D-Loop in Mitochondrion

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SVFIG

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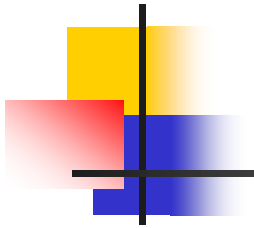
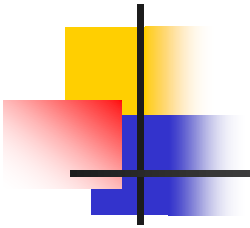


Life Forms

- All life forms were poorly designed.
- Too many compromises had to be made to deal with many different external requirements.



Plants

- Plants were better designed.
- External constraints are much less stringent.
- They acquire energy from sun light.
- They do not have to move.

Animals

- Animals were much more difficult to designed.
- They acquire energy from eating. Foods must be digested, and stored away.
- They have to move by burning stored nutrients for energy.

Respiratory and Circulatory Systems

- Oxygen is required to produce energy.
- Oxygen is toxic.
- Red cells must be sacrificed to carry oxygen to cells.
- Mitochondria are incorporated to oxidize nutrients for ATP.
- Oxygen escaping mitochondria must be neutralized by vitamin C.

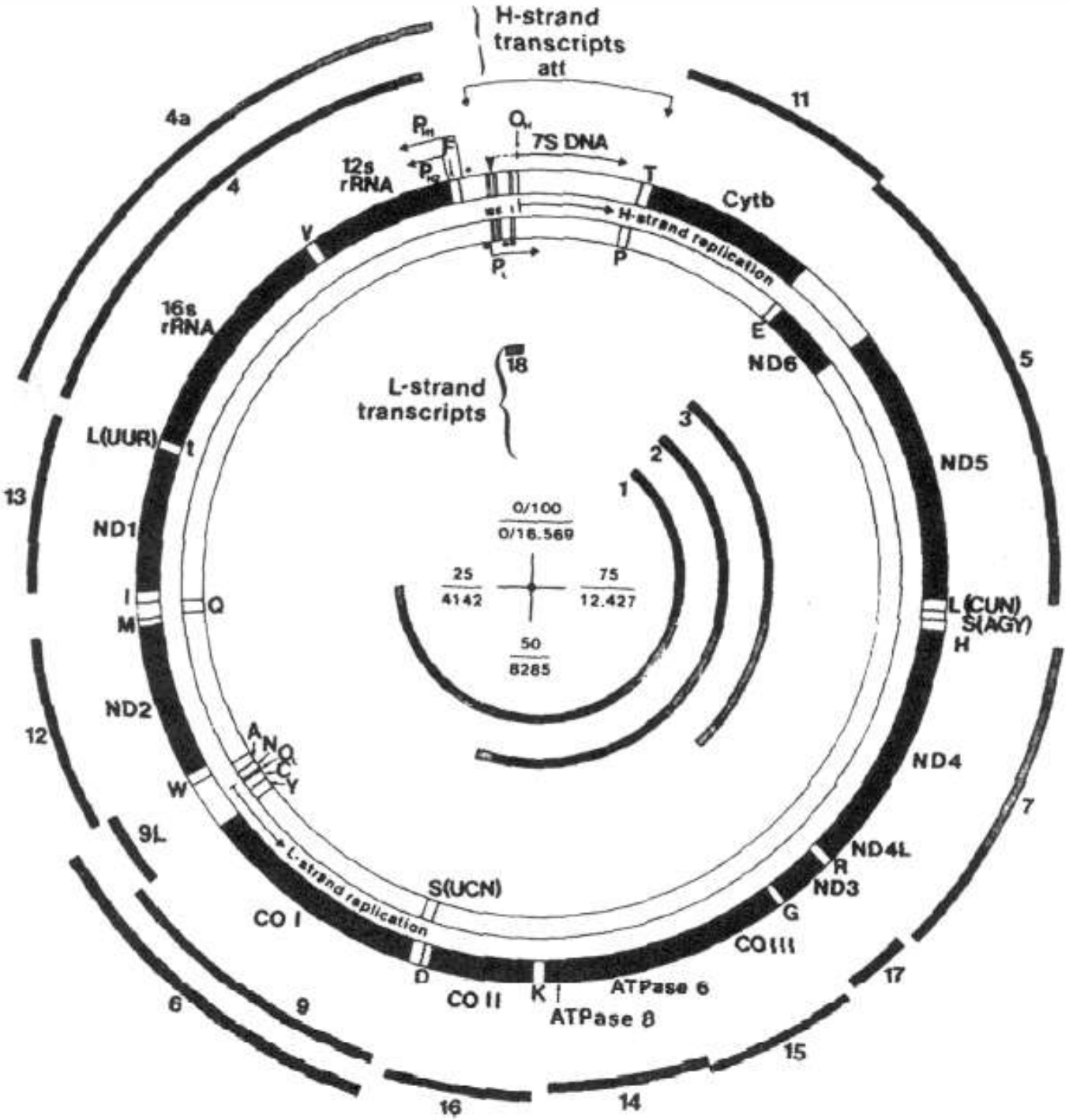
Mitochondria

- **Smallest endosymbiotic organisms required by all cells.**
- **Its DNA genome is inherited from mother, independent of nuclear genomes.**
- **Human mitochondrion has 16,569 bases.**

Mitochondria

Mitochondrial Genome

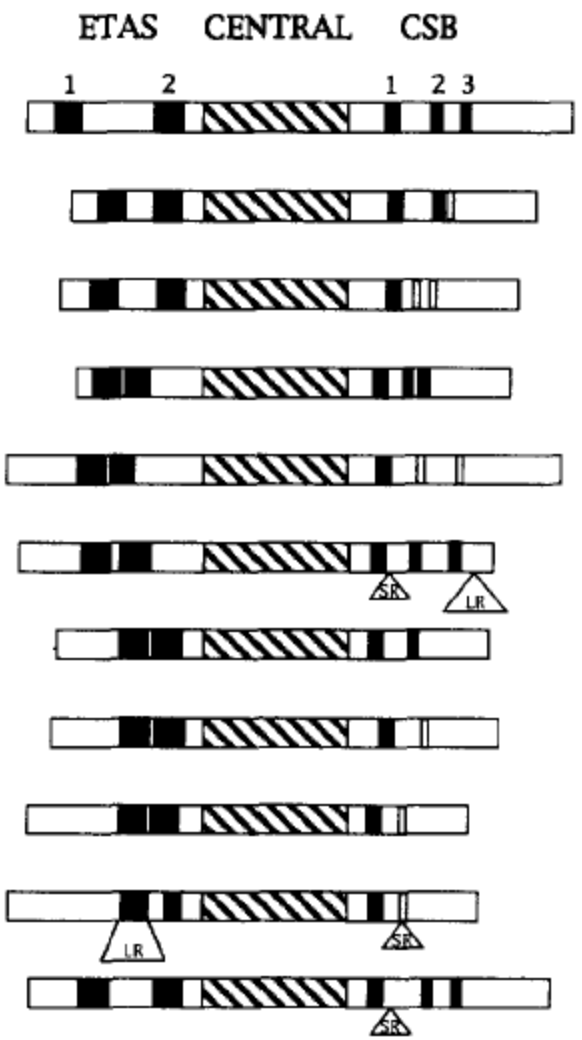
- It encodes 37 genes:
  - 13 for subunits of respiratory complexes I, III, IV and V
  - 22 for mitochondrial tRNA (for the 20 standard amino acids)
  - 2 extra genes for leucine and serine
  - 2 for rRNA
- One mitochondrion can contain two to ten copies of its DNA.


H-strand transcripts
att
7S DNA
12s rRNA
16s rRNA
Cytb
H-strand replication
L-strand transcripts
ND6
ND5
ND4
ND4L
ND3
CO III
ATPase 6
ATPase 8
CO II
CO I
L-strand replication
S(UCN)
L(UUR)
L(CUN)
S(AGY)
ND1
ND2
0/100
0/16.569
25
4142
75
12.427
50
8285
4a
4
11
5
13
12
9L
7
6
9
16
14
15
17

Mitochondrial D-Loop

- Three sections (1122 bases):
  - Left section, 371 (16024-16394)
  - Central section, 309 (16395-134)
  - Right section, 442 (135-576)
- Conserved blocks
  - Termination Associated Sequences
  - Central Section
  - Conserved Sequence Blocks

Conserved Blocks in D-Loop



H. lar, H. sapiens PRIMATES
P. paniscus, P. troglodytes

G. gorilla

P. pigmaeus

M. musculus, R. norvegicus RODENTIA

G. glis

O. cuniculus LAGOMORPHA

C. commersonii, B. mysticetus CETACEA

K. breviceps

B. taurus ARTIODACTYLA

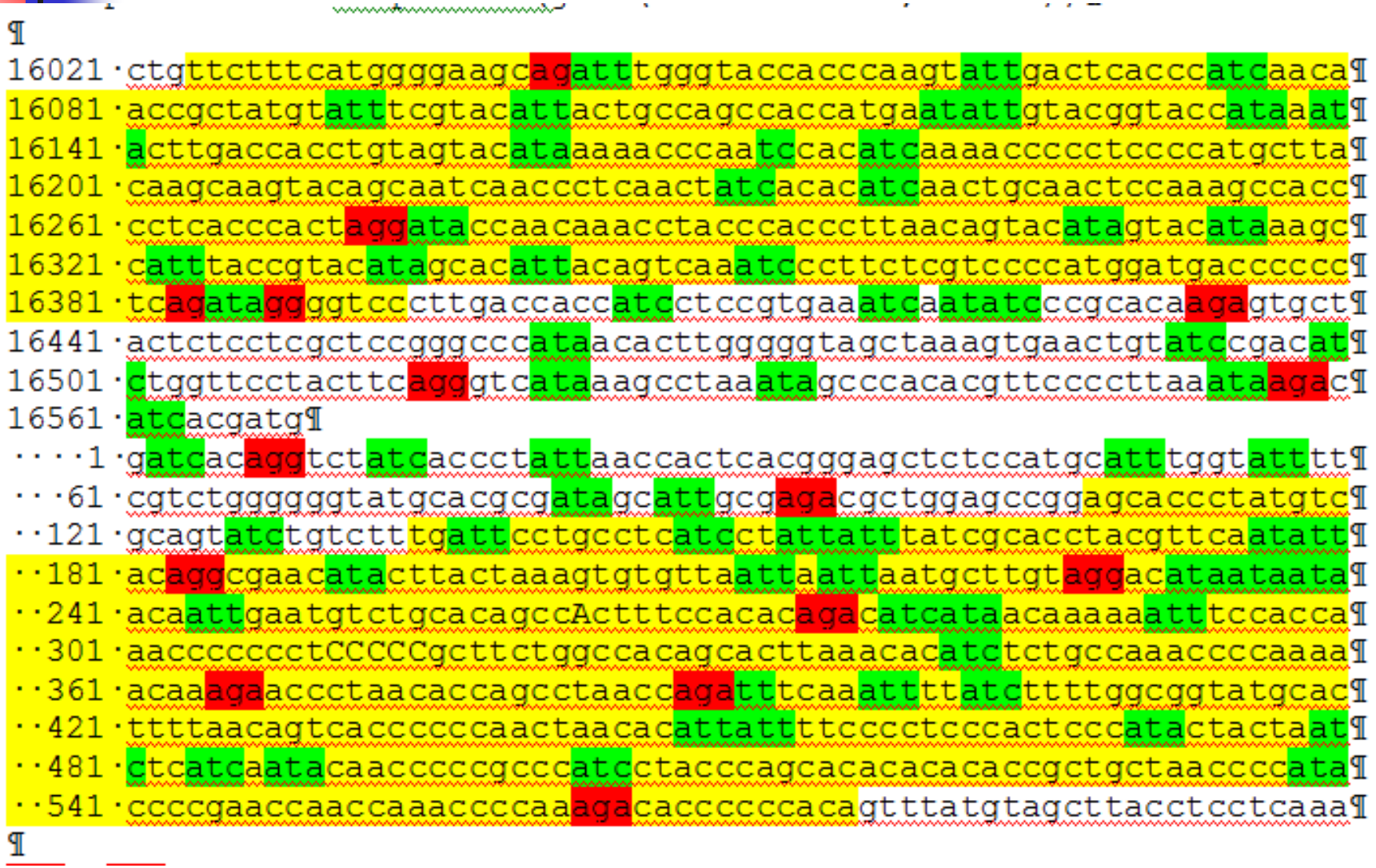
O. aries

D. bicornis

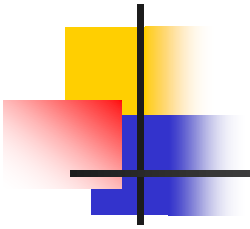
D-Loop Base Map (1997)

D-Loop Base Map (2017)

Start and Stop Codons



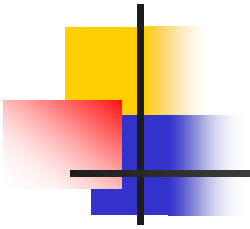
Longest Repeated Patterns



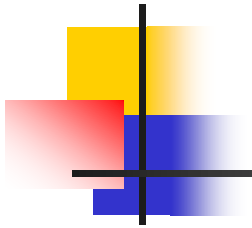
Longest Patterns

- The longest repeated patterns in the central conserved sections are:
  - caccctat
  - tgggggta/tggggta
  - gacatc
- What I expect are:
  - Call and return
  - Jump and conditional jump

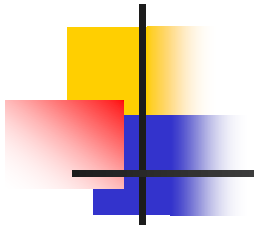
Secrets of Life



- Central conserved section in mitochondrial D-Loop looks like a computer program.
- We need to look up the code, **caccctat**, **tgggggta/tggggta** and **gacatc** in nuclear genomes to see if they are parts of genetic programs.



Questions?



Thank You!