Dipartimento di
Scienze Chimiche e Farmaceutiche

Corso integrato di BIOCHIMICA AVANZATA E BIOLOGIA MOLECOLARE (C.I.)

Corso di Biologia Molecolare

Fino a dicembre 2025
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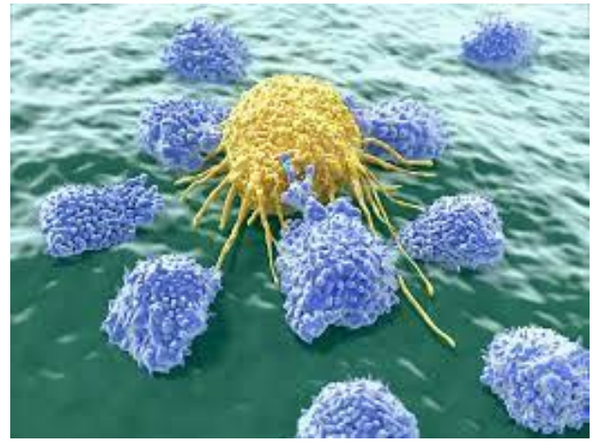
UNIVERSITÀ DEGLI STUDI DI TRIESTE

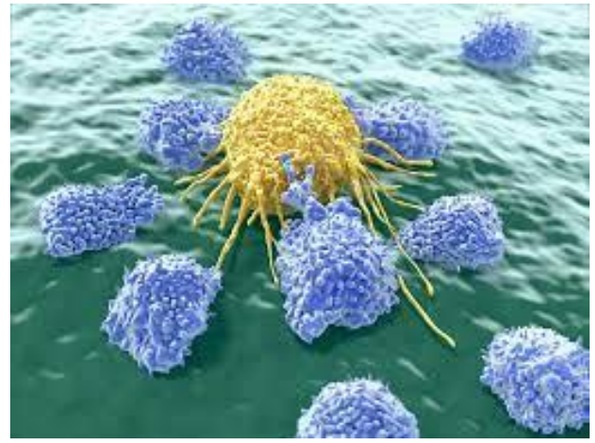
- Presidente della Commissione Paritetica Docenti-Studenti DSM
- Coordinatore 1 anno CLOPD
- Membro della Commissione Didattica CLOPD
- Membro della Commissione Tirocini CLOPD
- Delegato Orientamento in Itinere DSM

Laurea in Biologia Molecolare, Torino
PhD in Biochimica e Chimica Clinica, Torino



Tyrosine Kinase Receptor
Signaling in Cancer

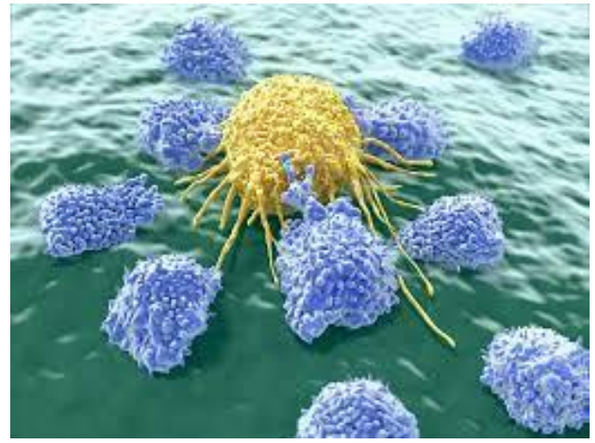
Laurea in Biologia Molecolare, Torino
PhD in Biochimica e Chimica Clinica, Torino



Tyrosine Kinase Receptor
Signaling in Cancer

Post-doc
IFOM e DiBiT, Istituto San Raffaele, Milano

Laurea in Biologia Molecolare, Torino
PhD in Biochimica e Chimica Clinica, Torino



Tyrosine Kinase Receptor
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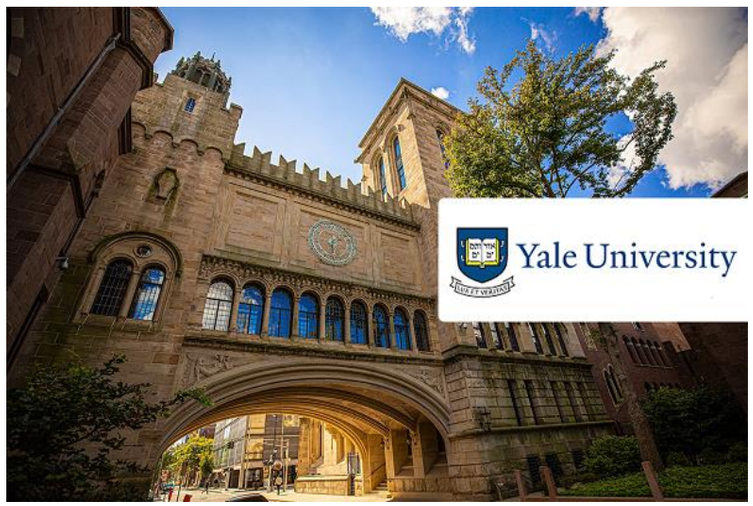
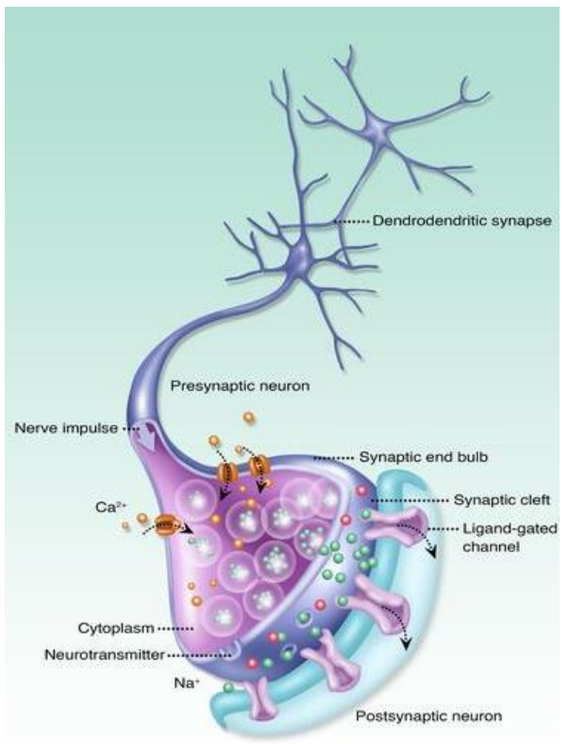
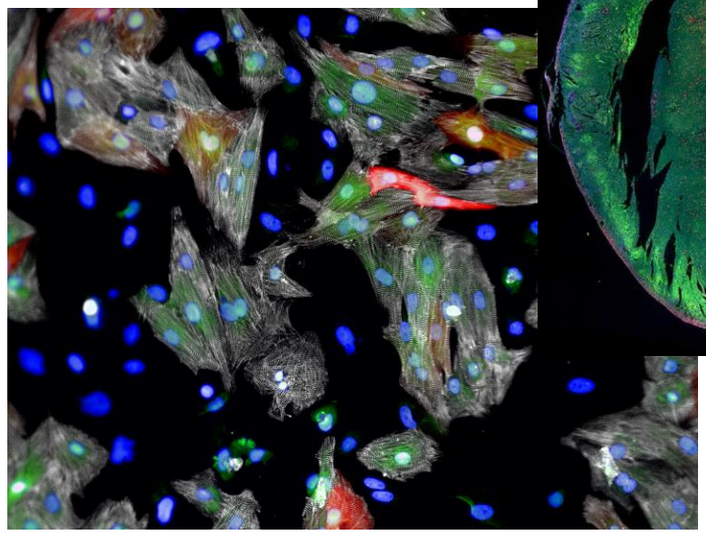


Post-doc
Dept. of Cell Biology, Yale University, New Haven, CT, USA



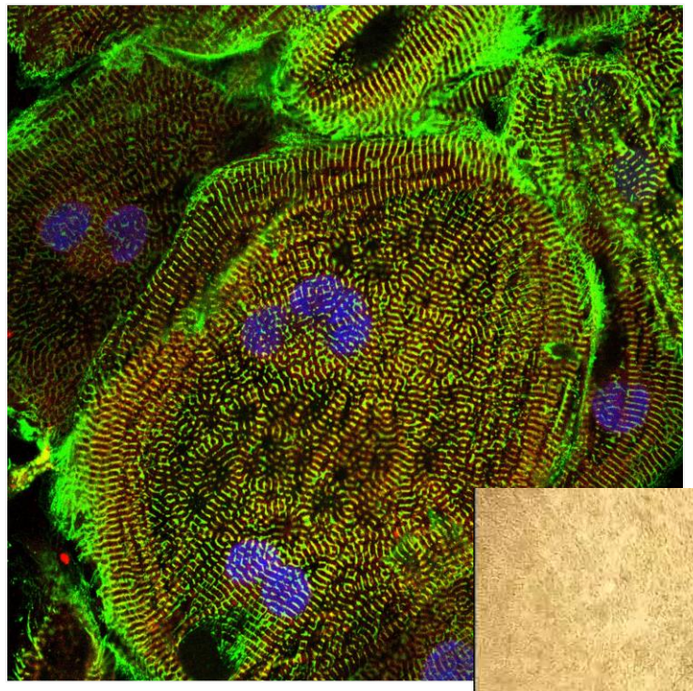
Clatrin Coated Vescicle
Endocytosis in Neurons

RU, International Centre for Genetic Engineering and Biotechnology, Trieste



Cardiomyocyte proliferation

PA, Dipartimento di Scienze Mediche, Cliniche e della Salute, Trieste



Heart disease modelling
Cardiac organoids

Che cosa studieremo?

Dove e' scritta l'informazione genica

Replicazione

Come si esprime l'informazione genica

Trascrizione e Traduzione

Meccanismi di CONTROLLO dell'espressione genica:

- Micro-RNA
- piccoli RNA regolatori

Come l'ambiente influenza l'espressione genica:

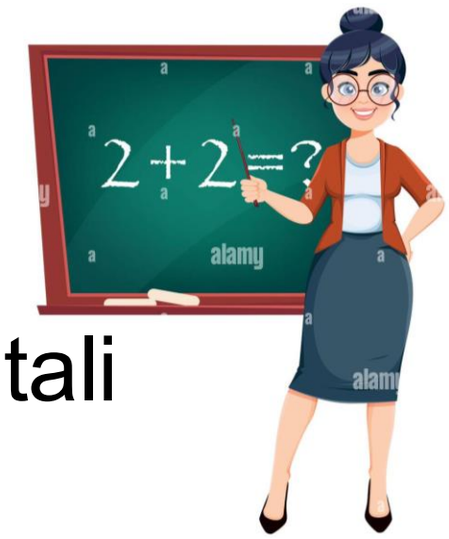
Epigenetica

Biologia Molecolare avanzata

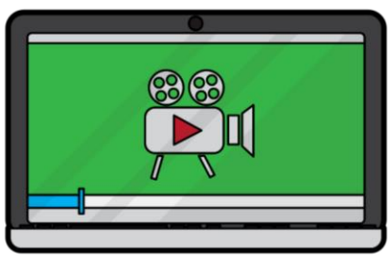
- Ingegneria Genetica
- Terapia Genica
- Gene e Genome Editing
- Biomolecole, biodrugs

Come?

- ✓ Lezioni Frontali



- ✓ Video



- ✓ Commenti di Articoli

Article

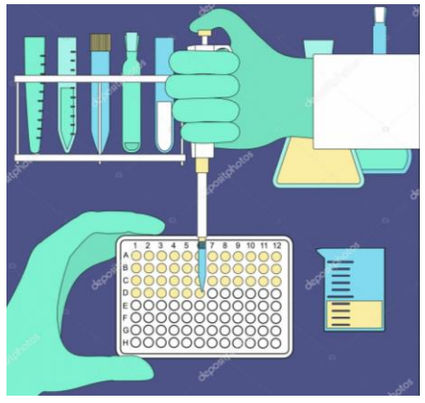
The oldest gnathostome teeth

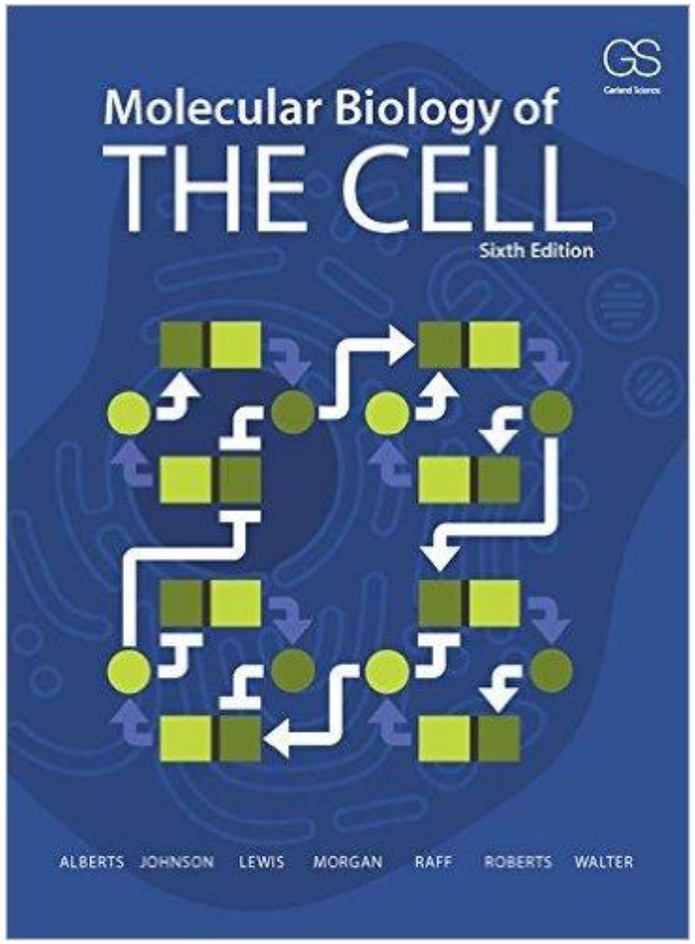
https://doi.org/10.1038/s41586-022-05166-2
Received: 24 April 2020
Accepted: 29 July 2022
Published online: 28 September 2022
Check for updates

Plamen S. Andreev[1,2,7], Ivan J. Sansom[3,7], Qiang Li[1,2,7], Wenjin Zhao[2,4,5], Jianhua Wang[1], Chun-Chieh Wang[6], Lijian Peng[1], Liantao Jia[2], Tuo Qiao[2,4] & Min Zhu[2,4,5]✉

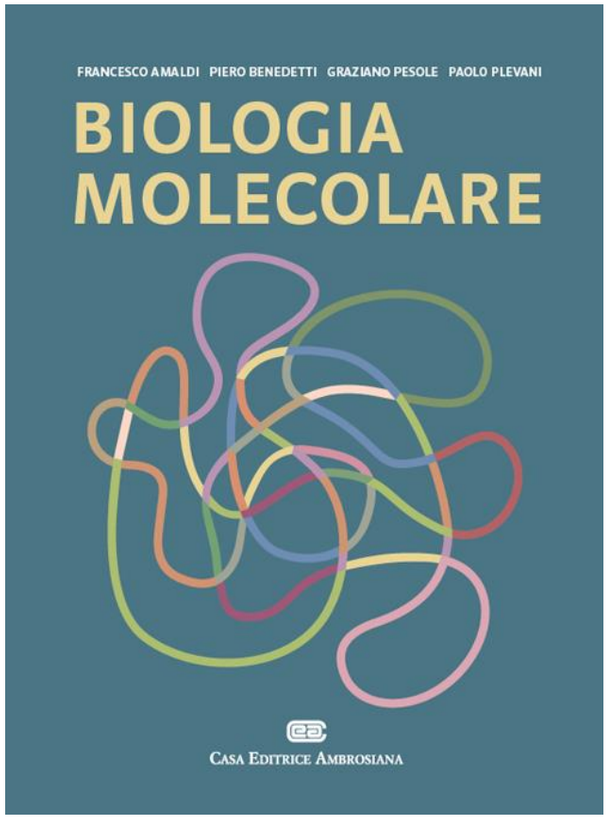
Mandibular teeth and dentitions are features of jawed vertebrates that were first acquired by the Palaeozoic ancestors[1–3] of living chondrichthyans and osteichthyans. The fossil record currently points to the latter part of the Siluri

- ✓ Schede tecniche





B. Alberts et al.
Molecular Biology of the Cell
Garland Publishing



F. Amaldi
BIOLOGIA MOLECOLARE
Casa Editrice Ambrosiana

B. Alberts et al.
Biologia Molecolare della cellula
Zanichelli

Per alcune lezioni che tratteranno argomenti particolarmente innovativi e non sufficientemente descritti nei libri di testo, sara' fornito agli studenti opportuno materiale didattico.

Regole d’interazione generale

✓ Lezioni registrate, come da RA

✓ Rilevazione della presenza in aula:
chi non raggiunge il 75% delle presenze non e’ ammesso all’esame

✓ Slides, materiale didattico caricati
✓ su Moodle

- ✓ Interazione in aula:
  domande, domande, domande..

- ✓ Chi non e’ interessato, e’ pregato di non disturbare i compagni

- ✓ Cellulari, Social, Chat NON attivi

ESAME

MODALITA’ ESAME

2 appelli a gennaio/febbraio

2 appelli a giugno/luglio

2 appelli a settembre

E’ possibile partecipare a **TUTTI** e **6** gli appelli.

ESEMPI DOMANDE CHIUSE

Quali delle seguenti proprieta' caratterizzano gli mRNA degli istoni:

1. sono trascritti durante la fase S del ciclo cellulare
2. sono trascritti dalla RNA polimerasi II
3. non sono poliadenilati
4. sono presenti solo nelle cellule eucariotiche

La proteina Dicer:

1. sta nel nucleo
2. è una ribonucleasi
3. è una endonucleasi che taglia RNA a doppio filamento
4. riconosce preferenzialmente gli mRNA dei geni housekeeping

ESEMPI DOMANDE APERTE

- ✓Cosa sono i frammenti di Okazaki?

- ✓Illustrare schematicamente I meccanismi di controllo della fedelta' di dulicazione del DNA

- ✓Illustrare brevemente come viene stabilito il corretto inizio della traduzione

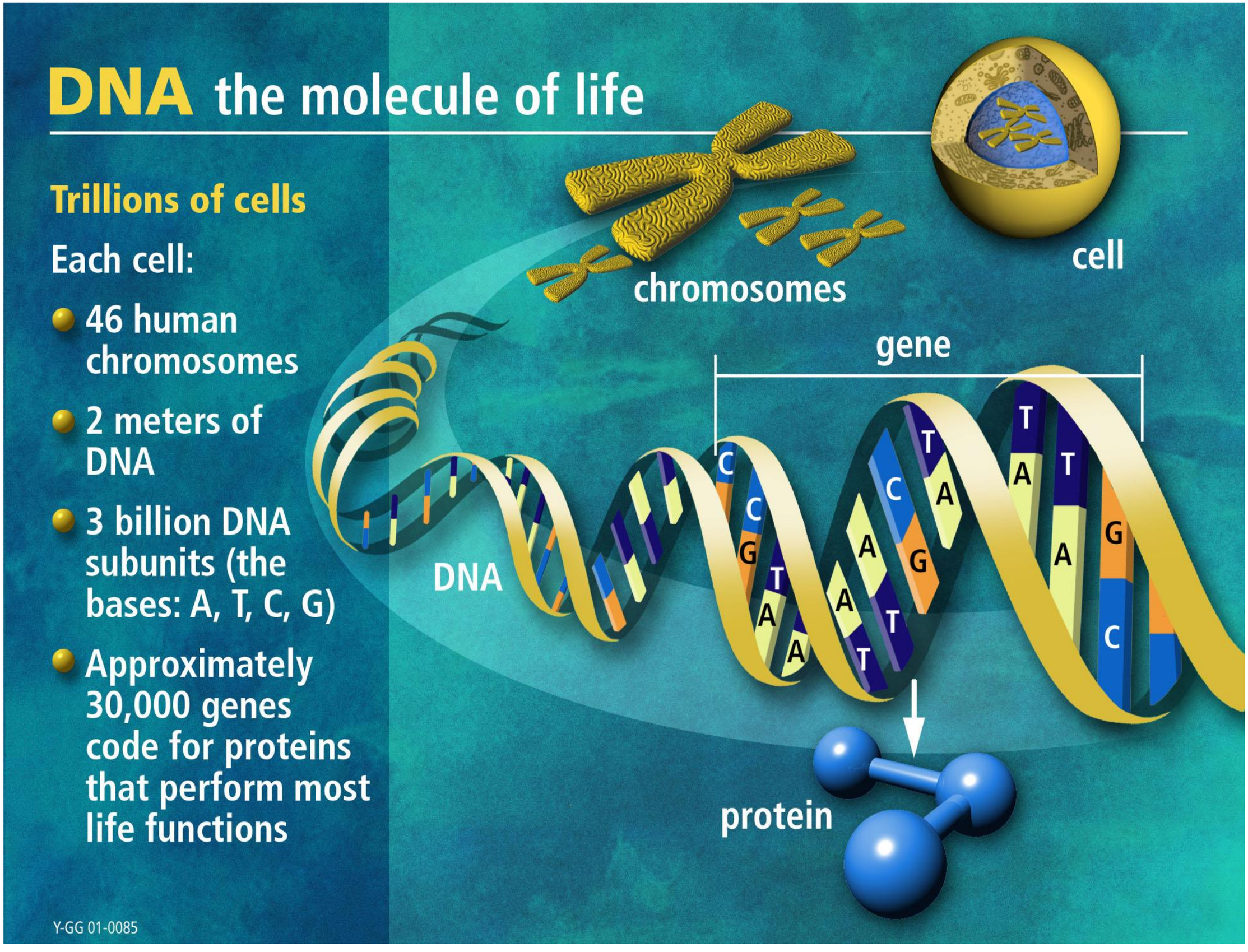
Cosa e' l'informazione genica?

L'informazione genica consiste in una sequenza lineare di nucleotidi (=DNA) che viene decodificata allo stesso modo in tutte le cellule di tutti gli organismi.

Il genoma:

- il complesso dell'informazione genica di una cellula
- la massa totale del DNA cellulare
- il patrimonio ereditario dell'organismo a cui appartiene

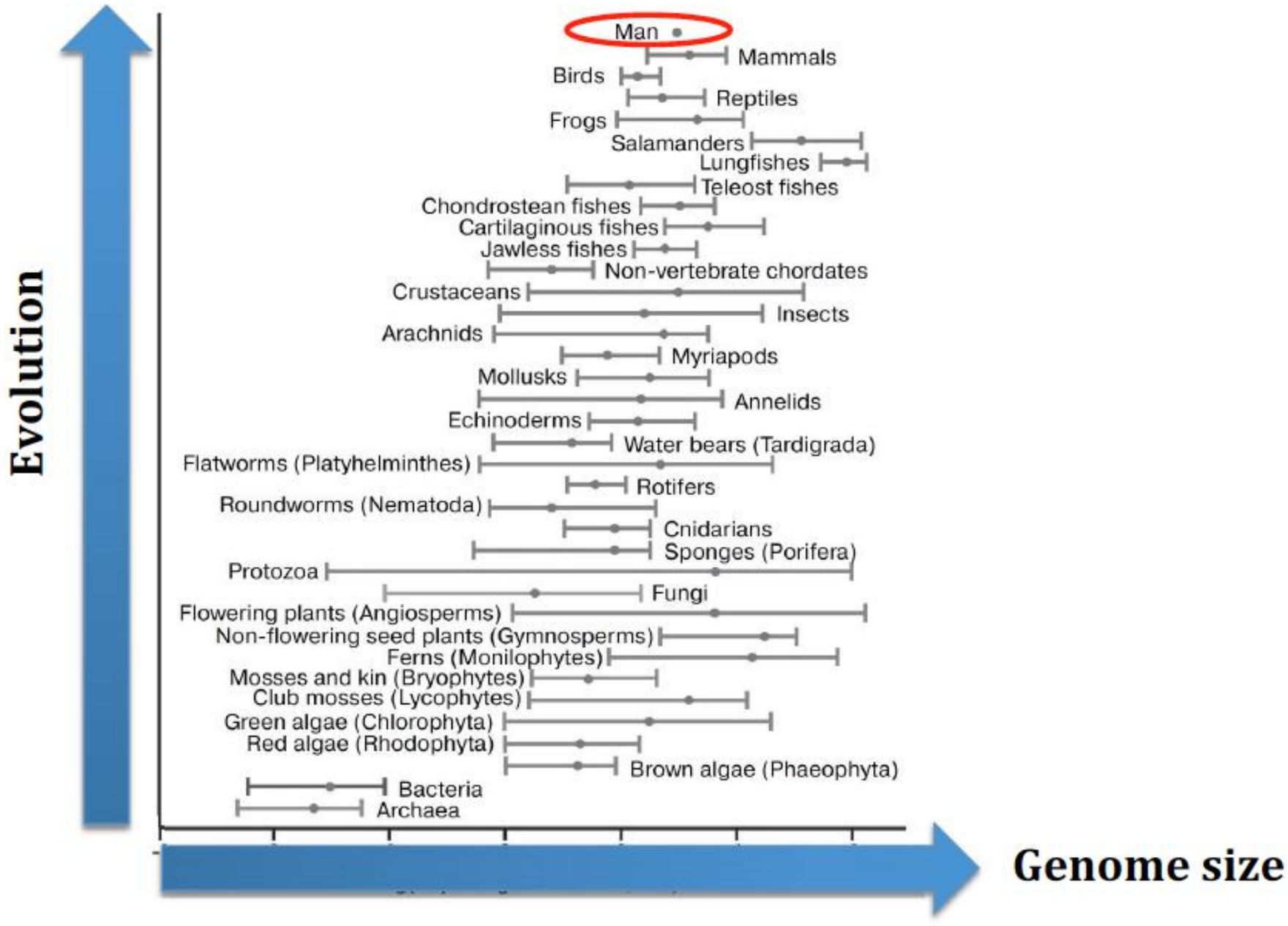
Dove e' scritta l'informazione genica?



Genome Size and Developmental Complexity

C- value or genome size paradox

The amount of genomic DNA does not correlate with organismal complexity



Patrushev et al., 2008

Il paradosso C dei genomi eucariotici

Nei **procarioti** numero di geni e dimensioni genomiche delle varie specie sono approssimativamente proporzionali, in ragione di circa **1.000-1.200 pb/gene**. Appare ragionevole.

Le **dimensioni genomiche** (corredo aploide) nelle **specie eucariotiche** per contro variano enormemente (da circa 10^7 a più di 10^{11}) senza alcuna relazione con la **complessità dell'organismo**. Ad esempio, negli unicellulari alcune amebe hanno le massime dimensioni genomiche mentre alcune alghe unicellulari e alcuni lieviti le minime. Nelle piante superiori si va da circa 10^8 a circa 10^{11} e lo stesso succede con gli animali.

Questa osservazione è stata chiamata il **Paradosso C** (Complessità).

iScience

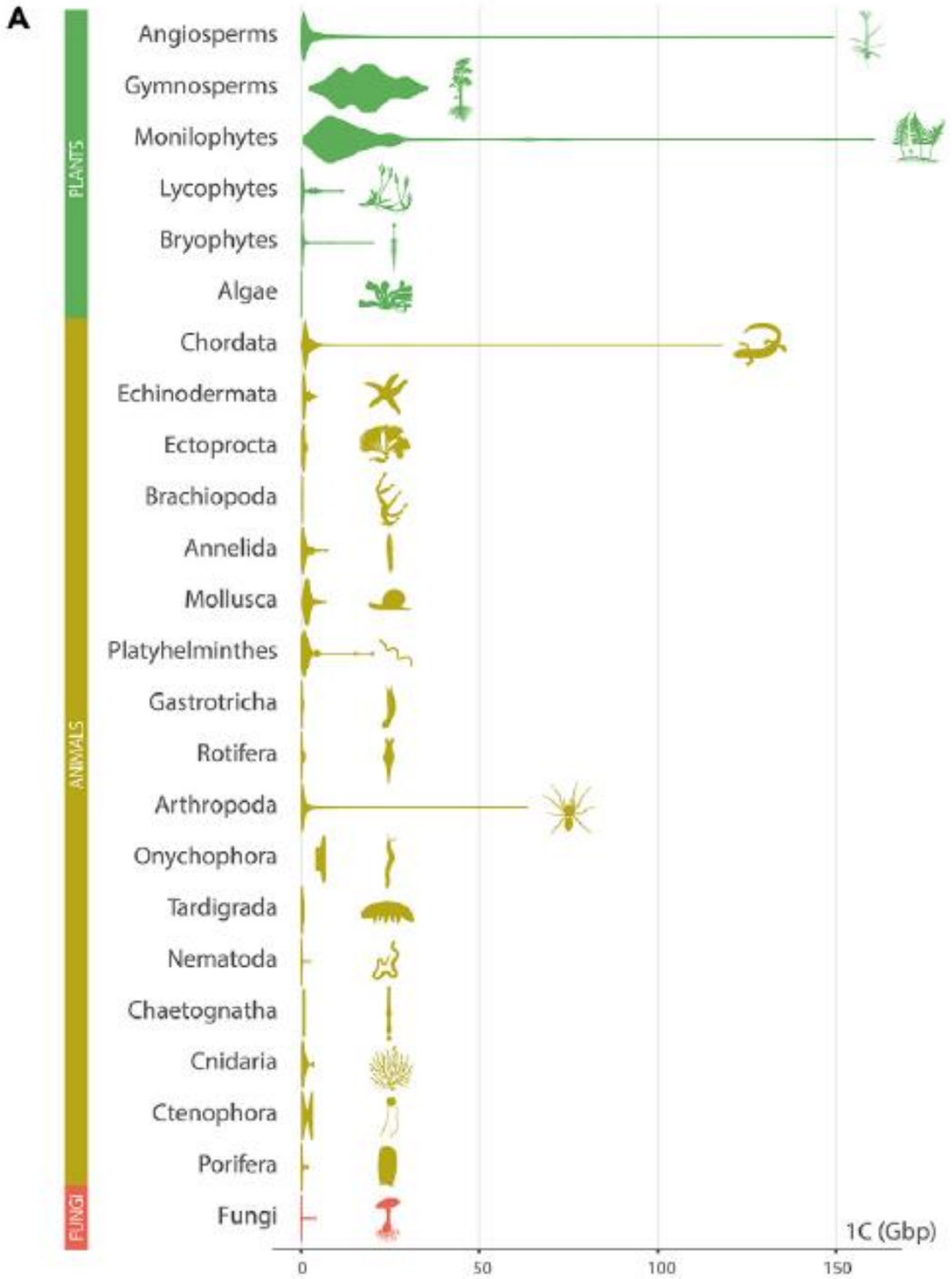
CellPress
OPEN ACCESS

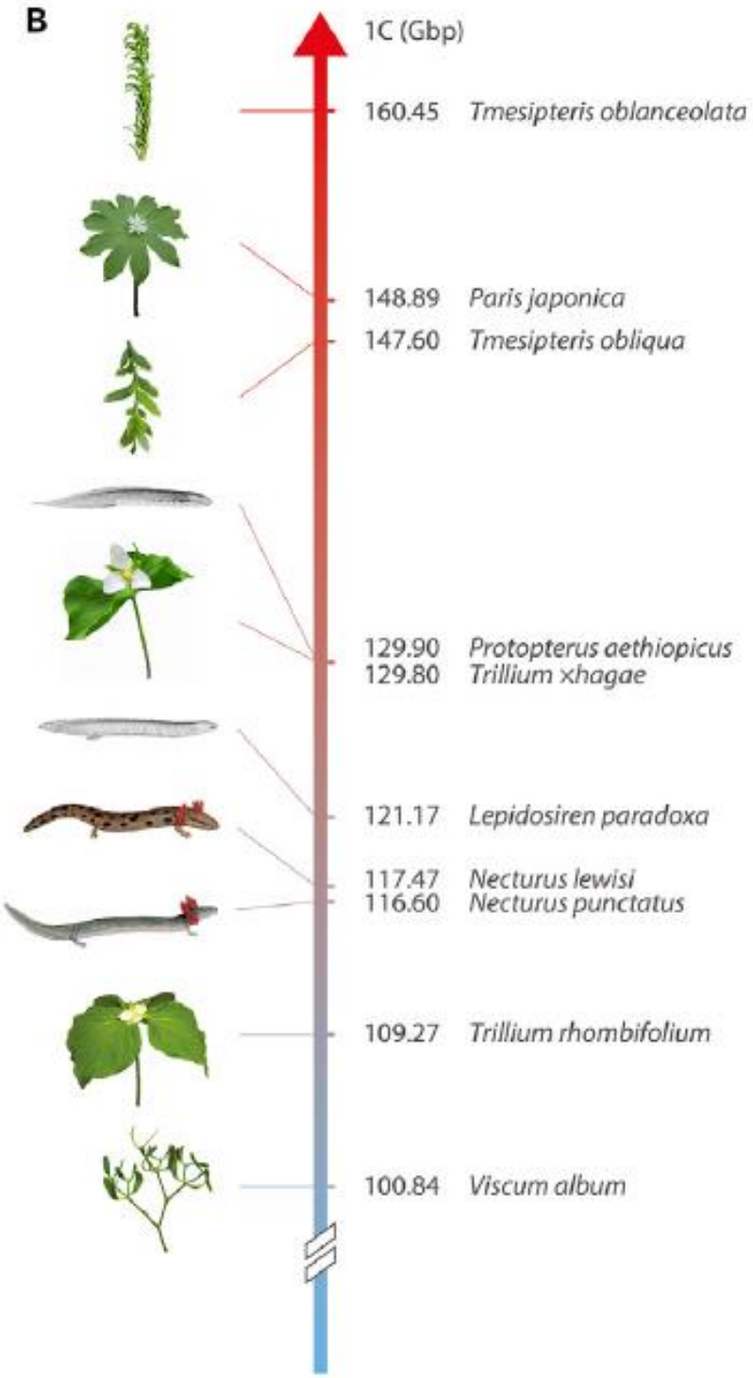
iScience 27, 109889, June 21, 2024 © 2024 The Author(s). Published by Elsevier Inc.

Article

A 160 Gbp fork fern genome shatters size record for eukaryotes

Pol Fernández,[1,2] Rémy Amice,[3] David Bruy,[4,5] Maarten J.M. Christenhusz,[6,7] Ilia J. Leitch,[6] Andrew L. Leitch,[8] Lisa Pokorny,[6,9] Oriane Hidalgo,[1,6,10] and Jaume Pellicer[1,6,10,11,*]





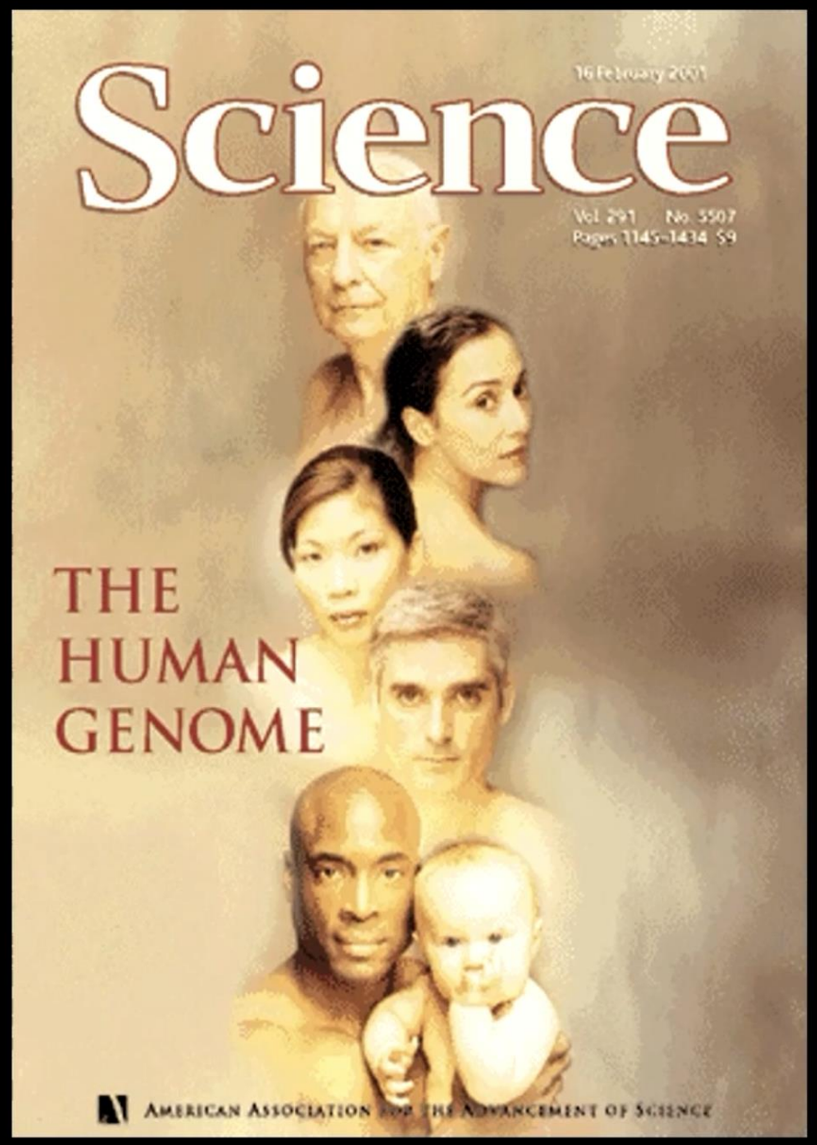
A species of fork fern, *Tmesipteris obl anceolata*, has the biggest genome ever recorded. It contains 160 billion base pairs — 11 billion more than the previous record holder, the flowering plant *Paris japonica*, and 50 times more than the human genome. It's not known why the plant evolved that way, or how it accesses the relatively small proportion of DNA that is actually useful.

NEWS

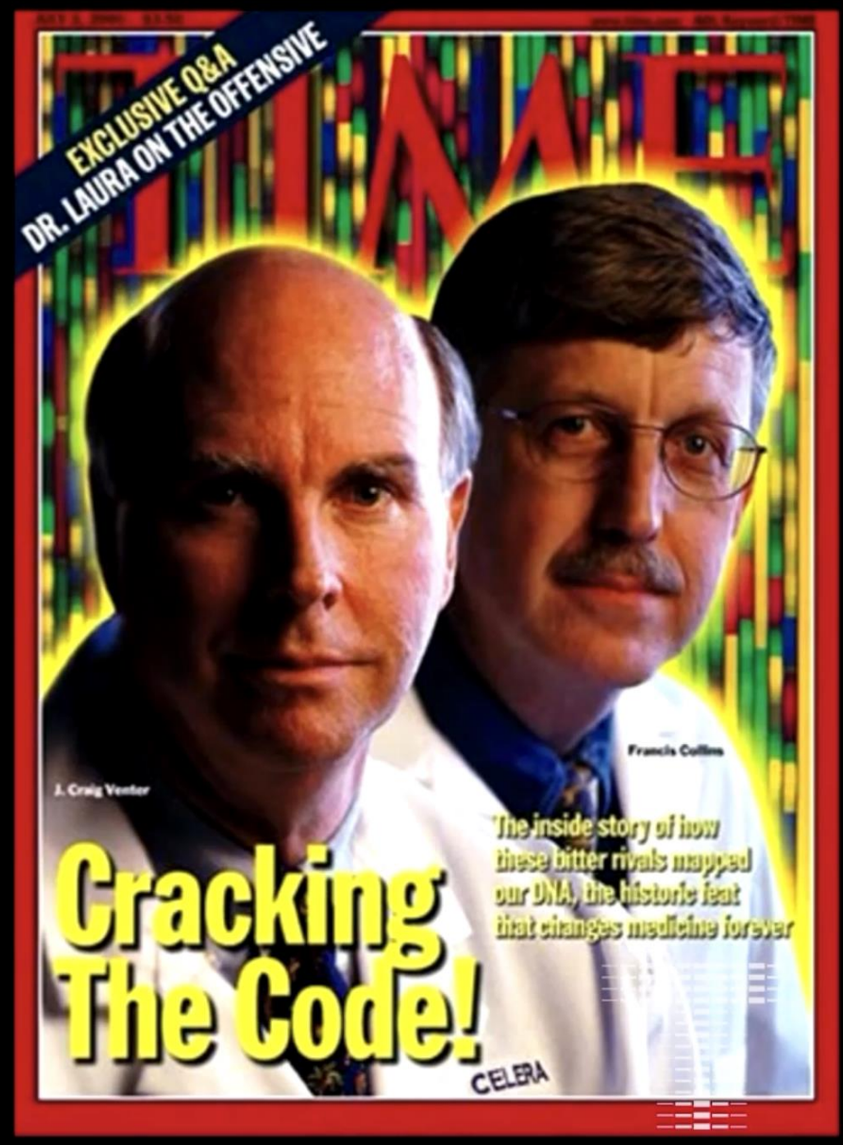
This odd fish has 30 times as much DNA as humans—a new record for animals

A species of lungfish found in South America has claimed the title of the animal with the biggest genome sequenced so far. The DNA of *Lepidosiren paradoxa* comprises a staggering 91 billion nucleotides," 30 times as many as the human genome. However, those 91 billion bases of DNA only contain about the same number of genes that humans have—roughly 20,000—with the rest consisting of noncoding, perhaps even "junk" DNA.

2001


Science
16 February 2001
Vol. 291 No. 5507
Pages 1145–1434 $9
THE HUMAN GENOME
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE


nature
www.nature.com
the human genome
Nuclear fission
Five-dimensional energy landscapes
Seafloor spreading
The view from under the Arctic ice
Career prospects
Sequence creates new opportunities
naturejobs
genomics special


EXCLUSIVE Q&A
DR. LAURA ON THE OFFENSIVE
J. Craig Venter
Francis Collins
Cracking The Code!
The inside story of how these bitter rivals mapped our DNA, the historic feat that changes medicine forever
CELERA

2 December 1999 international weekly journal of science

nature

www.nature.com

The Sequence of the Human Genome

J. Craig Venter,[1*] Mark D. Adams,[1] Eugene W. Myers,[1] Peter W. Li,[1] Richard J. Mural,[1] Granger G. Sutton,[1] Hamilton O. Smith,[1] Mark Yandell,[1] Cheryl A. Evans,[1] Robert A. Holt,[1] Jeannine D. Gocayne,[1] Peter Amanatides,[1] Richard M. Ballew,[1] Daniel H. Huson,[1] Jennifer Russo Wortman,[1] Qing Zhang,[1] Chinnappa D. Kodira,[1] Xiangqun H. Zheng,[1] Lin Chen,[1] Marian Skupski,[1] Ganeshan Subramanian,[1] Paul D. Thomas,[1] Jinghui Zhang,[1] George L. Gabor Miklos,[2] Catherine Nelson,[3] Samuel Broder,[4] Andrew G. Clark,[5] Joe Nadeau,[6] Victor A. McKusick,[6] Norton Zinder,[7] Arnold J. Levine,[7] Richard J. Roberts,[8] Mel Simon,[9] Carolyn Slayman,[10] Michael Hunkapiller,[11] Randall Bolanos,[1] Arthur Delcher,[1] Ian Dew,[1] Daniel Fasulo,[1] Michael Flanigan,[1] Liliana Florea,[1] Aaron Halpern,[1] Sridhar Hannenhalli,[1] Saul Kravitz,[1] Samuel Levy,[1] Clark Mobarry,[1] Knut Reinert,[1] Karin Remington,[1] Jane Abu-Threideh,[1] Ellen Beasley,[1] Kendra Biddick,[1] Vivien Bonazzi,[1] Rhonda Brandon,[1] Michele Cargill,[1] Ishwar Chandramouliswaran,[1] Rosane Charlab,[1] Kabir Chaturvedi,[1] Zuoming Deng,[1] Valentina Di Francesco,[1] Patrick Dunn,[1] Karen Eilbeck,[1] Carlos Evangelista,[1] Andrei E. Gabrielian,[1] Weiniu Gan,[1] Wangmao Ge,[1] Fangcheng Gong,[1] Zhiping Gu,[1] Ping Guan,[1] Thomas J. Heiman,[1] Maureen E. Higgins,[1] Rui-Ru Ji,[1] Zhaoxi Ke,[1] Karen A. Ketchum,[1] Zhongwu Lai,[1] Yiding Lei,[1] Zhenya Li,[1] Jiayin Li,[1] Yong Liang,[1] Xiaoying Lin,[1] Fu Lu,[1] Gennady V. Merkulov,[1] Natalia Milshina,[1] Helen M. Moore,[1] Ashwinikumar K. Naik,[1] Vaibhav A. Narayan,[1] Beena Neelam,[1] Deborah Nusskern,[1] Douglas B. Rusch,[1] Steven Salzberg,[12] Wei Shao,[1] Bixiong Shue,[1] Jingtao Sun,[1] Zhen Yuan Wang,[1] Aihui Wang,[1] Xin Wang,[1] Jian Wang,[1] Ming-Hui Wei,[1] Ron Wides,[13] Chunlin Xiao,[1] Chunhua Yan,[1] Alison Yao,[1] Jane Ye,[1] Ming Zhan,[1] Weiqing Zhang,[1] Hongyu Zhang,[1] Qi Zhao,[1] Liansheng Zheng,[1] Fei Zhong,[1] Wenyan Zhong,[1] Shiaoping C. Zhu,[1] Shaying Zhao,[12] Dennis Gilbert,[1] Suzanna Baumhueter,[1] Gene Spier,[1] Christine Carter,[1] Anibal Cravchik,[1] Trevor Woodage,[1] Feroze Ali,[1] Huijin An,[1] Aderonke Awe,[1] Danita Baldwin,[1] Holly Baden,[1] Mary Barnstead,[1] Ian Barrow,[1] Karen Beeson,[1] Dana Busam,[1] Amy Carver,[1] Angela Center,[1] Ming Lai Cheng,[1] Liz Curry,[1] Steve Danaher,[1] Lionel Davenport,[1] Raymond Desilets,[1] Susanne Dietz,[1] Kristina Dodson,[1] Lisa Doup,[1] Steven Ferriera,[1] Neha Garg,[1] Andres Gluecksmann,[1] Brit Hart,[1] Jason Haynes,[1] Charles Haynes,[1] Cheryl Heiner,[1] Suzanne Hladun,[1] Damon Hostin,[1] Jarrett Houck,[1] Timothy Howland,[1] Chinyere Ibegwam,[1] Jeffery Johnson,[1] Francis Kalush,[1] Lesley Kline,[1] Shashi Koduru,[1] Amy Love,[1] Felecia Mann,[1] David May,[1] Steven McCawley,[1] Tina McIntosh,[1] Ivy McMullen,[1] Mee Moy,[1] Linda Moy,[1] Brian Murphy,[1] Keith Nelson,[1] Cynthia Pfannkoch,[1] Eric Pratts,[1] Vinita Puri,[1] Hina Qureshi,[1] Matthew Reardon,[1] Robert Rodriguez,[1] Yu-Hui Rogers,[1] Deanna Romblad,[1] Bob Ruhfel,[1] Richard Scott,[1] Cynthia Sitter,[1] Michelle Smallwood,[1] Erin Stewart,[1] Renee Strong,[1] Ellen Suh,[1] Reginald Thomas,[1] Ni Ni Tint,[1] Sukyee Tse,[1] Claire Vech,[1] Gary Wang,[1] Jeremy Wetter,[1] Sherita Williams,[1] Monica Williams,[1] Sandra Windsor,[1] Emily Winn-Deen,[1] Kerilellen Wolfe,[1] Jayshree Zaveri,[1] Karena Zaveri,[1] Josep F. Abril,[14] Roderic Guigó,[14] Michael J. Campbell,[1] Kimmen V. Sjolander,[1] Brian Karlak,[1] Anish Kejariwal,[1] Huaiyu Mi,[1] Betty Lazareva,[1] Thomas Hatton,[1] Apurva Narechania,[1] Karen Diemer,[1] Anuradha Muruganujan,[1] Nan Guo,[1] Shinji Sato,[1] Vineet Bafna,[1] Sorin Istrail,[1] Ross Lippert,[1] Russell Schwartz,[1] Brian Walenz,[1] Shibu Yooseph,[1] David Allen,[1] Anand Basu,[1] James Baxendale,[1] Louis Blick,[1] Marcelo Caminha,[1] John Carnes-Stine,[1] Parris Caulk,[1] Yen-Hui Chiang,[1] My Coyne,[1] Carl Dahlke,[1] Anne Deslattes Mays,[1] Maria Dombroski,[1] Michael Donnelly,[1] Dale Ely,[1] Shiva Esparham,[1] Carl Fosler,[1] Harold Gire,[1] Stephen Glanowski,[1] Kenneth Glasser,[1] Anna Glodek,[1] Mark Gorokhov,[1] Ken Graham,[1] Barry Gropman,[1] Michael Harris,[1] Jeremy Heil,[1] Scott Henderson,[1] Jeffrey Hoover,[1] Donald Jennings,[1] Catherine Jordan,[1] James Jordan,[1] John Kasha,[1] Leonid Kagan,[1] [illegible] Kraft,[1] Alexander Levitsky,[1] Mark Lewis,[1] Xiangjun Liu,[1] John Lopez,[1] Daniel Ma,[1] Wil[illegible],[1] Joe McDaniel,[1] Sean Murphy,[1] Matthew Newman,[1] Trung Nguyen,[1] Ngoc Nguye[illegible]dell,[1] Sue Pan,[1] Jim Peck,[1] Marshall Peterson,[1] William Rowe,[1] Robert Sanders,[1] Jo[illegible],[1] Michael Simpson,[1] Thomas Smith,[1] Arlan Sprague,[1] Timothy Stockwell,[1] Russell Turner,[1] Eli Venter,[1] Mei Wang,[1] Meiyuan Wen,[1] David Wu,[1] Mitchell Wu,[1] Ashley Xia,[1] Ali Zandieh,[1] Xiaohong Zhu[1]

junk DNA or useful RNA?

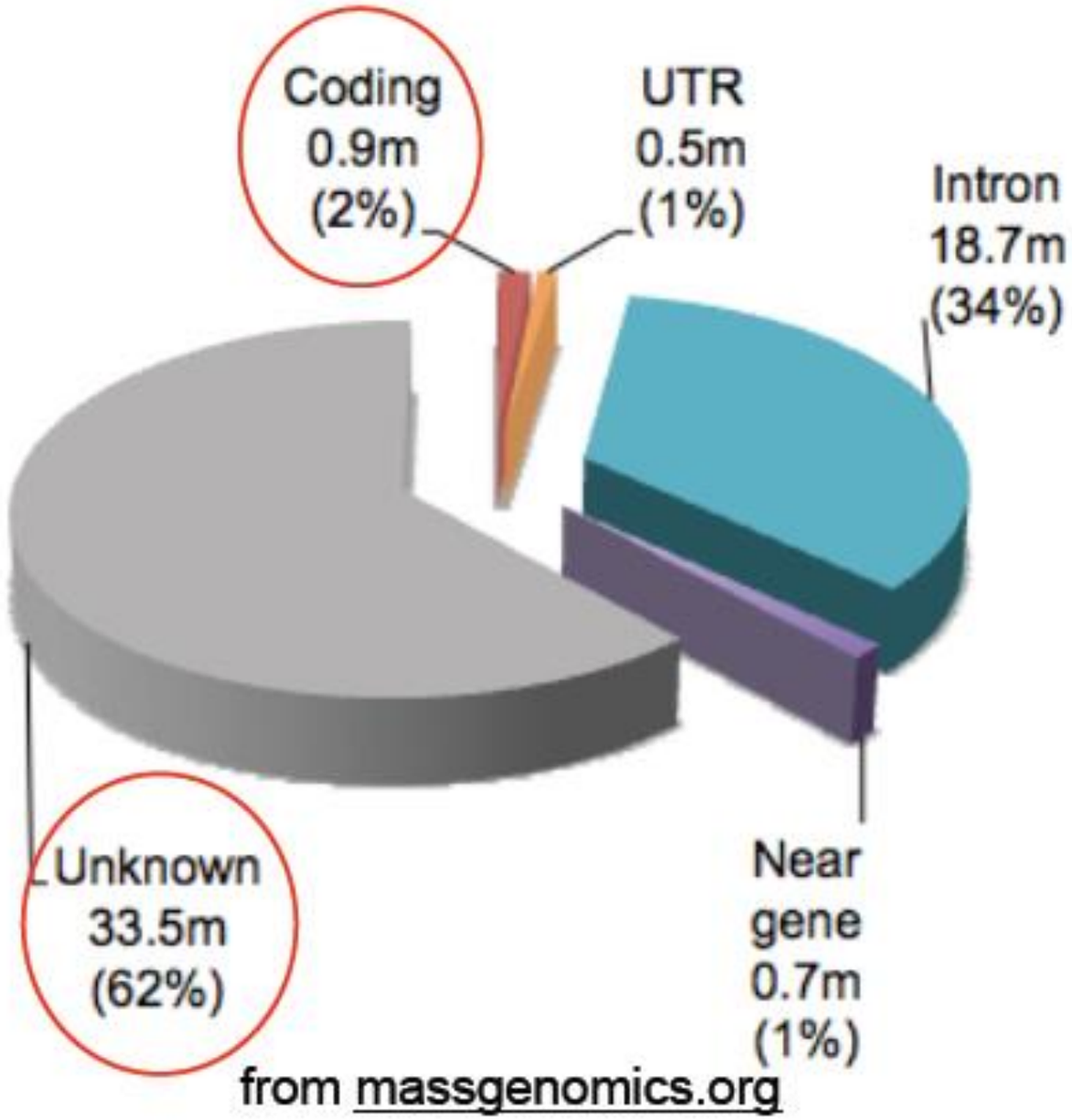
1972

Journal Title: Evolution of genetic systems.
Brookhaven sympoisa in biology, no. 23

SO MUCH "JUNK" DNA IN OUR GENOME

Susumu Ohno
City of Hope National Medical Center

The mammalian genome (haploid chromosome complement)
contains roughly 3.0 X 10^{-9} mg of DNA which represents a
3.0 X 10^{9} base pairs. This is at least 750 times the ge
size of *E. coli*. If we take the simplistic assumption t
the number of genes contained is proportional to the ger

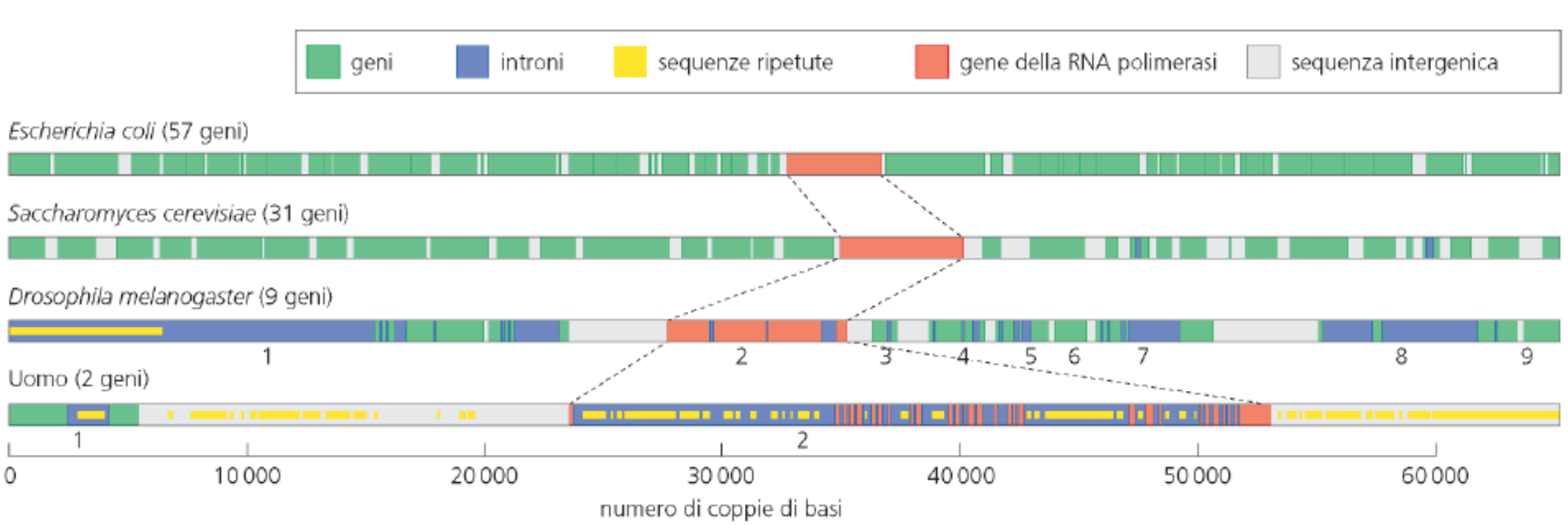


from massgenomics.org

Gli organismi più complessi hanno una minor densità genica

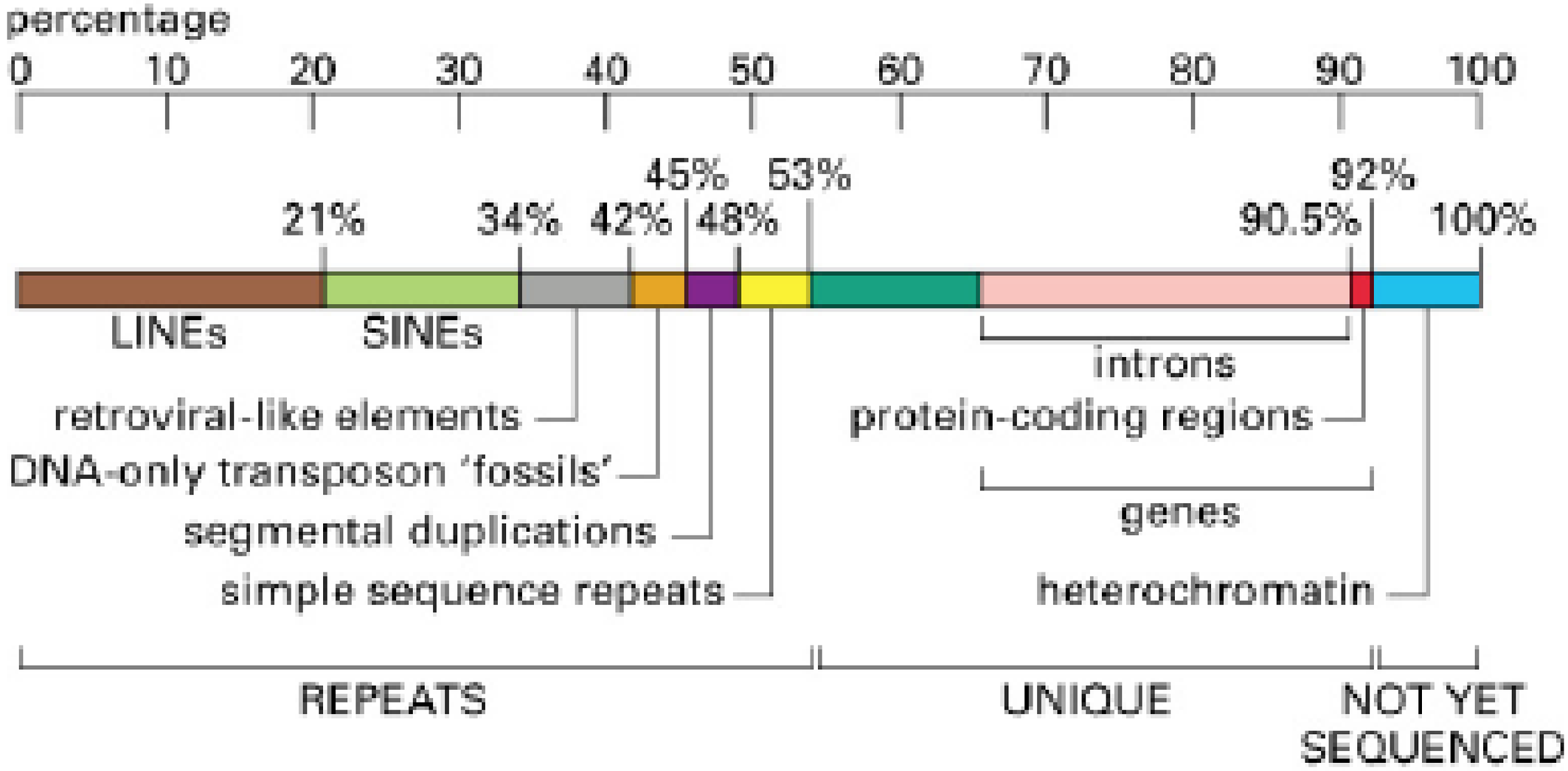
Densità genica = n° geni /Mb.

Esiste una approsimativa **correlazione inversa** fra densità genica e la complessità di un organismo. Le densità geniche più elevate si trovano nei virus dove entrambi i filamenti di un tratto di DNA possono codificare per geni sovrapposti.

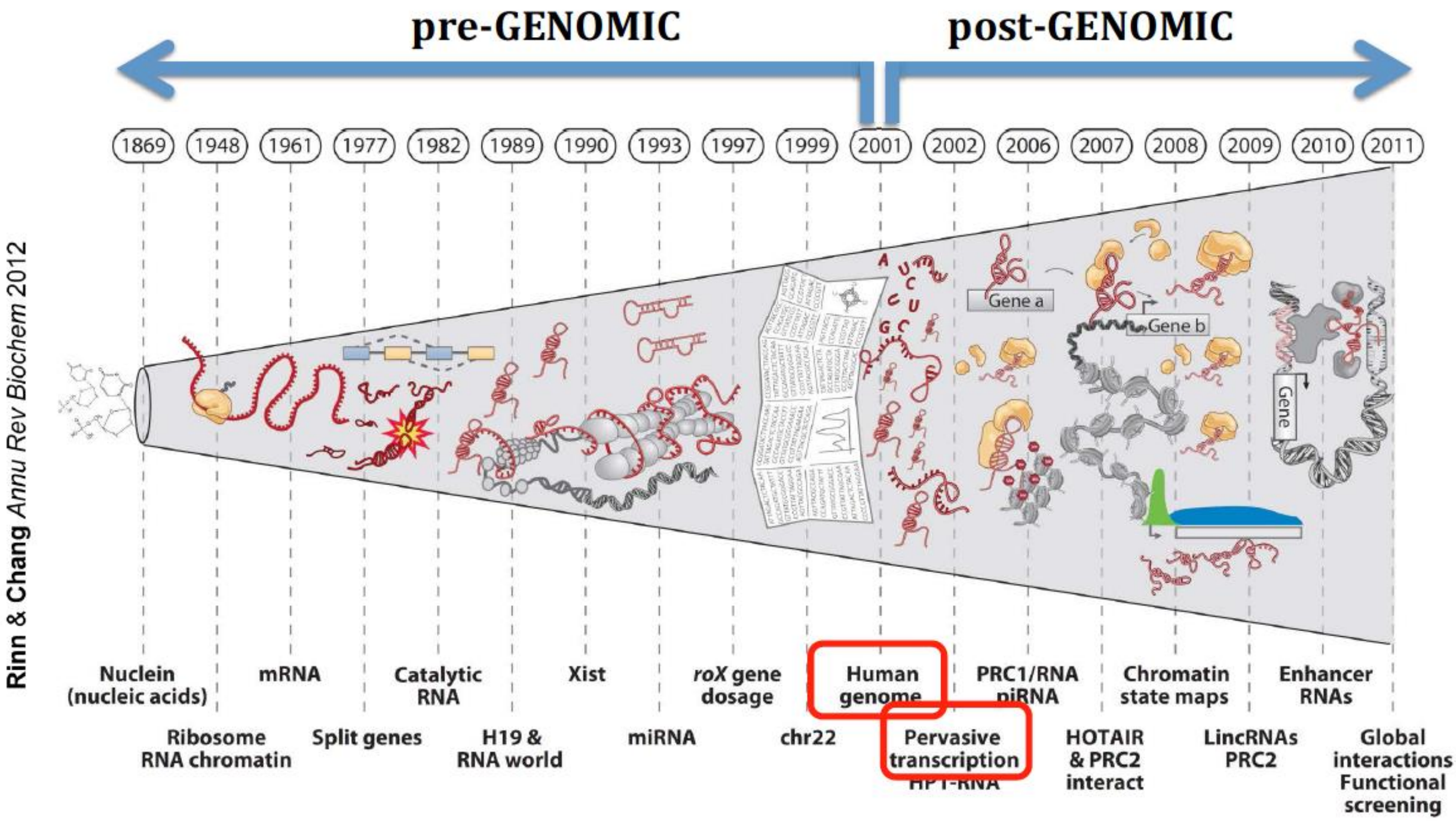


Regione genica codificante la subunità maggiore della RNA pol

Anatomy of the human genome



Era pre-GENOMICA e post-GENOMICA

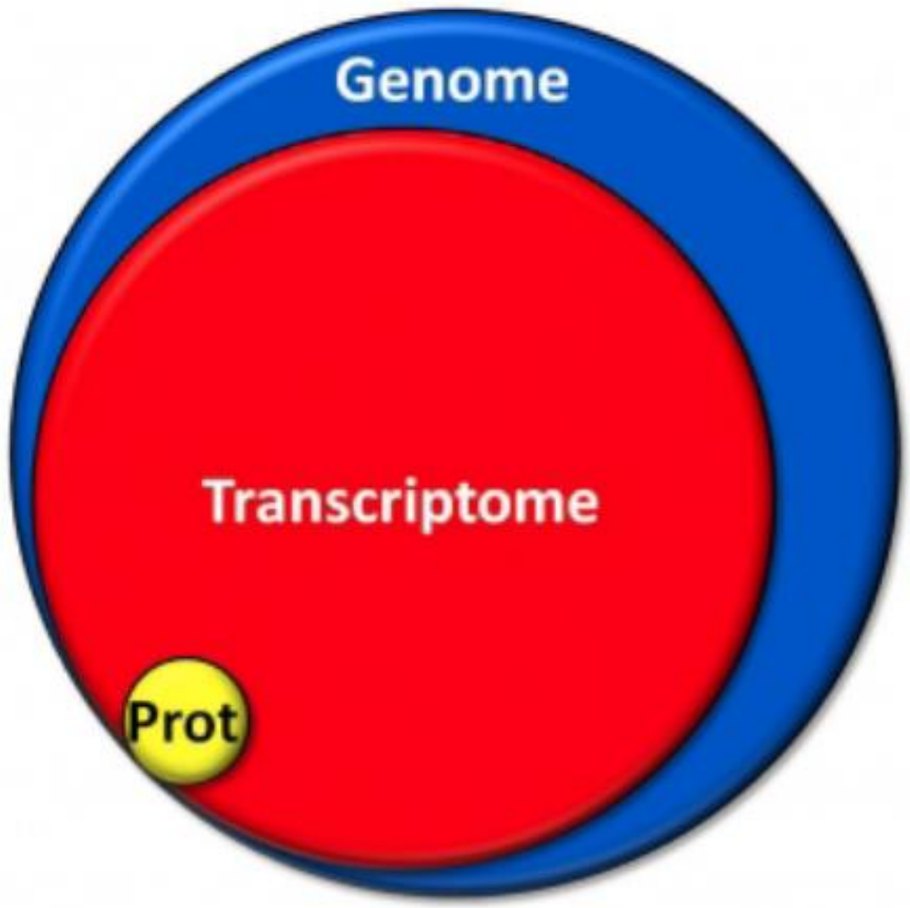


Rinn & Chang *Annu Rev Biochem* 2012

PERVASIVE Transcription

2003

Concept of "Pervasive Transcription"



- **The vast majority of the genome is TRANSCRIBED**
- **The vast majority of the transcripts DO NOT ENCODE for PROTEINS**

The central dogma REVISITED

DNA (2%)

↓

RNA

↓

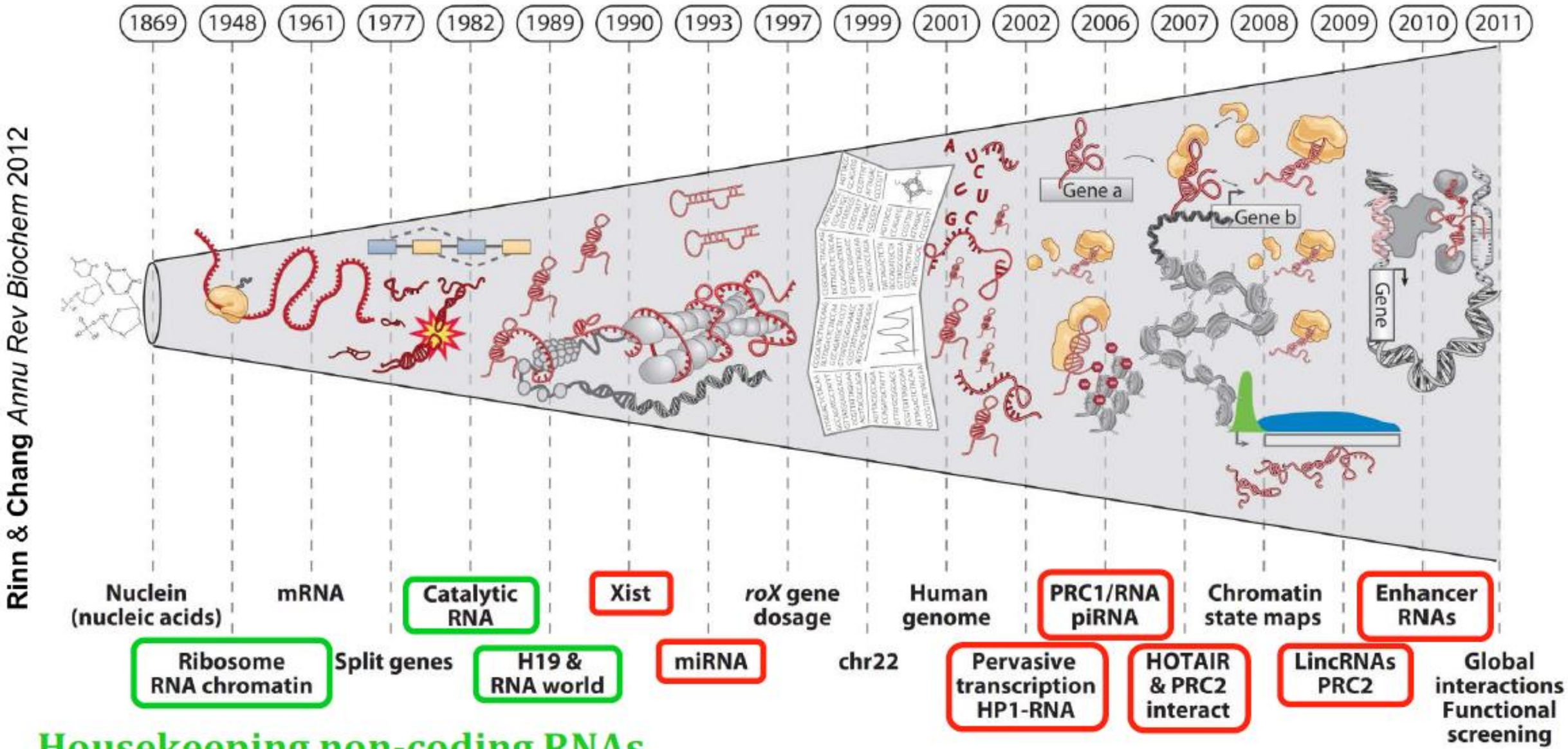
PROTEINs

DNA (90%)

↓

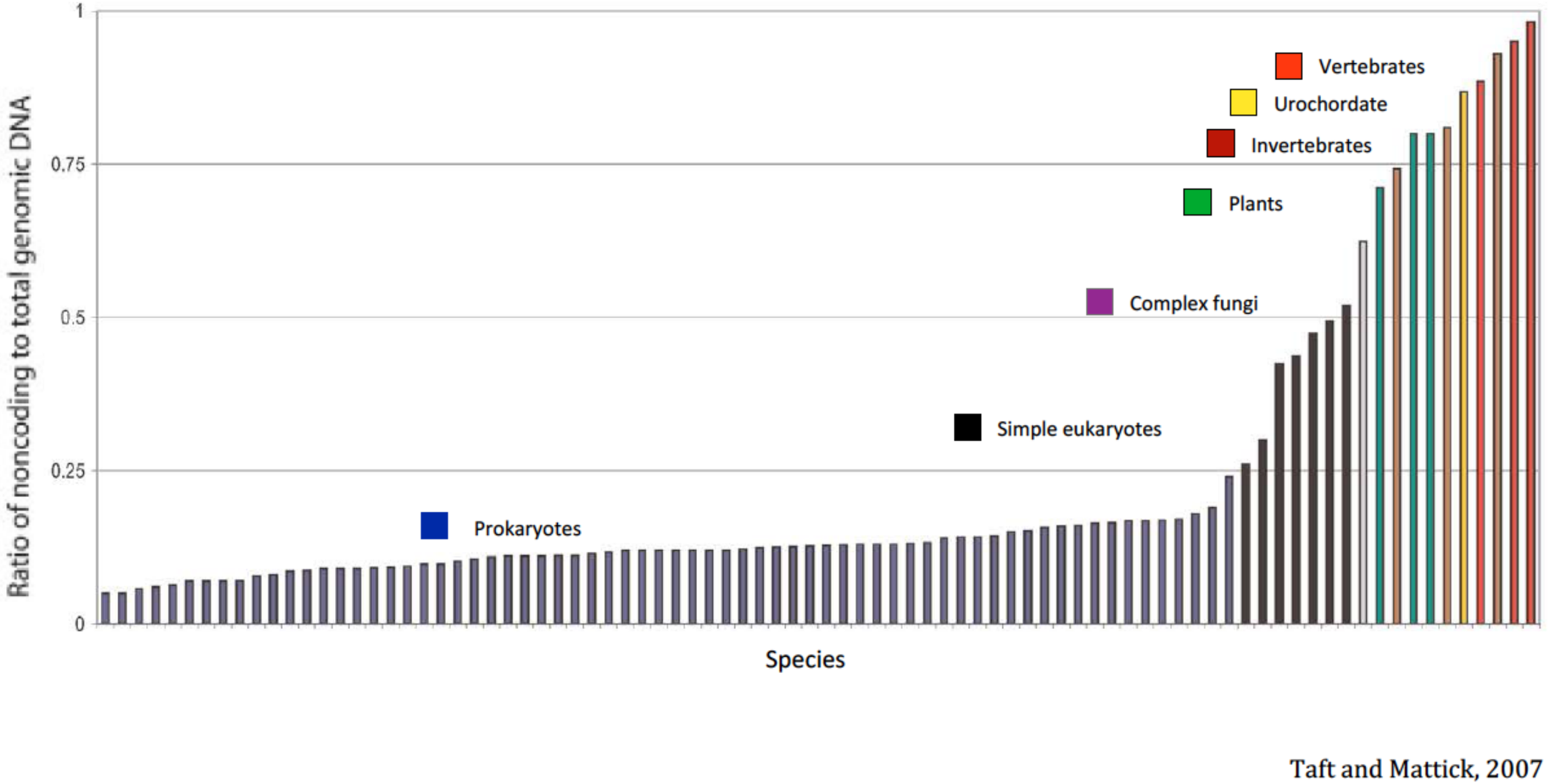
Non-coding RNAs

Next Generation Sequencing



The Proportion of ncDNA Increases with Developmental Complexity

C- value paradox SOLVED



Taft and Mattick, 2007