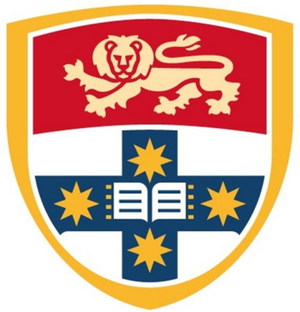
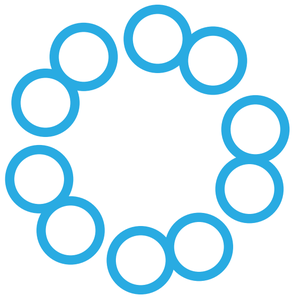


THE UNIVERSITY OF
SYDNEY



CANADA'S MICHAEL SMITH
GENOME
SCIENCES
CENTRE

ESSENTIALS OF DATA VISUALIZATION

THINKING ABOUT DRAWING DATA + COMMUNICATING SCIENCE

LABELS

respect type and use it to establish hierarchy

Open up a journal or your favourite text book. Find a figure. There's probably some labels in there.

Maybe it's a multi-panel figure and the labels are the titles.

Maybe there are some callouts that tell you what the parts are.

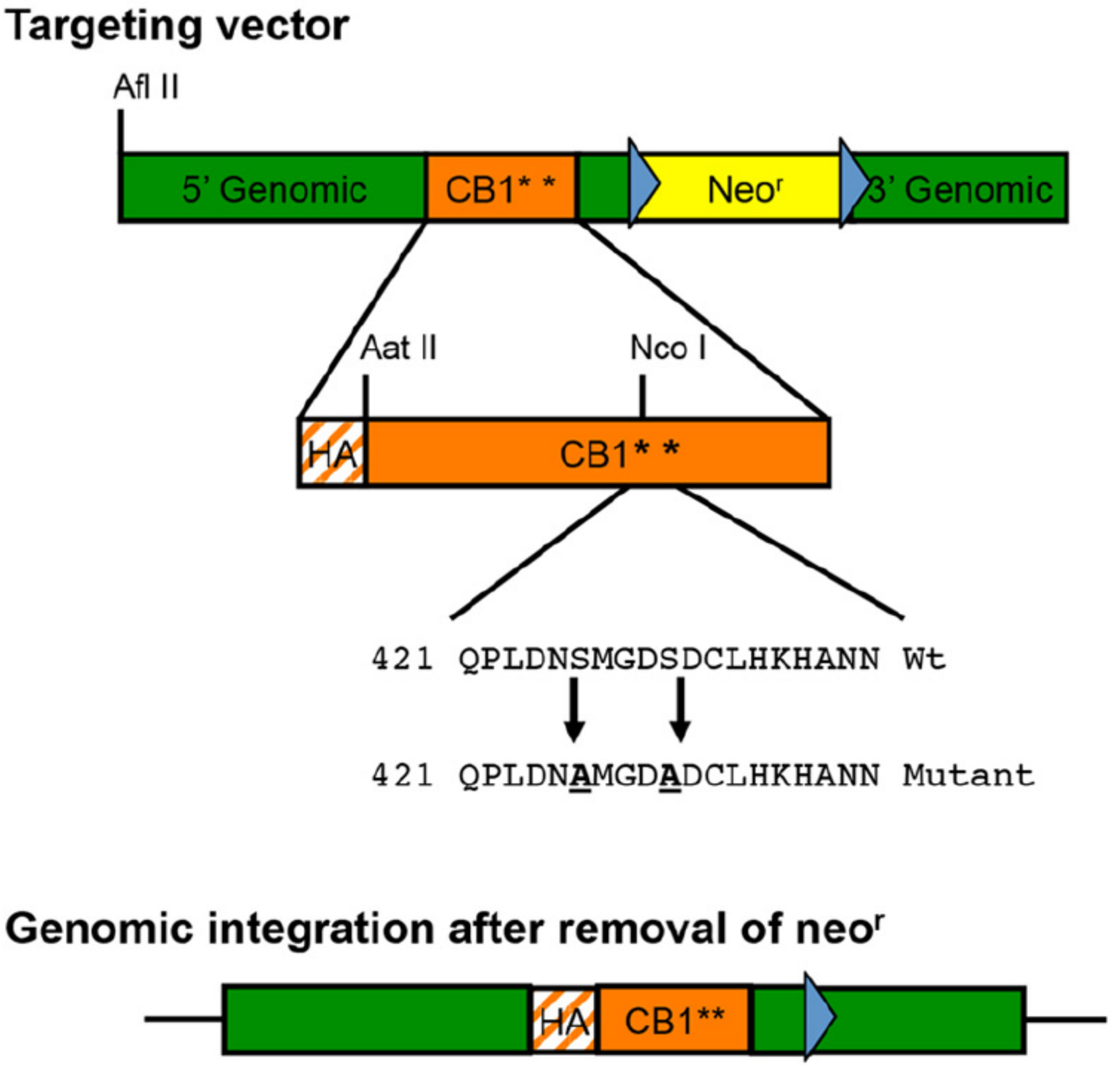
If it's a plot there are probably axis labels and tick labels and maybe a legend with some labels.

There's usually several informational layers in the image, each with their own labels. These labels should reflect that these layers are different. They should also reflect the relative importance of these layers.

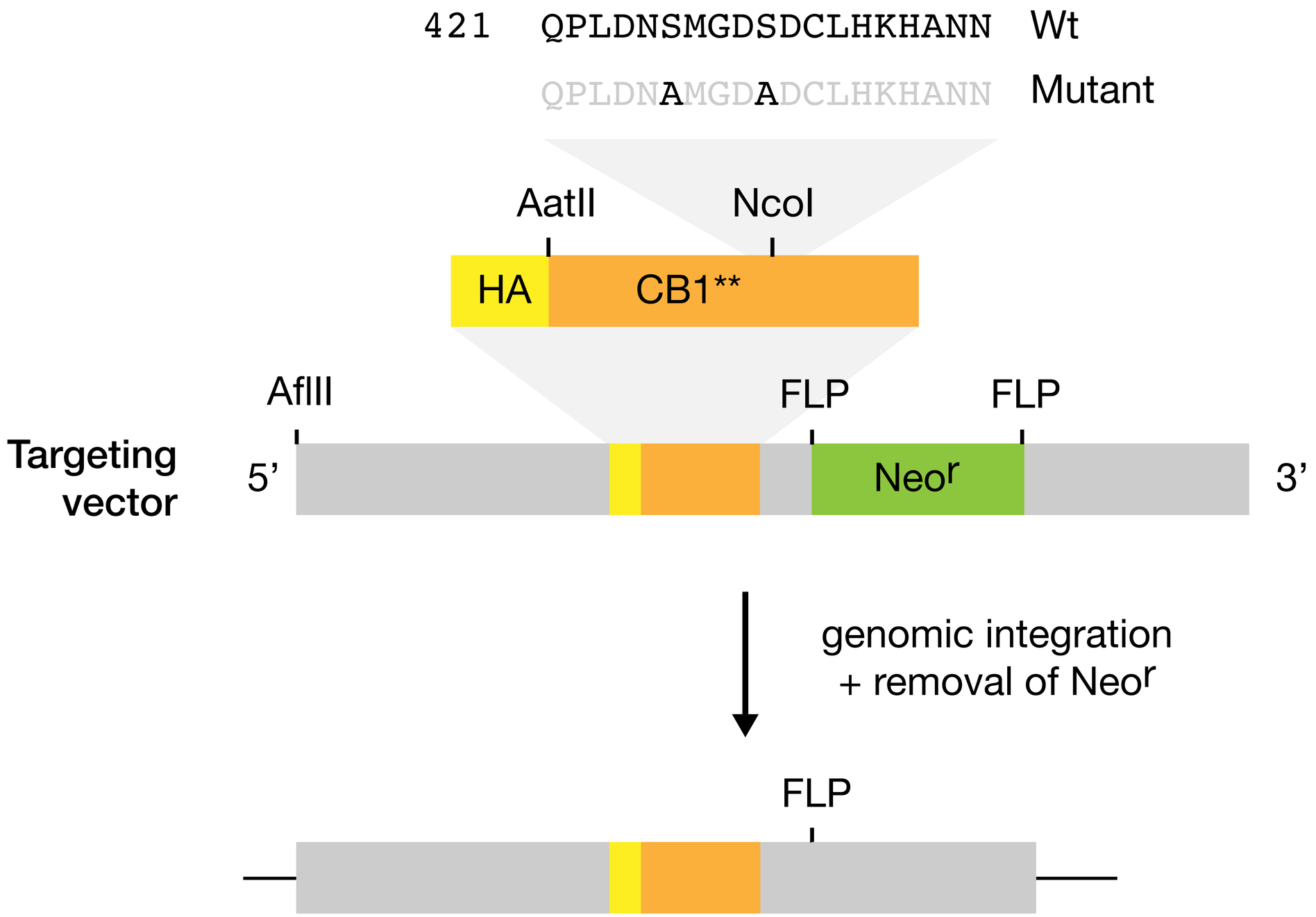
Type can do all this.

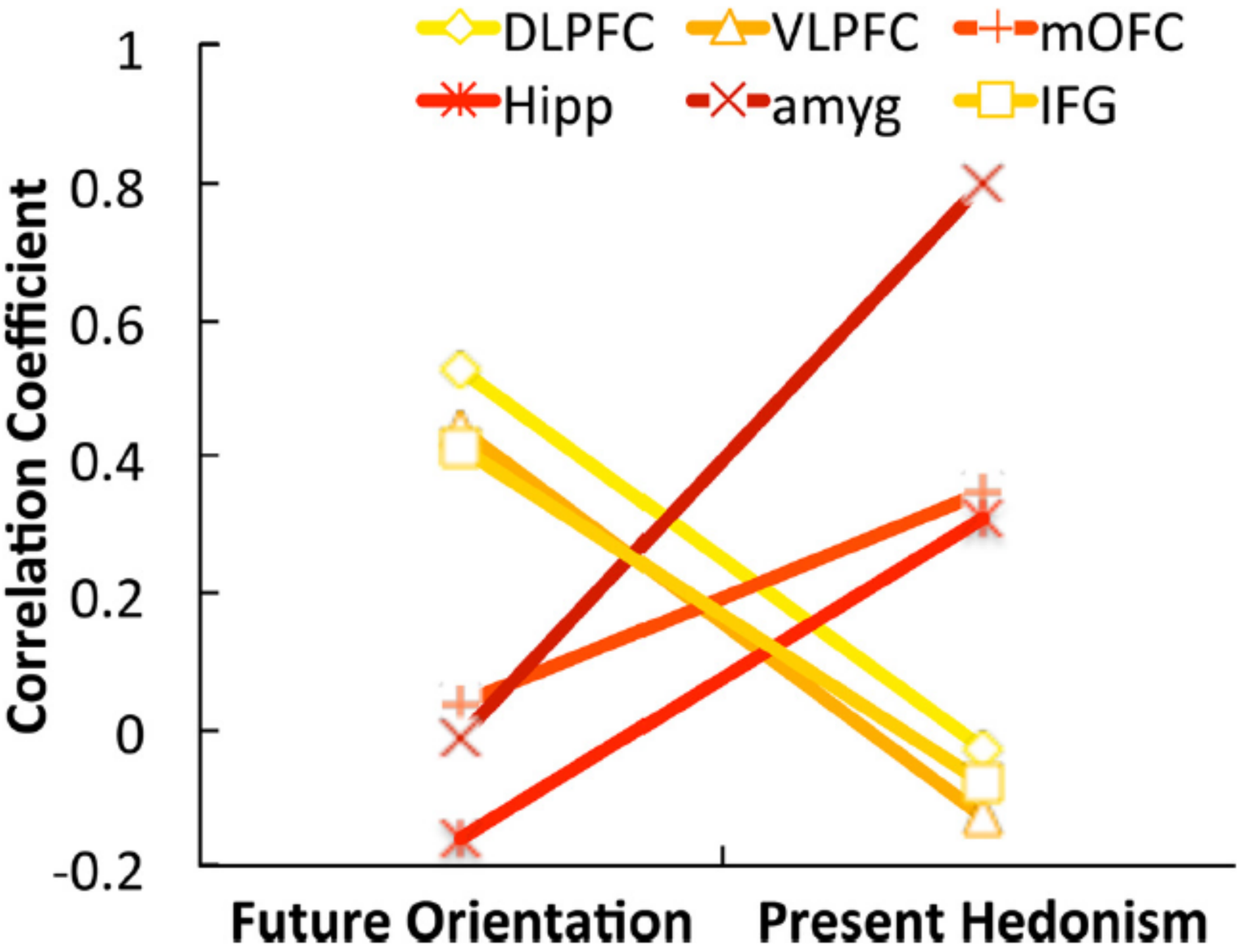
Neue Helvetica has 59 different typefaces. From ultra light to black extended—there's an almost infinite potential here to use the font to establish importance, hierarchy and other relationships.

Remember those Gestalt principles we talked about? Well, take advantage of these typefaces, along with size and alignment, to enhance the perception of similarity and grouping.

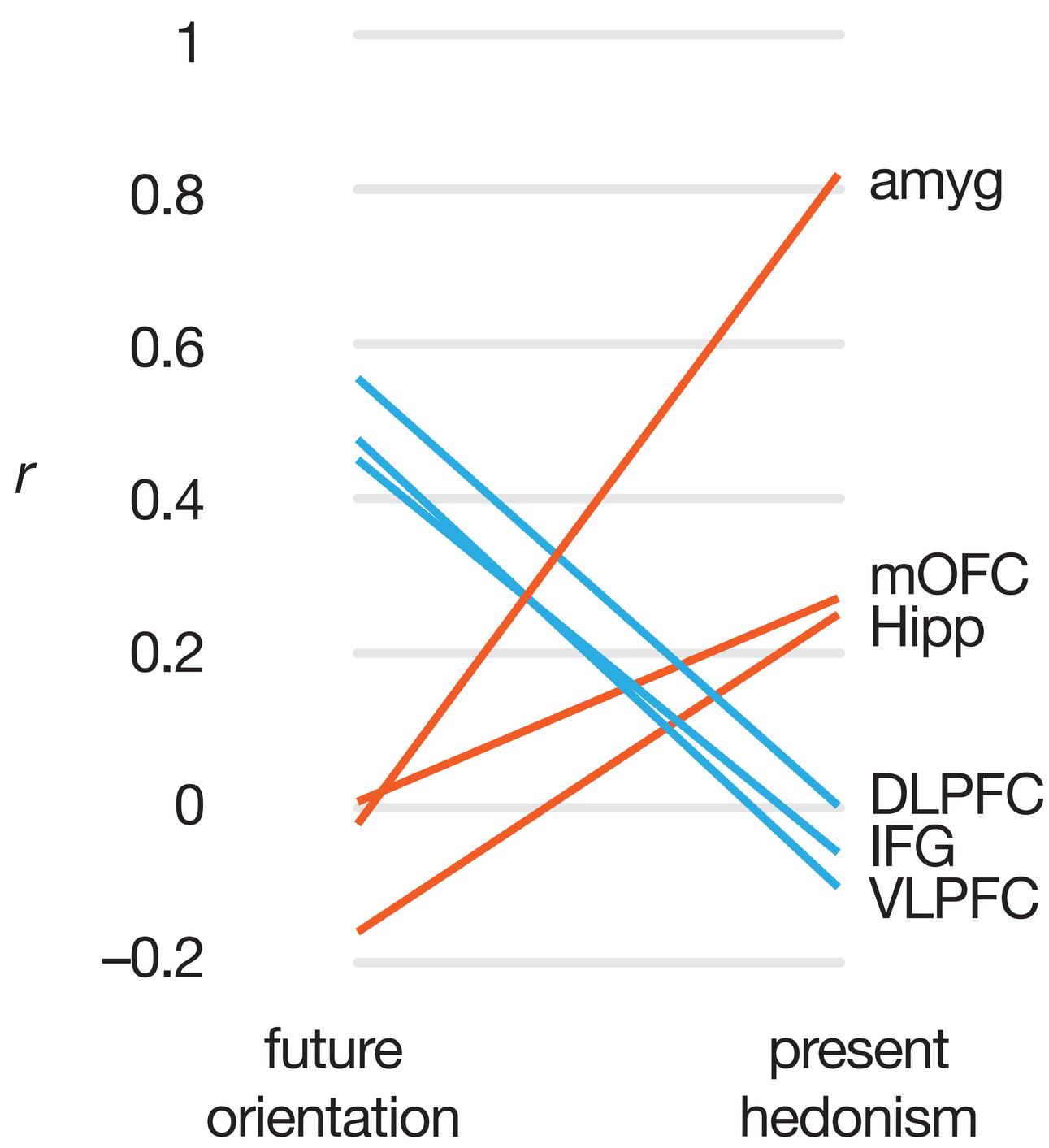


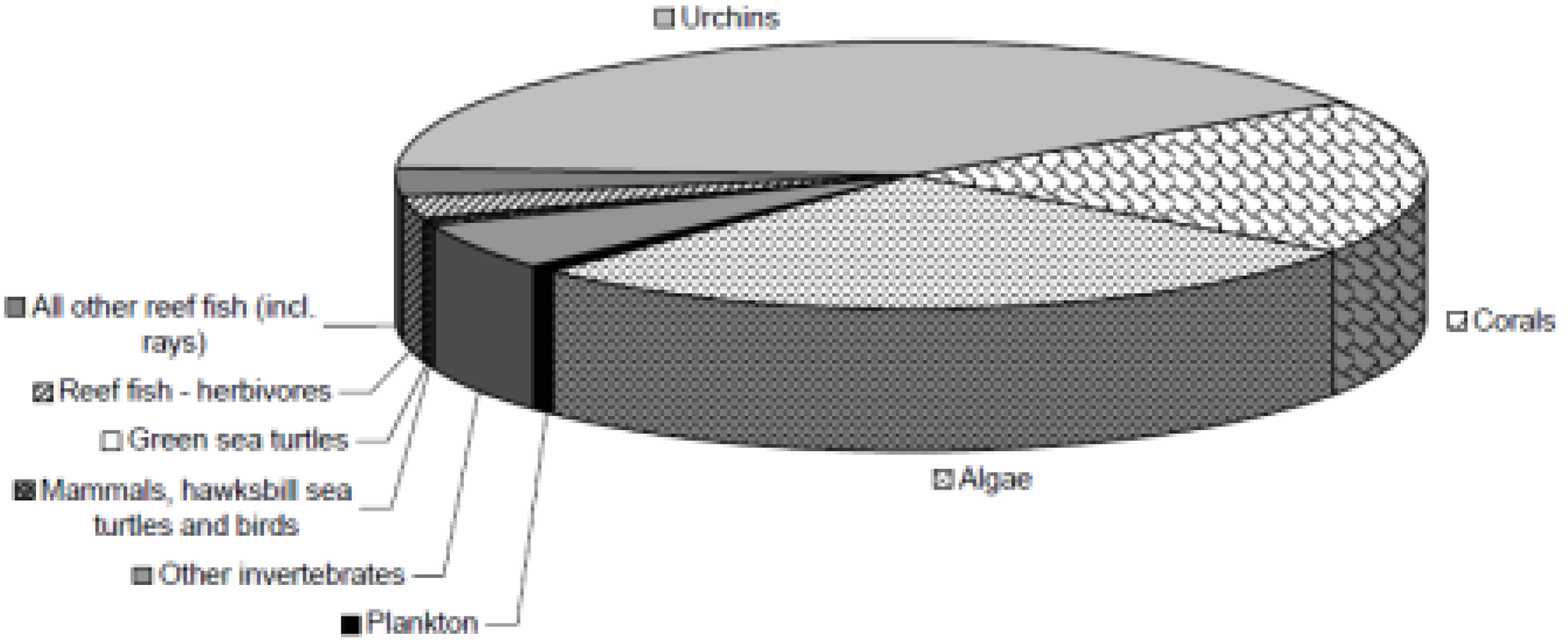
J Neurosci (2014) 34:5152–5163.


421 QPLDNSMGDSDCLHKHANN Wt
QPLDNAMGDADCLHKHANN Mutant
AatII
NcoI
HA
CB1**
AflII
FLP
FLP
Targeting vector
5'
Neor
3'
genomic integration
+ removal of Neor
FLP

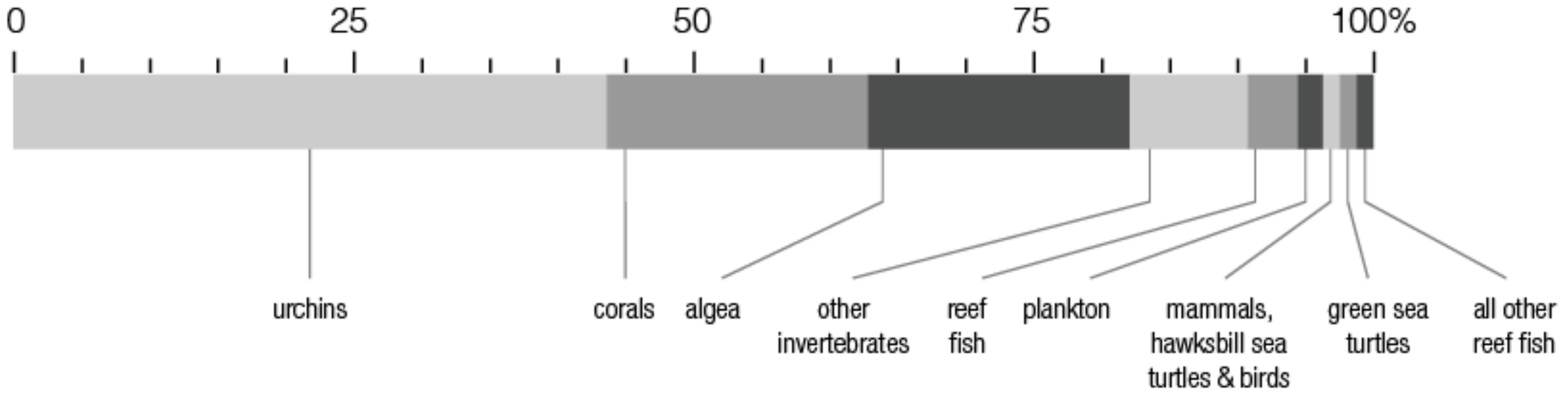


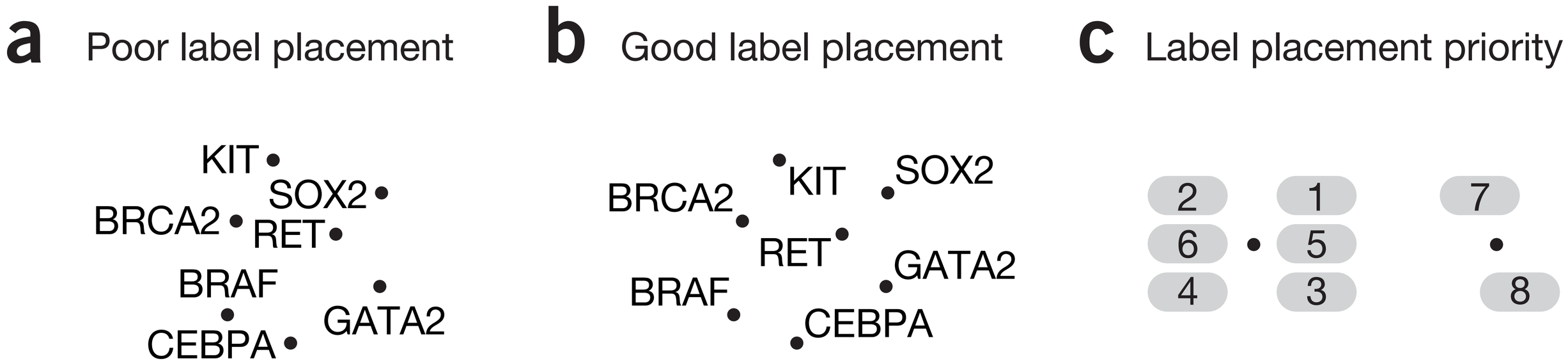
J Neurosci (2014) 34:10298–10310.


1
0.8
0.6
0.4
0.2
0
–0.2
r
amyg
mOFC
Hipp
DLPFC
IFG
VLPFC
future
orientation
present
hedonism

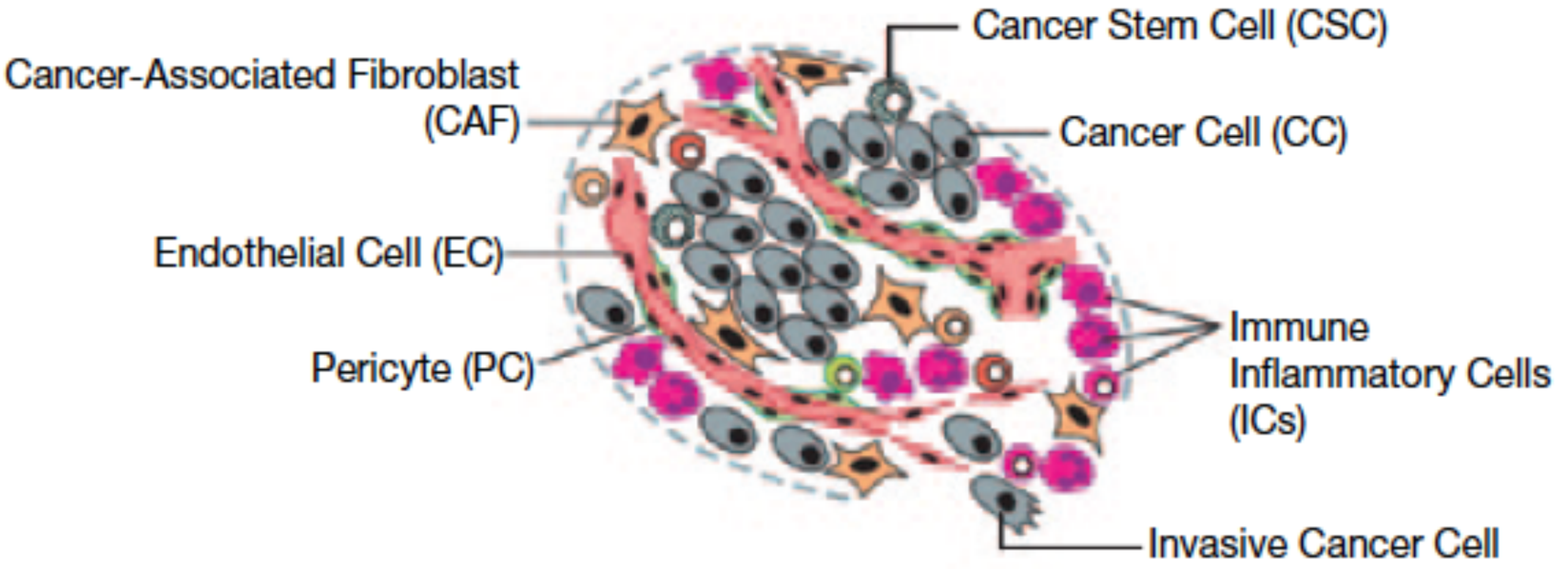

Urchins
All other reef fish (incl. rays)
Reef fish - herbivores
Green sea turtles
Mammals, hawksbill sea turtles and birds
Other invertebrates
Plankton
Corals
Algae

Proportions (%), in terms of biomass (t/km^2) of different groups within the Kaloko National Marine Park ecosystem

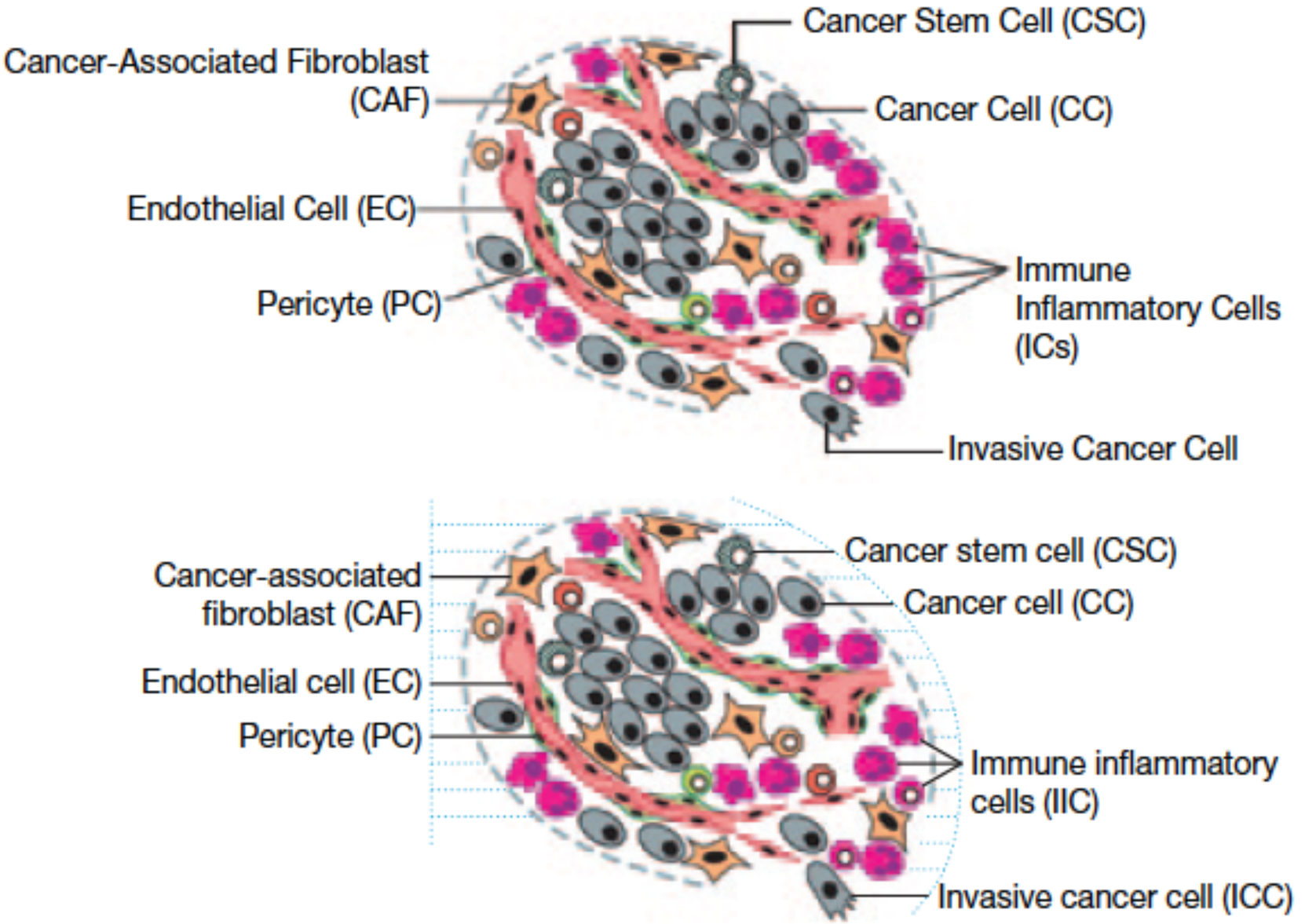




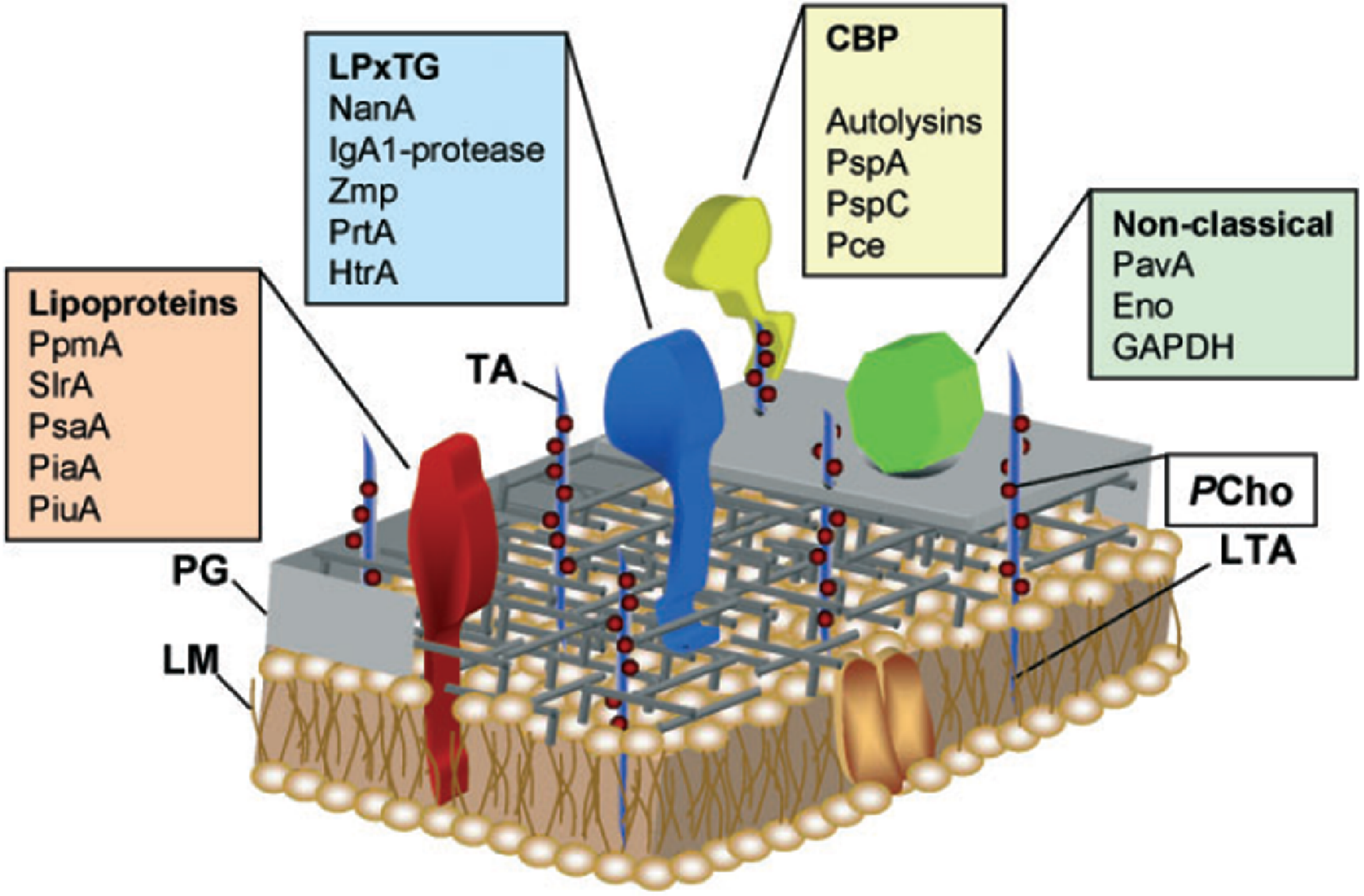
Nat Methods (2013) 10:275.

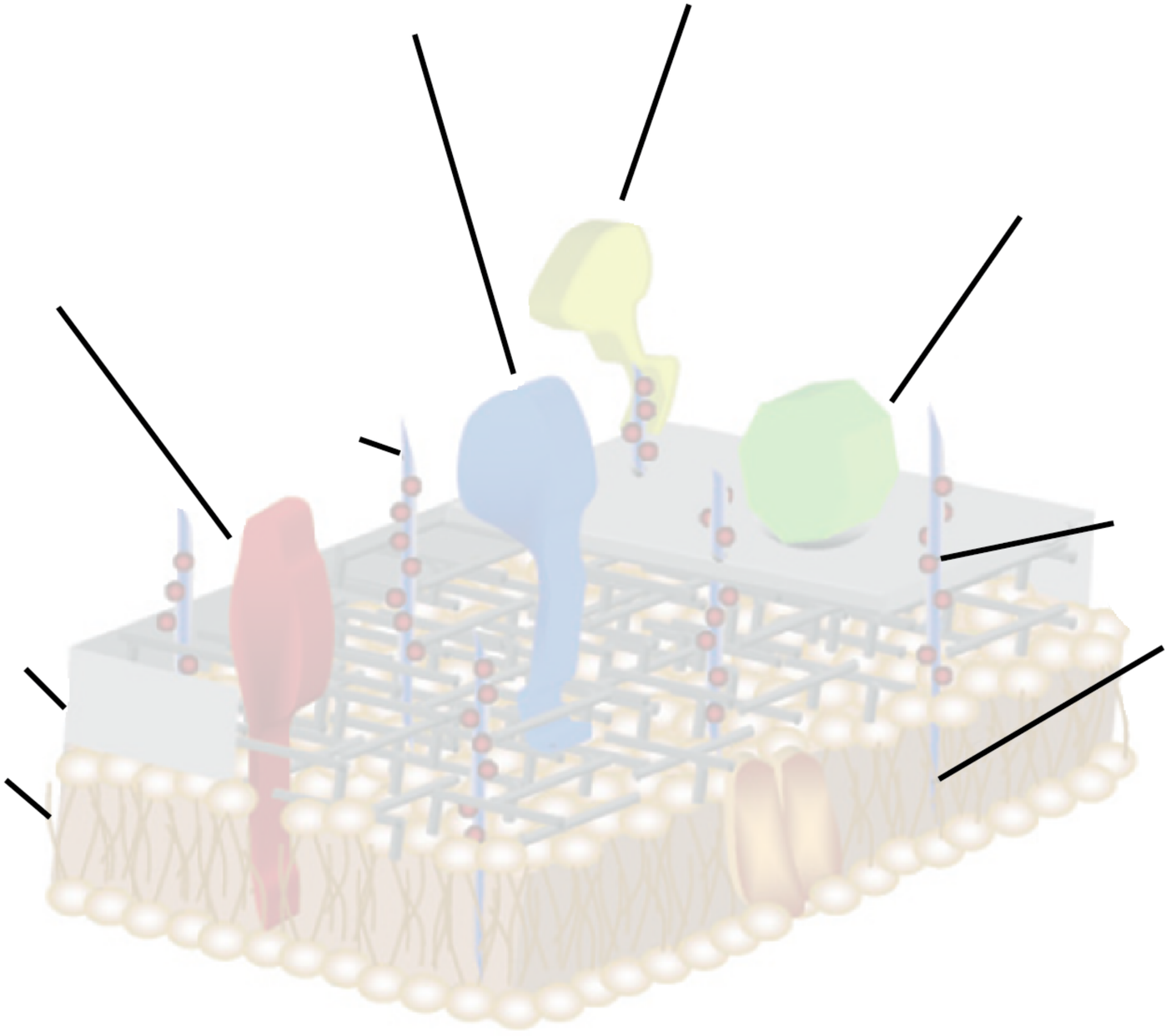


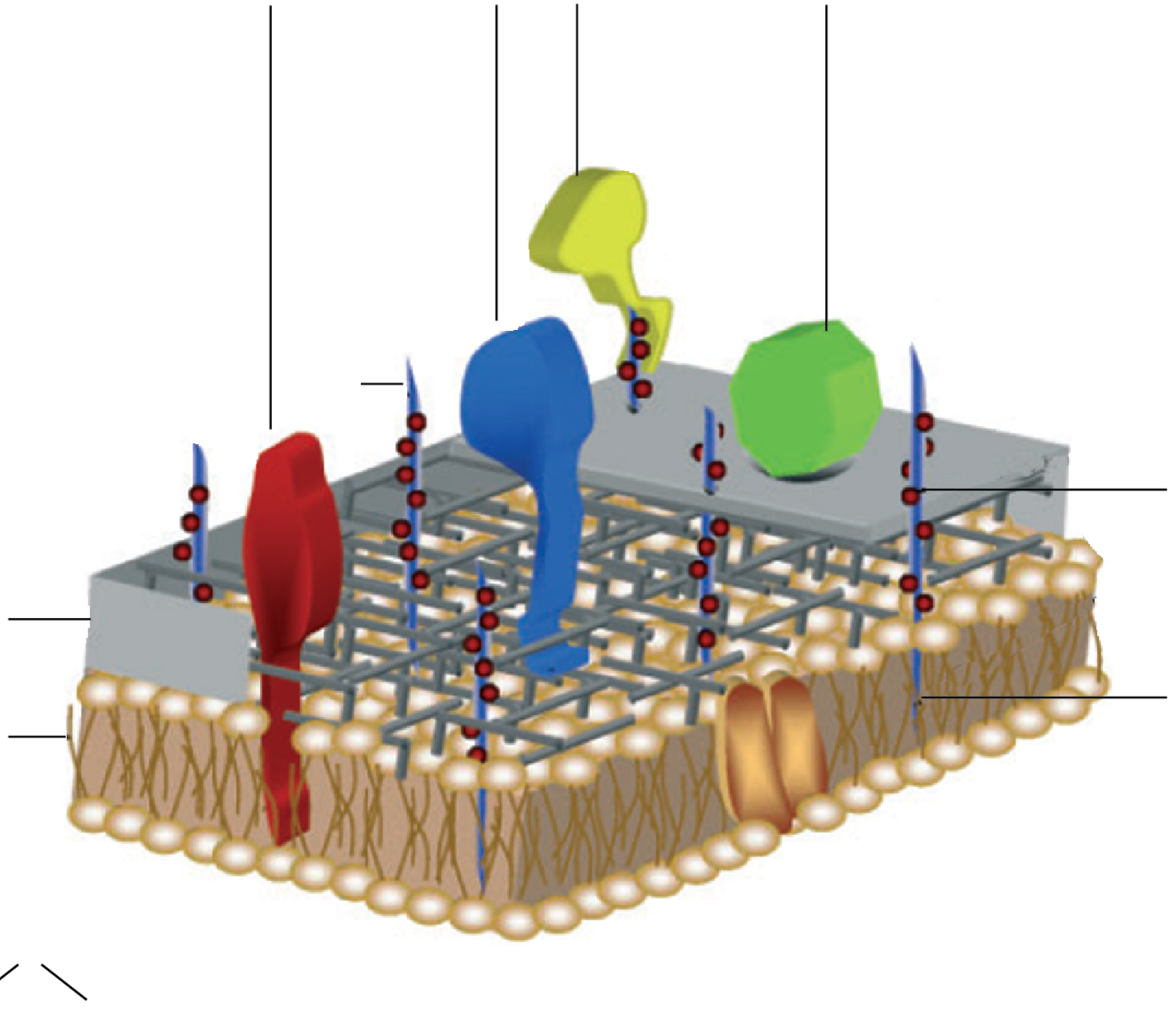
Nat Methods (2013) 10:275.

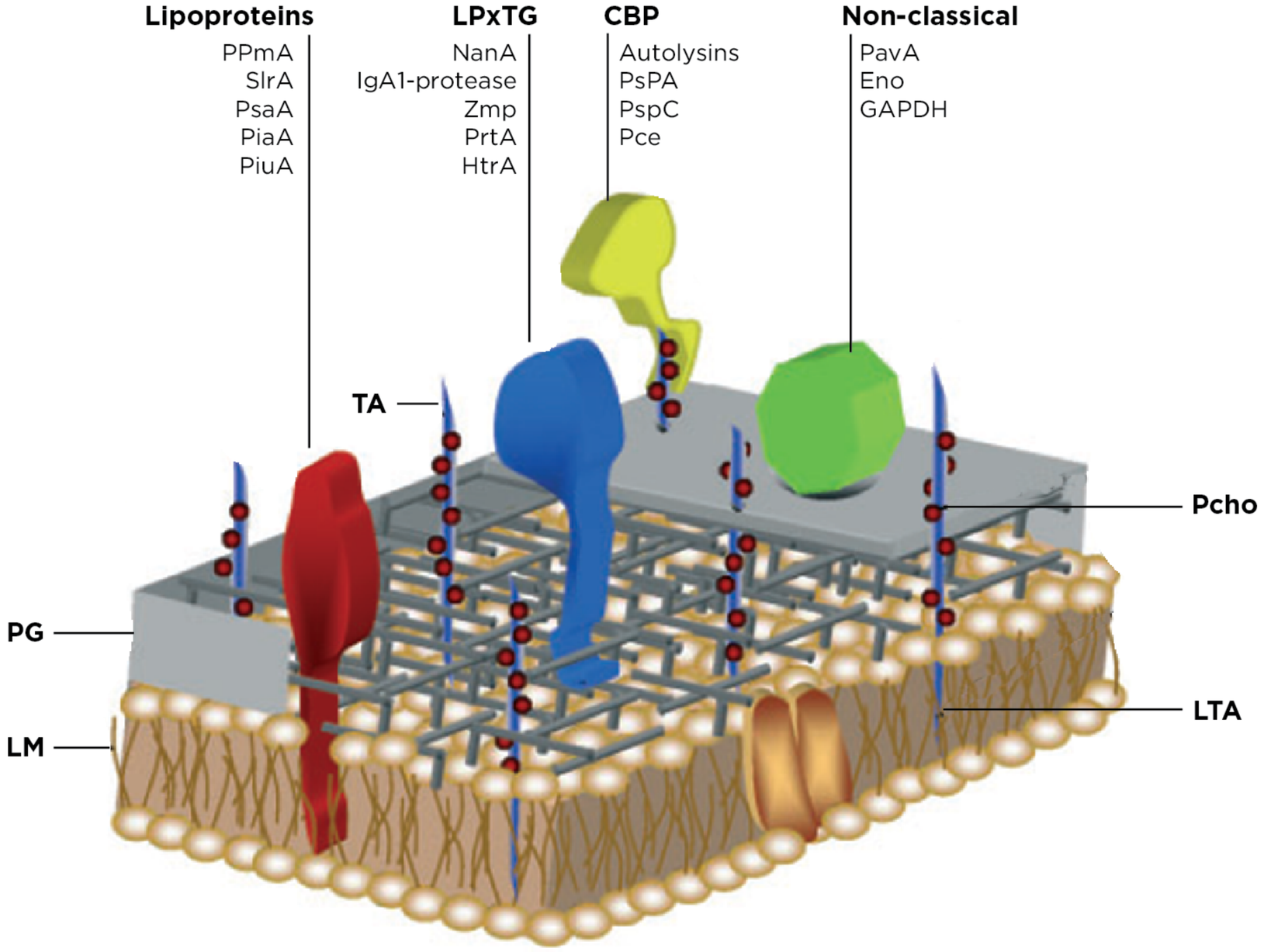


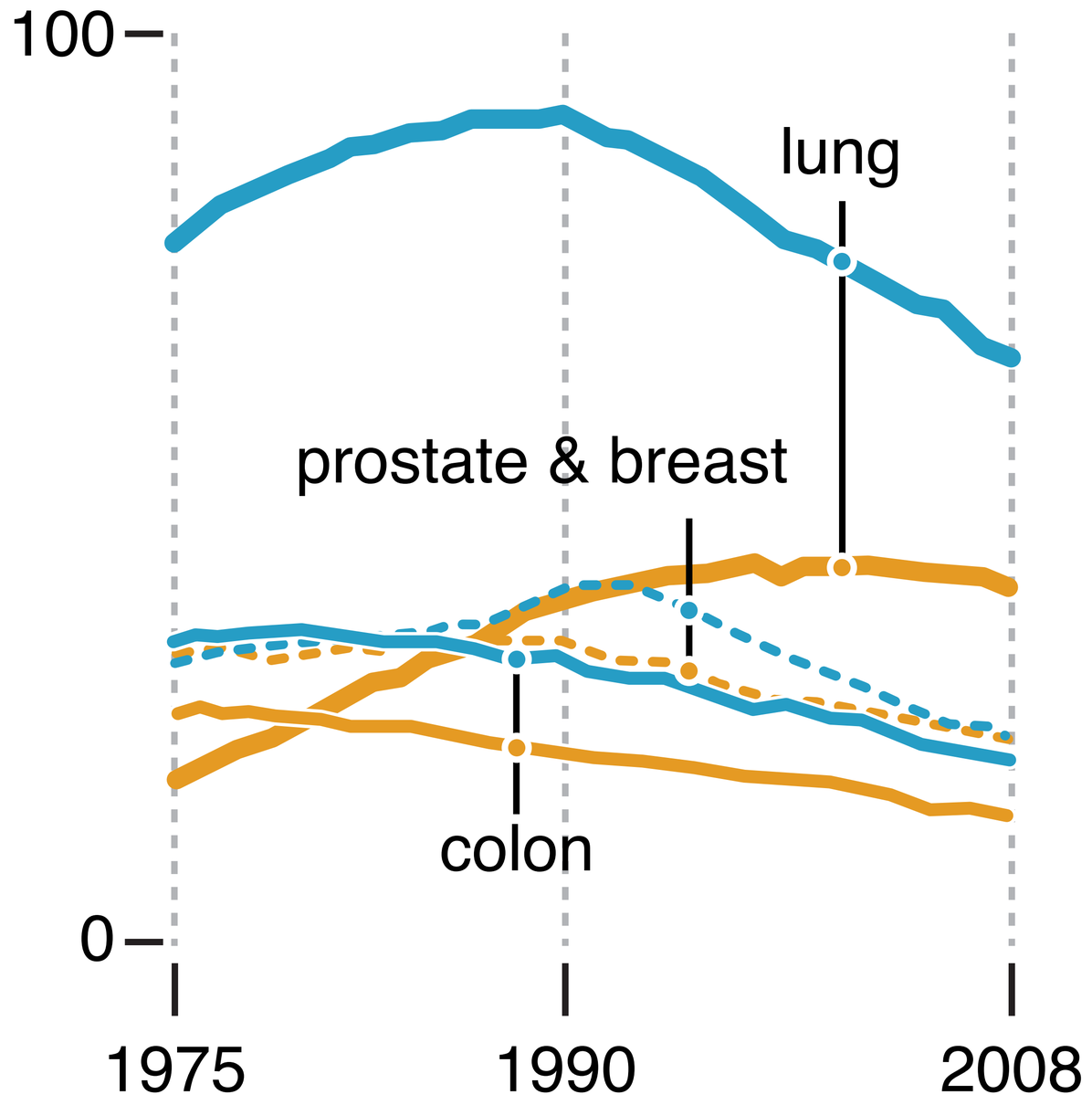
Nat Methods (2013) 10:275.


LPxTG
NanA
IgA1-protease
Zmp
PrtA
HtrA
CBP
Autolysins
PspA
PspC
Pce
Non-classical
PavA
Eno
GAPDH
Lipoproteins
PpmA
SlrA
PsaA
PiaA
PiuA
TA
PCho
LTA
PG
LM

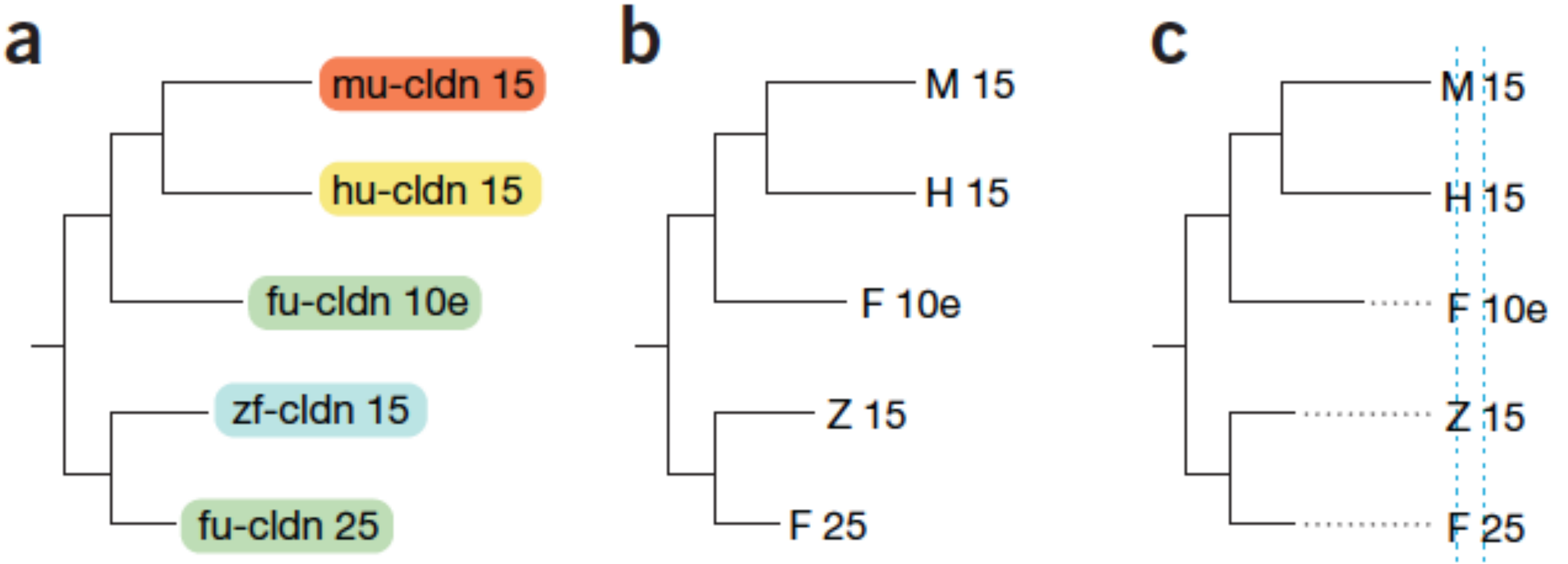




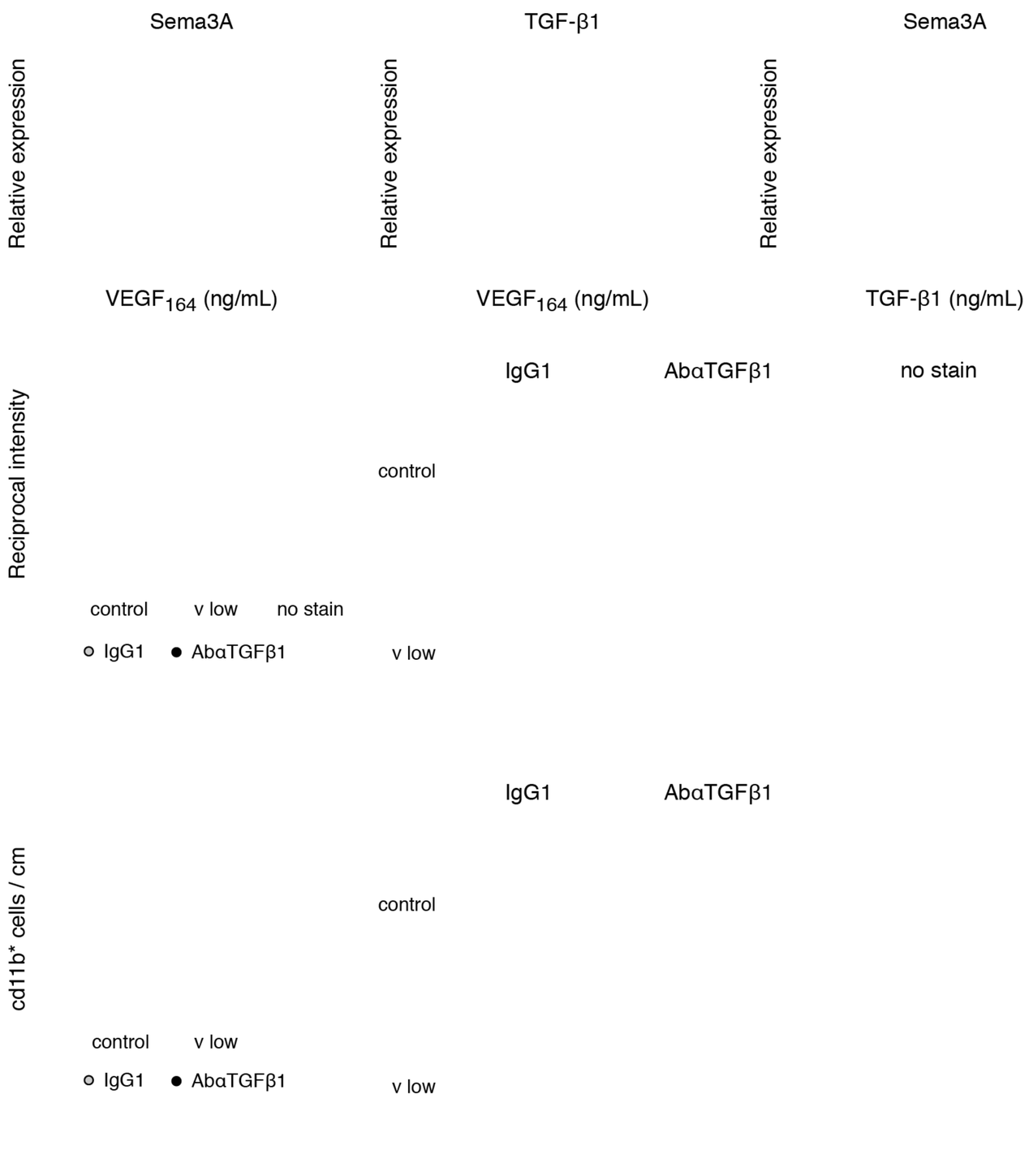

Lipoproteins
PPmA
SlrA
PsaA
PiaA
PiuA
LPxTG
NanA
IgA1-protease
Zmp
PrtA
HtrA
CBP
Autolysins
PsPA
PspC
Pce
Non-classical
PavA
Eno
GAPDH
TA
Pcho
PG
LTA
LM

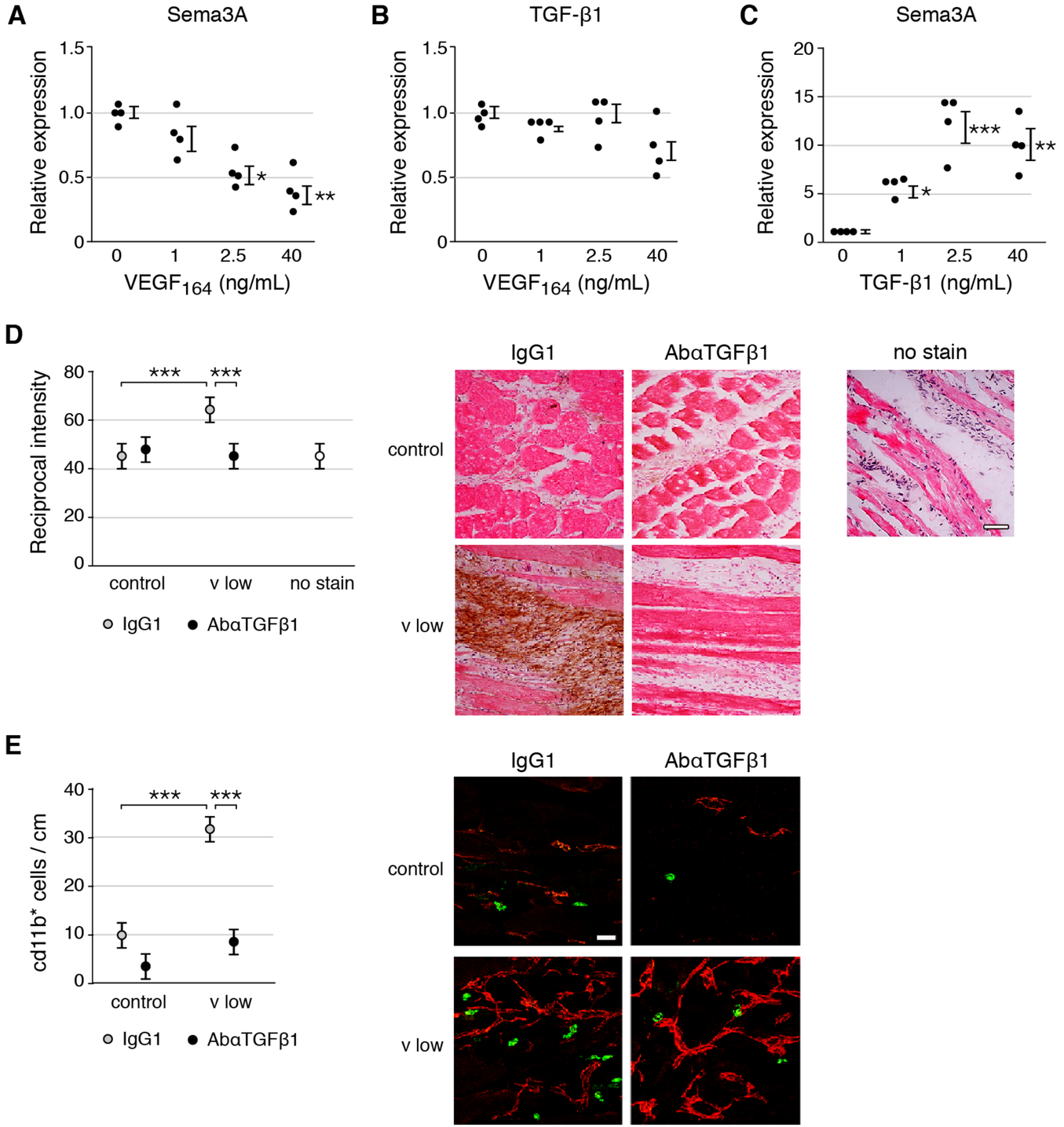


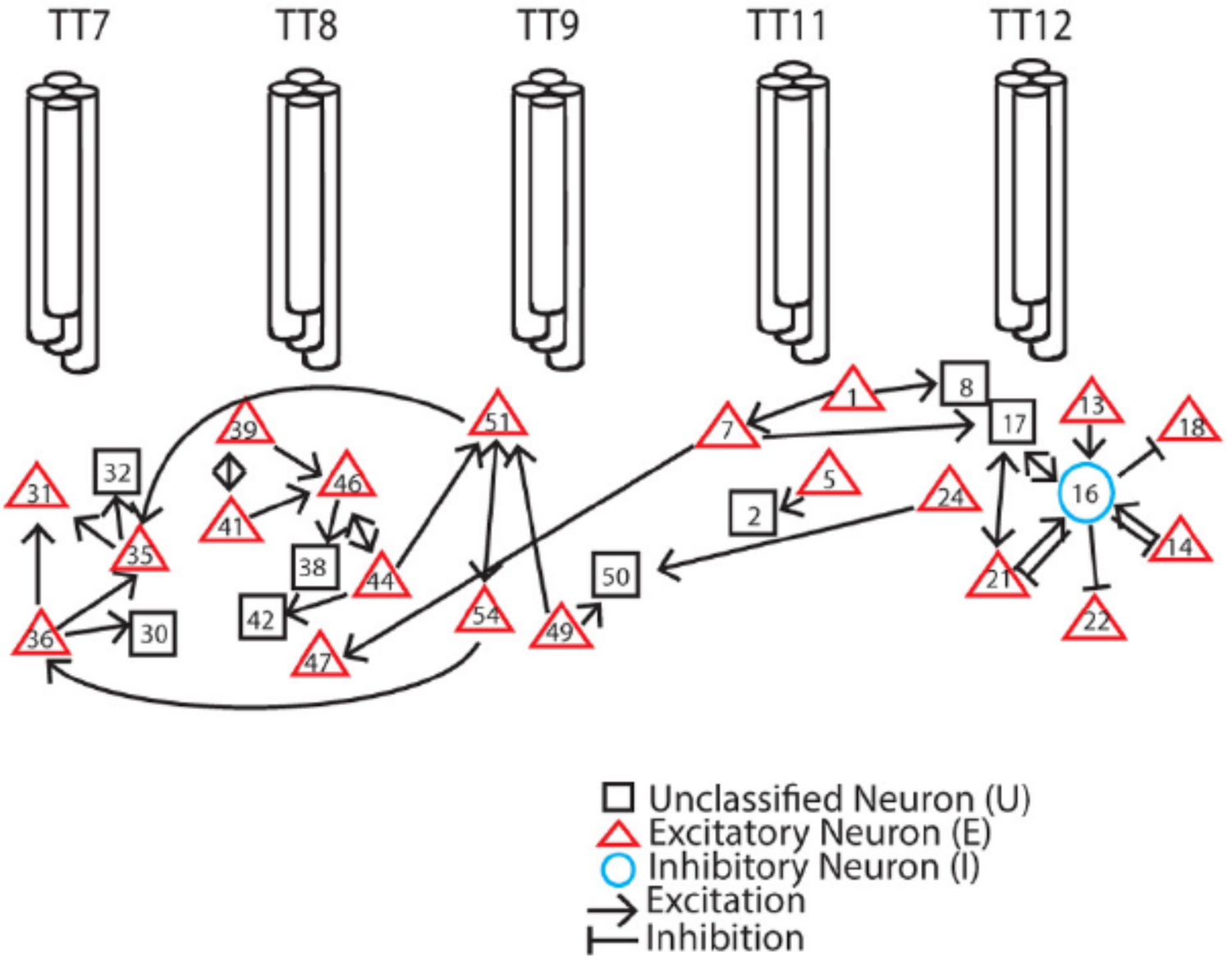
Nat Methods (2013) 10:687.



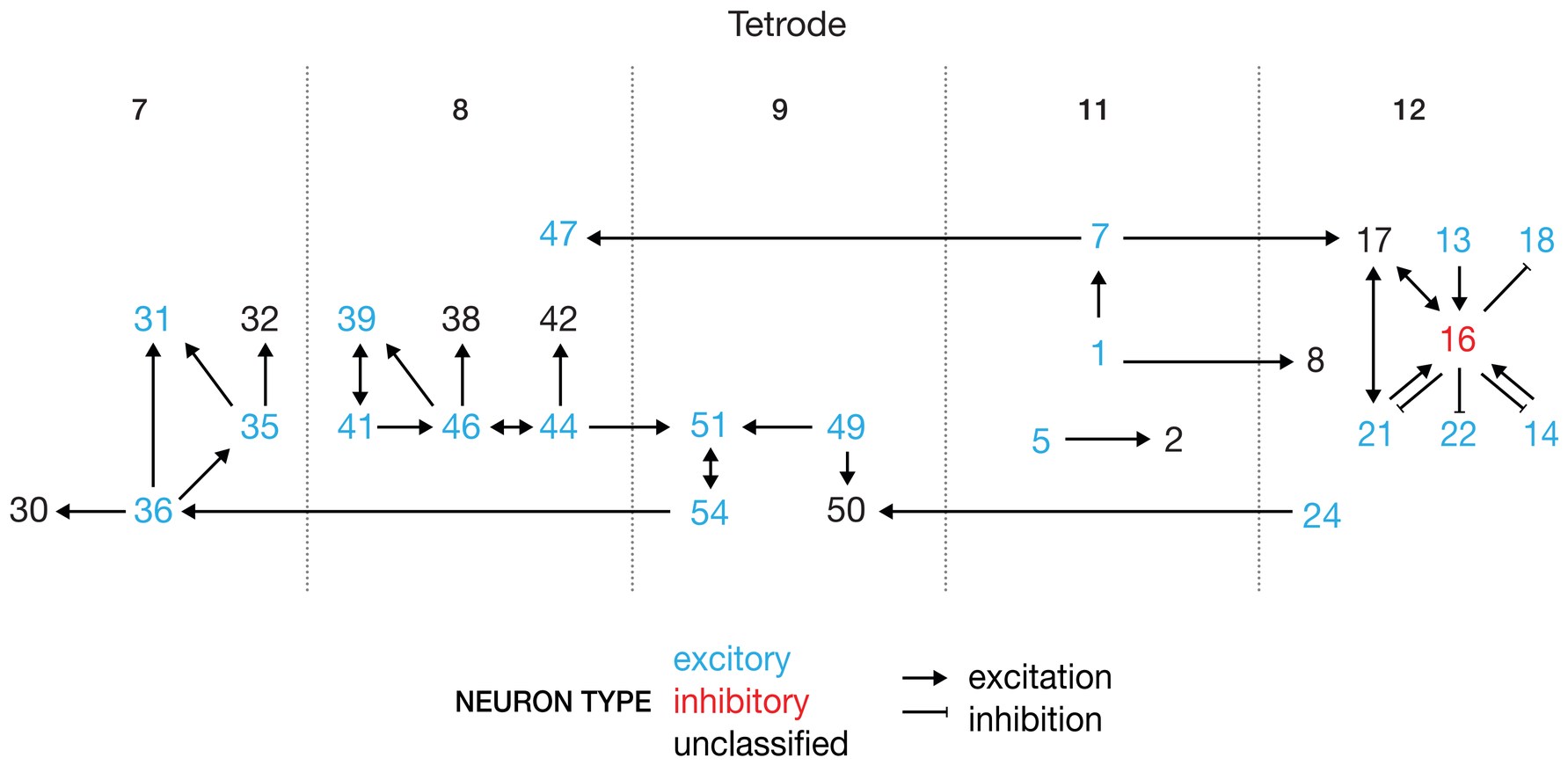
Genome Res (2004) 14:1248–1257.


Sema3A
TGF-β1
Sema3A
Relative expression
Relative expression
Relative expression
VEGF164 (ng/mL)
VEGF164 (ng/mL)
TGF-β1 (ng/mL)
IgG1
AbαTGFβ1
no stain
Reciprocal intensity
control
control
v low
no stain
IgG1
AbαTGFβ1
v low
IgG1
AbαTGFβ1
cd11b* cells / cm
control
control
v low
IgG1
AbαTGFβ1
v low


A
Sema3A
Relative expression
1.5
1.0
0.5
0
0
1
2.5
40
VEGF164 (ng/mL)
*
**
B
TGF-β1
Relative expression
1.5
1.0
0.5
0
0
1
2.5
40
VEGF164 (ng/mL)
C
Sema3A
Relative expression
20
15
10
5
0
***
**
*
0
1
2.5
40
TGF-β1 (ng/mL)
D
Reciprocal intensity
80
60
40
20
0
***
***
control
v low
no stain
IgG1
AbαTGFβ1
IgG1
AbαTGFβ1
no stain
control
v low
E
cd11b* cells / cm
40
30
20
10
0
***
***
control
v low
IgG1
AbαTGFβ1
IgG1
AbαTGFβ1
control
v low



J Neurosci (2014) 34:5454–5467.


Tetrode
7
8
9
11
12
47
7
17
13
18
31
32
39
38
42
1
16
8
35
41
46
44
51
49
5
2
21
22
14
30
36
54
50
24
NEURON TYPE
excitory
inhibitory
unclassified
excitation
inhibition

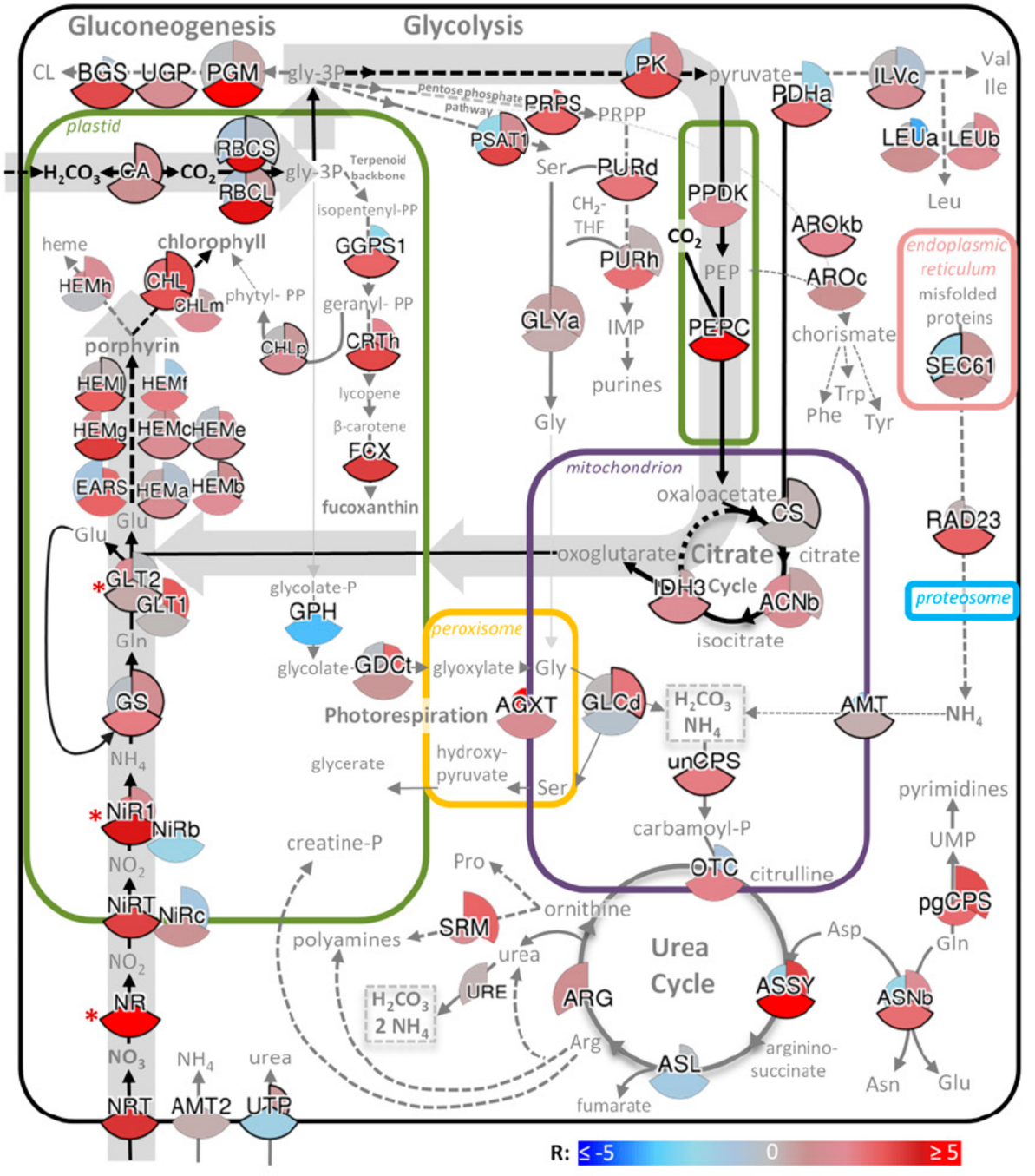
Ok, if you think that the last example was bad, the next one is suffering beyond death. It took me about 6 hours to redesign.

Is that a long time? Depends.

If the project involved 10 collaborators and lasted for 2 years then no. 6 hours of my time is absolutely worth it—it's a drop in the hat.

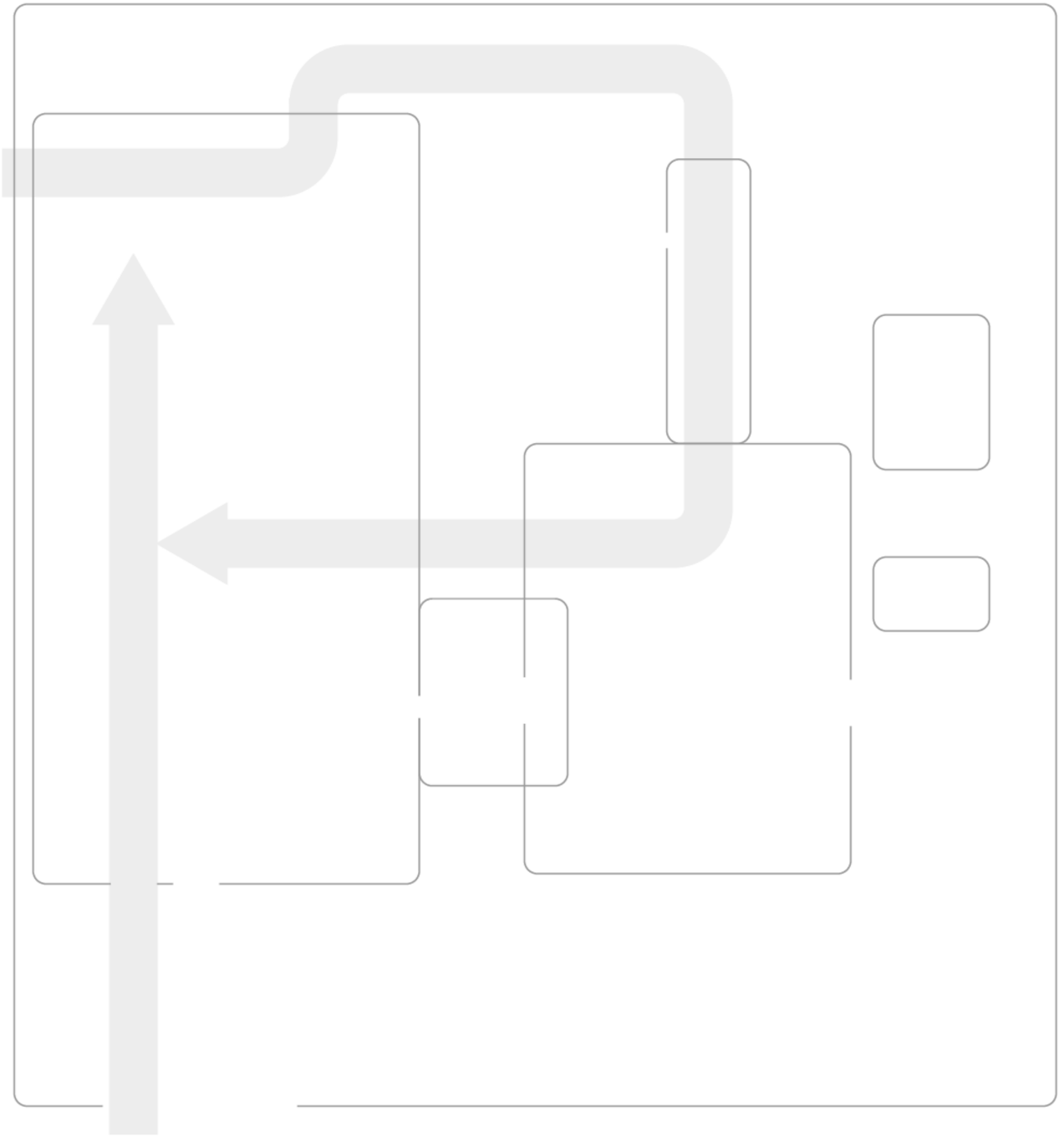
A well-designed graphic has longevity. Chances are, if you don't want to spend 6 hours on it, most other people don't want to either. This means that if you do a good job the world will thank you. Well, maybe. If not, at least you'll have a good sob story.

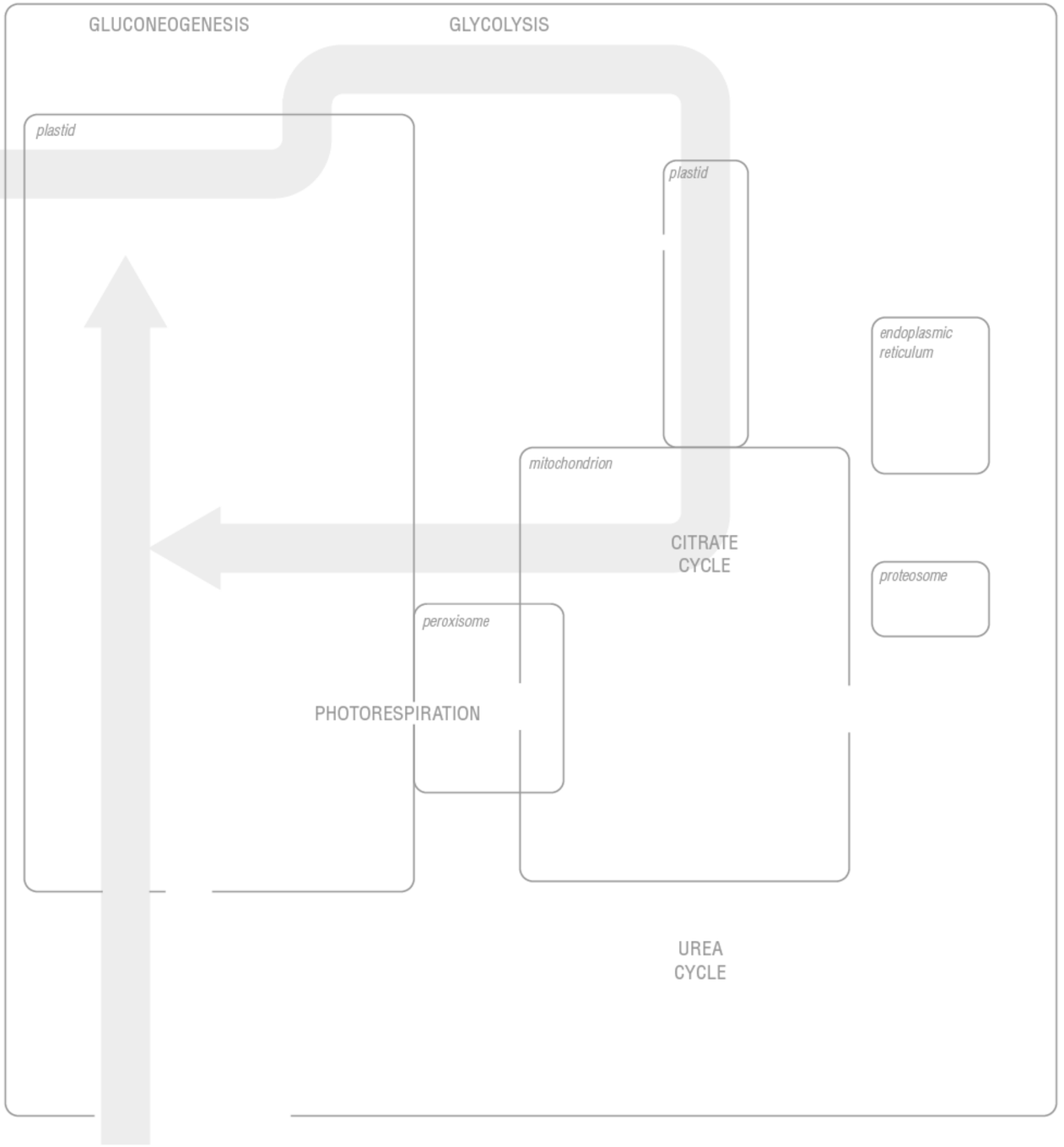
Ok, are you ready?

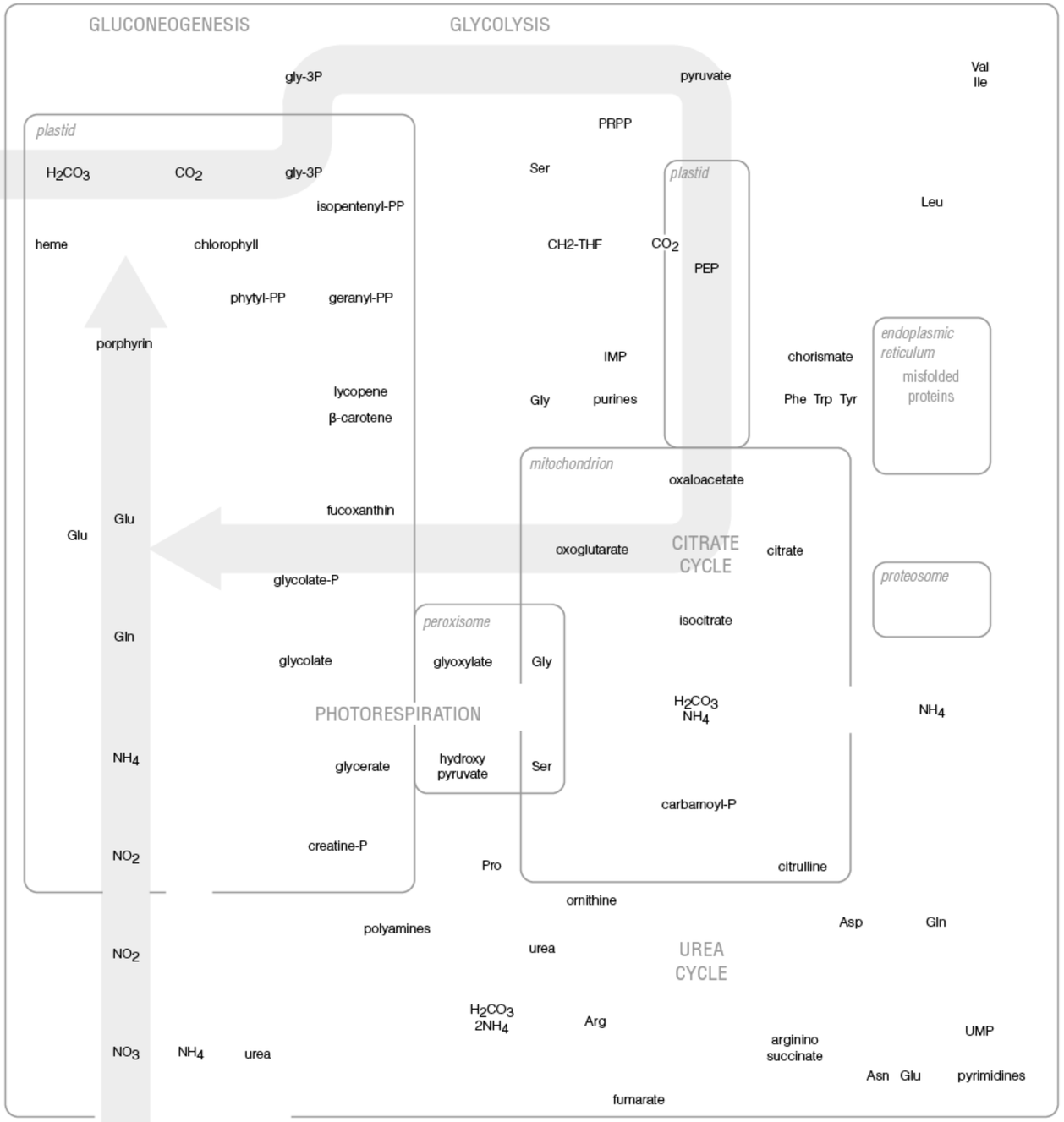


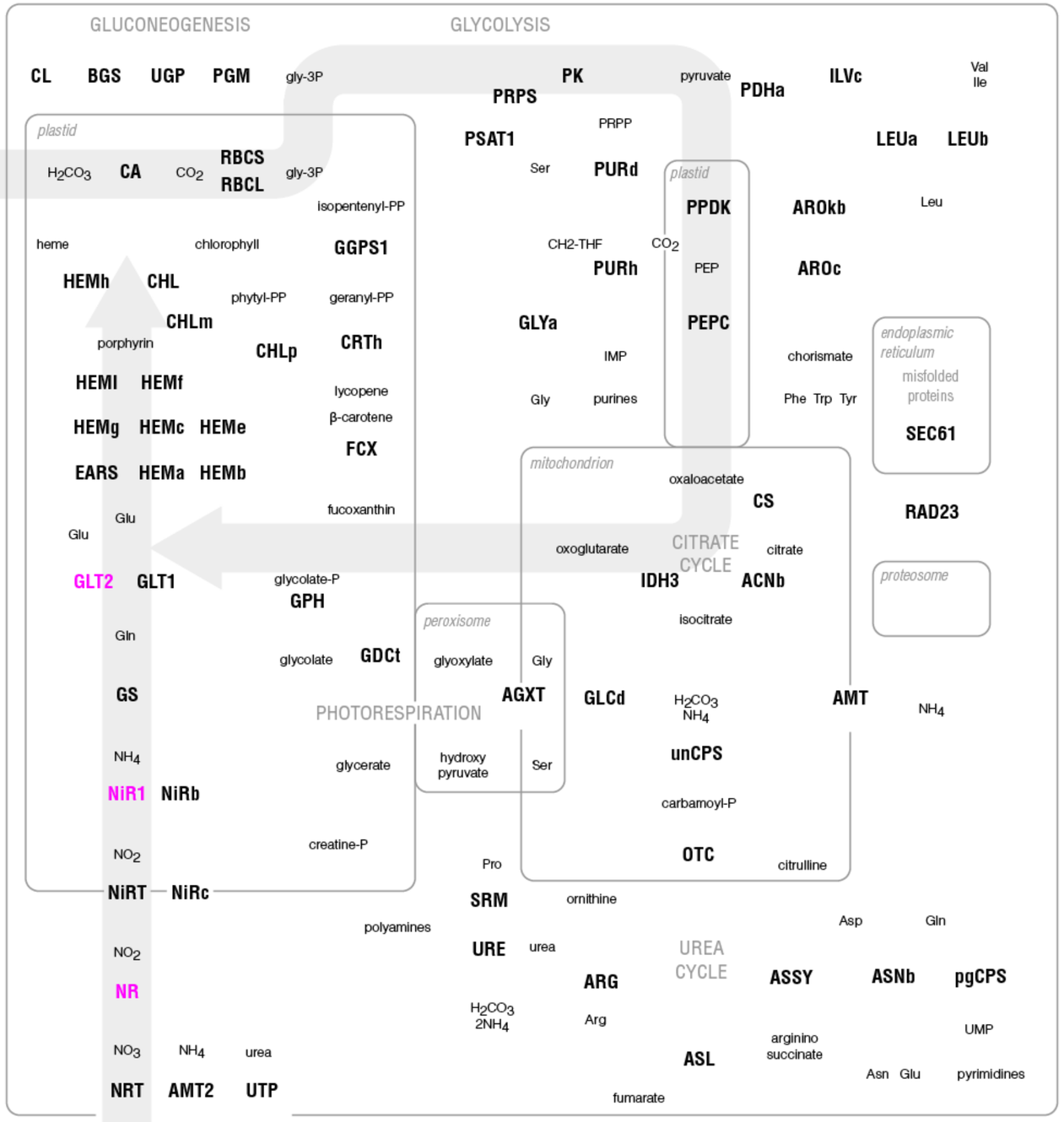
ACNb	aconitate hydratase 2
AGXT	serine--pyruvate aminotransferase
AMT, 2	**ammonium transporter**
ARG	arginase/agmatinase/formimionoglutamate hydrolase
AROc	chorismate synthase
AROkb	3-dehydroquinate synthase
ASL	argininosuccinate lyase
ASNb	asparagine synthase (glutamine-hydrolysing)
ASSY	**argininosuccinate synthase**
BGS	**callose synthase**
CA	**carbonic anhydrase**
CHL	**magnesium chelatase**
CHLm	magnesium-protoporphyrin O-methyltransferase
CHLp	geranylgeranyl reductase
CRTh	carotenoid isomerase
CS	citrate synthase
EARS	glutamyl-tRNA synthetase
FCX	**Lhcr7; fucoxanthin chl a/c light-harvesting protein**
GDTC	glycine dehydrogenase subunit 1
GGPS1	geranylgeranyl pyrophosphate synthetase
GLCD	glycolate oxidase
GLT1, 2	**glutamate synthase (NADPH/NADH, ferredoxin)**
GLYa	glycine hydroxymethyltransferase
GPH	2-phosphoglycolate phosphatase
GS	**glutamine synthetase**
HEMa	glutamyl-tRNA reductase
HEMb	porphobilinogen synthase
HEMc	hydroxymethylbilane synthase
HEMe	uroporphyrinogen decarboxylase
HEMf	coproporphyrinogen III oxidase
HEMg	protoporphyrinogen oxidase
HEMh	ferrochelatase
HEMl	glutamate-1-semialdehyde 2,1-aminomutase
IDH3	isocitrate dehydrogenase (NAD+)
ILVc	ketol-acid reductoisomerase
LEUa,b	2,3 isopropylmalate synthase, dehydrogenase
NiRb, 1	**nitrite reductase (NADH/NADPH, ferredoxin)**
NiRT, c	**nitrite transporters**
NR	**nitrate reductase**
NRT	**nitrate transporter**
OTC	**ornithine carbamoyltransferase**
PDHa	pyruvate dehydrogenase E1 component subunit alpha
PEPC	**phosphoenolpyruvate carboxylase**
pgCPS	carbamoyl-phosphate synthase / aspartate carbamoyltransferase
PGM	**phosphoglucomutase**
PK	pyruvate kinase
PPDK	pyruvate,orthophosphate dikinase
PRPS	ribose-phosphate pyrophosphokinase
PSAT1	phosphoserine aminotransferase
PURd	phosphoribosylamine--glycine ligase / phosphoribosylglycinamide
PURh	phosphoribosylaminoimidazolecarboxamide formyltransferase
RAD23	UV excision repair protein
RBCS, L	**ribulose-bisphosphate carboxylase (small , large) chain**
SEC61	transport protein subunit alpha
SRM	spermidine synthase
UGP	**precursor of phosphorylase udp-glucose diphosphorylase**
unCPS	**carbamoyl-phosphate synthase mitochindrial precursor**
URE	urease
UTP	**urea transporter**

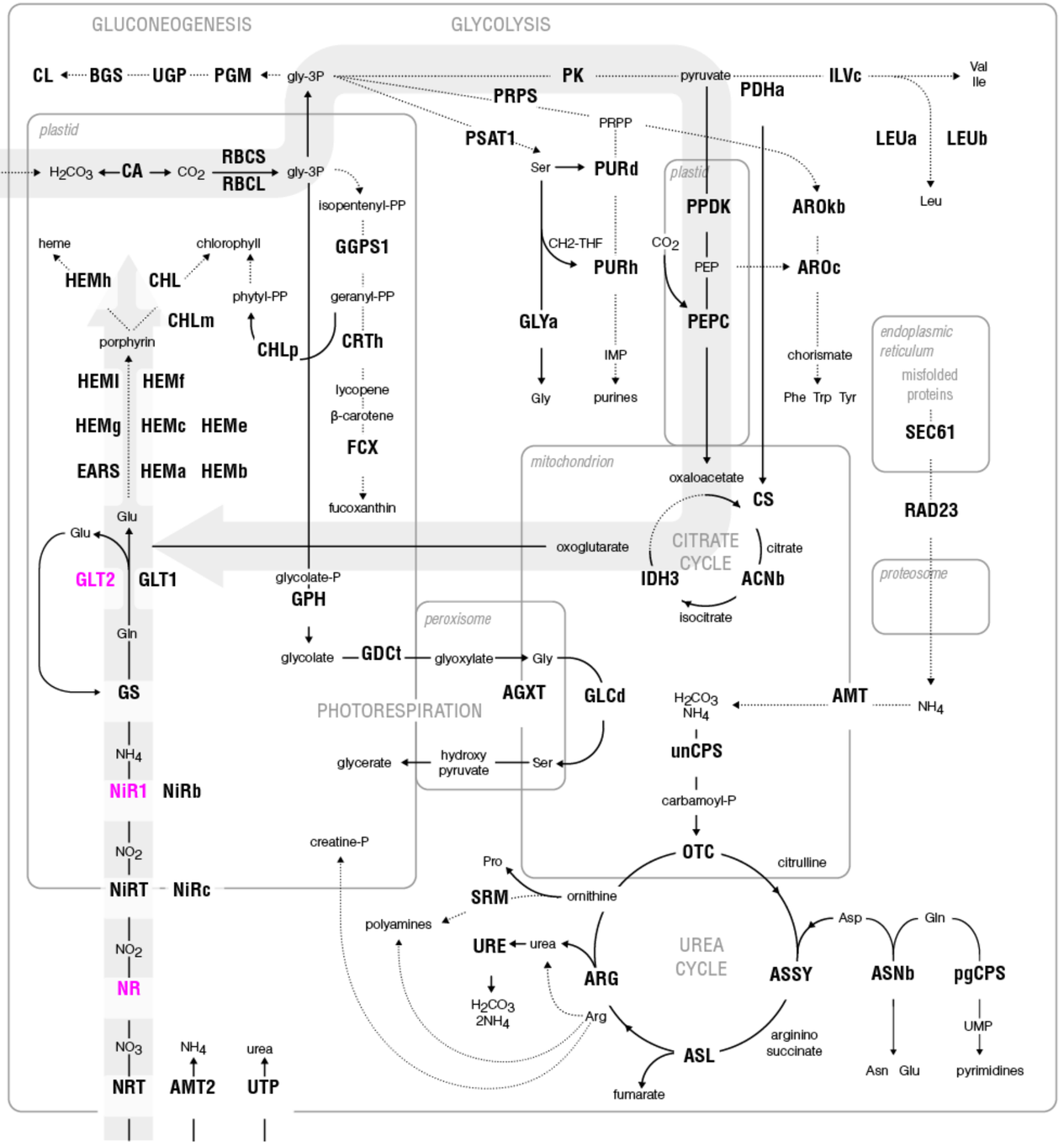
PNAS (2012) 109:E317–E325.

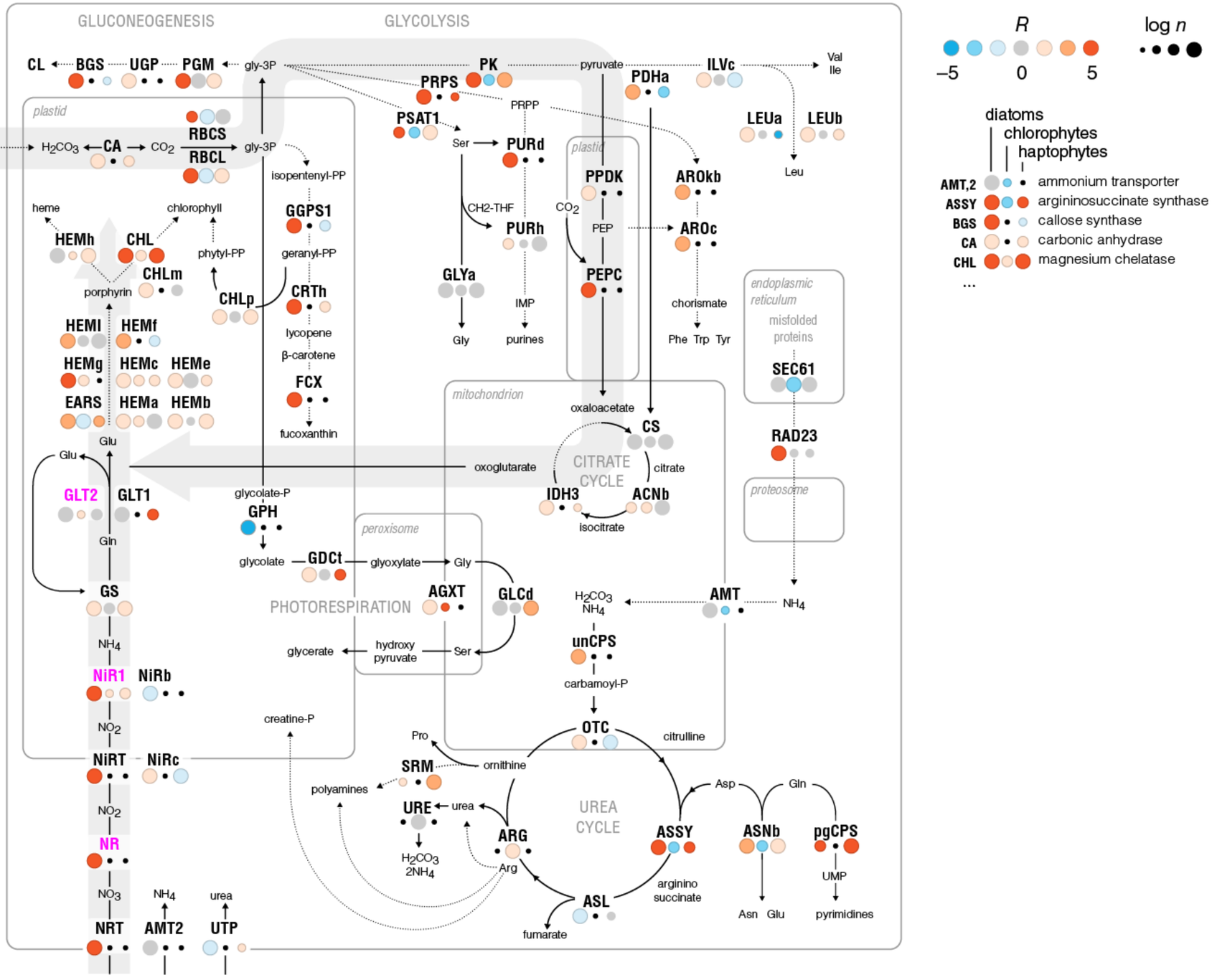



GLUCONEOGENESIS
GLYCOLYSIS
plastid
plastid
endoplasmic reticulum
mitochondrion
CITRATE CYCLE
proteosome
peroxisome
PHOTORESPIRATION
UREA CYCLE


GLUCONEOGENESIS
GLYCOLYSIS
gly-3P
pyruvate
Val
Ile
plastid
PRPP
H_2CO_3
CO_2
gly-3P
Ser
plastid
isopentenyl-PP
Leu
heme
chlorophyll
CH2-THF
CO_2
PEP
phytyl-PP
geranyl-PP
endoplasmic reticulum
misfolded proteins
porphyrin
IMP
chorismate
lycopene
β-carotene
Gly
purines
Phe Trp Tyr
mitochondrion
oxaloacetate
fucoxanthin
Glu
Glu
oxoglutarate
CITRATE CYCLE
citrate
proteosome
glycolate-P
peroxisome
isocitrate
Gln
glycolate
glyoxylate
Gly
H_2CO_3
NH_4
NH_4
PHOTORESPIRATION
glycerate
hydroxy pyruvate
Ser
carbamoyl-P
NO_2
creatine-P
Pro
citrulline
ornithine
Asp
Gln
polyamines
urea
UREA CYCLE
NO_2
H_2CO_3
$2NH_4$
Arg
UMP
NO_3
NH_4
urea
arginino succinate
Asn
Glu
pyrimidines
fumarate


GLUCONEOGENESIS
GLYCOLYSIS
CL
BGS
UGP
PGM
gly-3P
PK
pyruvate
PDHa
ILVc
Val
Ile
PRPS
PRPP
PSAT1
LEUa
LEUb
plastid
Ser
PURd
plastid
H_2CO_3
CA
CO_2
RBCS
RBCL
gly-3P
PPDK
AROkb
Leu
isopentenyl-PP
heme
chlorophyll
GGPS1
CH2-THF
CO_2
PURh
PEP
AROc
HEMh
CHL
phytyl-PP
geranyl-PP
GLYa
PEPC
CHLm
endoplasmic
reticulum
misfolded
proteins
porphyrin
CHLp
CRTh
IMP
chorismate
HEMl
HEMf
lycopene
Gly
purines
Phe Trp Tyr
SEC61
HEMg
HEMc
HEMe
β-carotene
FCX
mitochondrion
HEMa
HEMb
EARS
oxaloacetate
CS
RAD23
fucoxanthin
Glu
Glu
oxoglutarate
CITRATE
CYCLE
citrate
proteosome
GLT2
GLT1
glycolate-P
GPH
IDH3
ACNb
peroxisome
isocitrate
Gln
glycolate
GDCt
glyoxylate
Gly
AGXT
GLCd
H_2CO_3
NH_4
AMT
NH_4
GS
PHOTORESPIRATION
unCPS
NH_4
hydroxy
pyruvate
Ser
glycerate
NiR1
NiRb
carbamoyl-P
NO_2
creatine-P
OTC
citrulline
Pro
NiRT
NiRc
SRM
ornithine
polyamines
Asp
Gln
NO_2
URE
urea
UREA
CYCLE
NR
ARG
ASSY
ASNb
pgCPS
H_2CO_3
$2NH_4$
Arg
UMP
arginino
succinate
NO_3
NH_4
urea
ASL
Asn Glu
pyrimidines
NRT
AMT2
UTP
fumarate


GLUCONEOGENESIS
GLYCOLYSIS
CL
BGS
UGP
PGM
gly-3P
PK
pyruvate
PDHa
ILVc
Val
Ile
LEUa
LEUb
Leu
PRPS
PRPP
PSAT1
Ser
PURd
PURh
CH2-THF
GLYa
Gly
IMP
purines
plastid
PPDK
PEP
PEPC
CO2
AROkb
AROc
chorismate
Phe Trp Tyr
plastid
H2CO3
CA
CO2
RBCS
RBCL
gly-3P
isopentenyl-PP
GGPS1
geranyl-PP
CRTh
lycopene
β-carotene
FCX
fucoxanthin
heme
chlorophyll
HEMh
CHL
phytyl-PP
CHLm
CHLp
porphyrin
HEMl
HEMf
HEMg
HEMc
HEMe
EARS
HEMa
HEMb
endoplasmic reticulum
misfolded proteins
SEC61
RAD23
proteosome
mitochondrion
oxaloacetate
CS
CITRATE CYCLE
citrate
IDH3
ACNb
isocitrate
oxoglutarate
Glu
Glu
GLT2
GLT1
glycolate-P
GPH
Gln
GS
peroxisome
glycolate
GDCt
glyoxylate
Gly
AGXT
GLCd
PHOTORESPIRATION
glycerate
hydroxy pyruvate
Ser
H2CO3
NH4
AMT
NH4
unCPS
carbamoyl-P
NH4
NiR1
NiRb
NO2
NiRT
NiRc
creatine-P
OTC
citrulline
Pro
SRM
ornithine
polyamines
URE
urea
ARG
UREA CYCLE
ASSY
Asp
Gln
ASNb
pgCPS
H2CO3
2NH4
Arg
ASL
arginino succinate
UMP
Asn Glu
pyrimidines
fumarate
NO2
NR
NO3
NRT
NH4
AMT2
urea
UTP


GLUCONEOGENESIS
GLYCOLYSIS
CL
BGS
UGP
PGM
gly-3P
PK
pyruvate
ILVc
Val
Ile
PRPS
PDHa
PRPP
PSAT1
LEUa
LEUb
Leu
plastid
RBCS
RBCL
H2CO3
CA
CO2
gly-3P
isopentenyl-PP
Ser
PURd
plastid
PPDK
AROkb
heme
chlorophyll
GGPS1
CH2-THF
CO2
PEP
AROc
HEMh
CHL
phytyl-PP
geranyl-PP
PURh
CHLm
porphyrin
CHLp
GLYa
PEPC
CRTh
IMP
chorismate
lycopene
Gly
purines
Phe Trp Tyr
HEMl
HEMf
β-carotene
endoplasmic
reticulum
misfolded
proteins
HEMg
HEMc
HEMe
FCX
SEC61
EARS
HEMa
HEMb
mitochondrion
oxaloacetate
fucoxanthin
CS
RAD23
Glu
Glu
oxoglutarate
CITRATE
CYCLE
citrate
GLT2
GLT1
IDH3
ACNb
proteosome
glycolate-P
GPH
isocitrate
peroxisome
Gln
glycolate
GDCt
glyoxylate
Gly
GS
AGXT
GLCd
PHOTORESPIRATION
H2CO3
NH4
AMT
NH4
glycerate
hydroxy
pyruvate
Ser
unCPS
NH4
carbamoyl-P
NiR1
NiRb
creatine-P
OTC
citrulline
NO2
Pro
NiRT
NiRc
SRM
ornithine
polyamines
Asp
Gln
NO2
URE
urea
UREA
CYCLE
H2CO3
2NH4
ARG
ASSY
ASNb
pgCPS
NR
Arg
arginino
succinate
UMP
NO3
NH4
urea
ASL
Asn Glu
pyrimidines
NRT
AMT2
UTP
fumarate
R
log n
–5
0
5
diatoms
chlorophytes
haptophytes
AMT,2
ammonium transporter
ASSY
argininosuccinate synthase
BGS
callose synthase
CA
carbonic anhydrase
CHL
magnesium chelatase
...

Typography is a huge field—lots has been done in this space. How much of it do you really need to know?

You have to know one thing: that you must respect it, revere it, worship it.

The text comes first. The labels, the callouts, the little blurbs on the side of your image, they’re the things that you treat like little babies. You have to take care of them and support them. They’re not gonna make it on their own.

You will find that once you place the labels down, say on a grid or with otherwise careful alignment, a lot of other things just fall into place.

Don’t use the first font in that dropdown list. Actively seek out confrontation with people who use Comic Sans. Publicly despise them. Make kerning the topic of the real party conversation that’s worth having.

created by

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written and designed by

Martin Krzywinski

production

One Ski Digital Media Productions

with financial support by

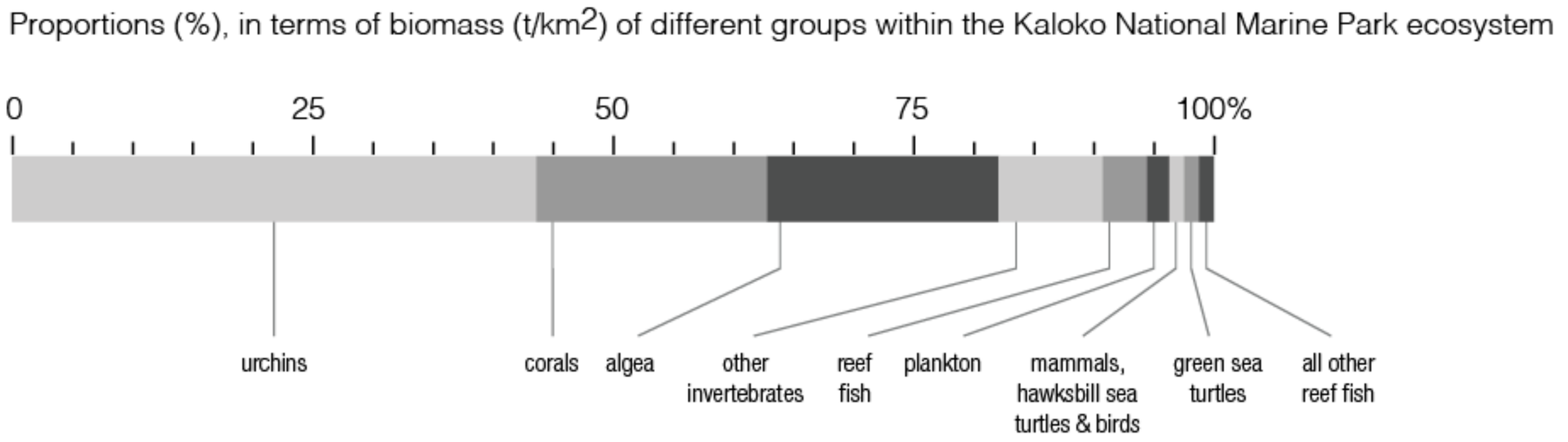
University of Sydney

filmed at

University of Sydney, Australia

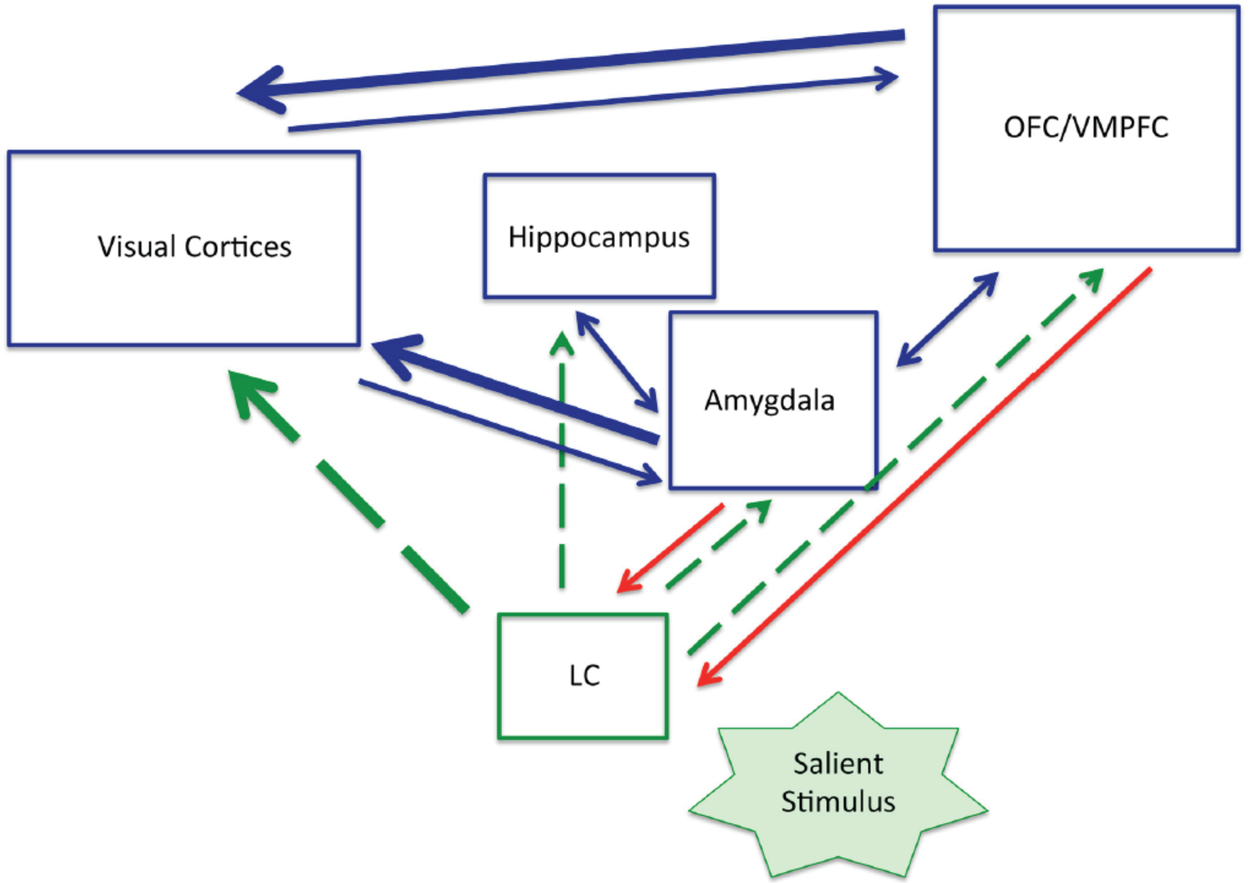
EXERCISE 1

Redesign this as a table.



EXERCISE 2

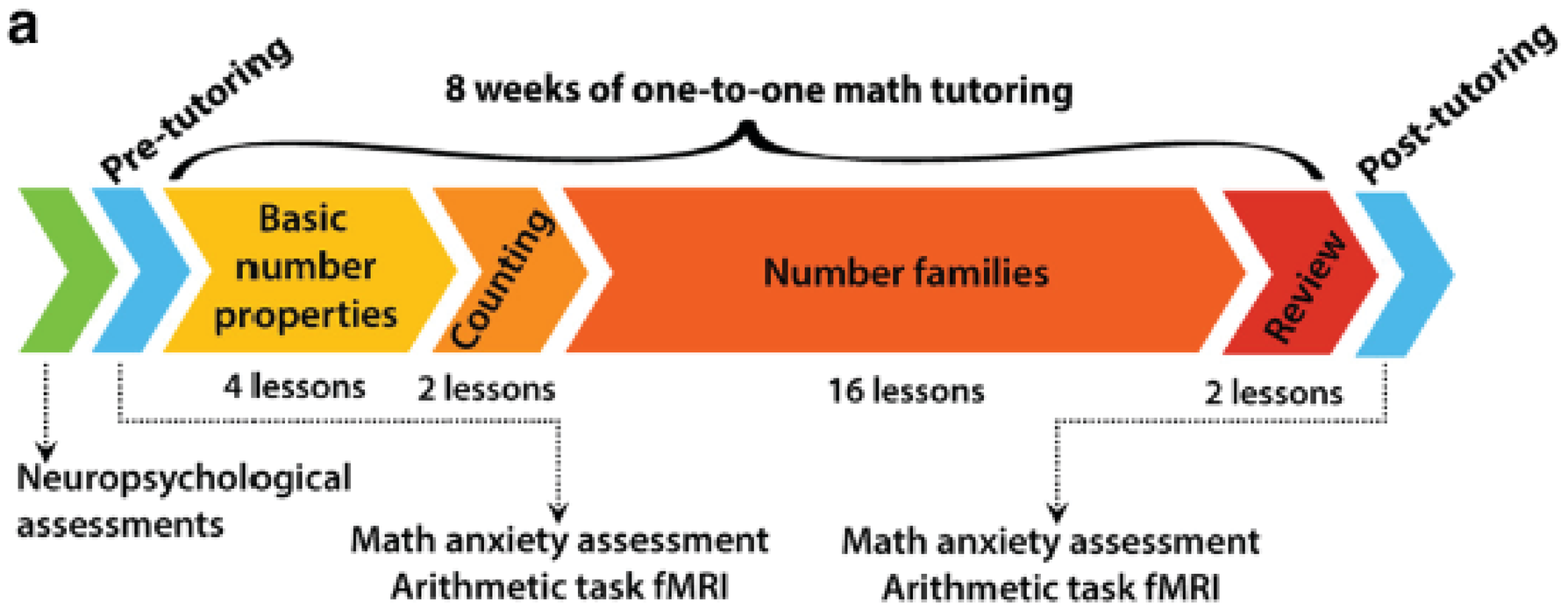
Redesign this figure.



J. Neurosci. 35(16):6506–6516

EXERCISE 3

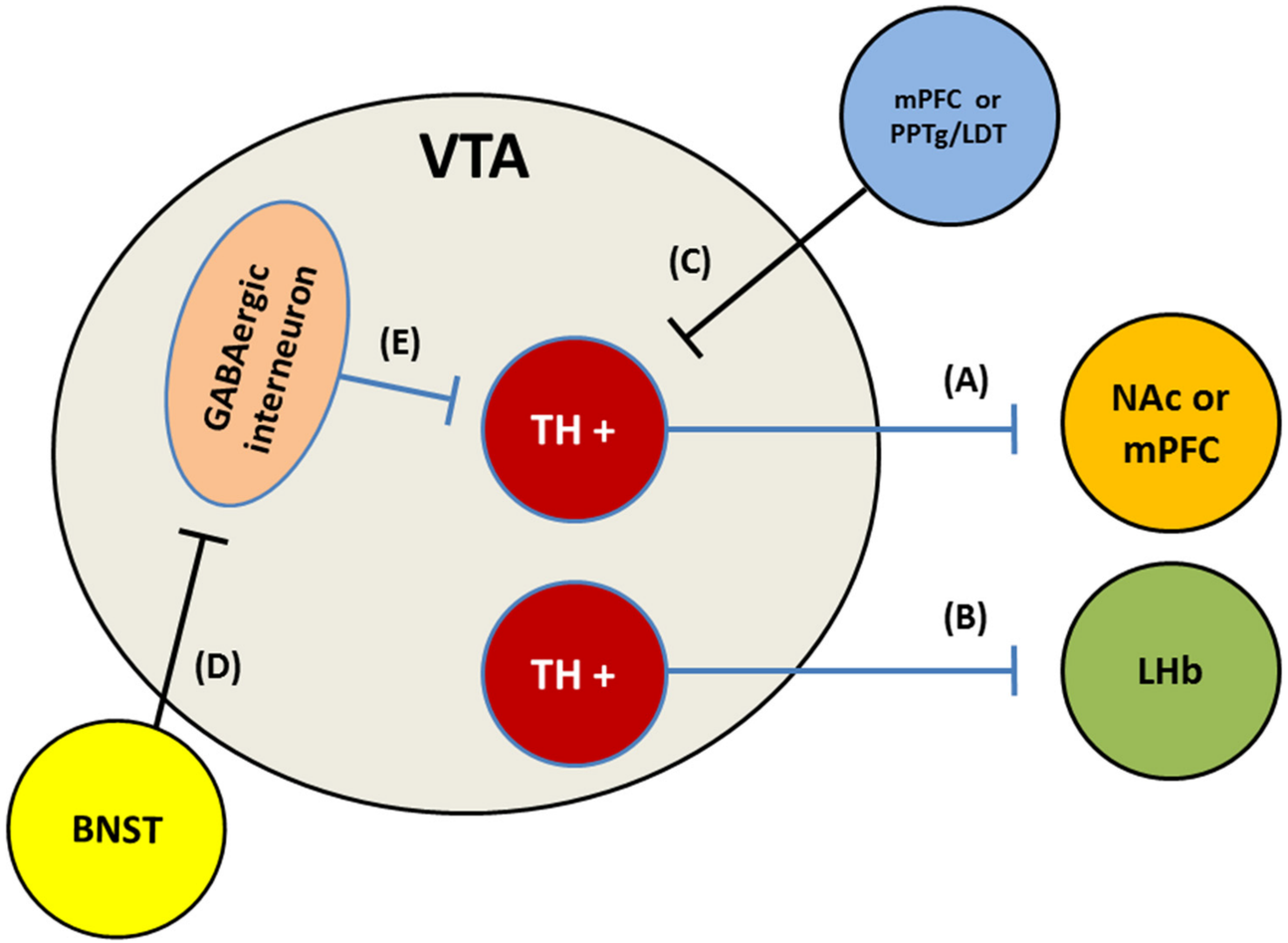
Redesign this figure.



J Neurosci (2015) 35:12574–12583.

EXERCISE 4

Redesign this figure.



J Neurosci (2014) 34:5824–5834.