CTL response peaked by 4 weeks and declined dramatically by 8 weeks • The response in the lymph nodes and peripheral blood was comparable				

HIV CTL Epitopes

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp160	gp120		DNA gag/pol, vif, and env vaccine	murine	[Kim97]
	NOTES: • A gag/pol, vif or env DNA vaccine, when delivered in conjuction with the plasmid encoding the co-stimulatory molecules B7 and IL-12, gave a dramatic increase in both the cytotoxic and proliferative responses in mice • When IL-12 was present, CTL response could be detected even without *in vitro* stimulation				
gp160(env)	gp120		DNA gag/pol, and env vaccine	murine	[Kim97b]
	NOTES: • A gag/pol or env DNA vaccine, when delivered in conjuction with the plasmid encoding the co-stimulatory molecules CD86, gave a dramatic increase in both the cytotoxic and proliferative responses in mice • When CD86 was present, CTL response could be detected even without *in vitro* stimulation				
gp120(gp160 HXBc2)	gp120	polyclonal	gp160 DNA vaccine, env protein boost	Macaca mulatta	[Letvin97]
	NOTES: • Vaccination of Macaques mulatta (Rhesus monkeys) with a HXBc2 env DNA prime and a protein boost elicited a T-cell proliferative response, a CTL response, and type-specific neutralizing antibodies • Vaccinated animals challenged with SHIV-HXB2 were protected from infection				
gp120(env MN)	gp120	polyclonal	env + rev MN DNA vaccine	human	[MacGregor98]
	NOTES: • An HIV DNA env and rev vaccine given to 15 asymptomatic HIV+ individuals at three different dosages, 30, 100 or 300 μg, was safe • The CTL response to gp120 was enhanced in 0/4 patients in the 30 μg group, 2/3 patients in the 100 μg group, and 0/3 in the 300 μg group – but the non-responding patients in the 300 μg group had a strong CTL response prior to vaccination, and the CTL results are inconclusive				

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
gp120(env IIIB)	gp120		HIV infection	human	[Trickett98]
	NOTES: • 12 HIV-1 infected patients were re-infused with their own lymphocytes, cryopreserved from an earlier time point in the infection • Improvement in CD4+ and CD8+ T cells was seen in 7/12, and an increase in the CTL response to Env was seen in one patient				
gp120(env LAI)	gp120		HIV infection	human	[Legrand97]
	NOTES: • 17 recently infected patients were tested for CTL response to HIV proteins Env, Gag, Pol, Rev, Nef, Vif and Tat • An early response (within a month following PI) was noted in 87% of the subjects to Gag, 75% to Env, and 50% to Nef • Early responses to Pol, Rev, Vif and Tat were rare				
gp120(env LAI)			HIV infection	human	[Corey98]
	NOTES: • Vaccinia-naive subjects were vaccinated with vaccinia-gp160 LAI and boosted with gp120 SF2, LAI, MN, or 160 MN • 26/51 had an anti-Env CTL response, and those that were boosted with gp120 tended to produce Abs that neutralized autologous laboratory strains with some cross-reactivity				
Env(env IIIB)			HIV-1 infection	human	[Betts97]
	NOTES: • 6/8 individuals from Zambia infected with C clade virus had CTL that were able to make response to B clade HIV-1 IIIB vaccinia expressed Gag, Pol and Env proteins • A vigorous cross-clade response was not limited to a particular protein, and the level of recognition of different proteins varied among the six patients				

HIV CTL Epitopes

Location	WEAU	Sequence	Immunogen	Species(HLA)	References
Env			HIV-1 infection	human	[DeMaria97]

NOTES:

- CD3+ cells that also carry a natural killer cell receptor (NKR+) can exhibit down regulation of T-cell function
- Anti-NKR IgM MAb masked this inhibitory function and increased HIV-1 specific CTL activity in phytohemagglutinin-activated PBMC cultured in the presence of IL-2 from 3/5 patients, and in one other case anti-NKR MAb brought HIV-1 specific CTL activity to detectable levels

Env			DNA vaccine pCMV160/Rev	murine(H-2^d)	[Ishii97]

NOTES:

- pCMV160/Rev is a DNA vaccine candidate carrying gp160 and Rev linked to a cytomegalovirus (CMV promotor)