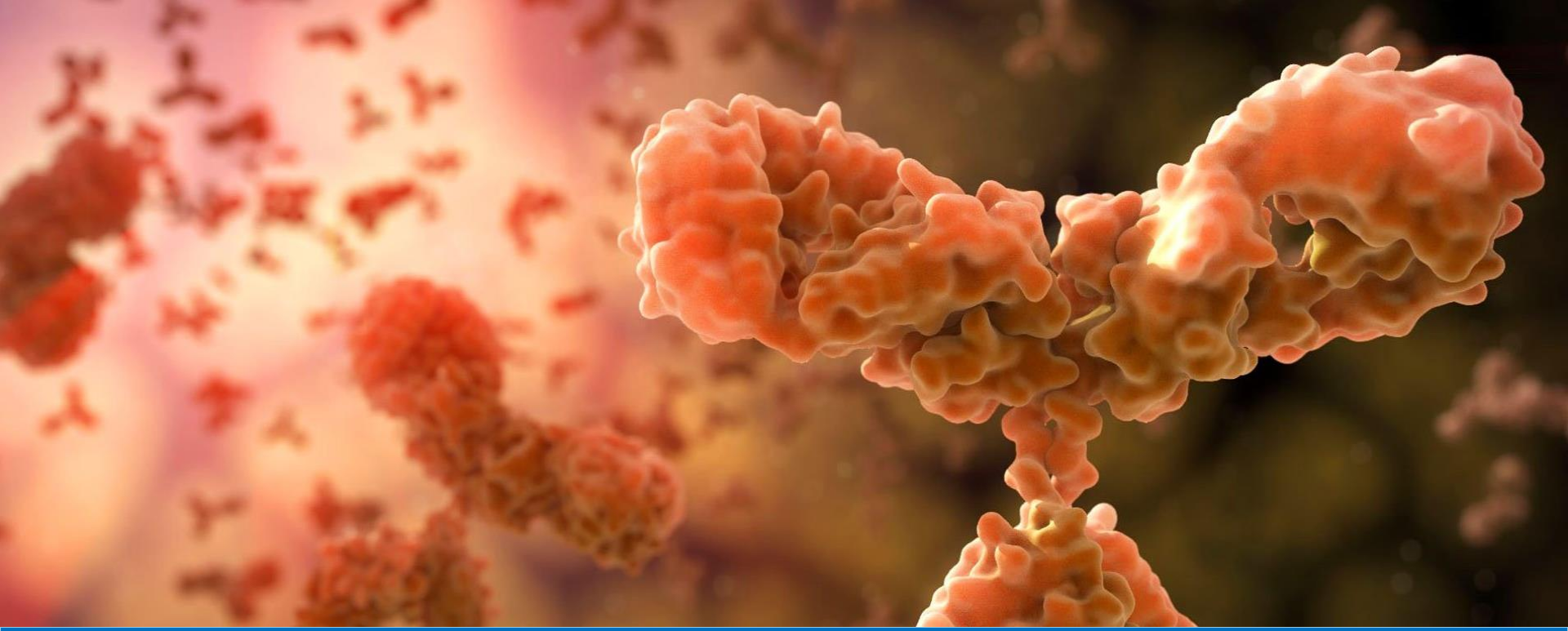

Antibody Characterization Using Next Generation Sequencing made easier with **Group My Abs** shiny app

Volha Tryputsen | Johnson & Johnson

R in Pharma | 15 August, 2018

Raise you hand if you are a Lego fan!

Lego Mess

Lego Sorting

Large molecule drug discovery: High-throughput screening results

ARHPAFNPAFDY	AKVGVWGSYELDY	ARDSYEYGRSNAFDY	ARGRGGLAGAFDY	ARDGGGSWGNYRGGYFDY	ARVSLGVAAFAY	ARDERYFDY	ARERSYYWLGSYGYAFDY	ARHYLSGSLGLDY
AKASGKGLDY	ARPKFDYGYQHFDY	ARVMNRFAYSHLDY	ARGTAIFDY	ARDLSGSNLDPAFDY	ARGFGYRFDY	AREATYGDFDY	AKDGNVVCDNYYLDY	ARKKPGDHRADLDY
ARDTRSYDGFDY	ARQLWGYLDY	ARGRSPRYFDY	AKLAGRTLDY	ARLADLFDY	ARGLGNSVARAFDY	ARFSPGSYGYLDY	AKKSNWFDY	ARPFRWLDY
AKRTKLLDY	ARISSDDDFDY	ARGVTTLGRRDYFDY	ARDTRASDGFDY	ARRAAWGGWADLDY	ARDAGGGDYYLDY	ARGPCFSIGTPLDY	ARFGFSLDY	ARVQDGLYSFIFDY
ARDRGRRLGVVYAFDY	ARHDPWSLDLDY	ARLARWTFRLDY	AKNSHYSALRFDY	ARVSRTFDGLDY	ARDCNVLDY	ARMMWDSFDN	ARGERRSLYMFDY	ARYGSSFDY
AKRTRDLDY	ARDRGYGNYLRSYLGYYYFDY	ARNTSYLDY	ARHTPFSGCYYCLDY	ARDCLTSCVWFDY	ARDSLTASSFAFDY	ARWRRELDY	ARNAGGDDYYLDY	ARYRSRFDY
ARVHYRRQVVLDY	ARDRYGWRSYPVYYFAY	ARHSWRTYHWELDY	ARTRGPAVPFDY	ARERYYRWRSYGSYYFDY	ARGRSLSGFDY	VRDAGGDDYYLDY	ARRCEWALDY	ARASRSYDGFDY
AKHQRPGLDY	AKLSPFPGWPFDY	AREGGGGSAGSYSDGFDY	AKGVFSNLFDY	ARGRTLGYFDY	ARVHSVFFLFDY	ARASSWARFDY	ARATVASGWVFWFDY	ARAVVPLDY
ARERYYRYGRYGYSYYFDY	ARDPGGSYRGAYGFDY	ARDYLYLDY	AKKHNWLDY	ARLQLLPFDY	ARGGGGWLTEGTYYFDY	ARGESDTDSGSFDY	ARDGGCEEACLDY	ARDRRYRYGLDY
AKHRRGGSLDY	ARVDPWSVDFDY	ARDRGPRYFLDY	AKKHTWFDY	ARRCYRLDY	AKGSVGSGDFDY	ARHCTDITNLYLDY	ARGGSRWRGAFDGFAY	ARFSPDADGGSFDY
ARVGRVSAGYIFDY	ARGPSYPWLLYGYGGAFDY	ARGRYYPWYVYGSYYFDY	ARRAAWVGDFDY	ARVAGWDLGKFDY	ARGSVCTIFCQSFDY	ARNKDGCSFTLDY	ARGRDYRGGTAFDY	ARGRGGRLYDAFDY
ARGRYYPWYGYGSYYFDY	ARDSRASDGFDY	ARDSRSVDGFDY	ARDRGIGYGGFDY	ARVQFLPLDY	ARGTWIFDY	ARVVAGFYMYQTYLDY	ARGRGRRLGVVYAFDY	ARHVLSGPELDY
AKGAGASVAWDFDY	ARMRKAQFDY	AKIRGWRRADFDY	ARDRGRRSPGFDY	ARGGWTGVSPYAFDY	ARRDIQWPHNEDLDY	ARDAGGDDHYLDY	ARIQMLLDY	ARVGGPAPWFDY
ARADPWSIDFDY	AKSSFDY	ARGTGAYNWAHGFDY	ARERSLNRSYRGFDY	ARNIRATYFDY	ARRYAFGTFALDY	ARETHSAFGDYAWLDY	ARLASVLDY	ARVLKWHLDY
ARDDGRQGFDY	AKQFRNSYSDPFDY	AREGGYYPVYADYDAFDY	ARGAGGDDYYLDY	AKDGGDYWGDFDY	ARDDAYGPYLFDY	ARGRYSRTFDY	ARRHIVFDY	ARYLIRFDY
ARGLYYPWYSYGSYYFDY	ARHRRGAFDY	AKHVFSTRGNLDY	ARGYRRTIYFGY	ARGPYGYYGNWIGDYFDY	ARVKRHSYYGSFDY	ARGSRSYDGFDY	AKHNARGEFDY	AKAAGNCAHGFFDY
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AKNAWGWFGAELDY	ARIWVSTYLGSFDY	ARGRRGGTGGFDY	ARGEAFGTCFDY	ARARGIVNWFDY	ARVTRRLDY	ARIAYSFSSFDY	ARGVTGSLPFDY	ARDAGGDDYYLDC
ARDSITSDGFDY	ARDTSFRLRYRFDY	ARDAGGDDYYFDY	ARLPRKFDY	ARGRRVGLFDY	AKPMNCLCLDY	ARKIDEREFYSGLDY	ARARRLGWFDY	ARDAGGDNYYLDY
AREYYLDSEGFDY	ARGYDFFAYAALDY	ARIAAGFAYGNLDY	ARDPDGYYSRFGFDY	ARGFSYYVFDY	ARDNAFYVLDY	ARNDSYFALDY	ARDGTSSSRYRAFDY	ARDVGGDDYYLDY
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ARIDSPYDCCGYLDY	ARVPHWSSKLDY	ARGSGCDIGDLDY	ARVQFVPLDY	ARGRYYPWRSYGYSYYFDY	ARGRRSYRLFDY	ARRTEVLDY	ARGGSRADLYGYYLYY	AREYSYGAGDAFDY
ARTYGYAGVSLDY	ARDTRGYDGFDY	ARRRNGSYFAY	ARDWVYSAHLDY	ARSIRGGFDY	ARHWISRLDY	ARVGVYNWNFDY	ARGTPYGGLDY	ARGAYGYWFDY
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ARVDPWSLDLDY	ARSRPSSVFDY	ARDRYYGGNSVRRGGYYFDY	ARDRRGKAGLDY	ARRRPWSGFLDY	ARVSWDGVFFDY	ARDEGNFATLDY	ARVSSRARFDY	ARLMALLDY
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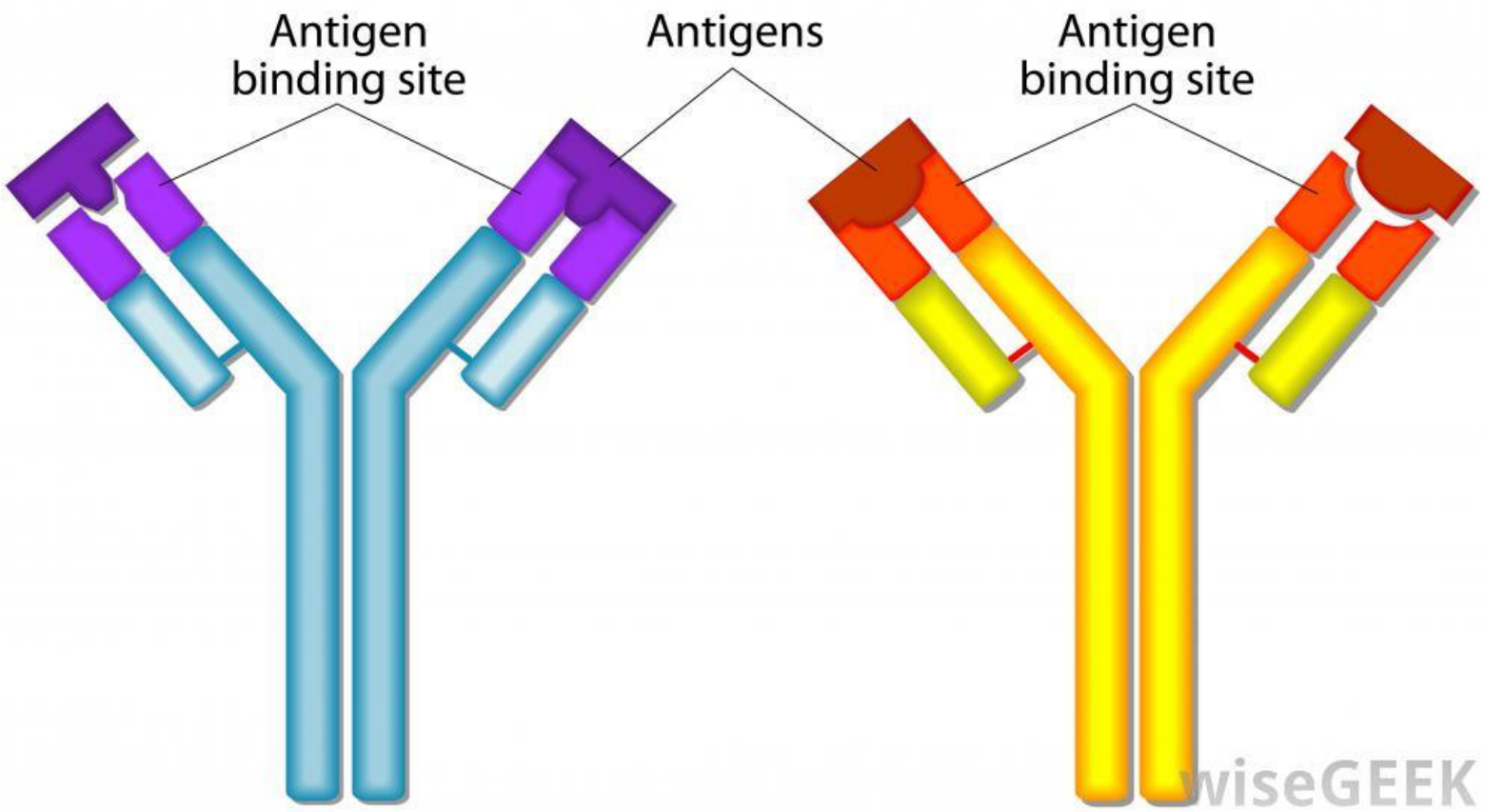
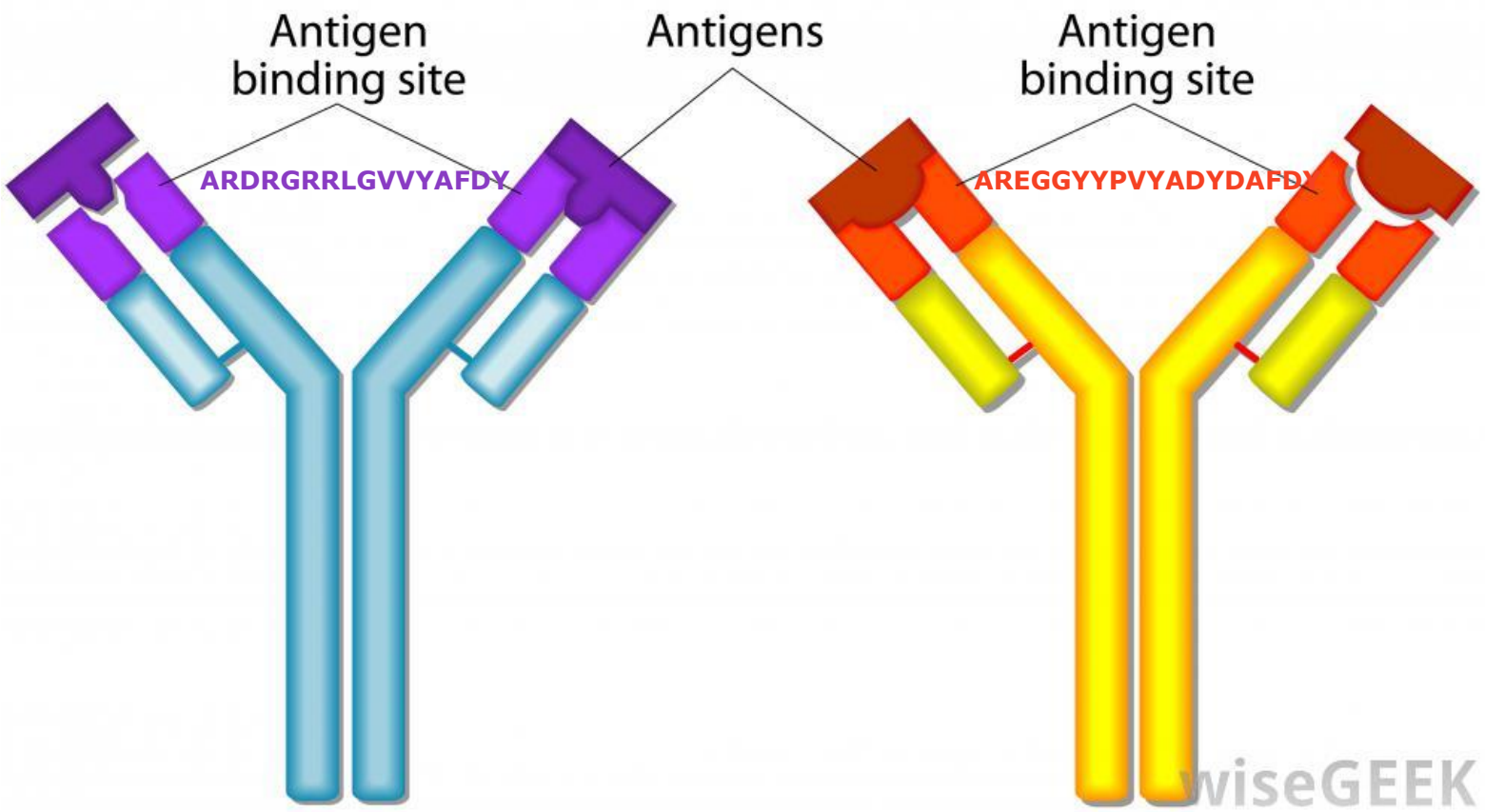
AKGWGFSGSGLDY	ARHWRGKYWSIFGLDY	AKKHVWFDY	ARVRIYGWRVRGYSYYFDY	ARGRSYEATANLDY	ARLWASFDY	ARGLTWLDY	ARDYVDVNDFDY	ARVSSWARFGY
AKGSKALFDY	AKGGYAGCCNDFDY	ARDTAGCWTFDY	ARAARIGTFDY	ARRAAWIGSFDY	ARPGRTIITLDY	ARHDCKYVKHLDY	ARGACGHGLDY	ARDEGGYYKFDY
ARDGRTSDGFDY	AKPYLWLDY	ARHTWGYYDAYGLDY	ARVDDWYRTFDY	ARVSSWARLDY	ARRGWPLDY	ARKLYALLDY	ARGCAGESLDY	ARDSATYDGFDY
ARDTRSSDGFDY	ARVDPWSWDFDY	ARDARTSDGFDY	AREYYYGSGDAFDY	AREPSWPGNGAGAFDY	ARVDDHDYILKLDY	ARQSVCLDY	ARGFGSSSLRAFDY	ARDY
AKMGKVFDY	ARGRYYRWVSYGSYYFDY	ARGQADSFDY	ARGDPWSMDLDY	ARGRVGGLSGFYFDY	ARASDTGSLDY	TRDAGGDDYYLDY	ARGRTALVVFDY	ARERAALDY
AKSSGKAFDY	ARISGWADDRFDY	ARGRGGGLWGFDY	ARGRGAYLIWFDYFDY	ARDAGGDDYYSDY	ARDEYEGSAWYFDY	AKHSWGWAGDLDY	ARLSRRLDY	ARERYDSYGVVDAFDY
ARDGYGAKHYVLAFDY	ARDPYGGGEVNTQRYYGMDV	ARIDPWSSDLDY	ARGWYPGYRGDLDY	ARVSPWARFDY	ARETMSLDY	ARARSDRWFLDY	ARQSWEFDY	ARGCYLLFCFDY
ARERYYRWRRSYGYYFDY	ARDPDGSLSAWGFDY	ARESGGTVSLSYYYYGFDY	ARTWIAMVFFDY	ARIWVWGLGMPFDY	ARGRGAGGRGFDY	ARDYVQVGGWLDY	ARRSWFTLPGSLDY	ARGGSVVYVAFDY
ARQRSYKSALRYFDY	ARDTRAYDGFDY	ARGSCCCSLDY	AKHGGHTVHWDLDY	ARNSGDWGASLDY	ARGRGNSLRGFDY	ARERYYRWRVRGYSYYLDY	ARSSRSLDY	ARGISSSDSFDY
ARGRGRYFMANFDY	ARGRRVAAFDY	ARQMVMFDY	ARGIDYAVDGFDY	AKHCVCGVFDY	AKDQVGMYPVEYLDY	ARGNEDWADYWDLLDY	AKGHSAWKPLDY	ARGPDYISAFDY
ARENRTYDGFDY	ARESRTNDGFDY	AKRGVGLRLDY	ARRNEEHLDY	ARHLDGTAAFDY	AR	ARSNVLLDY	AKLIAWFCFEYLDY	ARLEAFCVSCYCFDY
ARVSPGPYGLFDY	AKGNRAAGGFDY	ARALIASWFDY	ARDAGGDDY	ARNYGNTRDDFDY	ARAVSRFDY	ARDLYRGDGWFDY	ARAGFYVKVVGEFDY	ARNWYYCPYSLDY
ARDSLTSDGFDY	ARDGFQAYYAWYWLDY	ARDTLTSDGFDY	ARENRVLDY	ARRYPWIGHFDY	ARHRGYIHLELDY	ARDRRWFGAFDY	ARDGGYRTDGTTYYYFDY	ARSSGGNGSAHFDY
ARGDPWSVDFDY	ARSSIYPYLWVLDY	ARPYKGLDY	ARRGGSNNSTFDY	AREASSASSDAFDY	ARMQSRTFDY	ARDSSPYGYFDY	ARFSGQFLDY	ARVSSWARFNY
AKRRRDSRSRDLDY	ARVRDRFAYSMLDY	ARTSVGETFDY	ARVSRVEFDY	ARGRNTGSFDY	ARVDPWSHDLDY	ARDTAPGPGEDLDY	ARGCCGRTLDY	ARVYFSRFDY
	ARGRGRYGRGYFDY	ARGRYYRWRVRGYSYYFDY	ARDAGGDDYY	ARTVLGLDY	ARDAGGDDYYLGY	ARECPITNGYSTFDY	ARHDWSSYSWYLDY	ARWDTDACKYYGRFDY

Antibody binding



Antibody binding



Classifying antibodies

Classifying antibodies by a shape of a binding site

Group My Abs Shiny App

1. Upload data

Browse... NGSAnalysisDynSub-v2.1-BTLACHO_vs

Upload complete

2. Select your variable for analysis:

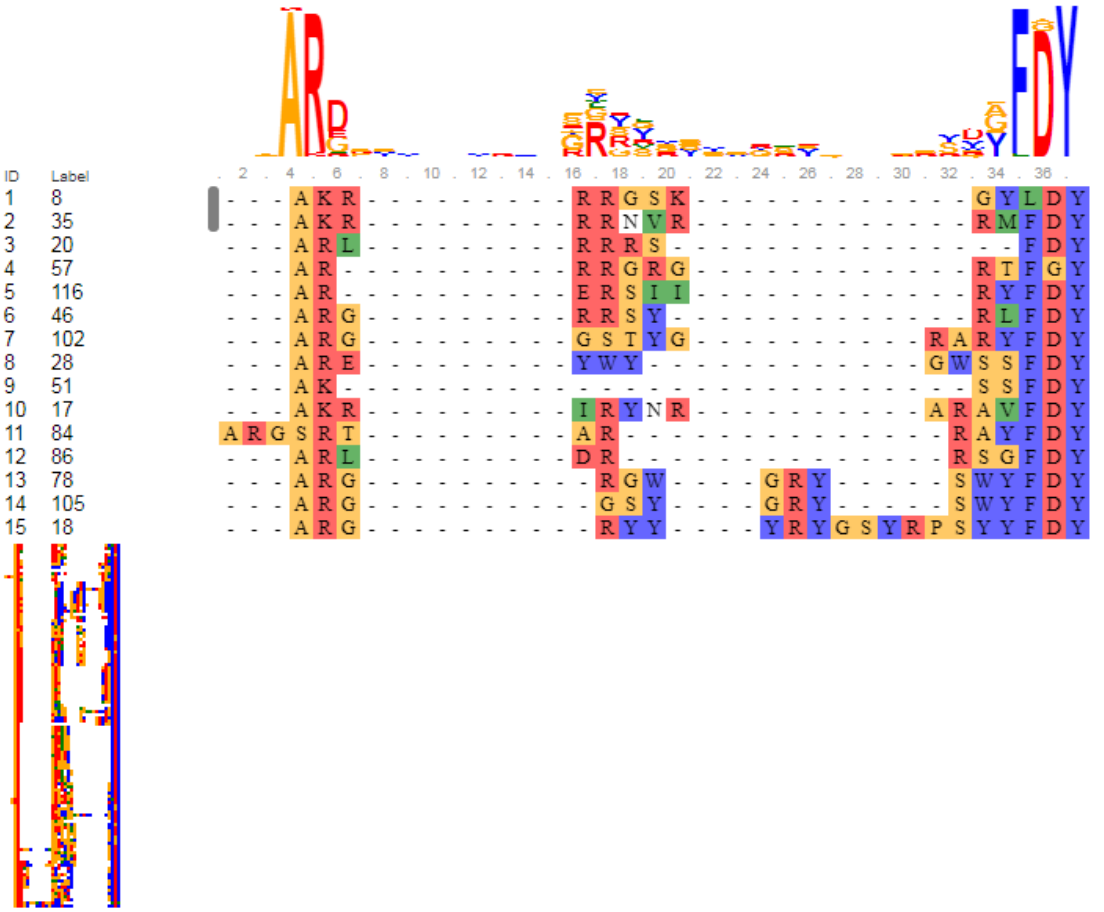
Amino.Acid.CDR3

3. Clean the data:

- [ ]
- [ ] Iso-Asp
- [ ] Trp
- [ ] N-link ,Deamidation site
- [ ] Met
- [ ] Iso-Asp ,Trp
- [ ] N-link
- [ ] Deamidation site
- [ ] Iso-Asp ,N-link ,Deamidation site

MSA Interactive | Clustal family arrangement | Documentation

Import | Sorting | Filter | Selection | Vis.elements | Color scheme | Extras | Export | Help



Shiny by RStudio

Steps in antibody classification

1. Make sequences **comparable**
2. Evaluate **differences** between the sequences
3. Classify sequences into **families**

1. Make sequences comparable

ARGRTVGYFDY
ARDLGDYRDYAFDY
ARDSRSYDGFDY
ARGRRVGYFDY
……..
ARGLGGFDY
ARETRSYDGFDY
AKRRRGSKGYLDY
ARGRYRVPTSFDY

100`s of sequences

Shiny
by RStudio

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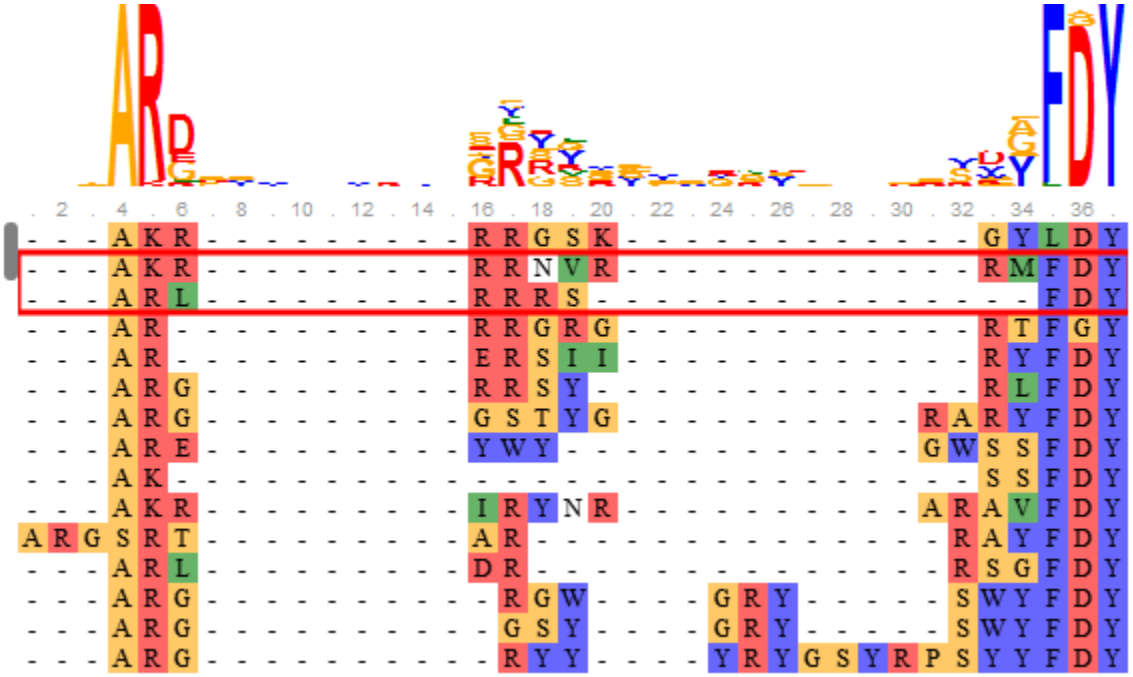

100`s of sequences

Dynamic Multiple Sequence Alignment with ClustalW

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2. Difference between two sequences

y	A	K	R	R	R	N	V	R	R	M	F	D	Y
x	A	R	L	R	R	R	S	F			F	D	Y

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by RStudio

2. Difference between two sequences

y	A	K	R	R	R	N	V	R	R	M	F	D	Y
x	A	R	L	R	R	R	S	F			F	D	Y

x	y
A	A
R	K
L	R
R	R
R	R
R	N
S	V
F	R
	R
	M
F	F
D	D
Y	Y

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by RStudio

2. Difference between two sequences

y	A	K	R	R	R	N	V	R	R	M	F	D	Y
x	A	R	L	R	R	R	S	F			F	D	Y

Amino acid	Hydrophobicity at pH 7 [1]	Hydrophilicity scale [2]	Avg side chain orientation angle scale [2]	Polarity scale [2]	H bond donors [2]	pI [3]
A	41	0.28	0.51	0.00	0.17	6.00
R	-14	1.00	0.37	1.00	0.73	10.76
N	-28	0.66	0.12	0.07	0.39	5.41
D	-55	0.79	0.14	0.96	0.30	2.77
C	49	0.07	0.91	0.03	0.31	5.07
Q	-10	0.65	0.02	0.07	0.53	5.65

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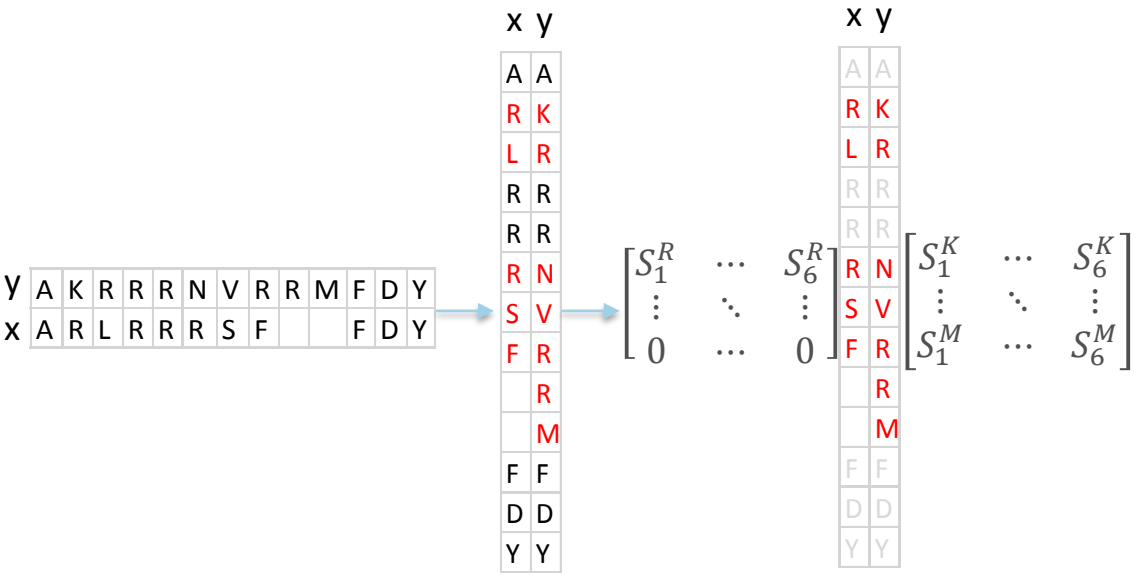
by RStudio

2. Difference between two sequences



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Shiny by RStudio

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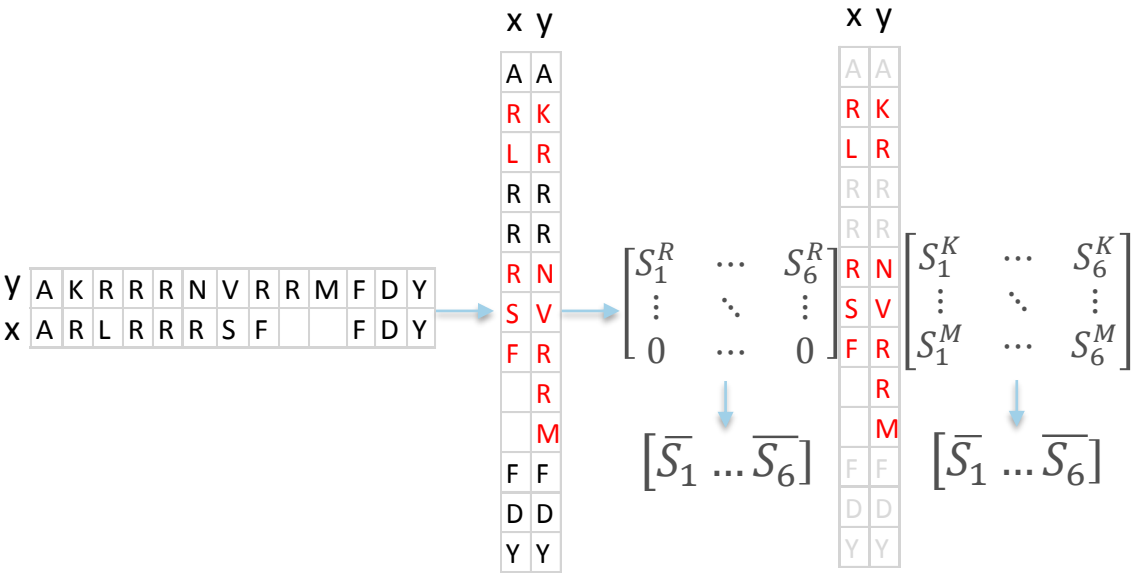

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Shiny by RStudio

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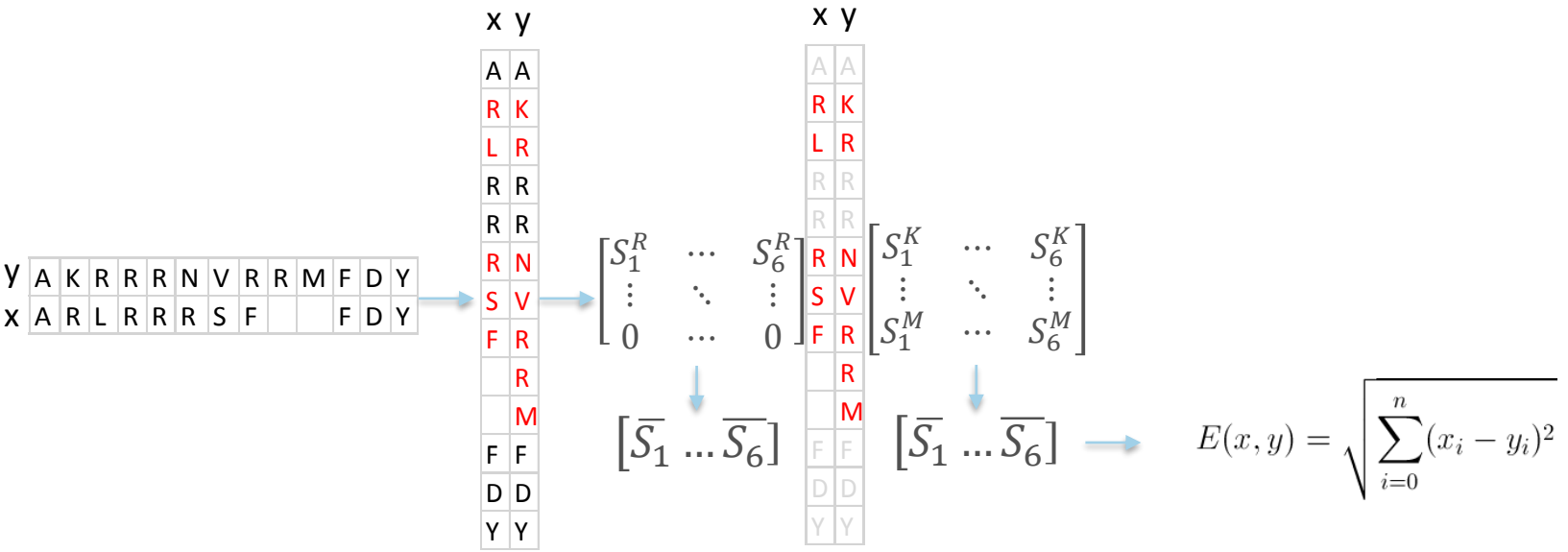

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Shiny by RStudio

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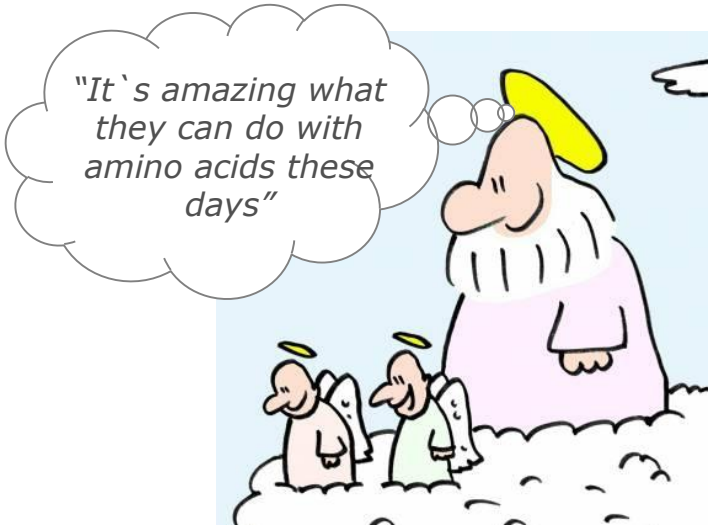

y	A	K	R	R	R	N	V	R	R	M	F	D	Y
x	A	R	L	R	R	R	S	F			F	D	Y

x	y
A	A
R	K
L	R
R	R
R	R
R	N
S	V
F	R
	R
	M
F	F
D	D
Y	Y

$$\begin{bmatrix} S_1^R & \cdots & S_6^R \\ \vdots & \ddots & \vdots \\ 0 & \cdots & 0 \end{bmatrix} \quad \begin{bmatrix} S_1^K & \cdots & S_6^K \\ \vdots & \ddots & \vdots \\ S_1^M & \cdots & S_6^M \end{bmatrix}$$

$$[\overline{S_1} \ldots \overline{S_6}] \quad [\overline{S_1} \ldots \overline{S_6}]$$

$$E(x,y) = \sqrt{\sum_{i=0}^{n}(x_i - y_i)^2}$$

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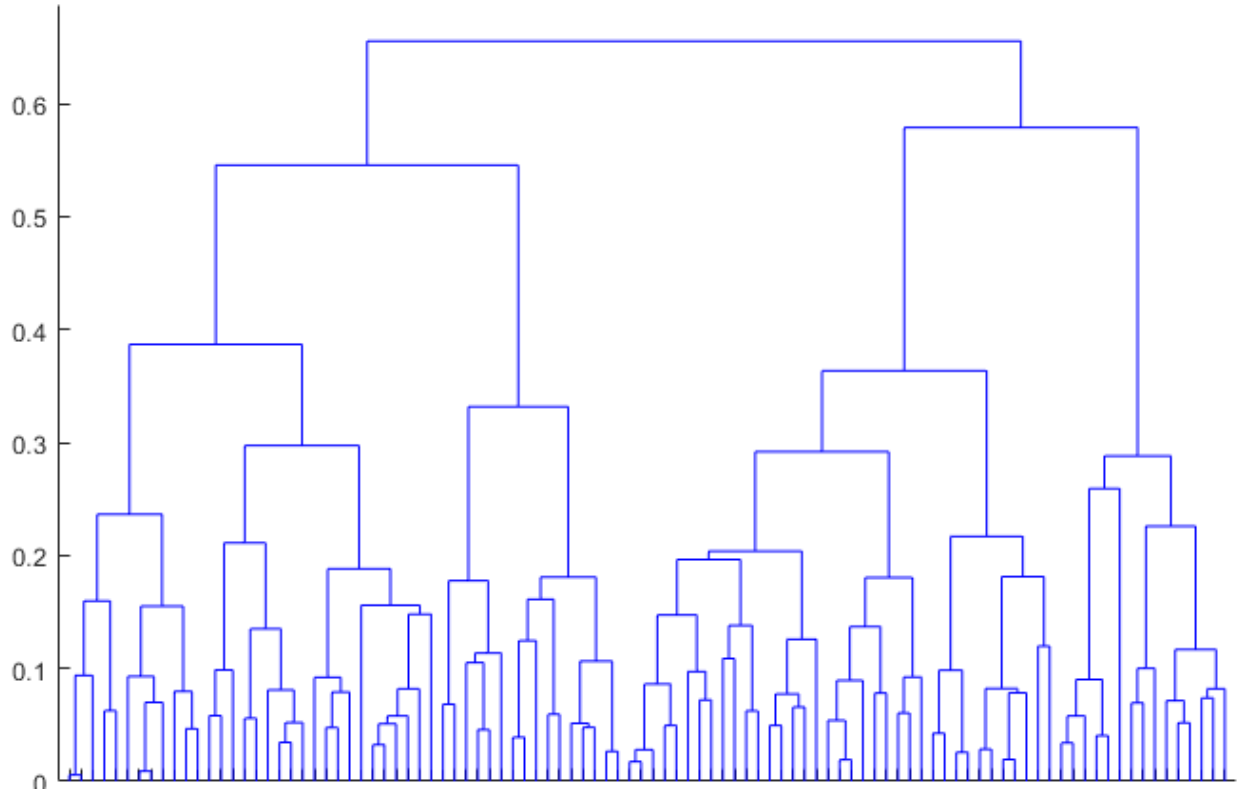
3. Classify sequences into families:
How many families do you think are there?



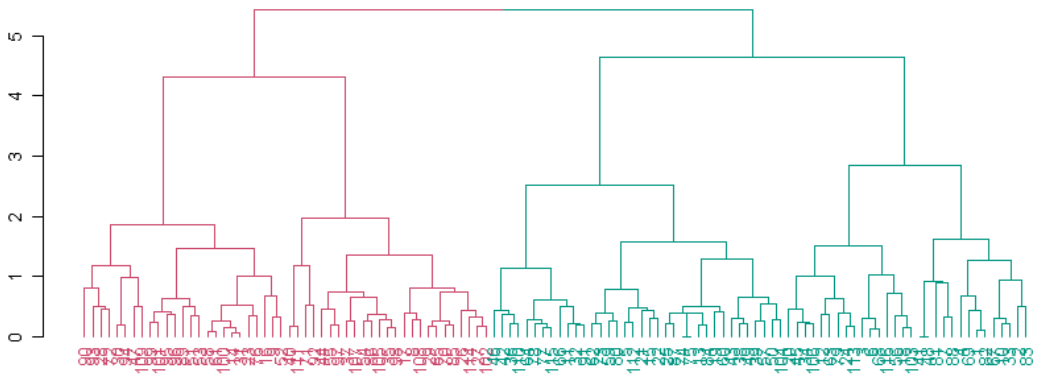
3. Classify sequences into families:
Group My Abs, how many families are there?

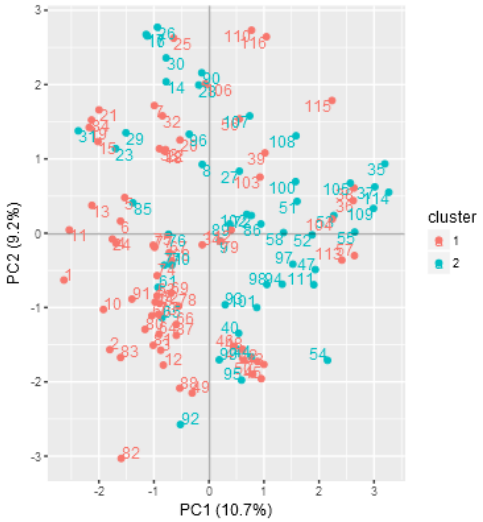
Suggested number of clusters:

Method	N_Clusters
frey	2.00
mcclain	2.00
cindex	2.00
silhouette	2.00
dunn	15.00

Choose the number of clusters:

2





Shiny
by RStudio

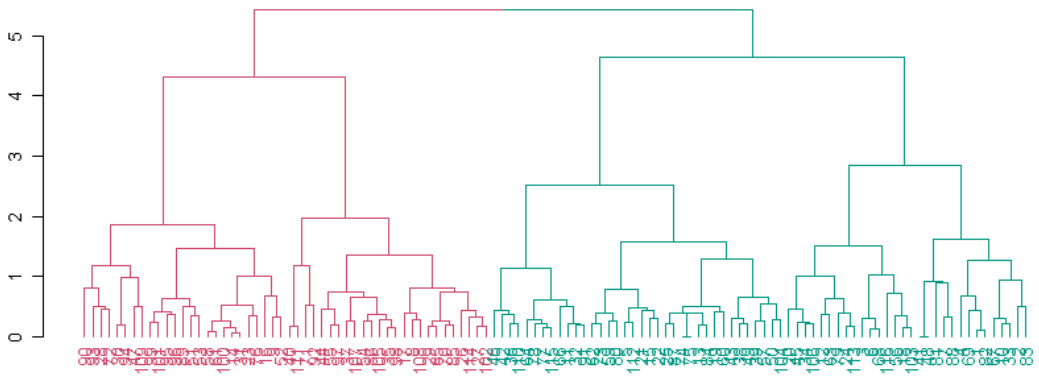
3. Classify sequences into families: Optimal number of clusters

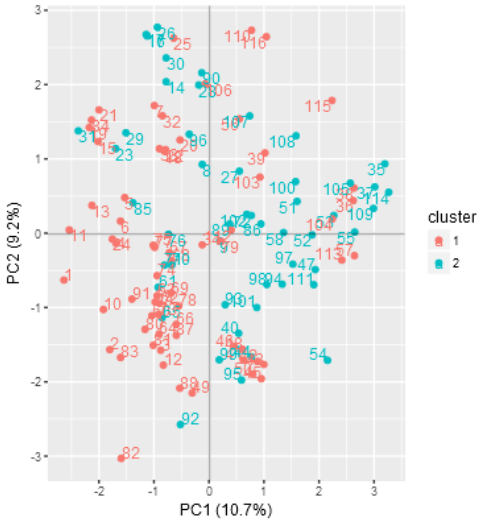
Suggested number of clusters:

Method	N_Clusters
frey	2.00
mcclain	2.00
cindex	2.00
silhouette	2.00
dunn	15.00

Choose the number of clusters:

2





Shiny
by RStudio

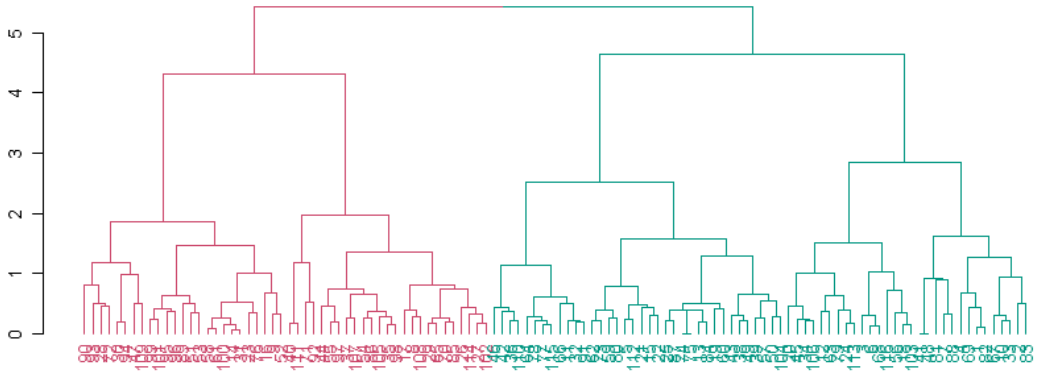
3. Classify sequences into families: Visualize families with a dendrogram

Suggested number of clusters:

Method	N_Clusters
frey	2.00
mcclain	2.00
cindex	2.00
silhouette	2.00
dunn	15.00

Choose the number of clusters:

2



Shiny
by RStudio

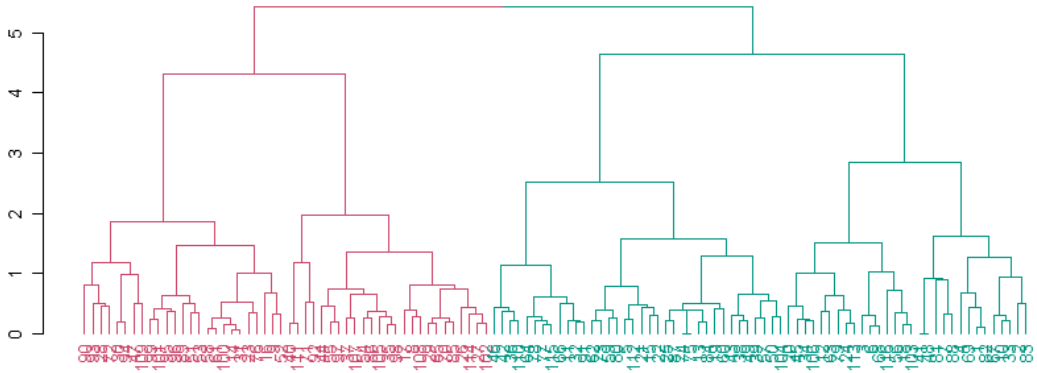
3. Classify sequences into families: Visualize families with MDS

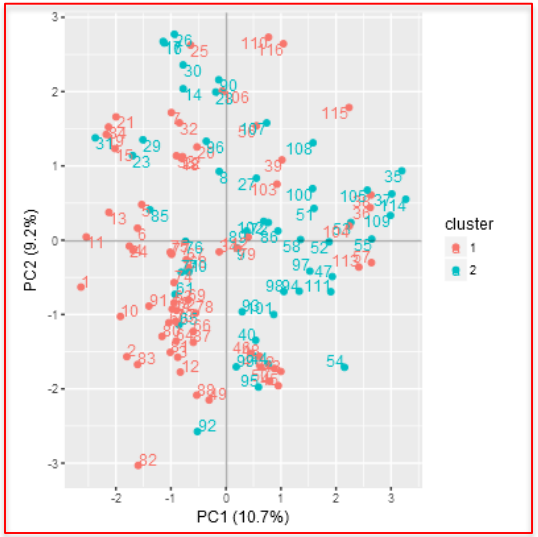
Suggested number of clusters:

Method	N_Clusters
frey	2.00
mcclain	2.00
cindex	2.00
silhouette	2.00
dunn	15.00

Choose the number of clusters:

2





Shiny
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Antibody Characterization Using Next Generation Sequencing

ARHPAFNPAFDY	AKVGVWGSYELDY	ARDSYEYGRSNAFDY	ARGRGGLAGAFDY	ARDGGGSWGNYRGGYFDY	ARVSLGVAAFAY	ARDERYFDY	ARERSYYWLGSYGYAFDY	ARHYLSGSLGLDY
AKASGKGLDY	ARPKFDYGYQHFDY	ARVMNRFAYSHLDY	ARGTAIFDY	ARDLSGSNLDPAFDY	ARGFGYRFDY	AREATYGDFDY	AKDGNVVCDNYYLDY	ARKKPGDHRADLDY
ARDTRSYDGFDY	ARQLWGYLDY	ARGRSPRYFDY	AKLAGRTLDY	ARLADLFDY	ARGLGNSVARAFDY	ARFSPGSYGYLDY	AKKSNWFDY	ARPFRWLDY
AKRTKLLDY	ARISSDDDFDY	ARGVTTLGRRDYFDY	ARDTRASDGFDY	ARRAAWGGWADLDY	ARDAGGGDYYLDY	ARGPCFSIGTPLDY	ARFGFSLDY	ARVQDGLYSFIFDY
ARDRGRRLGVVYAFDY	ARHDPWSLDLDY	ARLARWTFRLDY	AKNSHYSALRFDY	ARVSRTFDGLDY	ARDCNVLDY	ARMMWDSFDN	ARGERRSLYMFDY	ARYGSSFDY
AKRTRDLDY	ARDRGYGNYLRSYLGYYYFDY	ARNTSYLDY	ARHTPFSGCYYCLDY	ARDCLTSCVWFDY	ARDSLTASSFAFDY	ARWRRELDY	ARNAGGDDYYLDY	ARYRSRFDY
ARVHYRRQVVLDY	ARDRYGWRSYPVYYFAY	ARHSWRTYHWELDY	ARTRGPAVPFDY	ARERYYRWRSYGSYYFDY	ARGRSLSGFDY	VRDAGGDDYYLDY	ARRCEWALDY	ARASRSYDGFDY
AKHQRPGLDY	AKLSPFPGWPFDY	AREGGGGSAGSYSDGFDY	AKGVFSNLFDY	ARGRTLGYFDY	ARVHSVFFLFDY	ARASSWARFDY	ARATVASGWVFWFDY	ARAVVPLDY
ARERYYRYGRYGYSYYFDY	ARDPGGSYRGAYGFDY	ARDYLYLDY	AKKHNWLDY	ARLQLLPFDY	ARGGGGWLTEGTYYFDY	ARGESDTDSGSFDY	ARDGGCEEACLDY	ARDRRYRYGLDY
AKHRRGGSLDY	ARVDPWSVDFDY	ARDRGPRYFLDY	AKKHTWFDY	ARRCYRLDY	AKGSVGSGDFDY	ARHCTDITNLYLDY	ARGGSRWRGAFDGFAY	ARFSPDADGGSFDY
ARVGRVSAGYIFDY	ARGPSYPWLLYGYGGAFDY	ARGRYYPWYVYGSYYFDY	ARRAAWVGDFDY	ARVAGWDLGKFDY	ARGSVCTIFCQSFDY	ARNKDGCSFTLDY	ARGRDYRGGTAFDY	ARGRGGRLYDAFDY
ARGRYYPWYGYGSYYFDY	ARDSRASDGFDY	ARDSRSVDGFDY	ARDRGIGYGGFDY	ARVQFLPLDY	ARGTWIFDY	ARVVAGFYMYQTYLDY	ARGRGRRLGVVYAFDY	ARHVLSGPELDY
AKGAGASVAWDFDY	ARMRKAQFDY	AKIRGWRRADFDY	ARDRGRRSPGFDY	ARGGWTGVSPYAFDY	ARRDIQWPHNEDLDY	ARDAGGDDHYLDY	ARIQMLLDY	ARVGGPAPWFDY
ARADPWSIDFDY	AKSSFDY	ARGTGAYNWAHGFDY	ARERSLNRSYRGFDY	ARNIRATYFDY	ARRYAFGTFALDY	ARETHSAFGDYAWLDY	ARLASVLDY	ARVLKWHLDY
ARDDGRQGFDY	AKQFRNSYSDPFDY	AREGGYYPVYADYDAFDY	ARGAGGDDYYLDY	AKDGGDYWGDFDY	ARDDAYGPYLFDY	ARGRYSRTFDY	ARRHIVFDY	ARYLIRFDY
ARGLYYPWYSYGSYYFDY	ARHRRGAFDY	AKHVFSTRGNLDY	ARGYRRTIYFGY	ARGPYGYYGNWIGDYFDY	ARVKRHSYYGSFDY	ARGSRSYDGFDY	AKHNARGEFDY	AKAAGNCAHGFFDY
AKNSGKGFDY	ARQYVYDASDGGDLDY	ARGHRSDVYTYLDY	ARGSSSGPTCYCRFDY	ARGRRNIDSRGFDY	ARVPSWARFDY	ARGVRMRYGYSLDY	ARAPGSTYIFDY	AKHRVRAFWFDY
AKNAWGWFGAELDY	ARIWVSTYLGSFDY	ARGRRGGTGGFDY	ARGEAFGTCFDY	ARARGIVNWFDY	ARVTRRLDY	ARIAYSFSSFDY	ARGVTGSLPFDY	ARDAGGDDYYLDC
ARDSITSDGFDY	ARDTSFRLRYRFDY	ARDAGGDDYYFDY	ARLPRKFDY	ARGRRVGLFDY	AKPMNCLCLDY	ARKIDEREFYSGLDY	ARARRLGWFDY	ARDAGGDNYYLDY
AREYYLDSEGFDY	ARGYDFFAYAALDY	ARIAAGFAYGNLDY	ARDPDGYYSRFGFDY	ARGFSYYVFDY	ARDNAFYVLDY	ARNDSYFALDY	ARDGTSSSRYRAFDY	ARDVGGDDYYLDY
AKASGRAFDY	ARERYYLLGRRGYGYYFDY	AKSDGGSRGLLDY	ARGDPWWGDFDY	ARGRRNVYFDY	ARDRLWGGYRAFDY	ARNIWLVVLDY	ARDRRQYGGLDY	ARDWEAFRYKHRLDY
ARIDSPYDCCGYLDY	ARVPHWSSKLDY	ARGSGCDIGDLDY	ARVQFVPLDY	ARGRYYPWRSYGYSYYFDY	ARGRRSYRLFDY	ARRTEVLDY	ARGGSRADLYGYYLYY	AREYSYGAGDAFDY
ARTYGYAGVSLDY	ARDTRGYDGFDY	ARRRNGSYFAY	ARDWVYSAHLDY	ARSIRGGFDY	ARHWISRLDY	ARVGVYNWNFDY	ARGTPYGGLDY	ARGAYGYWFDY
AKESRTADGFDY	AREPSSYPWNNGASSYDAFDY	AREASDGDFDY	ARGRGGGSTFDY	AKVDRDGRWAGLDY	ARMCEELDY	ARVWSHMVIPLFYLDY	ARNRMLLDY	ARGRYYPWRVRGYSYYFDY
AKRMRGSKRYLDY	ARGRGYGLRGFDY	ARVFSHGWGSLDY	ARDSLTYDGFDY	ARGAYVDDWFDY	ARVGEYVSFDY	ACDAGGDDYYLDY	ARTWVYLDY	ARHCFAFDY
ARVDPWSLDLDY	ARSRPSSVFDY	ARDRYYGGNSVRRGGYYFDY	ARDRRGKAGLDY	ARRRPWSGFLDY	ARVSWDGVFFDY	ARDEGNFATLDY	ARVSSRARFDY	ARLMALLDY
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ARDPARGRSRGFDY	AKEDRQYDGFDY	ARHIWGYFDFYGLDY	ARGVYWGHGSLDY	AKHLHGSLDY	ARGIDRGKCCQDLDY	ARDYNLGNNDAELDY	AKDIWKWHFDY	ARSVGDWFDY
AKSVRIFDY	ARENPNGDFDY	AKCRINLWDYDPGFDY	ARQFMMLDY	ARDVPITQLDY	ARGRVGTFDY	ARGLSGYLLGGRRYGYFDY	AKGFNARLDY	ARVDPWSTDFDY
AKGWGFSGSGLDY	ARHWRGKYWSIFGLDY	AKKHVWFDY	ARVRIYGWRVRGYSYYFDY	ARGRSYEATANLDY	ARLWASFDY	ARGLTWLDY	ARDYVDVNDFDY	ARVSSWARFGY
AKGSKALFDY	AKGGYAGCCNDFDY	ARDTAGCWTFDY	ARAARIGTFDY	ARRAAWIGSFDY	ARPGRTIITLDY	ARHDCKYVKHLDY	ARGACGHGLDY	ARDEGGYYKFDY
ARDGRTSDGFDY	AKPYLWLDY	ARHTWGYYDAYGLDY	ARVDDWYRTFDY	ARVSSWARLDY	ARRGWPLDY	ARKLYALLDY	ARGCAGESLDY	ARDSATYDGFDY
ARDTRSSDGFDY	ARVDPWSWDFDY	ARDARTSDGFDY	AREYYYGSGDAFDY	AREPSWPGNGAGAFDY	ARVDDHDYILKLDY	ARQSVCLDY	ARGFGSSSLRAFDY	ARDY
AKMGKVFDY	ARGRYYRWVSYGSYYFDY	ARGQADSFDY	ARGDPWSMDLDY	ARGRVGGLSGFYFDY	ARASDTGSLDY	TRDAGGDDYYLDY	ARGRTALVVFDY	ARERAALDY
AKSSGKAFDY	ARISGWADDRFDY	ARGRGGGLWGFDY	ARGRGAYLIWFDYFDY	ARDAGGDDYYSDY	ARDEYEGSAWYFDY	AKHSWGWAGDLDY	ARLSRRLDY	ARERYDSYGVVDAFDY
ARDGYGAKHYVLAFDY	ARDPYGGGEVNTQRYYGMDV	ARIDPWSSDLDY	ARGWYPGYRGDLDY	ARVSPWARFDY	ARETMSLDY	ARARSDRWFLDY	ARQSWEFDY	ARGCYLLFCFDY
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ARQRSYKSALRYFDY	ARDTRAYDGFDY	ARGSCCCSLDY	AKHGGHTVHWDLDY	ARNSGDWGASLDY	ARGRGNSLRGFDY	ARERYYRWRVRGYSYYLDY	ARSSRSLDY	ARGISSSDSFDY
ARGRGRYFMANFDY	ARGRRVAAFDY	ARQMVMFDY	ARGIDYAVDGFDY	AKHCVCGVFDY	AKDQVGMYPVEYLDY	ARGNEDWADYWDLLDY	AKGHSAWKPLDY	ARGPDYISAFDY
ARENRTYDGFDY	ARESRTNDGFDY	AKRGVGLRLDY	ARRNEEHLDY	ARHLDGTAAFDY	AR	ARSNVLLDY	AKLIAWFCFEYLDY	ARLEAFCVSCYCFDY
ARVSPGPYGLFDY	AKGNRAAGGFDY	ARALIASWFDY	ARDAGGDDY	ARNYGNTRDDFDY	ARAVSRFDY	ARDLYRGDGWFDY	ARAGFYVKVVGEFDY	ARNWYYCPYSLDY
ARDSLTSDGFDY	ARDGFQAYYAWYWLDY	ARDTLTSDGFDY	ARENRVLDY	ARRYPWIGHFDY	ARHRGYIHLELDY	ARDRRWFGAFDY	ARDGGYRTDGTTYYYFDY	ARSSGGNGSAHFDY
ARGDPWSVDFDY	ARSSIYPYLWVLDY	ARPYKGLDY	ARRGGSNNSTFDY	AREASSASSDAFDY	ARMQSRTFDY	ARDSSPYGYFDY	ARFSGQFLDY	ARVSSWARFNY
AKRRRDSRSRDLDY	ARVRDRFAYSMLDY	ARTSVGETFDY	ARVSRVEFDY	ARGRNTGSFDY	ARVDPWSHDLDY	ARDTAPGPGEDLDY	ARGCCGRTLDY	ARVYFSRFDY
	ARGRGRYGRGYFDY	ARGRYYRWRVRGYSYYFDY	ARDAGGDDYY	ARTVLGLDY	ARDAGGDDYYLGY	ARECPITNGYSTFDY	ARHDWSSYSWYLDY	ARWDTDACKYYGRFDY

Antibody Characterization Using Next Generation Sequencing
made easier

ARHPAFNPAFDY	AKVGVWGSYELDY	ARDSYEYGRSNAFDY	ARGRGGLAGAFDY	ARDGGGSWGNYRGGYFDY	ARVSLGVAAFAY	ARDERYFDY	ARERSYYWLGSYGYAFDY	ARHYLSGSLGLDY
AKASGKGLDY	ARPKFDYGYQHFDY	ARVMNRFAYSHLDY	ARGTAIFDY	ARDLSGSNLDPAFDY	ARGFGYRFDY	AREATYGDFDY	AKDGNVVCDNYYLDY	ARKKPGDHRADLDY
ARDTRSYDGFDY	ARQLWGYLDY	ARGRSPRYFDY	AKLAGRTLDY	ARLADLFDY	ARGLGNSVARAFDY	ARFSPGSYGYLDY	AKKSNWFDY	ARPFRWLDY
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ARDRGRRLGVVYAFDY	ARHDPWSLDLDY	ARLARWTFRLDY	AKNSHYSALRFDY	ARVSRTFDGLDY	ARDCNVLDY	ARMMWDSFDN	ARGERRSLYMFDY	ARYGSSFDY
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AKHQRPGLDY	AKLSPFPGWPFDY	AREGGGGSAGSYSDGFDY	AKGVFSNLFDY	ARGRTLGYFDY	ARVHSVFFLFDY	ARASSWARFDY	ARATVASGWVFWFDY	ARAVVPLDY
ARERYYRYGRYGYSYYFDY	ARDPGGSYRGAYGFDY	ARDYLYLDY	AKKHNWLDY	ARLQLLPFDY	ARGGGGWLTEGTYYFDY	ARGESDTDSGSFDY	ARDGGCEEACLDY	ARDRRYRYGLDY
AKHRRGGSLDY	ARVDPWSVDFDY	ARDRGPRYFLDY	AKKHTWFDY	ARRCYRLDY	AKGSVGSGDFDY	ARHCTDITNLYLDY	ARGGSRWRGAFDGFAY	ARFSPDADGGSFDY
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ARGRYYPWYGYGSYYFDY	ARDSRASDGFDY	ARDSRSVDGFDY	ARDRGIGYGGFDY	ARVQFLPLDY	ARGTWIFDY	ARVVAGFYMYQTYLDY	ARGRGRRLGVVYAFDY	ARHVLSGPELDY
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ARDDGRQGFDY	AKQFRNSYSDPFDY	AREGGYYPVYADYDAFDY	ARGAGGDDYYLDY	AKDGGDYWGDFDY	ARDDAYGPYLFDY	ARGRYSRTFDY	ARRHIVFDY	ARYLIRFDY
ARGLYYPWYSYGSYYFDY	ARHRRGAFDY	AKHVFSTRGNLDY	ARGYRRTIYFGY	ARGPYGYYGNWIGDYFDY	ARVKRHSYYGSFDY	ARGSRSYDGFDY	AKHNARGEFDY	AKAAGNCAHGFFDY
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AKNAWGWFGAELDY	ARIWVSTYLGSFDY	ARGRRGGTGGFDY	ARGEAFGTCFDY	ARARGIVNWFDY	ARVTRRLDY	ARIAYSFSSFDY	ARGVTGSLPFDY	ARDAGGDDYYLDC
ARDSITSDGFDY	ARDTSFRLRYRFDY	ARDAGGDDYYFDY	ARLPRKFDY	ARGRRVGLFDY	AKPMNCLCLDY	ARKIDEREFYSGLDY	ARARRLGWFDY	ARDAGGDNYYLDY
AREYYLDSEGFDY	ARGYDFFAYAALDY	ARIAAGFAYGNLDY	ARDPDGYYSRFGFDY	ARGFSYYVFDY	ARDNAFYVLDY	ARNDSYFALDY	ARDGTSSSRYRAFDY	ARDVGGDDYYLDY
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ARIDSPYDCCGYLDY	ARVPHWSSKLDY	ARGSGCDIGDLDY	ARVQFVPLDY	ARGRYYPWRSYGYSYYFDY	ARGRRSYRLFDY	ARRTEVLDY	ARGGSRADLYGYYLYY	AREYSYGAGDAFDY
ARTYGYAGVSLDY	ARDTRGYDGFDY	ARRRNGSYFAY	ARDWVYSAHLDY	ARSIRGGFDY	ARHWISRLDY	ARVGVYNWNFDY	ARGTPYGGLDY	ARGAYGYWFDY
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ARVDPWSLDLDY	ARSRPSSVFDY	ARDRYYGGNSVRRGGYYFDY	ARDRRGKAGLDY	ARRRPWSGFLDY	ARVSWDGVFFDY	ARDEGNFATLDY	ARVSSRARFDY	ARLMALLDY
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AKGWGFSGSGLDY	ARHWRGKYWSIFGLDY	AKKHVWFDY	ARVRIYGWRVRGYSYYFDY	ARGRSYEATANLDY	ARLWASFDY	ARGLTWLDY	ARDYVDVNDFDY	ARVSSWARFGY
AKGSKALFDY	AKGGYAGCCNDFDY	ARDTAGCWTFDY	ARAARIGTFDY	ARRAAWIGSFDY	ARPGRTIITLDY	ARHDCKYVKHLDY	ARGACGHGLDY	ARDEGGYYKFDY
ARDGRTSDGFDY	AKPYLWLDY	ARHTWGYYDAYGLDY	ARVDDWYRTFDY	ARVSSWARLDY	ARRGWPLDY	ARKLYALLDY	ARGCAGESLDY	ARDSATYDGFDY
ARDTRSSDGFDY	ARVDPWSWDFDY	ARDARTSDGFDY	AREYYYGSGDAFDY	AREPSWPGNGAGAFDY	ARVDDHDYILKLDY	ARQSVCLDY	ARGFGSSSLRAFDY	ARDY
AKMGKVFDY	ARGRYYRWVSYGSYYFDY	ARGQADSFDY	ARGDPWSMDLDY	ARGRVGGLSGFYFDY	ARASDTGSLDY	TRDAGGDDYYLDY	ARGRTALVVFDY	ARERAALDY
AKSSGKAFDY	ARISGWADDRFDY	ARGRGGGLWGFDY	ARGRGAYLIWFDYFDY	ARDAGGDDYYSDY	ARDEYEGSAWYFDY	AKHSWGWAGDLDY	ARLSRRLDY	ARERYDSYGVVDAFDY
ARDGYGAKHYVLAFDY	ARDPYGGGEVNTQRYYGMDV	ARIDPWSSDLDY	ARGWYPGYRGDLDY	ARVSPWARFDY	ARETMSLDY	ARARSDRWFLDY	ARQSWEFDY	ARGCYLLFCFDY
ARERYYRWRRSYGYYFDY	ARDPDGSLSAWGFDY	ARESGGTVSLSYYYYGFDY	ARTWIAMVFFDY	ARIWVWGLGMPFDY	ARGRGAGGRGFDY	ARDYVQVGGWLDY	ARRSWFTLPGSLDY	ARGGSVVYVAFDY
ARQRSYKSALRYFDY	ARDTRAYDGFDY	ARGSCCCSLDY	AKHGGHTVHWDLDY	ARNSGDWGASLDY	ARGRGNSLRGFDY	ARERYYRWRVRGYSYYLDY	ARSSRSLDY	ARGISSSDSFDY
ARGRGRYFMANFDY	ARGRRVAAFDY	ARQMVMFDY	ARGIDYAVDGFDY	AKHCVCGVFDY	AKDQVGMYPVEYLDY	ARGNEDWADYWDLLDY	AKGHSAWKPLDY	ARGPDYISAFDY
ARENRTYDGFDY	ARESRTNDGFDY	AKRGVGLRLDY	ARRNEEHLDY	ARHLDGTAAFDY	AR	ARSNVLLDY	AKLIAWFCFEYLDY	ARLEAFCVSCYCFDY
ARVSPGPYGLFDY	AKGNRAAGGFDY	ARALIASWFDY	ARDAGGDDY	ARNYGNTRDDFDY	ARAVSRFDY	ARDLYRGDGWFDY	ARAGFYVKVVGEFDY	ARNWYYCPYSLDY
ARDSLTSDGFDY	ARDGFQAYYAWYWLDY	ARDTLTSDGFDY	ARENRVLDY	ARRYPWIGHFDY	ARHRGYIHLELDY	ARDRRWFGAFDY	ARDGGYRTDGTTYYYFDY	ARSSGGNGSAHFDY
ARGDPWSVDFDY	ARSSIYPYLWVLDY	ARPYKGLDY	ARRGGSNNSTFDY	AREASSASSDAFDY	ARMQSRTFDY	ARDSSPYGYFDY	ARFSGQFLDY	ARVSSWARFNY
AKRRRDSRSRDLDY	ARVRDRFAYSMLDY	ARTSVGETFDY	ARVSRVEFDY	ARGRNTGSFDY	ARVDPWSHDLDY	ARDTAPGPGEDLDY	ARGCCGRTLDY	ARVYFSRFDY
	ARGRGRYGRGYFDY	ARGRYYRWRVRGYSYYFDY	ARDAGGDDYY	ARTVLGLDY	ARDAGGDDYYLGY	ARECPITNGYSTFDY	ARHDWSSYSWYLDY	ARWDTDACKYYGRFDY

Shiny
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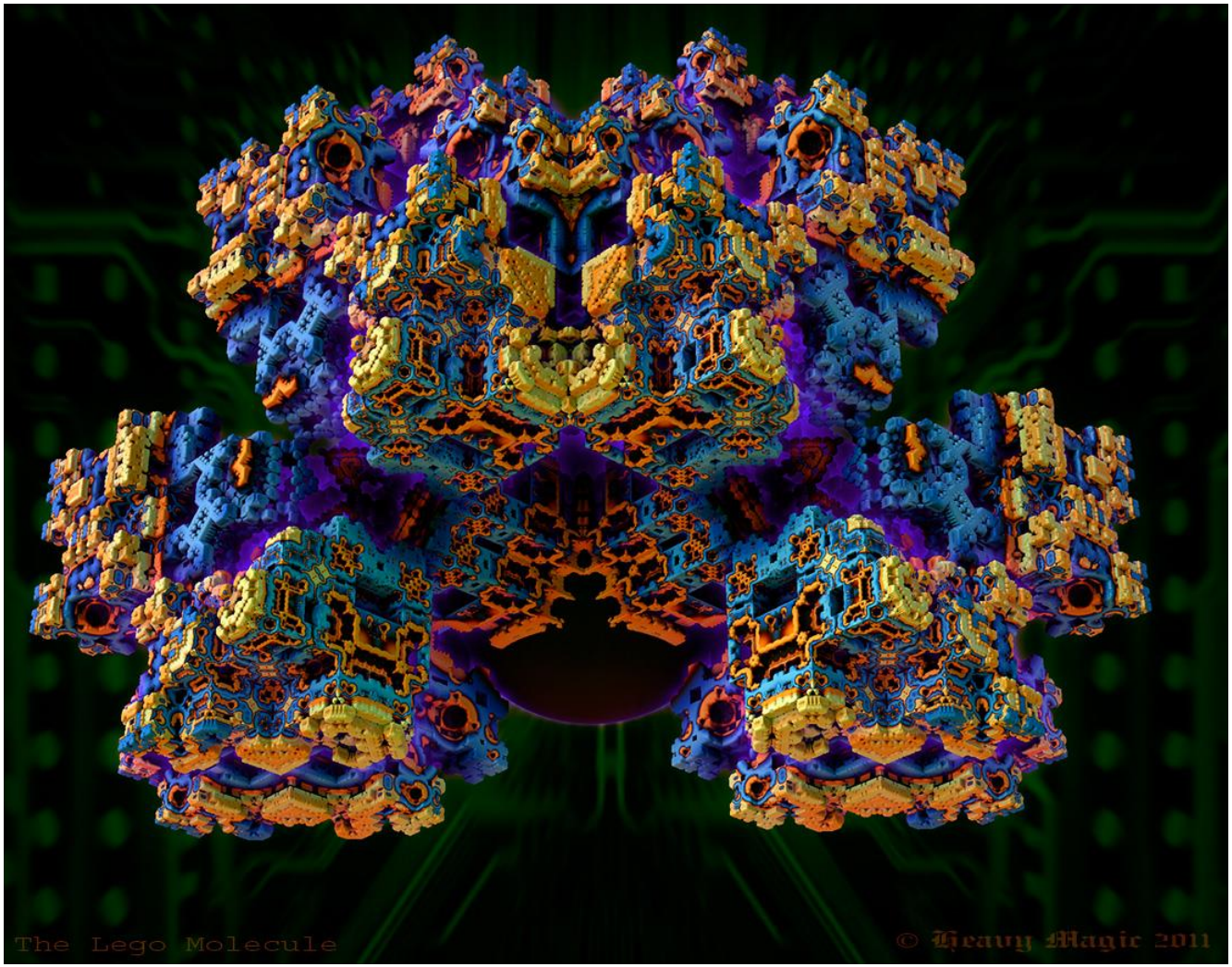
Getting closer to discovering new antibody treatments



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Thank you!

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Paulo Bargo

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