

Substitutions based on BLOSUM matrices is shown below.

Amino acids encountered (first column) in the reference input sequence are substituted with the amino acids shown across the first line, by BLOSUM score.

**BLOSUM62, modified**

	A	C	D	E	F	G	H	I	K	L	M	N	P	Q	R	S	T	V	W	Y
A		0	-2	-1	-2	0	-2		-1	-1	-1	-2	-1	-1	-1	1	0	0	-3	-2
C	0		-3	-4	-2	-3	-3		-3	-1	-1	-3	-3	-3	-3	-1	-1	-1	-2	-2
D	-2	-3		2	-3	-1	-1		-1	-3	-3	1	-1	0	-2	0	-1	-3	-4	-3
E	-1	-4	2		-3	-2	0		1	-3	-2	0	-1	2	0	0	-1	-2	-3	-2
F	-2	-2	-3	-3		-3	-1		-3	0	0	-3	-4	-3	-3	-2	-2	-1	1	3
G	0	-3	-1	-2	-3		-2		-2	-4	-3	0	-2	-2	-2	0	-2	-3	-2	-3
H	-2	-3	-1	0	-1	-2			-1	-3	-2	1	-2	0	0	-1	-2	-3	-2	2
I	-1	-1	-3	-3	0	-4	-3		-3		1	-3	-3	-3	-3	-2	-1	3	-3	-1
K	-1	-3	-1	1	-3	-2	-1			-2	-1	0	-1	1	2	0	-1	-2	-3	-2
L	-1	-1	-4	-3	0	-4	-3		-2		2	-3	-3	-2	-2	-2	-1	1	-2	-1
M	-1	-1	-3	-2		-3	-2		-1	2		-2	-2	0	-1	-1	-1	1	-1	-1
N	-2	-3	1	0	-3	0	1		0	-3	-2		-2	0	0	1	0	-3	-4	-2
P	-1	-3	-1	-1	-4	-2	-2		-1	-3	-2	-2		-1	-2	-1	-1	-2	-4	-3
Q	-1	-3	0	2	-3	-2	0		1	-2	0	0	-1		1	0	-1	-2	-2	-1
R	-1	-3	-2	0	-3	-2	0		2	-2	-1	0	-2	1		-1	-1	-3	-3	-2
S	1	-1	0	0	-2	0	-1		0	-2	-1	1	-1	0	-1		1	-2	-3	-2
T	0	-1	-1	-1	-2	-2	-2		-1	-1	-1	0	-1	-1	-1	1		0	-2	-2
V	0	-1	-3	-2	-1	-3	-3		-2	3	1	-3	-2	-2	-3	-2	0		-3	-1
W	-3	-2	-4	-3	1	-2	-2		-3	-2	-1	-4	-4	-2	-3	-3	-2	-3		2
Y	-2	-2	-3	-2	3	-3	2		-2	-1	-1	-2	-3	-1	-2	-2	-2	-1	2	

Exclusions: M>F; I>L; ANY>I; and

ONLY ANY>L is allowed for ANY>I or ANY>L substitutions,

ANY>L is always implemented at the less stringent value between ANY>I or ANY>L

These adjustments for ANY>L include D>L=-3 (not -4), V>L=3 (not 1)

**BLOSUM90, modified**

	A	C	D	E	F	G	H	I	K	L	M	N	P	Q	R	S	T	V	W	Y
A		-1	-3	-1	-3	0	-2		-1	-2	-2	-2	-1	-1	-2	1	0	-1	-4	-3
C	-1		-5	-6	-3	-4	-5		-4	-2	-2	-4	-4	-4	-5	-2	-2	-2	-4	-4
D	-3	-5		1	-5	-2	-2		-1	-5	-4	1	-3	-1	-3	-1	-2	-5	-6	-4
E	-1	-6	1		-5	-3	-1		0	-4	-3	-1	-2	2	-1	-1	-1	-3	-5	-4
F	-3	-3	-5	-5		-5	-2		-4	0	-1	-4	-4	-4	-4	-3	-3	-2	0	3
G	0	-4	-2	-3	-5		-3		-2	-5	-4	-1	-3	-3	-3	-1	-3	-5	-4	-5
H	-2	-5	-2	-1	-2	-3			-1	-4	-3	0	-3	1	0	-2	-2	-4	-3	1
I	-2	-2	-5	-4	-1	-5	-4		-4		1	-4	-4	-4	-4	-3	-1	3	-4	-2
K	-1	-4	-1	0	-4	-2	-1			-3	-2	0	-2	1	2	-1	-1	-3	-5	-3
L	-2	-2	-5	-4	0	-5	-4		-3		2	-4	-4	-3	-3	-3	-2	0	-3	-2
M	-2	-2	-4	-3		-4	-3		-2	2		-3	-3	0	-2	-2	-1	0	-2	-2
N	-2	-4	1	-1	-4	-1	0		0	-4	-3		-3	0	-1	0	0	-4	-5	-3
P	-1	-4	-3	-2	-4	-3	-3		-2	-4	-3	-3		-2	-3	-2	-2	-3	-5	-4
Q	-1	-4	-1	2	-4	-3	1		1	-3	0	0	-2		1	-1	-1	-3	-3	-3
R	-2	-5	-3	-1	-4	-3	0		2	-3	-2	-1	-3	1		-1	-2	-3	-4	-3
S	1	-2	-1	-1	-3	-1	-2		-1	-3	-2	0	-2	-1	-1		1	-2	-4	-3
T	0	-2	-2	-1	-3	-3	-2		-1	-1	-1	0	-2	-1	-2	1		-1	-4	-2
V	-1	-2	-5	-3	-2	-5	-4		-3	3	0	-4	-3	-3	-3	-2	-1		-3	-3
W	-4	-4	-6	-5	0	-4	-3		-5	-3	-2	-5	-5	-3	-4	-4	-4	-4	-3	2
Y	-3	-4	-4	-4	3	-5	1		-3	-2	-2	-3	-4	-3	-3	-3	-2	-3	2	

Exclusions: M>F; I>L; ANY>I; and

ONLY ANY>L is allowed for ANY>I or ANY>L substitutions,

ANY>L is always implemented at the less stringent value between ANY>I or ANY>L

These adjustments for ANY>L include T>L=-1 (not -2), V>L=3 (not 0)