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- : (Jonathan Latham)
 - : “Genetics Is Giving Way to a New Science of Life“(2017.2.6) / Creative Commons Attribution 3.0 License
 - :
 - :
-

DNA() .
 DNA
 (master molecule) .
 DNA 가
 . DNA (主) (master controller)가
 .
 .
 .

1. DNA

DNA
 (Kary Mullis) DNA “ ” “

”(the big one) . DNA
(James Watson) □DNA: □(DNA: The Secret of Life) “
” DNA .

MIT < >(Broad
Institute) (Eric Lander) □DNA: 』
“ ” . - (Mary-
Claire King) “ DNA • • •
• ” .

DNA 가
□(Life) DNA DNA

’ □(The Language of Life), □ (Francis Collins)가
□(Language of God)
DNA 가 DNA가

DNA
DNA ,
가 DNA •RNA()
, DNA ‘
DNA가 , .

가? □ DNA가 가
□ DNA가 가?
.
DNA가 , 가
.
가 ,
가 .
DNA
DNA , .

2. (systems) .

DNA 가 . 가 (complex systems)
. 가
가 .
가 .

— , , — .

가 (器官)
, 가
,

DNA가 (Crick, 1970) , RNA
 DNA 가
 가 가
 DNA ‘ ’ 가
 DNA가 가 . DNA
 가 DNA •RNA•DNA가 , RNA
 가 DNA
 가, 가
 가 가
 , DNA DNA
 DNA DNA
 DNA DNA
 ‘ ’ , ‘ ’ , ‘ ’ (expression)
 DNA DNA
 DNA가
 가

DNA가

“ (transcriptional variation) ” (Chick et al., 2016) .
24 (the circadian rhythm) DNA가 가
(Nakajima et al., 2005).

DNA 가 , ‘ , ‘ ,
가 DNA (Nobel, 2003) .
DNA , DNA
DNA DNA
‘ , ‘ , “
DNA ” ‘ ,

가
가
(emergent properties)
(a relational model)
RNA (input) DNA RNA

(Carl Woese)가 ‘

가

(Denis Noble)

가 가 DNA

3. DNA가 ' ' 가 ' ' ?

DNA가 .

RNA . (viroid)

DNA DNA

RNA RNA가

RNA가 DNA

DNA RNA , RNA DNA
RNA DNA .

□ RNA () DNA

□ RNA DNA .

(modification) 가

. (A, C, G, T 가) DNA

가 가 . DNA

가 (epigenetics)

. RNA 가 (A, C, G, U) 가 .

RNA가

□ RNA DNA

1%

가

99%

RNA

DNA

□ RNA가 DNA

. RNA

가

가 RNA

RNA가

DNA

RNA가

DNA

RNA

가 DNA

. DNA

(司書)

가

DNA

가

RNA

가

DNA

가

RNA

4. DNA

DNA

『 』

DNA가

가

가

1.

2.

DNA

가

(, ,) DNA가 가
(Carter, 2016).

()
『 』

.

가 , 가 (e.g.
Kauffman, 1993; Carter, 2016). DNA가
가

. DNA가 가 가
가 (Batten)

“

”(“Self-organization proposes what natural selection disposes”)
([Batten et al., 2008](#))

. DNA

3

([Munson et al., 1996](#)). (+

charge) . DNA가

DNA

(PH), □

3 (APT) , (chaperones)

(molecular channels) 가 가

,

DNA

DNA ()

(ultra-determinist)

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가

DNA

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DNA

가

가

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(Patrick Bateson)—

—

“

(genotypes)

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가

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DNA가

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DNA가

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DNA가

가

가

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5.

가

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RNA

가

DNA

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. DNA

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DNA

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DNA

(種)

DNA

DNA

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가

가

가

DNA가

•

(落果)

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6. DNA

(Robert Rosen) “ ”

8

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, .

가 DNA RNA 가

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DNA (

‘DNA ’) 가 가

DNA .

. DNA

가

가 (e.g. Kaufman, 1993; [Strohman, 1997](#); Rose, 1999; Woese 2004; Annala and Baverstock 2014; Friston et al., 2015).

가 DNA

- 가

(Ioannidis, 2007; [Dermitzakis and Clark, 2009](#); [Manolio et al., 2009](#)).

가 . (Pasteur) 가

(Carl Woese)

“ ” .

가 가 .

‘ , ’ • •
([Badylak, 2016](#)).

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‘ , ’ .

가 가 .

() ,
([Strohman, 1997](#)).

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7.

(Helmholtz machine)

. , ()

(reviewed in Clark, 2013).

. 가

가 가 (. . . —) 가

. 가 , 가 가

가 “ ” (“ ”)

가 . 가

(Friston, 2010).

, . . .

(the vascular system).

2 (Wheeler and Stroock, 2008).

(掌心).

가

(metabolon) .

(metabolon)

3 (metabolic pathway)

30% (Laursen et al., 2017).

(homeostasis)

가 24 가

가 (Nicolas Rashevsky) 1972
 (Robert Rosen) AH (AH Louie)가
 가? (What is life?)
 (Erwin Schrödinger), (The Origins of Order,
 1933) (Stuart Kauffman), :
 (Lifelines: Biology beyond determinism, 1997)
 (Steven Rose), (The Art of Genes, 1999)
 (Enrico Coen), (The Music of Life, 2003)
 : (Dance to the Tune of Life: Biological Relativity,
 2017) (Denis Noble), 2
 (Annala) (Baverstock) . (Annala
 and Baverstock, 2014; see also Friston et al., 2015).

가 —
 —
 가 'RNA
 'RNA ' DNA 가 'RNA
 ' -RNA 가

-RNA (Carter, 2016) RNA
 가 () 가
 (1 2) 가
 . 1 2 (가
) 가
 RNA
 가 (Carter 2016). RNA
 RNA 가 가 가

. RNA

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-RNA

가

, RNA가

(a replication-first theory)

RNA

(a metabolism-first theory)

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8. DNA ()

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가

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(life)

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가

가

가

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가

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.” [Anand et al., 2008](#))

(Craig Venter)

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가

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DNA

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DNA

가?

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가?

가?

Meaning of Life”) , 「 □ (“The



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