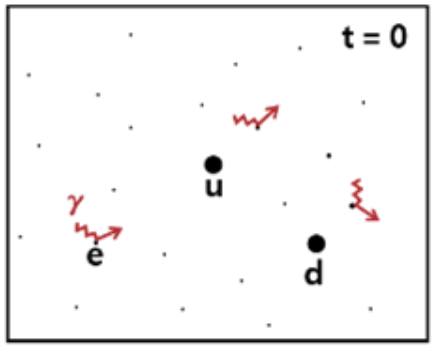
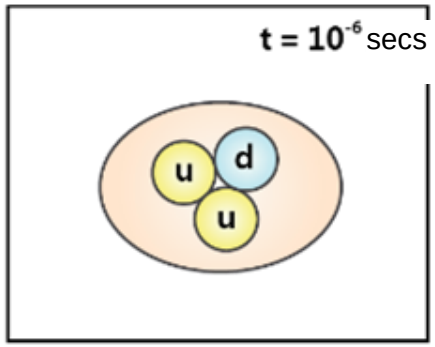
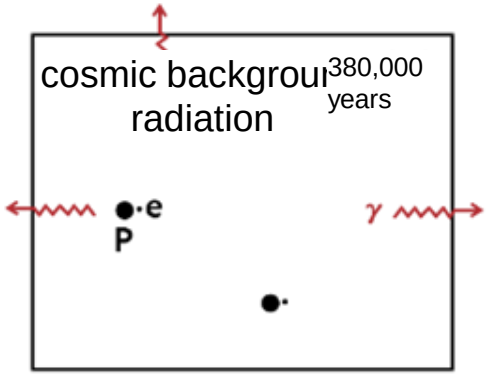


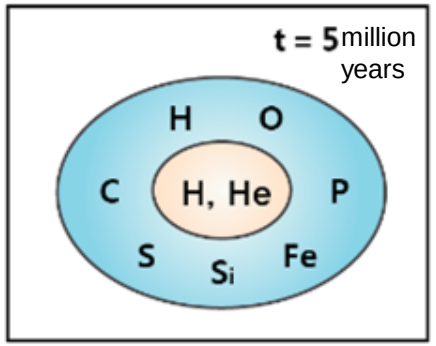
big bang



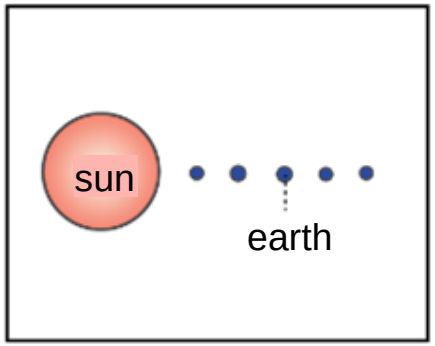
appearance of proton



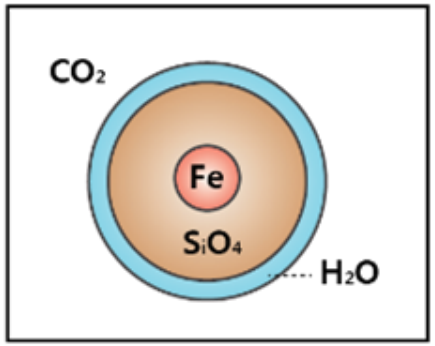
appearance of
hydrogen atom



the first stars

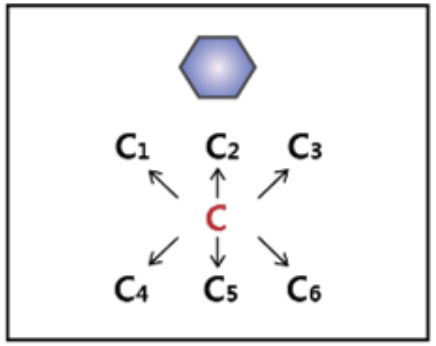


formation of
the solar system

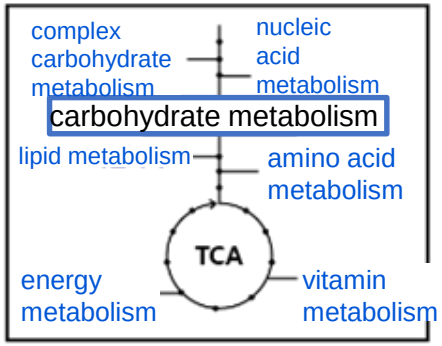


evolution of planets

C,H,O world

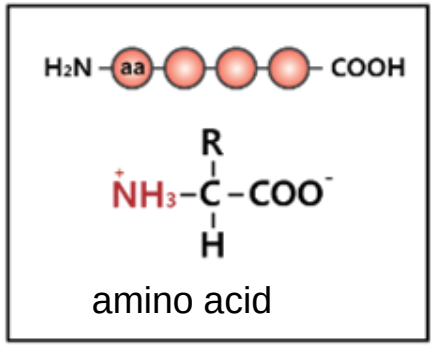


carbon skeleton



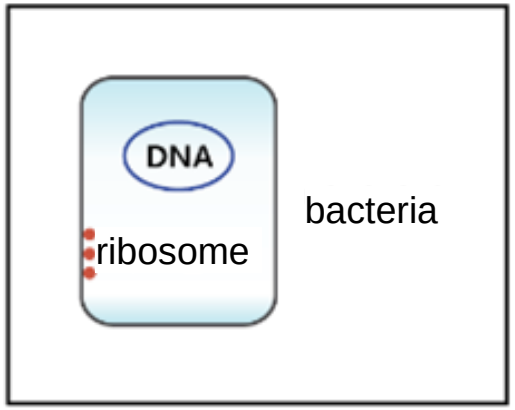
emergence of
biochemical circuits

C,H,O,N world

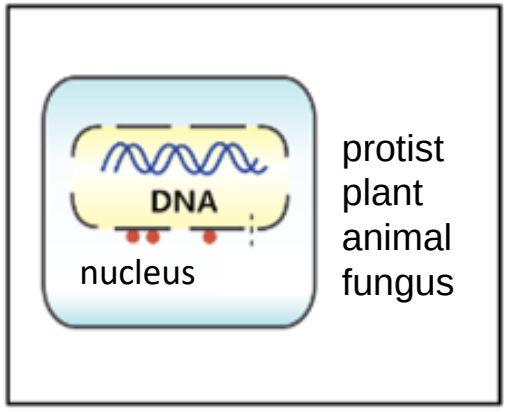


amino acid

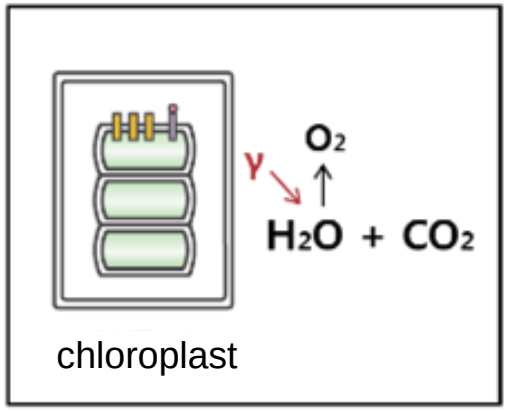
RNA world



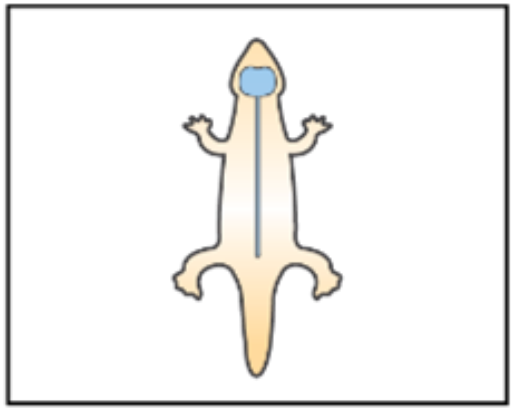
prokaryotic cell



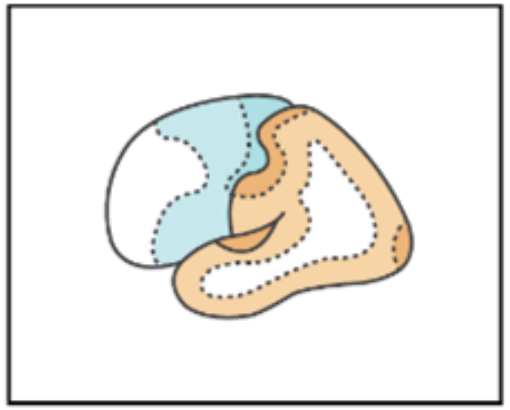
eukaryotic cell



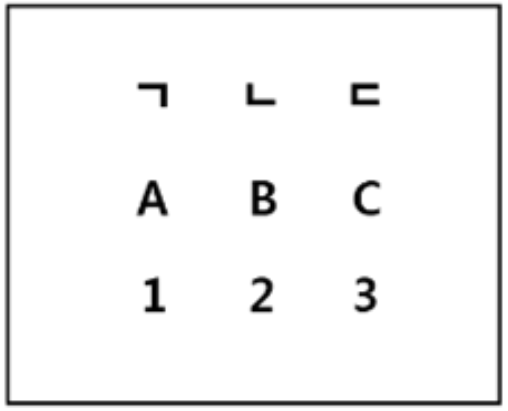
photosynthesis



vertebrate

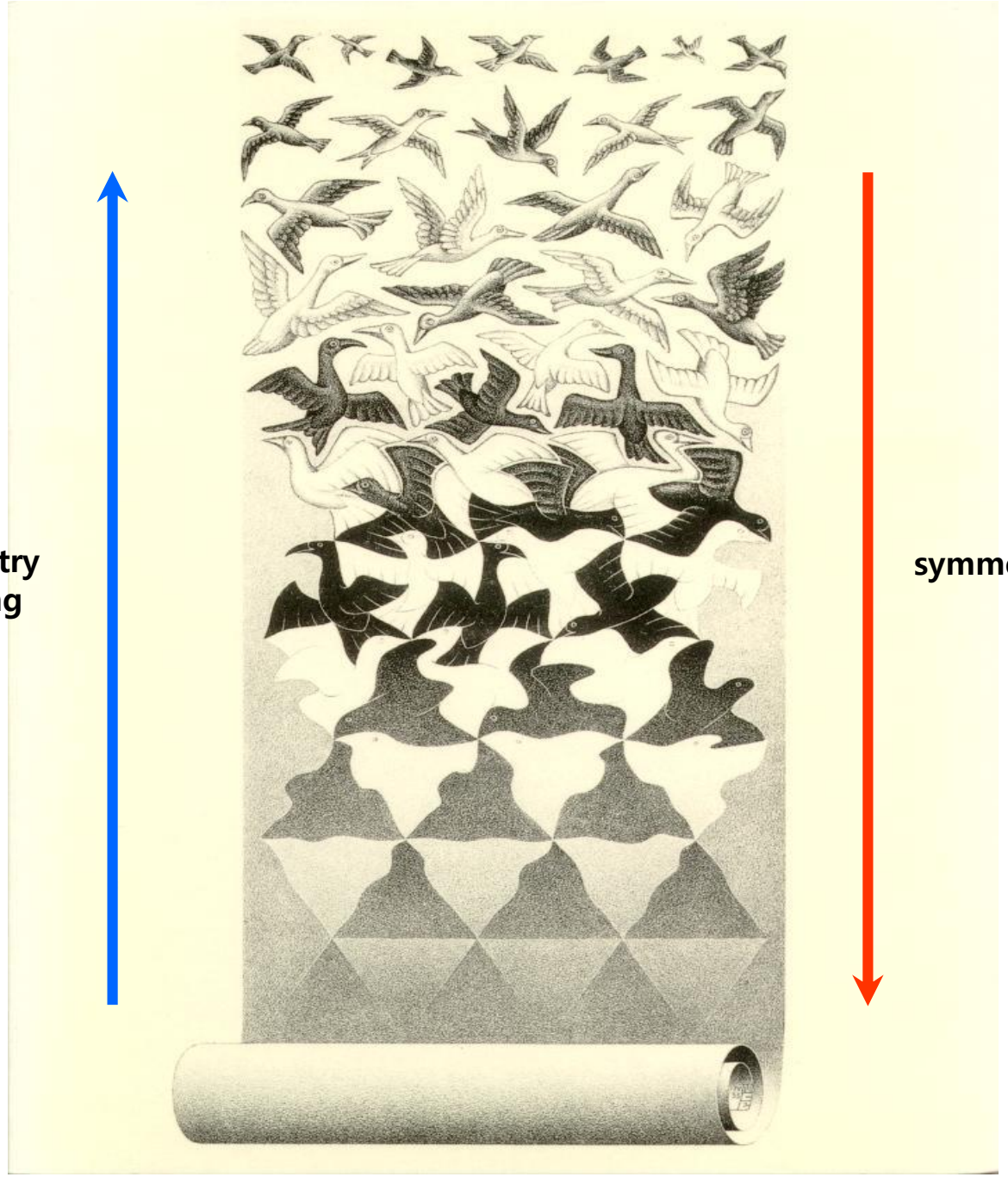


evolution of nervous system

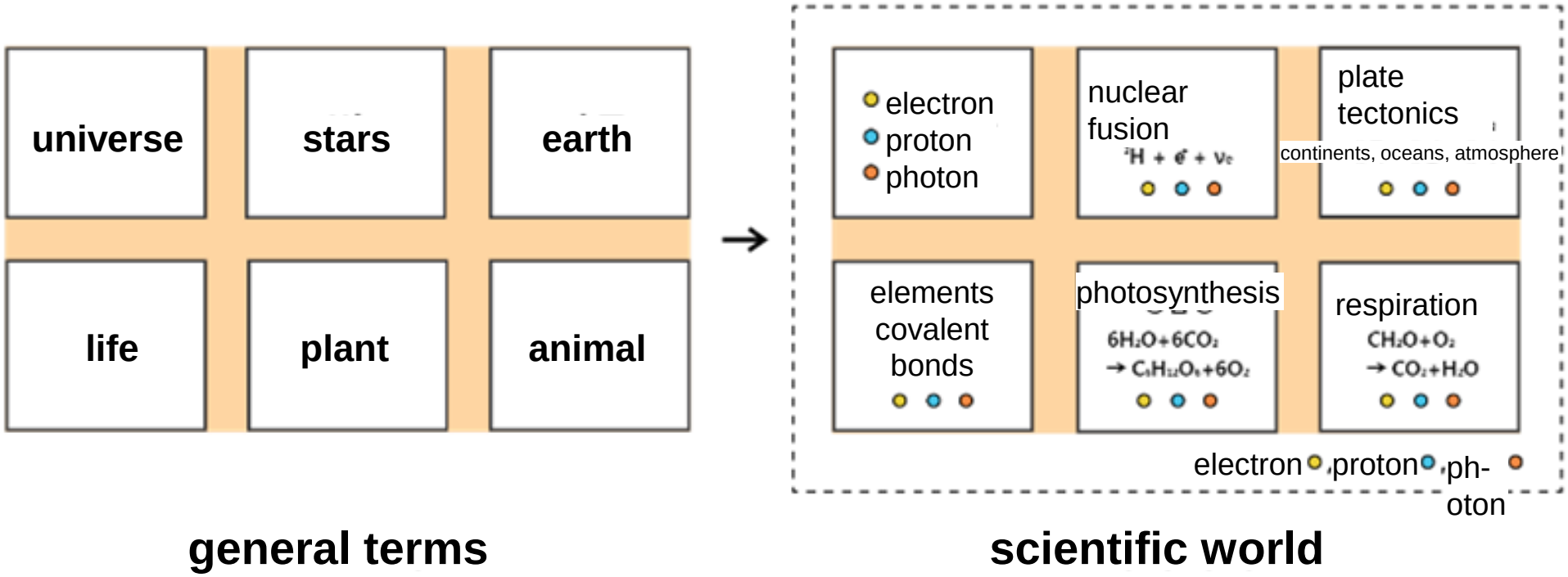


emergence of consciousness

symmetry breaking



symmetry


universe
stars
earth
life
plant
animal
electron
proton
photon
nuclear fusion
plate tectonics
continents, oceans, atmosphere
elements covalent bonds
photosynthesis
respiration
electron
proton
photon
general terms
scientific world

$E = K.E. + P.E. = \frac{1}{2}mv^2 + V(r)$

$H = \frac{p^2}{2m} + V(r)$ $\quad H \to i\hbar\frac{\partial}{\partial t}$, $p \to -i\hbar\nabla$ $\quad i\hbar\frac{\partial}{\partial t}\Psi = -\frac{\hbar^2}{2m}\nabla^2\Psi + V\Psi$ $\quad (i\hbar\gamma^\mu\partial_\mu - mc)\Psi = 0$, $(\gamma^\mu P_\mu - mc)\Psi = 0$ $\quad E^2 = (pc)^2 + (mc^2)^2$, $E = \sqrt{(pc)^2 + (mc^2)^2}$

ground gravity

celestial gravity

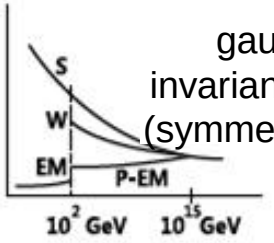
$F = ma = \frac{dP}{dt}$ $\quad \nabla^2\phi = 4\pi G\rho$ → general relativity

$\frac{du^\mu}{ds} + \Gamma^\mu_{ij}u^i u^j = 0$ $\quad R^{\mu\nu} - \frac{1}{2}g^{\mu\nu}R = \frac{8\pi G}{c^4}T^{\mu\nu}$

symmetry → L → E → F

electromagnetic force → γ

gauge invariance (symmetry)



weak force → w^+, z^0

strong force → gluon

super-string theory

light → Maxwell → local symmetry

quantum electrodynamics

electric force

magnetic force

U(1) $\quad j^\mu = \partial_\mu F^{\mu\nu}$

$\frac{\partial L}{\partial q} - \frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}}\right) = 0$ $\quad (D^\mu\phi)^\dagger(D_\mu\phi) - V(\phi^\dagger\phi)$

standard model

$m_W = \frac{1}{2}vg_2$, $m_Z = \frac{1}{2}v\sqrt{g_1^2 + g_2^2}$, $m_A = \sqrt{2\lambda v^2}$

Lagrangian mechanics

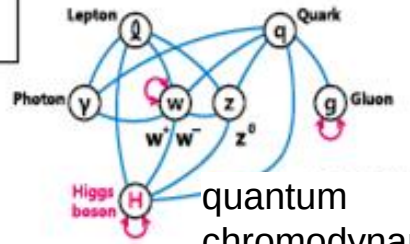
electromagnetic relativity

quantum mechanics

Grand Unified Theory

weak force

SU(2) $\quad p + e \leftrightarrow n + \nu_e$



$SU_C(3) \times SU_L(2) \times U_Y(1)$

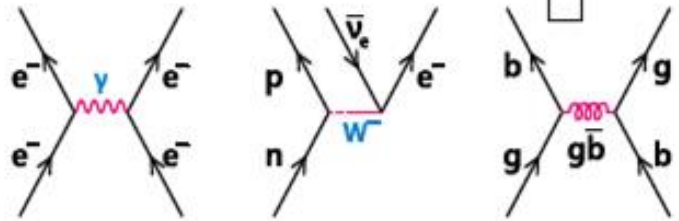
$\frac{\partial}{\partial x_\nu}f_{\mu\nu} + 2\varepsilon(b_\nu \times f_{\mu\nu}) + J_\mu = 0$

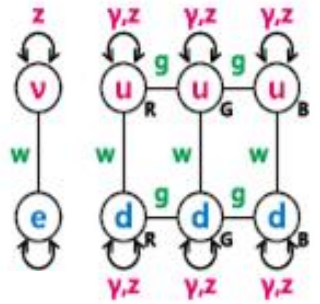
strong force

SU(3)

quantum chromodynamics

	렙톤		쿼크	
전하	-1	0	2/3	-1/3
1세대	e^-	ν_e	u	d
2세대	μ^-	ν_μ	c	s
3세대	τ^-	ν_τ	t	b





electromagnetic force / weak force / strong force

$$\ell = \ell_0 \sqrt{1 - \left(\frac{v}{c}\right)^2}$$

$$t = \frac{t_0}{\sqrt{1 - \left(\frac{v}{c}\right)^2}}$$

$$m = \frac{m_0}{\sqrt{1 - \left(\frac{v}{c}\right)^2}}$$

$$m = \frac{m_0}{\sqrt{1 - \left(\frac{v}{c}\right)^2}} \qquad m^2\left[1 - \left(\frac{v}{c}\right)^2\right] = m_0^2$$

$$dE = (dm)c^2$$

$$m^2c^2 + m_0^2c^2 = m^2v^2$$

$$(2mdm)c^2 + 0 = (2mdm)v^2 + (2vdv)m^2$$

$$\int dE = E = \int (dm)\, c^2 = mc^2$$

$$(dm)c^2 = (dm)v^2 + (vdv)m$$

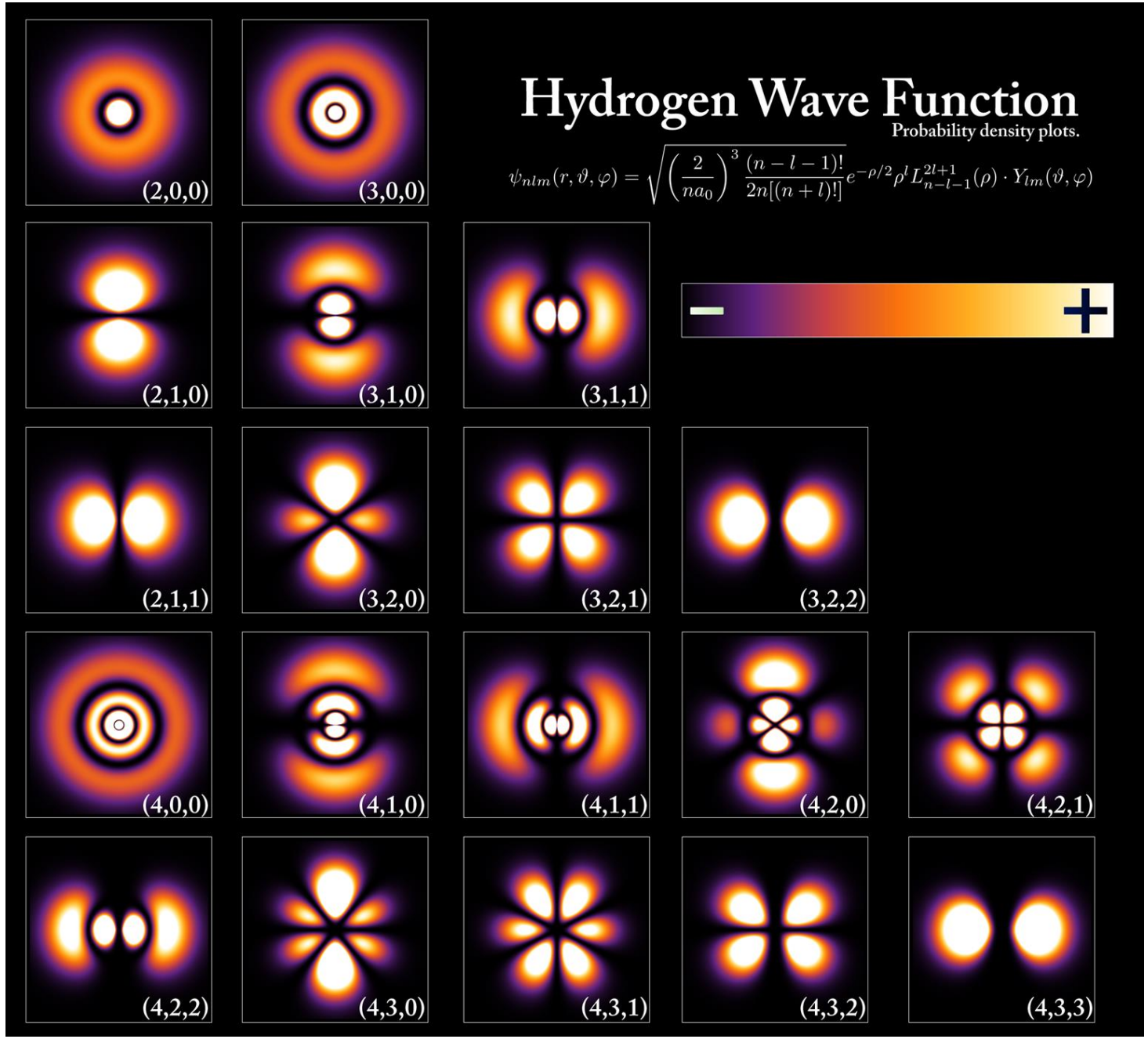
$$E = mc^2$$

$$dE = Fdx = \left(\frac{dp}{dt}\right)dx = \left(\frac{dx}{dt}\right)dp = vd(mv)$$
$$= v(mdv + vdm) = (dm)v^2 + (vdv)m$$

$$R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R = \frac{8\pi G}{c^4}$$

$$t = \frac{2}{3H_0\sqrt{\Omega_{\Lambda 0}}} \ln\left[\sqrt{1 + \frac{\Omega_{\Lambda 0}}{\Omega_{m0}} R^3} + \sqrt{\frac{\Omega_{\Lambda 0}}{\Omega_{m0}} R^3}\right]$$

2002년 WMAP 인공위성의 측정값인 우주구성 성분에서 물질값 기여분 $\Omega_{m0} = 0.27$ 과 암흑에너지 기여분 $\Omega_{\Lambda 0} = 0.73$ 현재의 크기인자 $R = 1$, 현재의 허블상수 $H_0 = 71 \frac{Km}{sec \cdot MPc} = 2.3x10^{-8} sec$ 을 대입하면 $t = 4.32x10^{17}$ 초 $= 137$ 억년 이 구해진다. 출처 : 현대천체물리학, 청범출판사, B. W. Carroll


Hydrogen Wave Function
Probability density plots.
$\psi_{nlm}(r,\vartheta,\varphi) = \sqrt{\left(\frac{2}{na_0}\right)^3 \frac{(n-l-1)!}{2n[(n+l)!]}} e^{-\rho/2} \rho^l L_{n-l-1}^{2l+1}(\rho) \cdot Y_{lm}(\vartheta,\varphi)$
−
+
(2,0,0)
(3,0,0)
(2,1,0)
(3,1,0)
(3,1,1)
(2,1,1)
(3,2,0)
(3,2,1)
(3,2,2)
(4,0,0)
(4,1,0)
(4,1,1)
(4,2,0)
(4,2,1)
(4,2,2)
(4,3,0)
(4,3,1)
(4,3,2)
(4,3,3)

Symmetry	Things as they are	**Higgs field**
Symmetry breaking	ignorance	**Boson, Fermion**

particle=(mass, spin, charge)

mass-> Higgs field

spin-> Boson, Fermion

Charge-> electrical charge

weak charge

Color charge

Vacuum □ Higgs field □ weak charge ocean
□ Mass generation

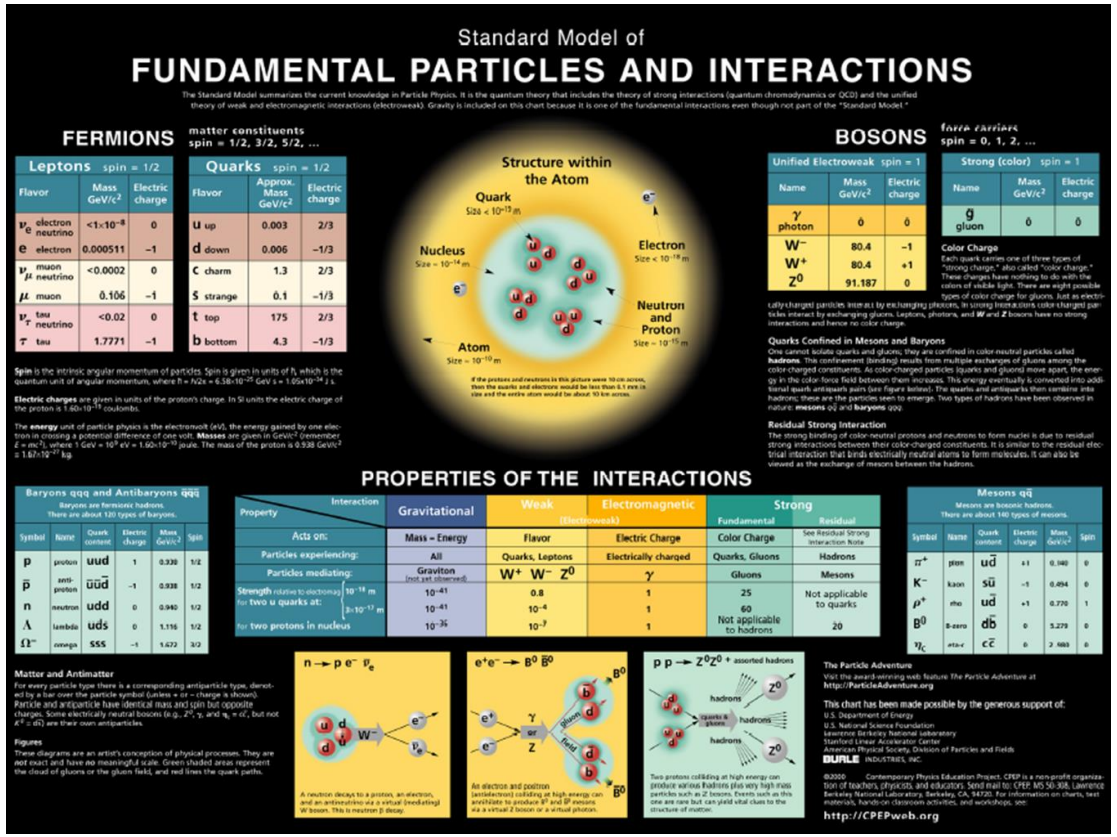
Vacuum □ weak chargre □ Higgs field

All particles swim in a vacuum ocean.

The resistance value of water becomes particle mass.

Vacuum is filled with weak chargre.

Symmetry □ Weak charge should be conserved.

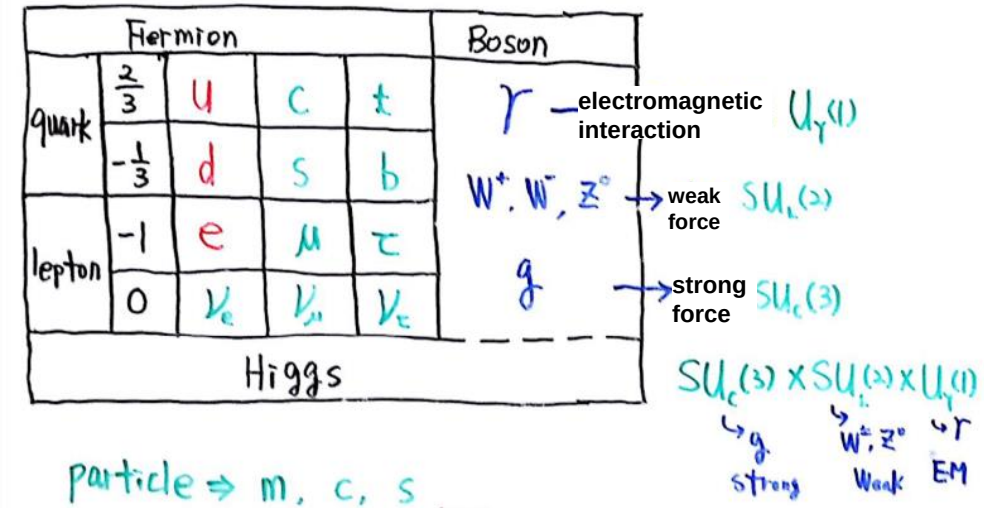


particle=(mass, spin, charge)

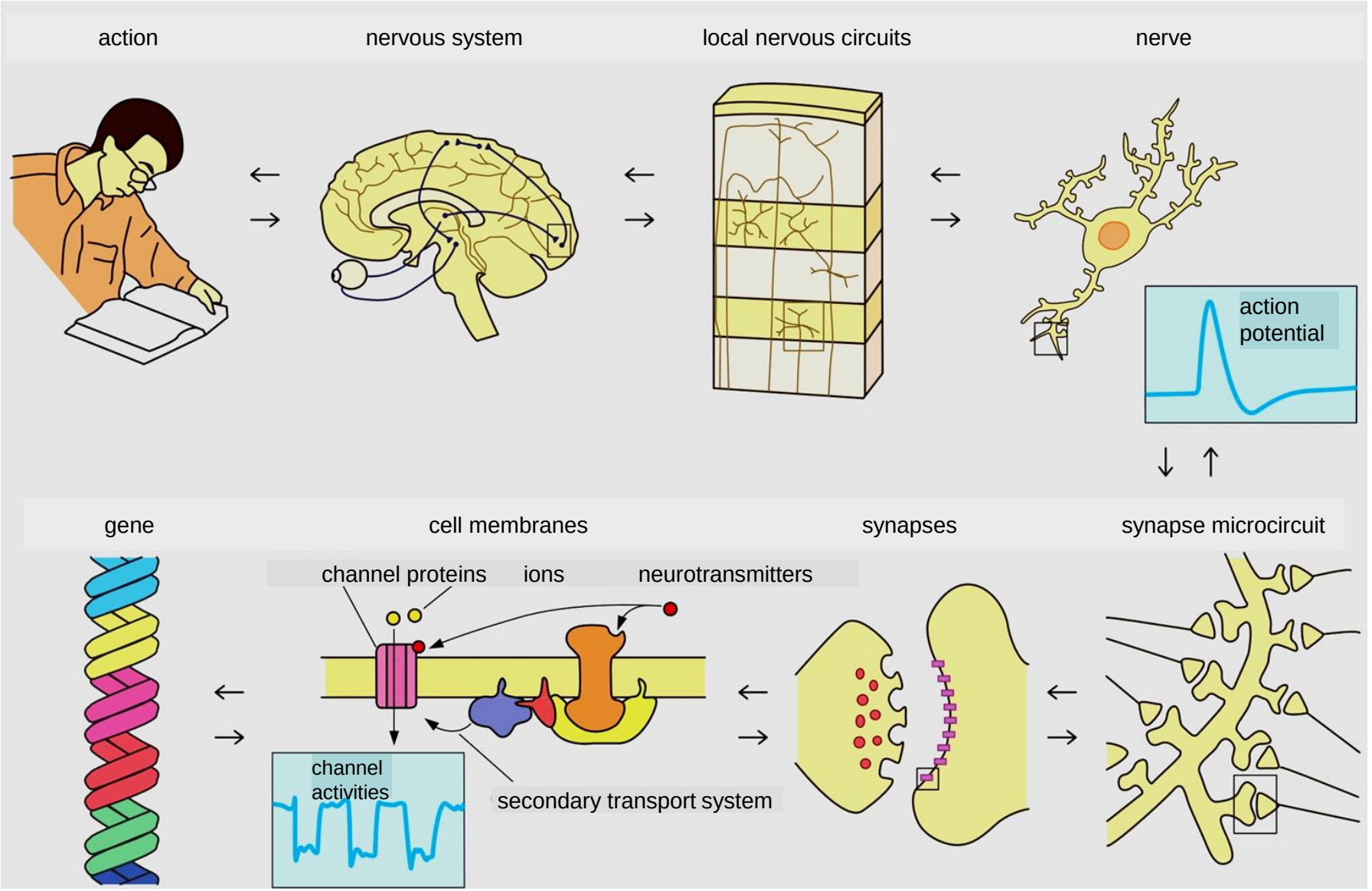
mass−> Higgs field

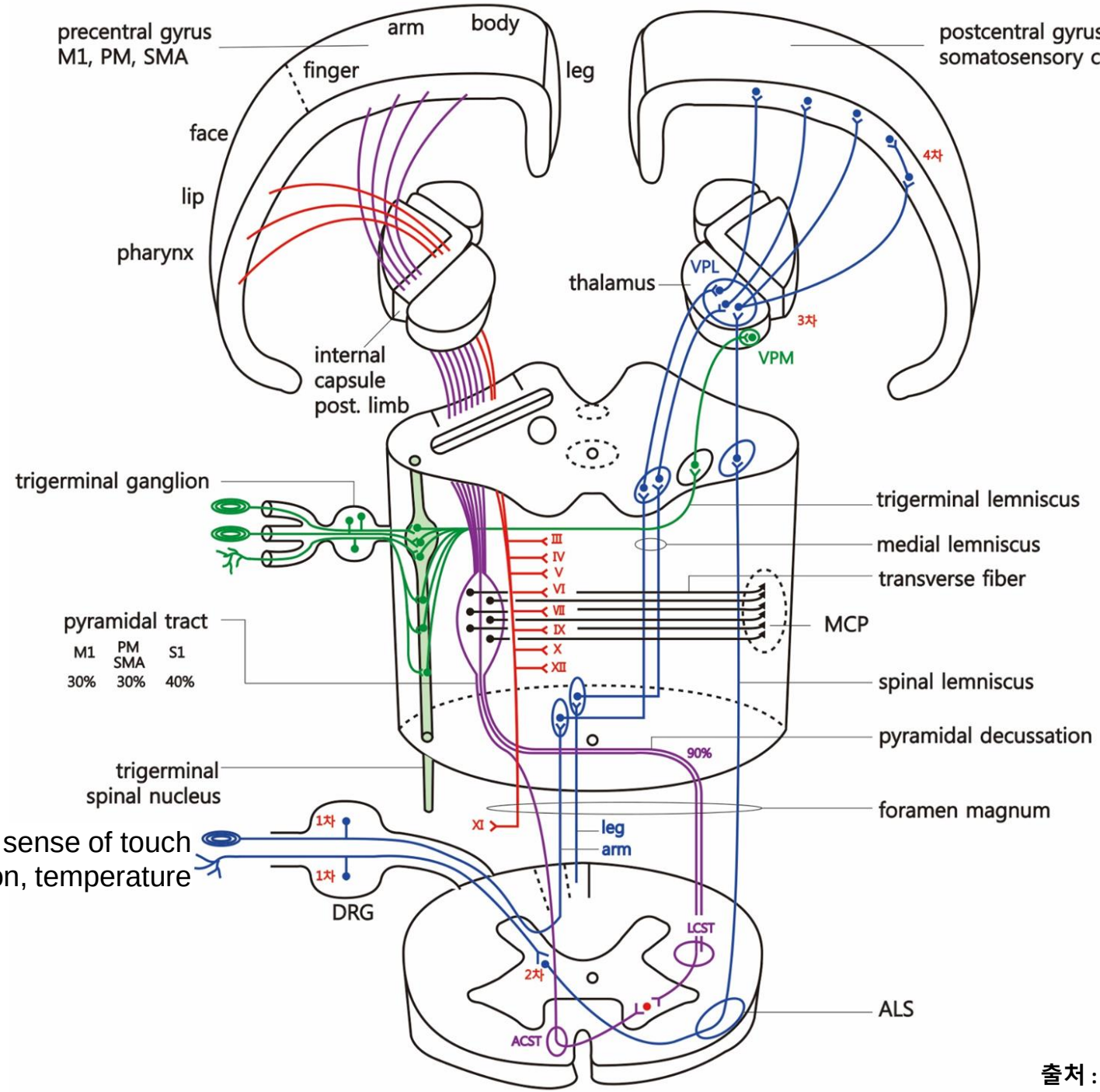
spin−> Boson, Fermion

Charge−> electrical charge
weak charge
Color charge



Vacuum is filled with weak charge.


action
nervous system
local nervous circuits
nerve
action potential
gene
cell membranes
synapses
synapse microcircuit
channel proteins
ions
neurotransmitters
channel activities
secondary transport system



출처 : 박문호의 뇌과학 공부-김영사

Things and processes cannot be said to exist: only faster processes and slower processes do.

Static image is an illusion. We seem to be fascinated by our ability to stop change for an extended period. That is why we cherish paintings or sculptures which give us a stationary illusion.

What happens when a movie is shown? The real universe, which moves and changes, is reproduced from sequences of illusory images, not vice versa.

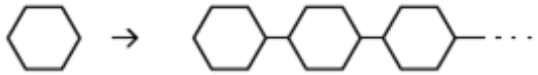
Existence is an illusion by itself.

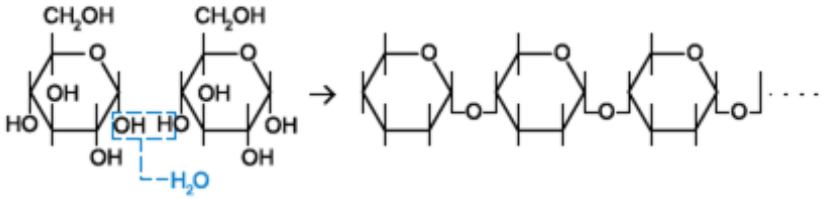
A series of measurement is similar to the still images of each static moment of a movie. Based on the illusion of these static moments, one creates a misconception that the universe consists of things.

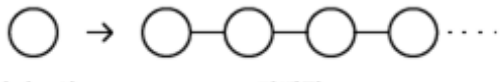
The past is a collection of emerged events, and the future is a collection of events that will give influence to the future. In the causal universe, there is time but not a moment. In case the universe consists of processes, time is synonymous with the law of cause and effect.

출처 : 카를로 로밸리

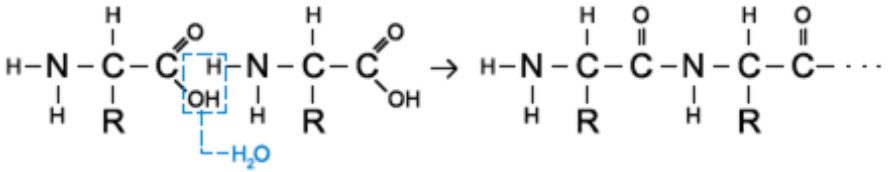
Universal language







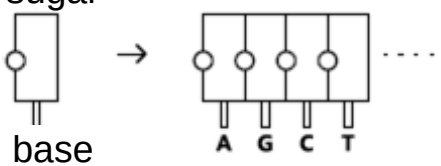
amino acid protein

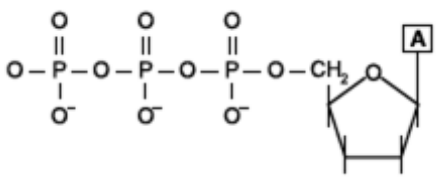


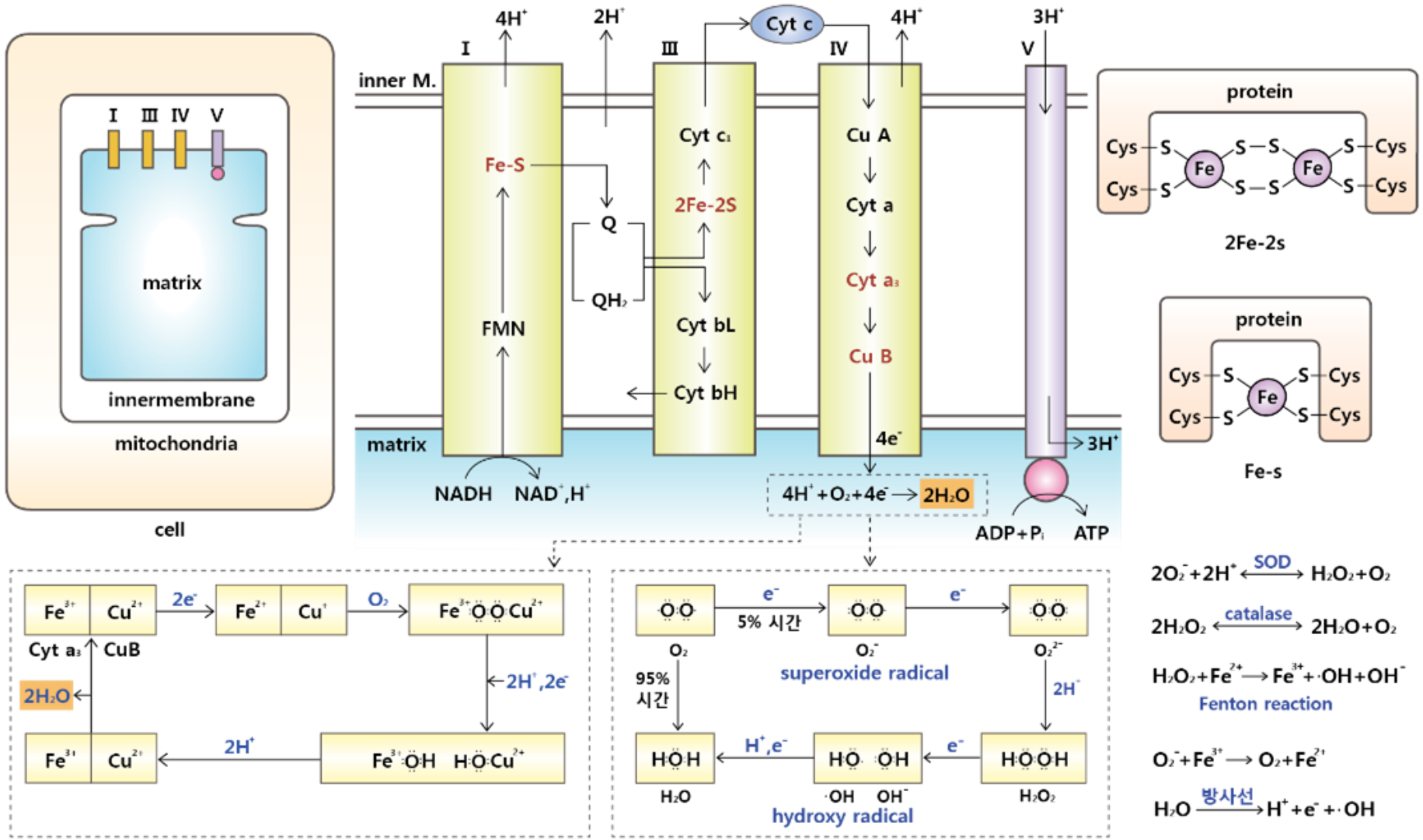
sugar

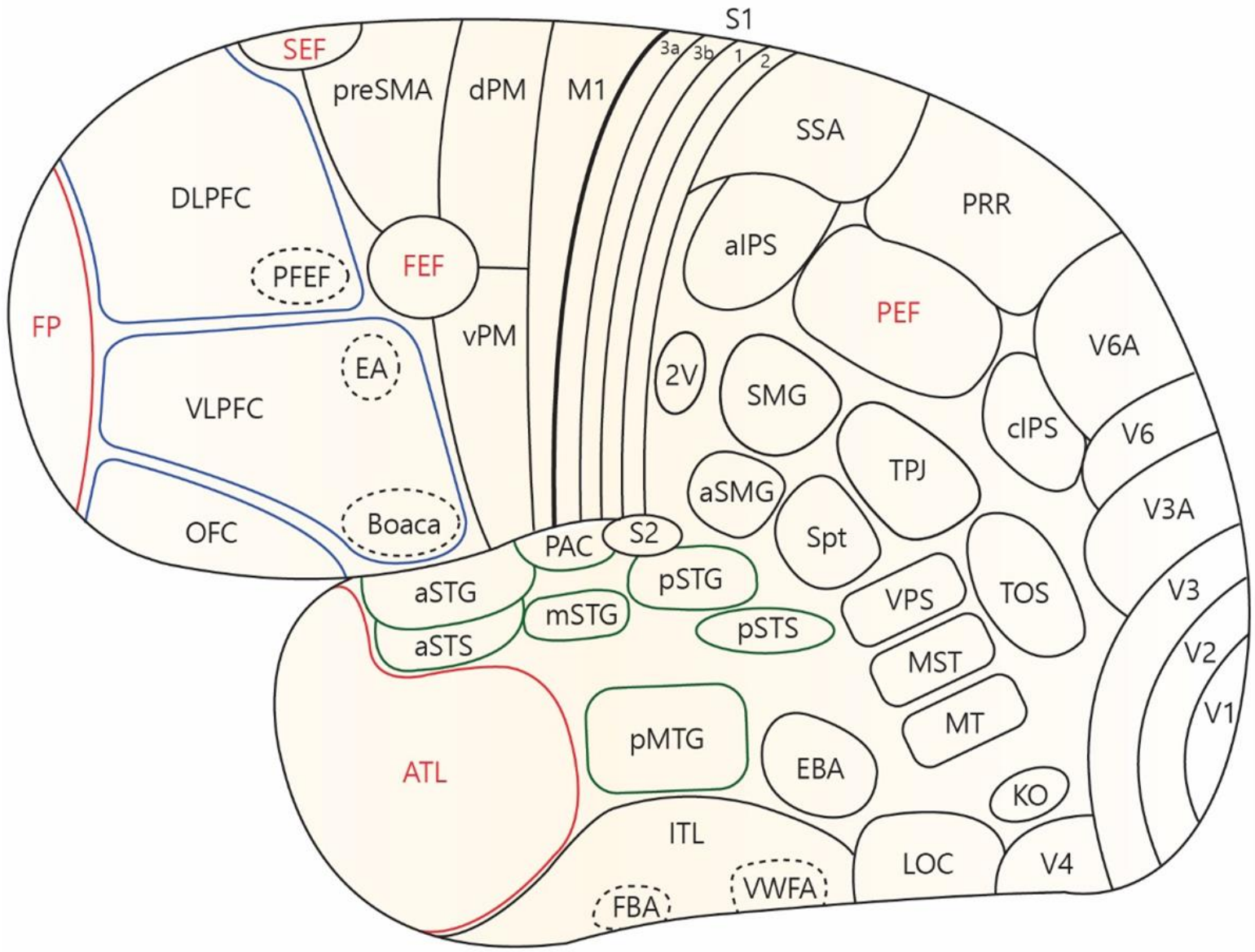
phosphate

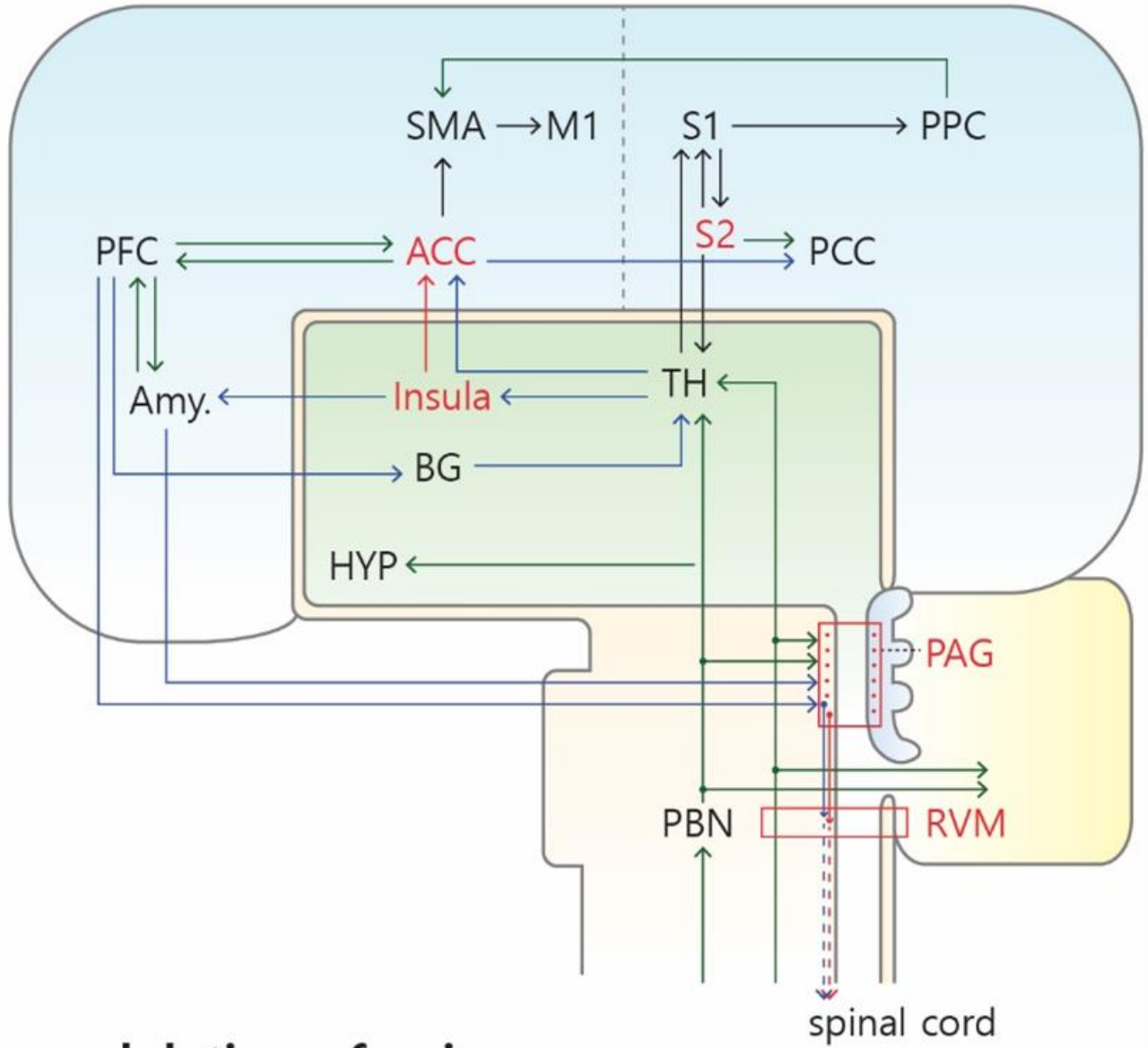
base



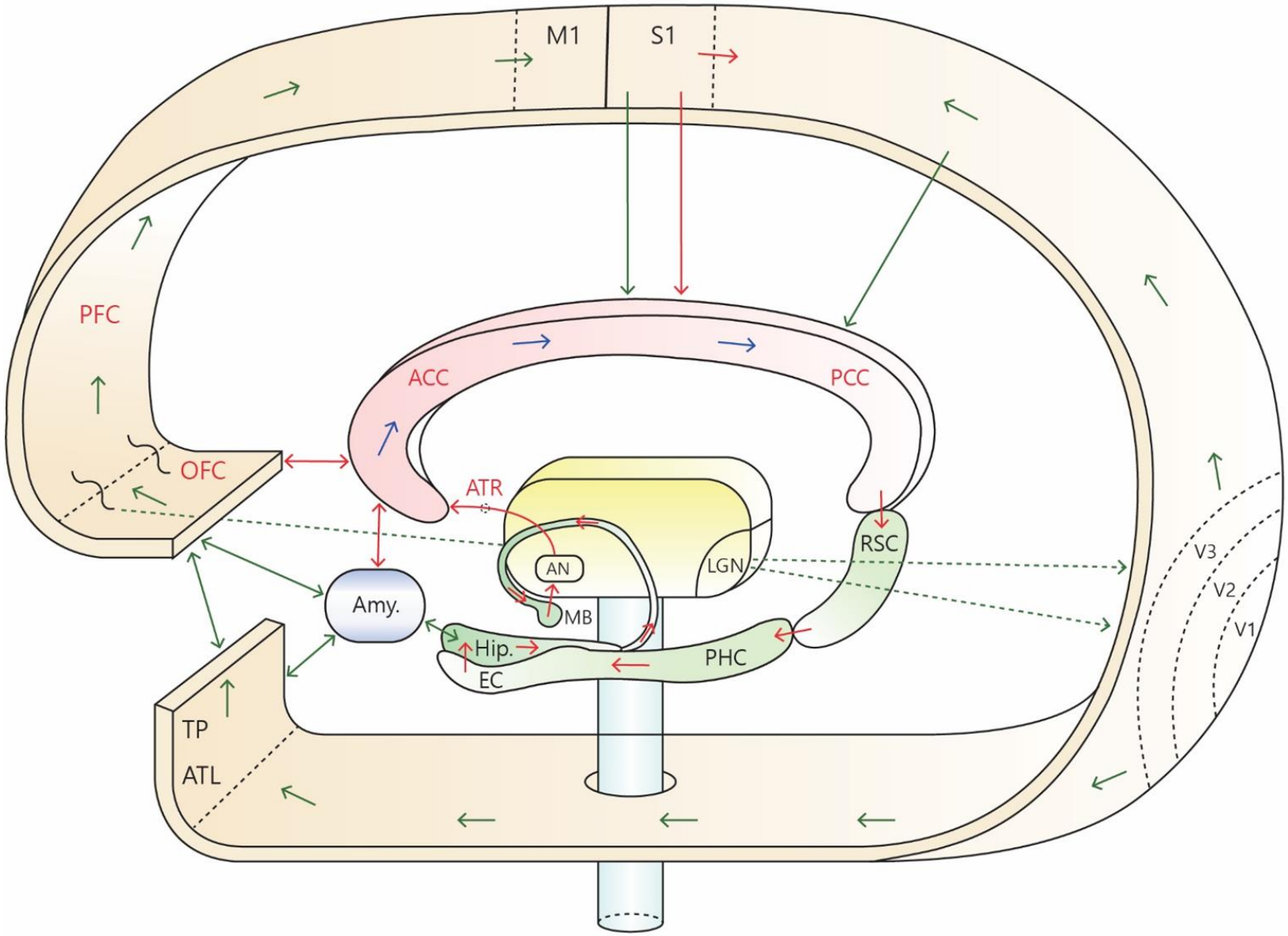


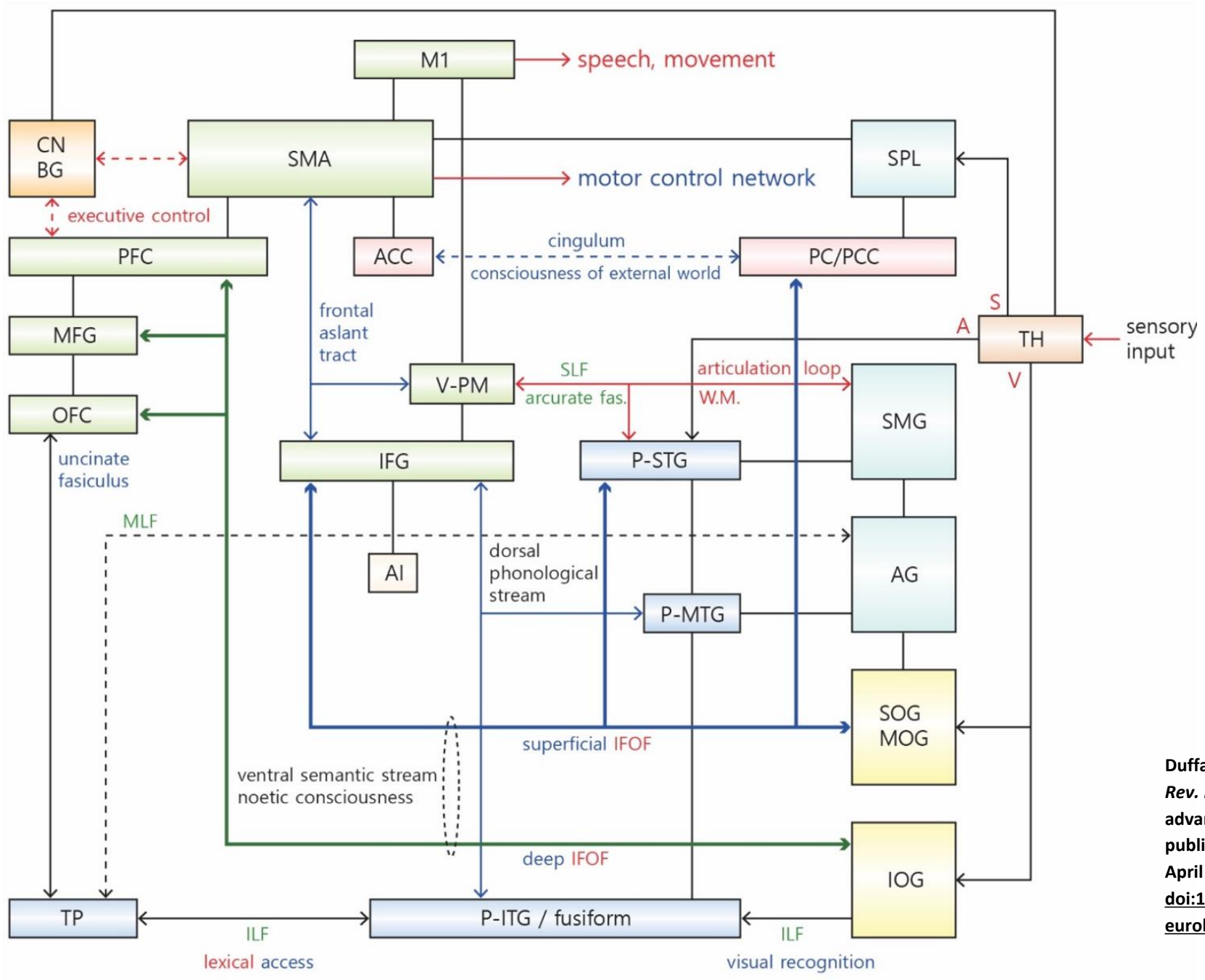

I III IV V
matrix
innermembrane
mitochondria
cell
inner M.
4H+
2H+
Cyt c
4H+
3H+
I
III
IV
V
Fe-S
Q
QH2
FMN
Cyt c1
2Fe-2S
Cyt bL
Cyt bH
Cu A
Cyt a
Cyt a3
Cu B
4e-
matrix
3H+
NADH
NAD+,H+
4H+ +O2+4e- → 2H2O
ADP+Pi
ATP
protein
Cys S Fe S S Fe S Cys
Cys S S S S Cys
2Fe-2s
protein
Cys S Fe S Cys
Cys S S Cys
Fe-s
Fe3+ Cu2+
2e-
Fe2+ Cu+
O2
Fe3+ O O Cu2+
Cyt a3
CuB
2H2O
2H+,2e-
Fe3+ Cu2+
2H+
Fe3+ O H H O Cu2+
O O
e-
5% 시간
O O
e-
O O
O2
O2-
O2 2-
95% 시간
superoxide radical
2H+
H O H
H+,e-
H O O H
e-
H O O H
H2O
·OH OH-
H2O2
hydroxy radical
2O2- + 2H+ SOD H2O2 + O2
2H2O2 catalase 2H2O + O2
H2O2 + Fe2+ → Fe3+ + ·OH + OH-
Fenton reaction
O2- + Fe3+ → O2 + Fe2+
H2O 방사선 H+ + e- + ·OH


S1
3a
3b
1
2
SEF
preSMA
dPM
M1
SSA
PRR
DLPFC
aIPS
FEF
PFEF
PEF
V6A
FP
vPM
2V
SMG
cIPS
V6
EA
VLPFC
TPJ
aSMG
V3A
Spt
Boaca
OFC
PAC
S2
pSTG
TOS
aSTG
VPS
V3
mSTG
pSTS
aSTS
MST
V2
MT
V1
pMTG
ATL
EBA
KO
ITL
LOC
V4
VWFA
FBA

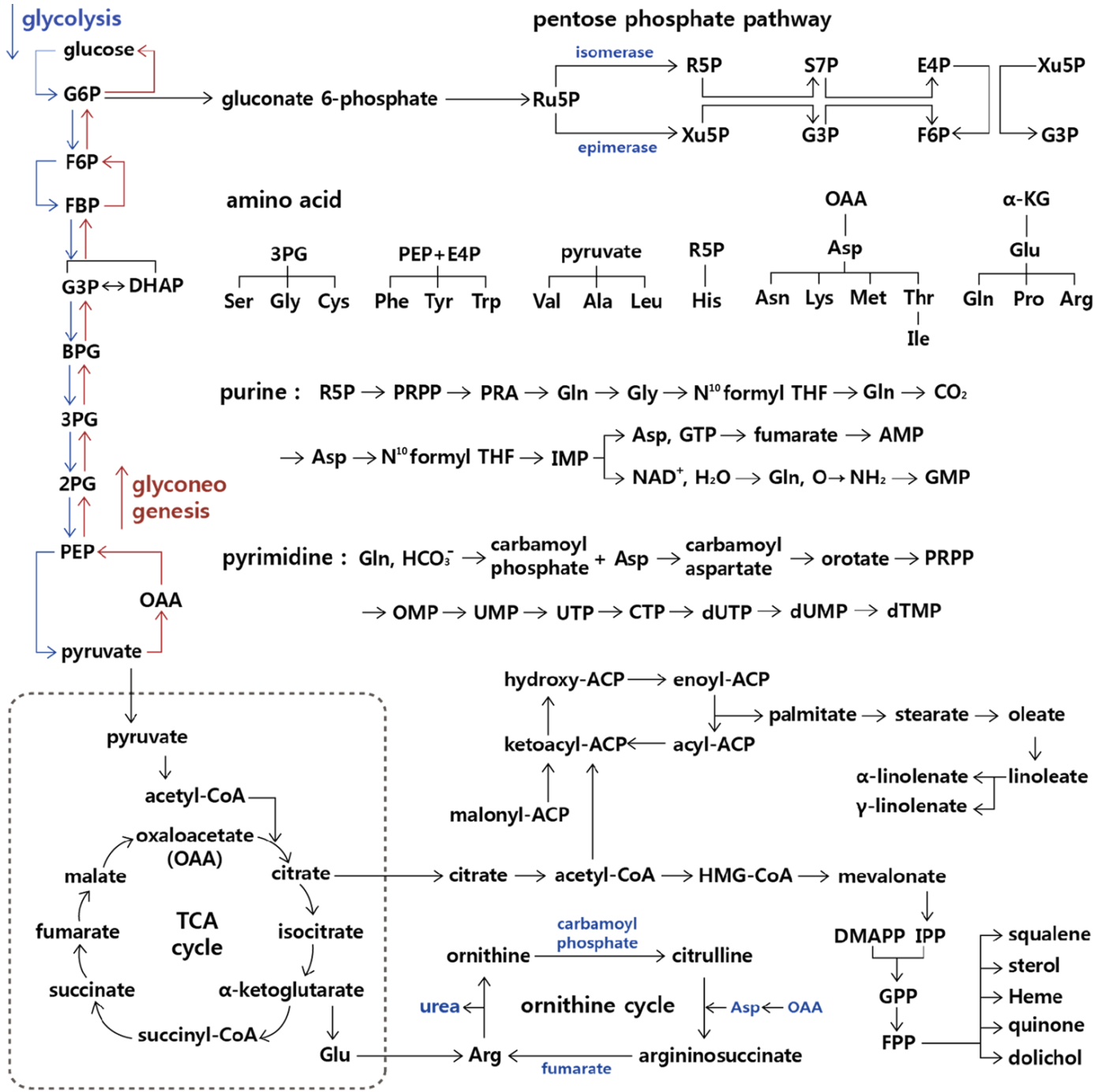


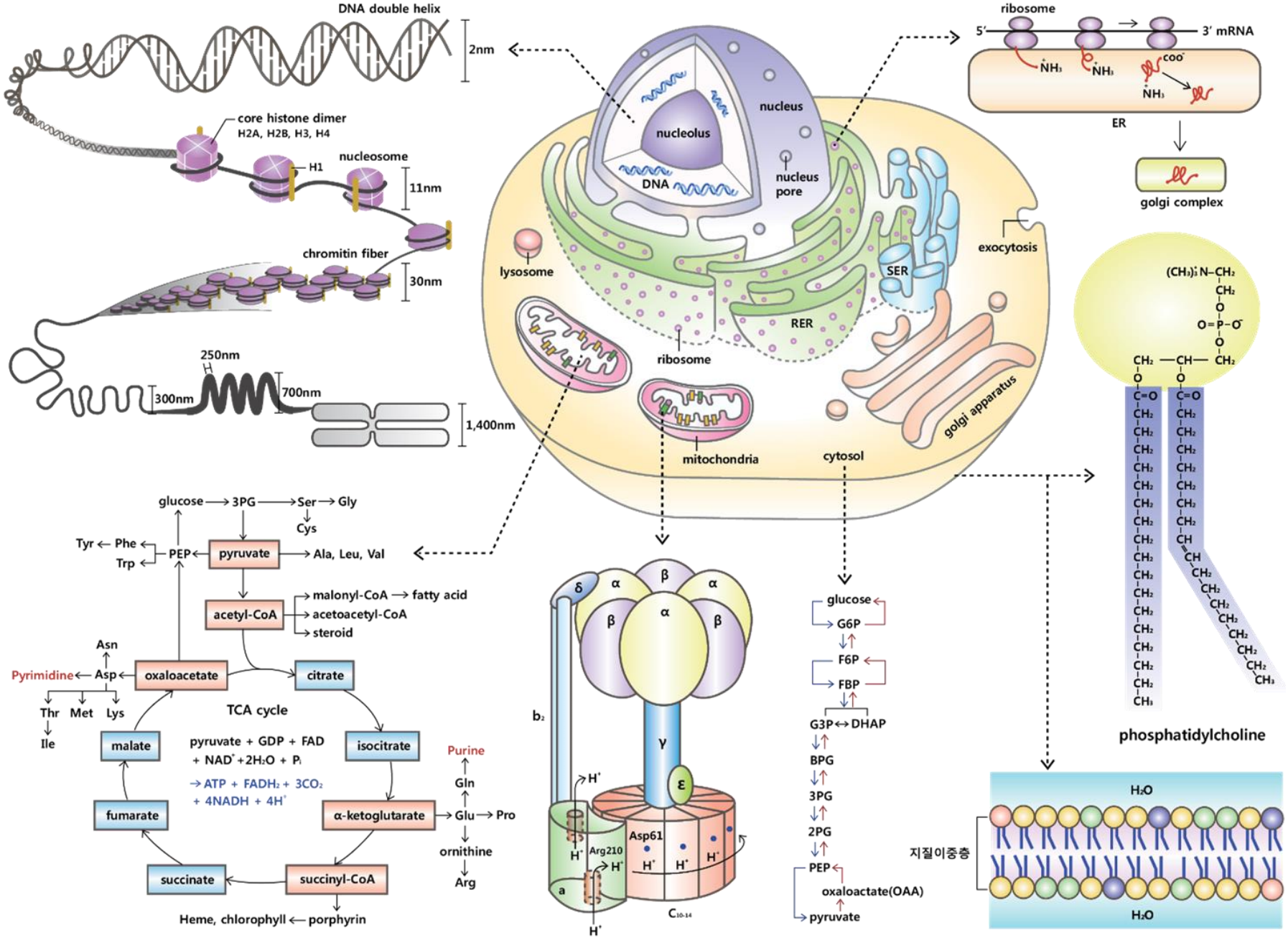
modulation of pain


M1
S1
PFC
ACC
PCC
OFC
ATR
AN
LGN
RSC
V3
V2
V1
Amy.
MB
Hip.
PHC
EC
TP
ATL

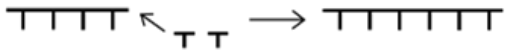


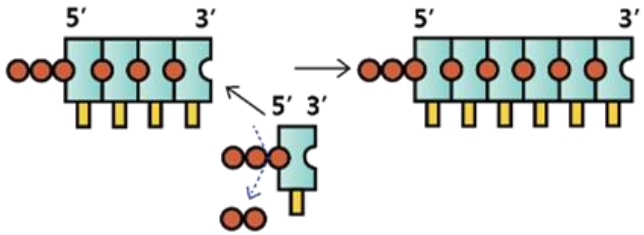
Duffau, H. *Nat. Rev. Neurol.* advance online publication 7 April 2015; doi:10.1038/nrneurol.2015.51

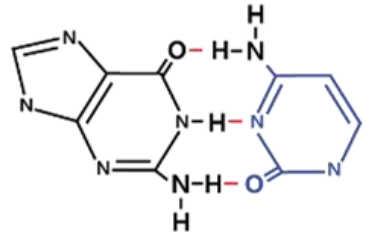

glycolysis
glucose
G6P
F6P
FBP
G3P ↔ DHAP
BPG
3PG
2PG
PEP
pyruvate
glyconeo genesis
OAA
pentose phosphate pathway
gluconate 6-phosphate
Ru5P
isomerase
epimerase
R5P
S7P
E4P
Xu5P
Xu5P
G3P
F6P
G3P
amino acid
3PG
Ser Gly Cys
PEP+E4P
Phe Tyr Trp
pyruvate
Val Ala Leu
R5P
His
OAA
Asp
Asn Lys Met Thr
Ile
α-KG
Glu
Gln Pro Arg
purine : R5P → PRPP → PRA → Gln → Gly → N10 formyl THF → Gln → CO2
→ Asp → N10 formyl THF → IMP
Asp, GTP → fumarate → AMP
NAD+, H2O → Gln, O → NH2 → GMP
pyrimidine : Gln, HCO3- → carbamoyl phosphate + Asp → carbamoyl aspartate → orotate → PRPP
→ OMP → UMP → UTP → CTP → dUTP → dUMP → dTMP
pyruvate
acetyl-CoA
oxaloacetate (OAA)
citrate
isocitrate
α-ketoglutarate
succinyl-CoA
succinate
fumarate
malate
TCA cycle
hydroxy-ACP → enoyl-ACP
palmitate → stearate → oleate
ketoacyl-ACP ← acyl-ACP
malonyl-ACP
α-linolenate
γ-linolenate
linoleate
citrate → acetyl-CoA → HMG-CoA → mevalonate
DMAPP IPP
GPP
FPP
squalene
sterol
Heme
quinone
dolichol
carbamoyl phosphate
ornithine
citrulline
urea
ornithine cycle
Asp ← OAA
Glu
Arg
fumarate
argininosuccinate

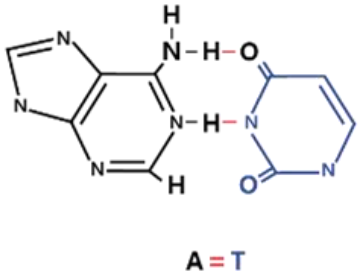

DNA double helix
2nm
core histone dimer
H2A, H2B, H3, H4
H1
nucleosome
11nm
chromatin fiber
30nm
250nm
300nm
700nm
1,400nm
nucleus
nucleolus
DNA
nucleus pore
ribosome
5′
3′ mRNA
NH3
coo-
ER
golgi complex
exocytosis
lysosome
SER
RER
ribosome
golgi apparatus
mitochondria
cytosol
glucose → 3PG → Ser → Gly
Cys
Tyr ← Phe
Trp
PEP
pyruvate → Ala, Leu, Val
acetyl-CoA
malonyl-CoA → fatty acid
acetoacetyl-CoA
steroid
Asn
Pyrimidine ← Asp
oxaloacetate
citrate
Thr Met Lys
Ile
TCA cycle
malate
pyruvate + GDP + FAD
+ NAD+ + 2H2O + Pi
→ ATP + FADH2 + 3CO2
+ 4NADH + 4H+
isocitrate
Purine
Gln
fumarate
α-ketoglutarate
Glu → Pro
ornithine
Arg
succinate
succinyl-CoA
Heme, chlorophyll ← porphyrin
δ α β α β α β
b2
γ
ε
H+
Asp61
Arg210
a
C10-14
glucose
G6P
F6P
FBP
G3P ↔ DHAP
BPG
3PG
2PG
PEP
oxaloactate(OAA)
pyruvate
(CH3)3N–CH2
CH2
O
O=P–O-
CH2 —CH— CH2
C=O
CH2
CH3
phosphatidylcholine
H2O
지질이중층
H2O

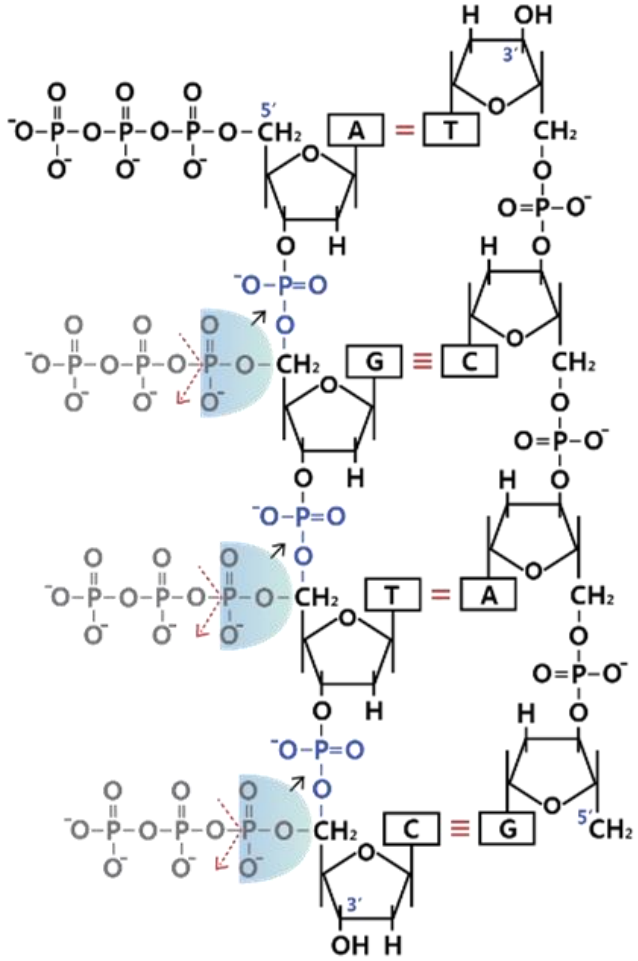

T C T G A
A G A C T

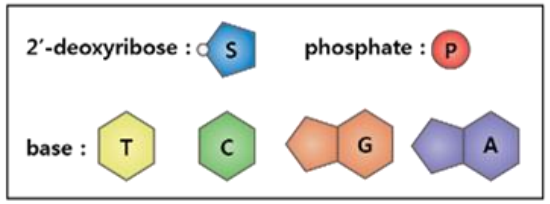

T T


5′
3′
5′
3′
5′
3′

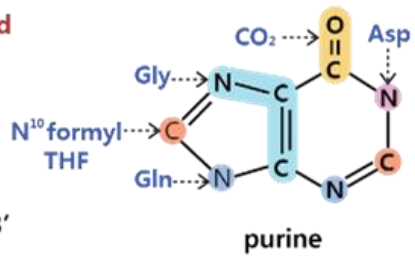

G ≡ C

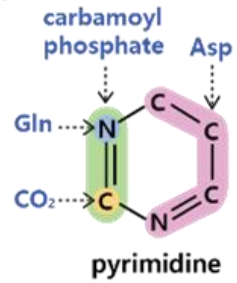

A = T

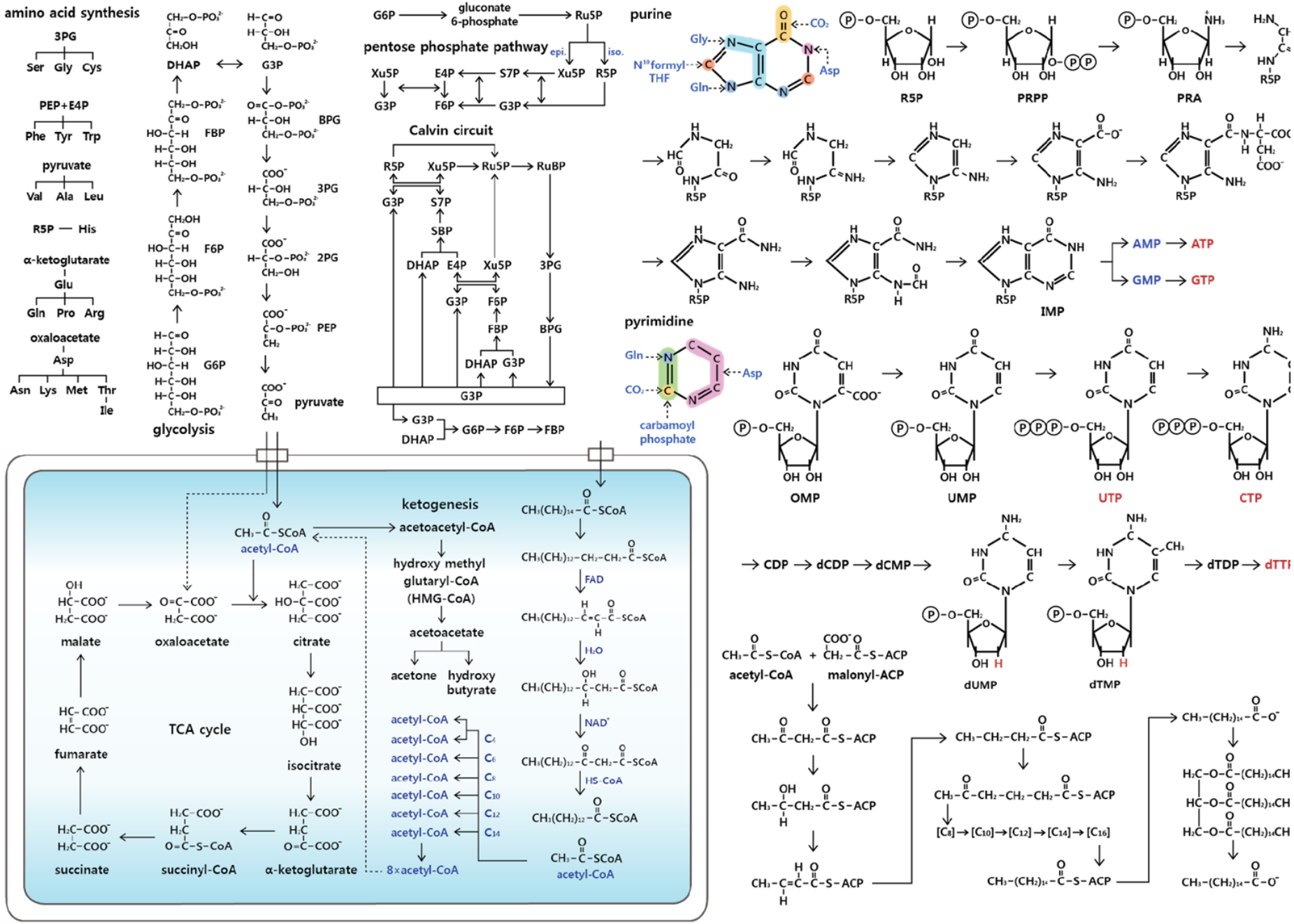

A
T
G
C
T
A
C
G


2′-deoxyribose :
S
phosphate :
P
base :
T
C
G
A

3′
5′
H-bond
5′
3′


CO₂
Asp
Gly
N¹⁰ formyl THF
Gln
purine


carbamoyl phosphate
Asp
Gln
CO₂
pyrimidine


amino acid synthesis
3PG
Ser Gly Cys
PEP+E4P
Phe Tyr Trp
pyruvate
Val Ala Leu
R5P — His
α-ketoglutarate
Glu
Gln Pro Arg
oxaloacetate
Asp
Asn Lys Met Thr
Ile
DHAP
G3P
FBP
F6P
G6P
BPG
3PG
2PG
PEP
pyruvate
glycolysis
G6P
gluconate 6-phosphate
Ru5P
pentose phosphate pathway
epi.
iso.
Xu5P
E4P
S7P
R5P
F6P
Calvin circuit
Ru5P
RuBP
SBP
3PG
BPG
DHAP G3P
purine
Gly
N10formyl-THF
Gln
CO2
Asp
R5P
PRPP
PRA
IMP
AMP
ATP
GMP
GTP
pyrimidine
Gln
CO2
Asp
carbamoyl phosphate
OMP
UMP
UTP
CTP
CDP
dCDP
dCMP
dTDP
dUMP
dTMP
acetyl-CoA
malonyl-ACP
ketogenesis
acetoacetyl-CoA
hydroxy methyl glutaryl-CoA (HMG-CoA)
acetoacetate
acetone
hydroxy butyrate
FAD
H2O
NAD+
HS-CoA
malate
oxaloacetate
citrate
isocitrate
α-ketoglutarate
succinyl-CoA
succinate
fumarate
TCA cycle
8×acetyl-CoA
[C8]→[C10]→[C12]→[C14]→[C16]

Object □ a way of setting direction in the midst of complexity

Object □ a way of sharing the world

Special system interacting with external world □ life phenomena

A piece of sculpture exists in the interrelated array pattern of atoms in one's brain.

Purpose □ result of choosing forms effective for survival

We are not atoms but arrays of atoms.

World comprised exclusively of interacting quantum fields

출처 : 카를로 로밸리

A series of measurement is similar to the still images of each static moment of a movie.

Based on the illusion of these static moments, one creates a misconception that the universe consists of things.

The past is collection of emerged events, and the future is collection of events that will give influence to the future.

In the causal universe, there is time but not a moment.

In case the universe consists of processes, time is synonymous with the law of cause and effect.

출처 : 카를로 로밸리

The structure of causal relations concerning an event can be depicted by past light cone and future light cone.

The world comprises of causal relations.

This means that the universe consists not of matter, but of processes that make matter arise.

Each object you see is a result of the processes in which the information reaches you in the form of a heap of photons. The farther away an object is, the longer it will take for the photons to reach you.

Therefore, when you look around, you are not seeing a space but going back to this history of the universe.

출처 : 카를로 로밸리

The structure of spin networks, in response to the transit of gravity wave, evolves with time.

Spin networks in change are very similar to time and space, but discontinuous.

The world of existing objects is a world of possible interactions, and reality comes down to relations.

All attributes of an object exist only in its relations with other objects.

Relations are not established by existence of an object; rather, relations establish the concept of object.

출처 : 카를로 로밸리

Because space is a gravitational field, the quanta of the gravitational field are the quanta of the space, in other words, particle composition of the space.

A spin networks is quantum state of a gravitational field.

Two nodes connected by a link are quanta of adjacent spaces, and two particles of inter-contacting spaces.

This contact produces the structure of a space.

A space is not a specific spin network, but probability clouds encompassing the whole domains of all possible spin networks.

Quanta in a gravitational field do not change in time; rather as a result of interaction of these quanta, time arises.

According to Wheeler-deWitt equation, time emerges from the quantum gravity field along with space.

As is common to all reality, time has characteristics of probabilistic indeterminacy, particle and relations.

출처 : 카를로 로밸리

The passage of time is embedded in the world; it is the world; and it is born from the world based on the relations between quantum events which create their own time.

The direction of time passage only appears when heat exists.

Only in the existence of heat, the past is distinguished from the future.

Specific or special situations gradually disappear.

출처 : 카를로 로밸리

There is no special moment corresponding to what is regarded as the present or now.

Expansion of the present, inappropriate extrapolation of experiences

The present of the universe had no meaning.

Time is a trace of movements.

출처 : 카를로 로밸리

Spacetime can be overlapped in diverse forms.

Concreteness manifests only in relations of physical system.

gravitational field: the basis determining the time intervals and physical distances

Time is a loose network of relations.

출처 : 카를로 로밸리

Time intervals are an aspect of dynamic field, and a dynamic field takes concrete form only from interactions.

It is not grammar of existence, but grammar of becoming.

The world equates not to things, but to network of events.

An object is an event which won't change temporarily.

What we can speak of is the present seen from the perspective of a moving observer.

출처 : 카를로 로밸리

The world cannot be regarded as a series of the presents.

Nature exists in its own way.

A timeless world is a web of events.

The spatiality of the world is interacting networks of particles.

Particles do not live in time.

출처 : 카를로 로밸리

The world is the summation of perspectives which exist in mutual relations.

The interaction between basic quantum fields determines spatial expansion and temporal length.

In small scale, quanta just appear and disappear.

Time and space only exist in relations of events.

출처 : 카를로 로밸리

Our well-defined, local, and unique identity exists only in our inner reality. In the fundamental dimension it is an illusion.

Mathematical structure is permanent and unchanging. Mathematical universe hypothesis suggests that time passage is an illusion like changes.

출처: 맥스태그마크의 유니버스

Because spacetime contains all times and all places, there is no specific time as there is no specific place.

In spacetime, the future is as real as the past; because spacetime is stationary and unchanging, all parts are equally real.

Time is not an illusion, but passage of time is an illusion.

In spacetime, the future exists, and the past does not disappear.

출처: 맥스태그마크의 유니버스

-Each point in spacetime has numbers, which informs of the reality itself.

-A field is something represented by numbers at each point in spacetime.

-In an electromagnetic field, each point of spacetime is defined by 6 numbers.

-In the quantum field theory, wave function represents realistic degree of electric field and magnetic field. This wave function is an abstract point in the Hilbert space.

-The magnitude of an electromagnetic field corresponds to the number of photons at each time and place.

출처: 맥스태그마크의 유니버스

External physical reality is mathematical structure.

You are a mathematical pattern of spacetime, and a knot of intricate spacetime.

The knot of spacetime, which corresponds to the mind, is one of the most beautiful and complex patterns we have ever seen in the universe.

A thought is a spacetime pattern consisting of 10^{29} atoms.

The mind is an array of atoms that perceives itself.

All particles gather, interact, and eventually go their own ways.

출처: 맥스태그마크의 유니버스

The knots of spacetime are undone from both ends.

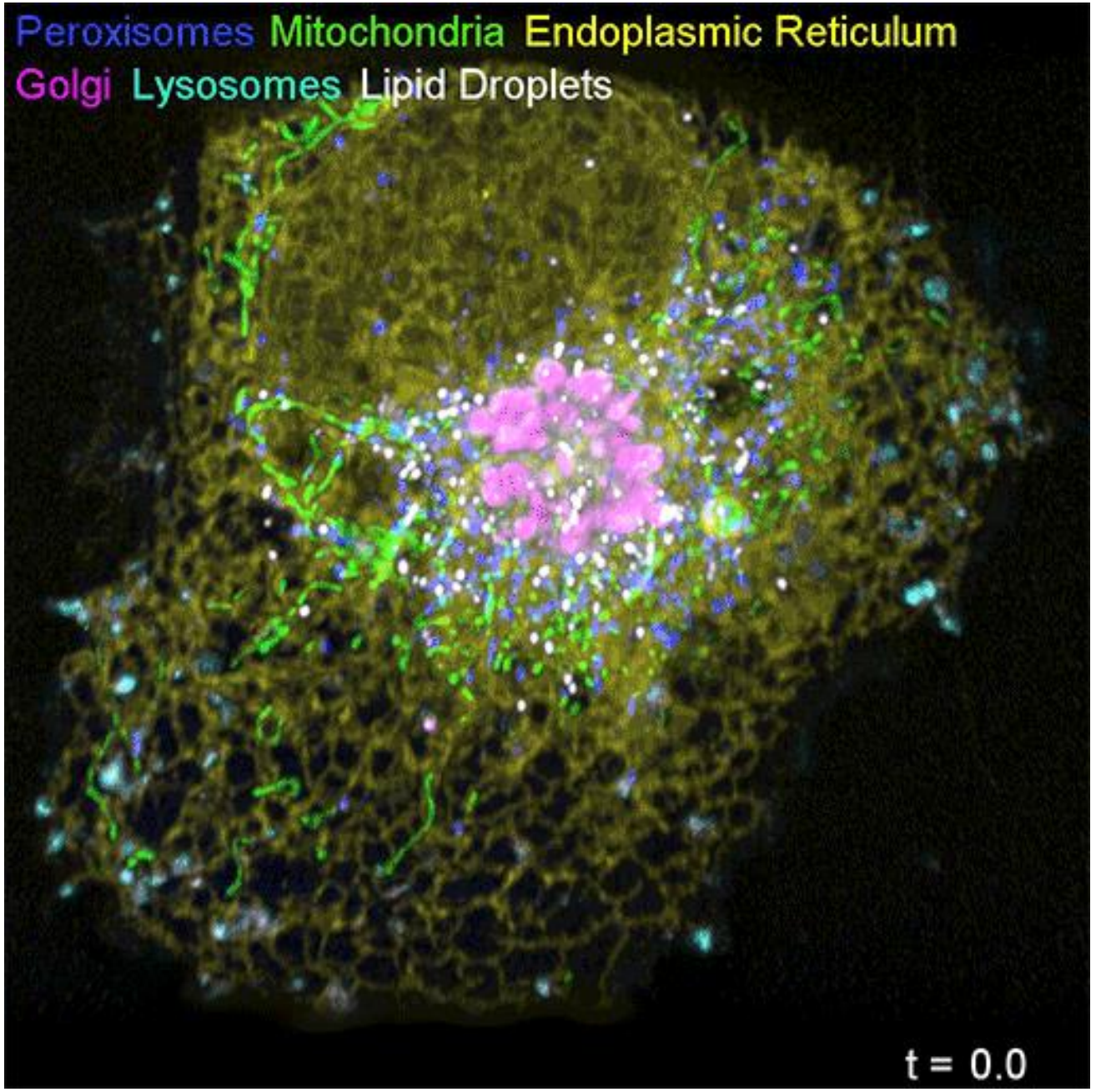
A series of observer moments makes one feel that time passes.

From a single observer moment, one looks at the reality model in their brain.

Passage of time is relations between memories.

Matter is given symmetry by the inherent symmetry of spacetime.

출처: 맥스태그마크의 유니버스

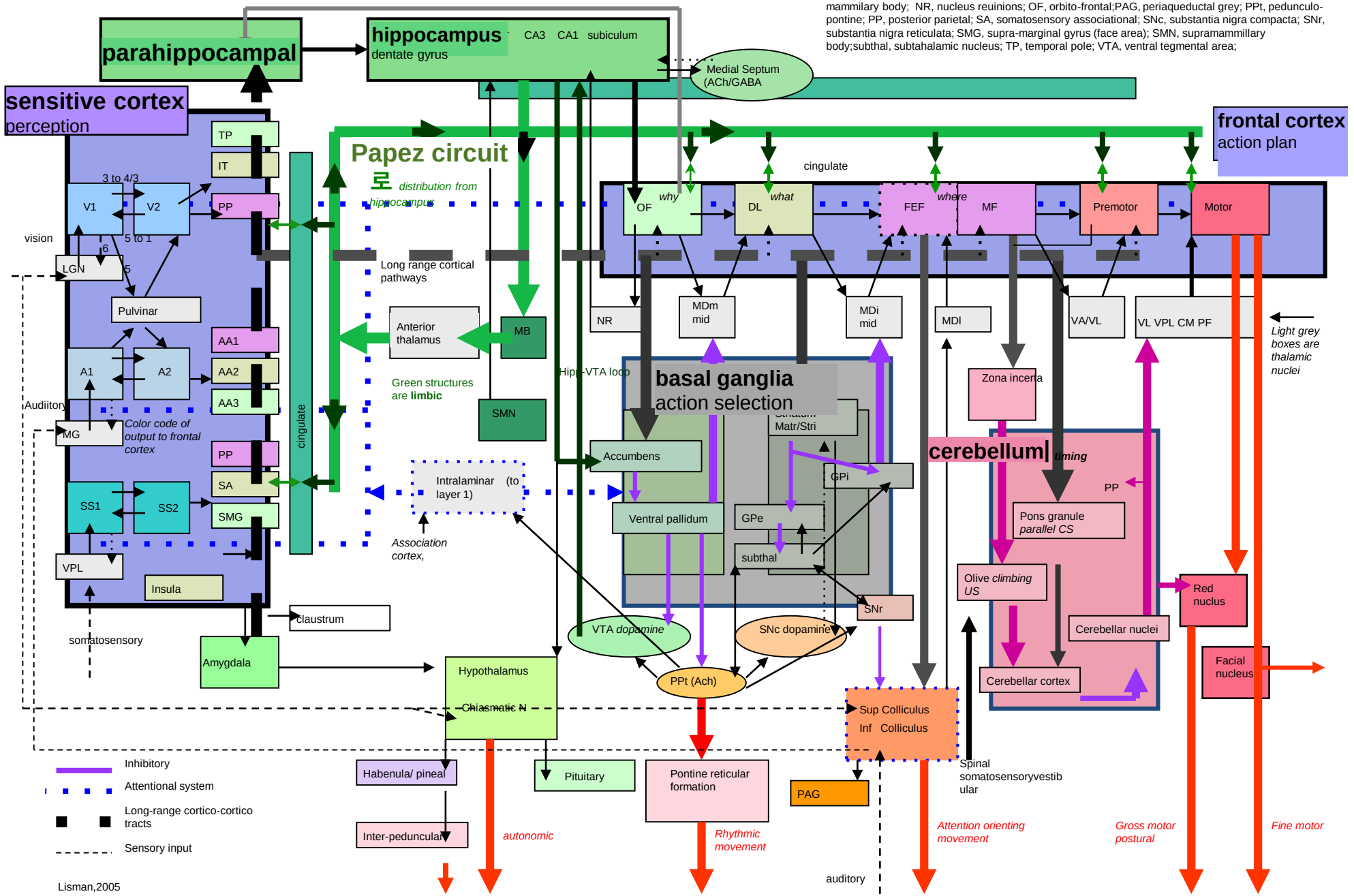


Various organelles inside this cell are labeled with different colored fluorescent probes, allowing Lippincott-Schwartz to observe them simultaneously.

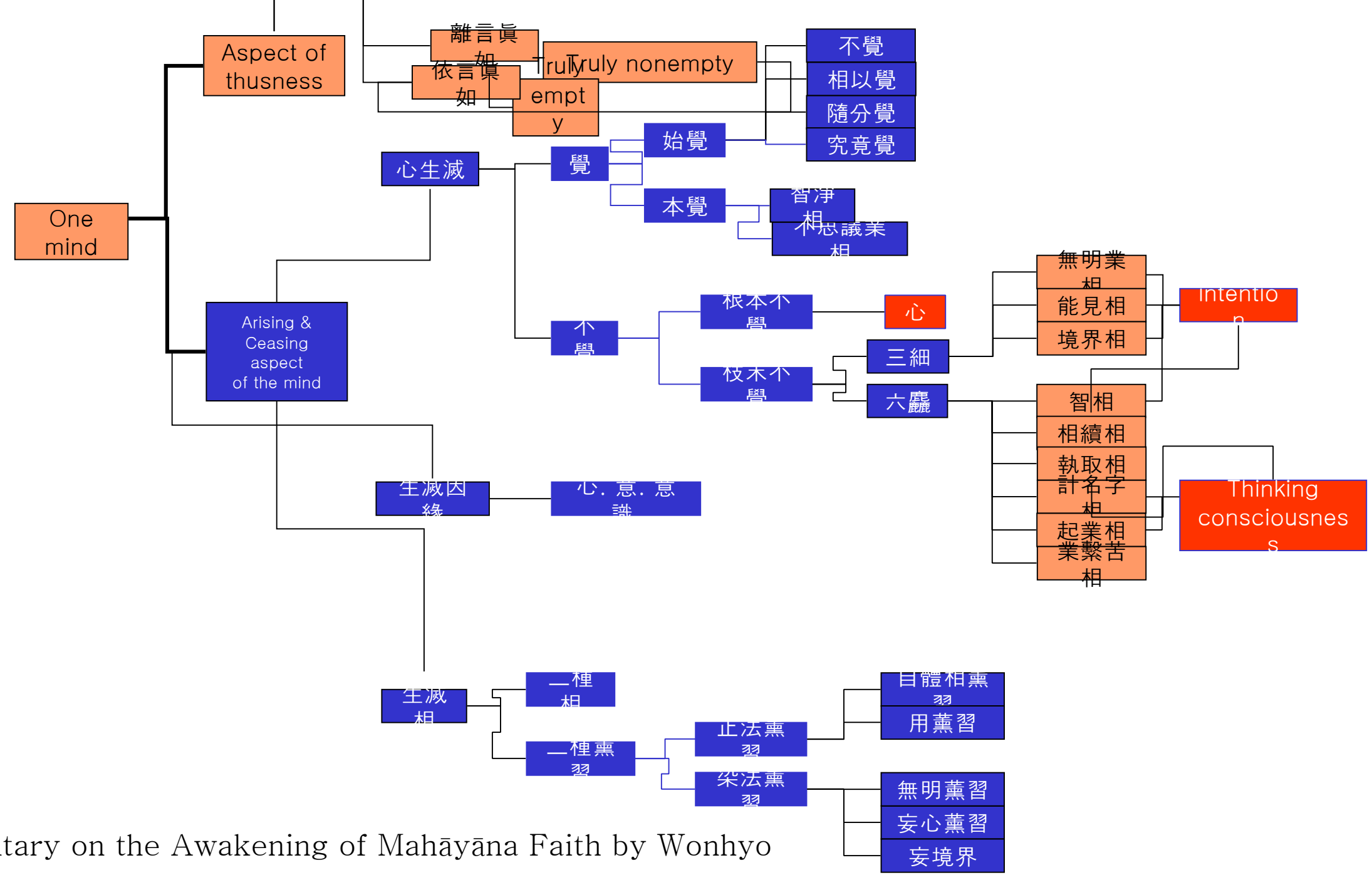
Credit: Sarah Cohen and Alex Valm

Major Brain Regions and Their Major Interconnections

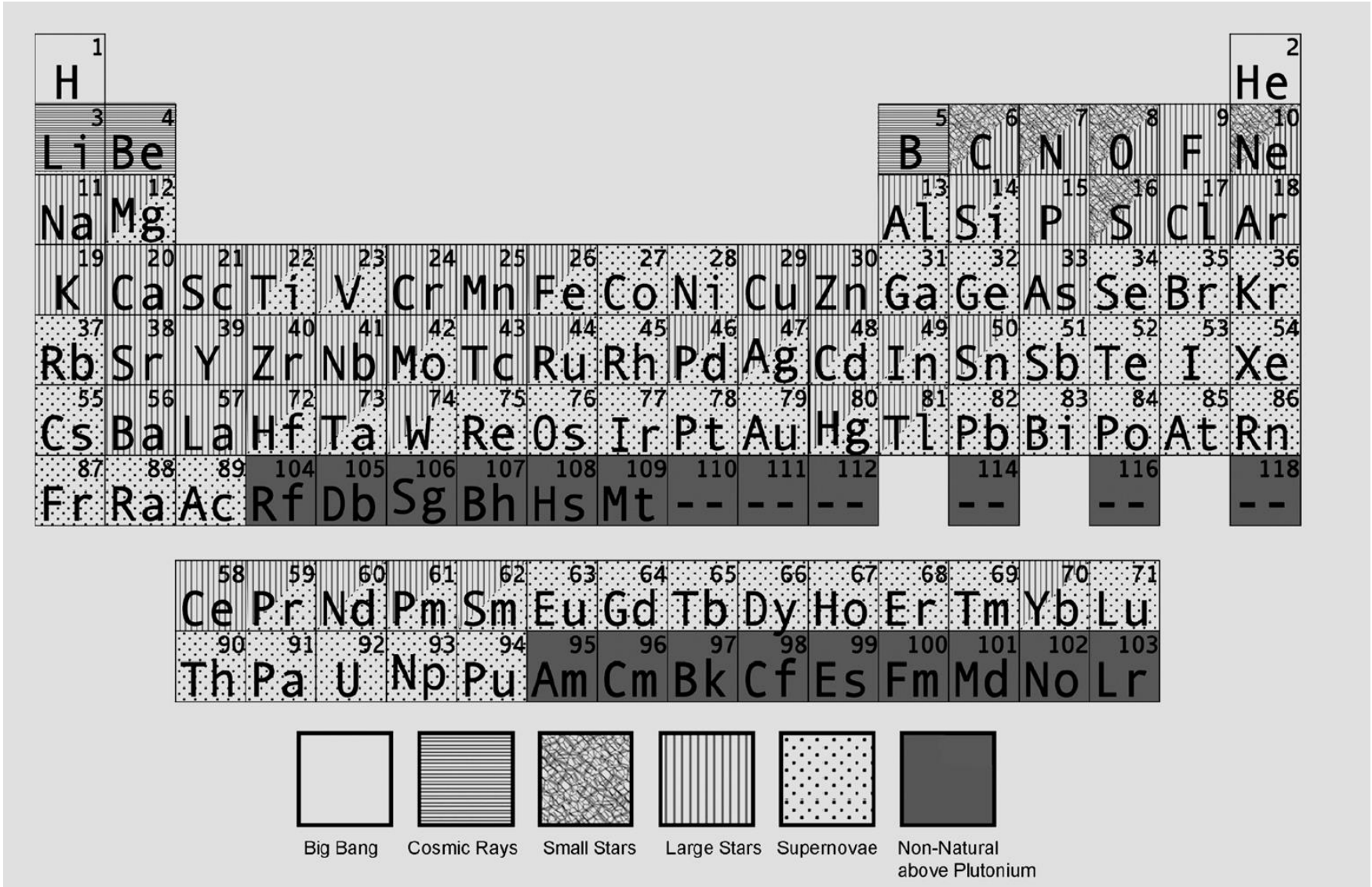
A1, primary auditory; AA1-3, auditory associational; GP, globus palidus (internal/externall); IT, infero-temporal;FEF, frontal eye field; Mf, medial frontal, M1, primary motor, M2 secondary motor; MB, mammilary body; NR, nucleus reuinions; OF, orbito-frontal;PAG, periaqueductal grey; PPt, pedunculo-pontine; PP, posterior parietal; SA, somatosensory associational; SNc, substantia nigra compacta; SNr, substantia nigra reticulata; SMG, supra-marginal gyrus (face area); SMN, supramammillary body;subthal, subtahalamic nucleus; TP, temporal pole; VTA, ventral tegmental area;



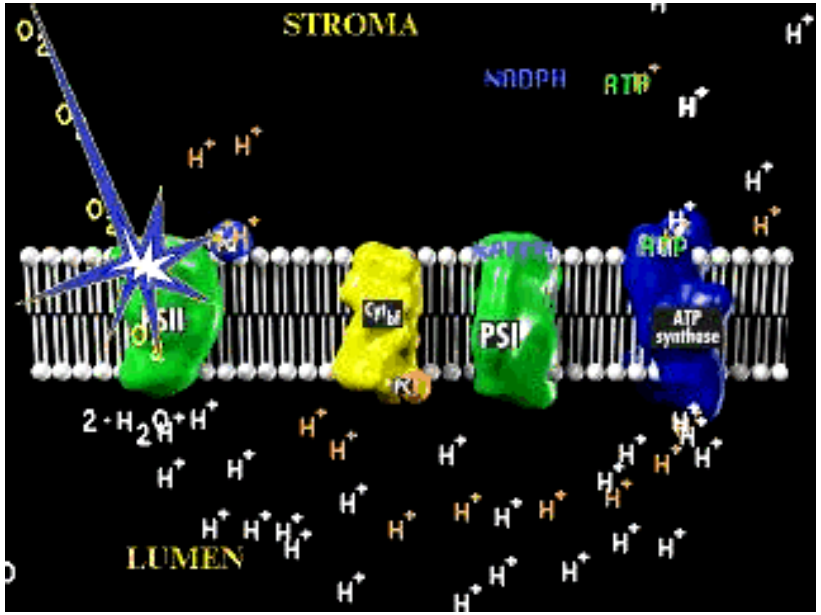
Lisman,2005



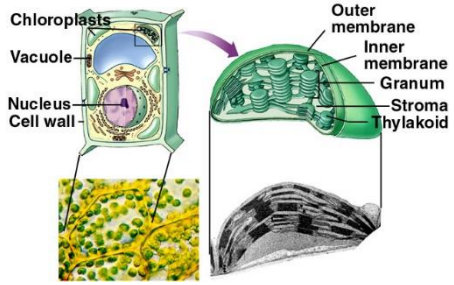
Commentary on the Awakening of Mahāyāna Faith by Wonhyo


H
He
Li Be
B C N O F Ne
Na Mg
Al Si P S Cl Ar
K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn Ga Ge As Se Br Kr
Rb Sr Y Zr Nb Mo Tc Ru Rh Pd Ag Cd In Sn Sb Te I Xe
Cs Ba La Hf Ta W Re Os Ir Pt Au Hg Tl Pb Bi Po At Rn
Fr Ra Ac Rf Db Sg Bh Hs Mt -- -- -- -- -- --
Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu
Th Pa U Np Pu Am Cm Bk Cf Es Fm Md No Lr
Big Bang
Cosmic Rays
Small Stars
Large Stars
Supernovae
Non-Natural above Plutonium

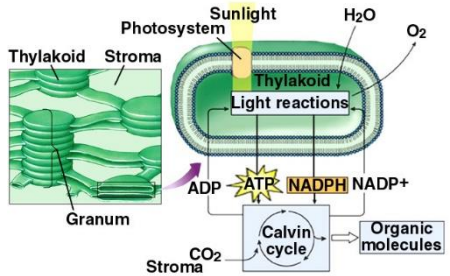
출처 : NASA



Leaf—Levels of Organization (2)



Leaf—Levels of Organization (3)



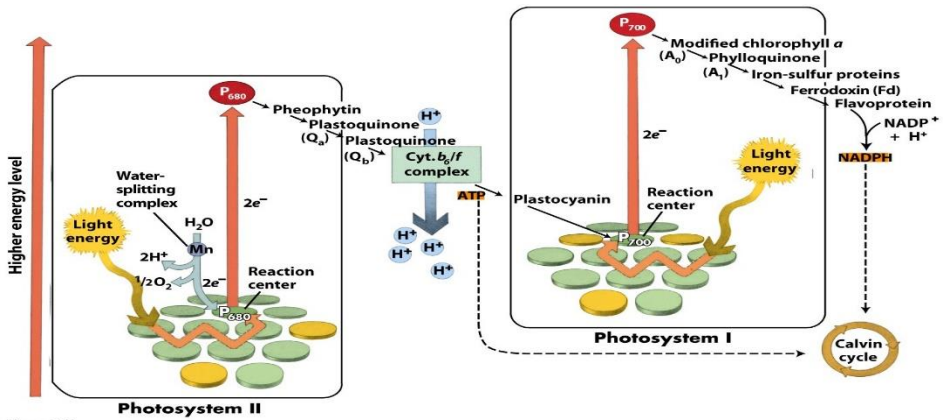
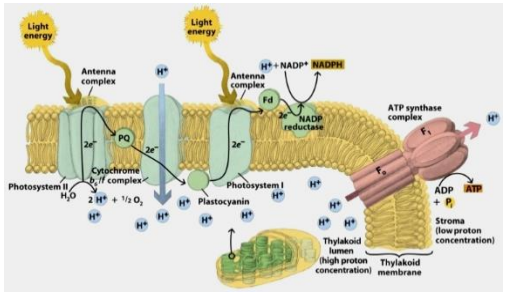


Figure 7-11
Biology of Plants, Seventh Edition



The view from Earth

The ancients had it wrong: The Earth is not the center of the universe. But the Earth *is* at the center of the part of the universe that we can see. A being on a planet orbiting, say, a star in the galaxy M87 would see a different part of the universe, one centered on him. In a universe thought to be 11 to 15 billion years old, we can see out a distance of 11 to 15 billion light-years in all directions. From the Earth's viewpoint at midnight GMT, January 1, 2000, the elements of the cosmos will appear as they do here (right). Distances are not shown to scale but increase dramatically as they become more remote. The farther out we look, the farther back in time we see. Light takes 50 million years to arrive from M87, so we see it as it appeared 50 million years ago. The limit of our view is the time when the universe emerged from a state of hot plasma and became transparent, some 300,000 years after the big bang. That period is seen as the glow of the microwave background (shown in red and blue). If we could look beyond that veil, we would see—according to the standard models—the big bang itself, no matter in which direction we looked.