Model organisms and developmental biology

仲寒冰

zhonghb@sustc.edu.cn

Course Overview

- I. Biology of popular model organisms

- II. Fundamentals of developmental biology
    1. History
    2. Animal developmental processes
    3. Rules in development

- III. Topics
    1. Classical questions, e.g. organ asymmetry
    2. Current hot topics, e.g. angiogenesis

Our Goals

- 1. Learn how to choose an appropriate model organism.
- 2. Understand the fundamentals and key questions of developmental biology.
- 3. Train yourself and apply what you learn to your own research in future.

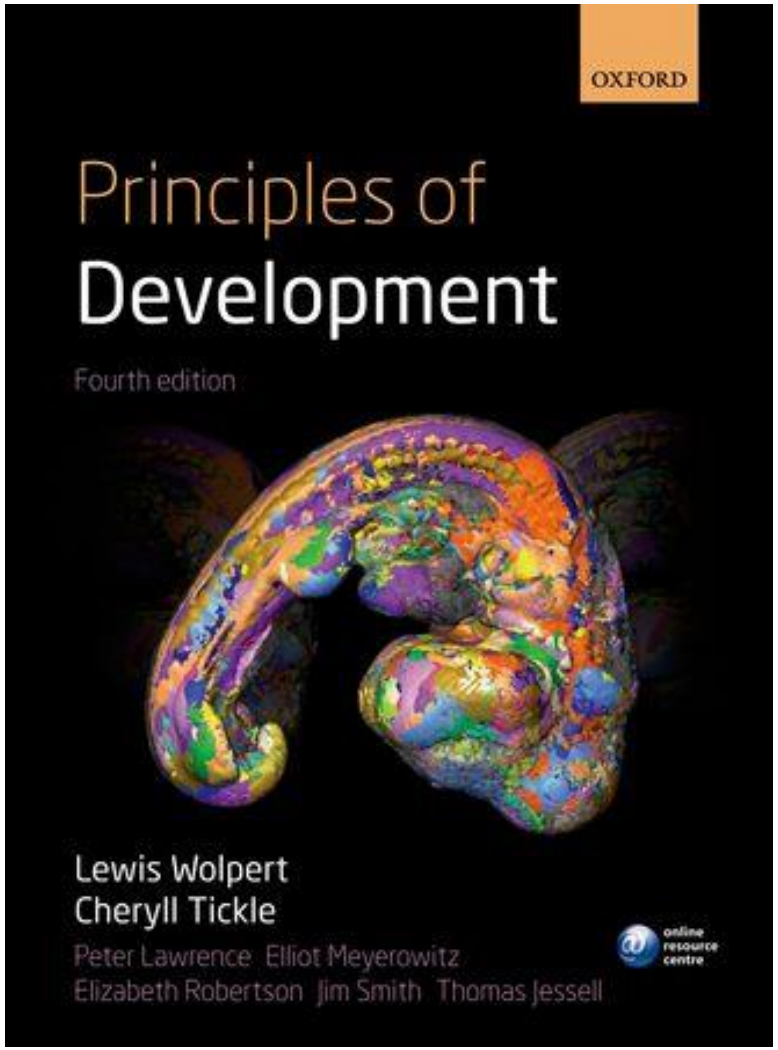
Grading

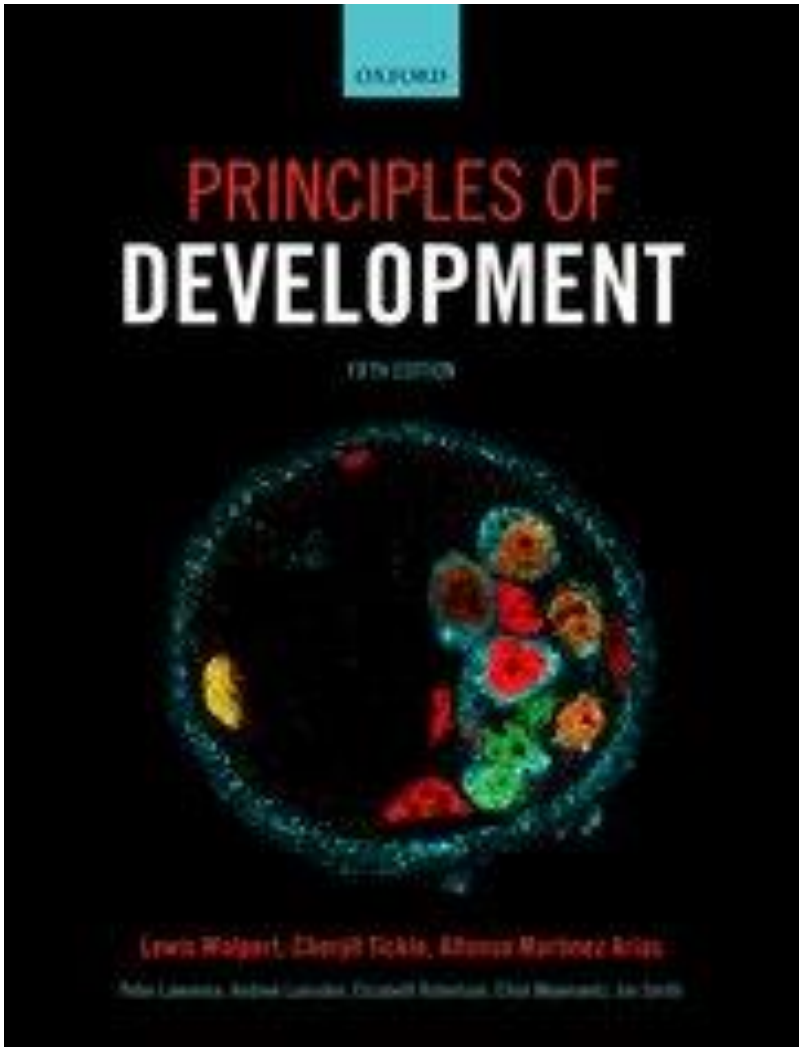
- Class participation, 10 points
- Homework, 10 points
- Mini review or oral presentation, 10 points
- Quiz, 10 points
- Midterm examination, 25 points
- Final examination, 35 points
- Total, 100 points

Office hour

- Monday 10:00-11:00 am
- 一科208
- Phone, 88018417, 18503067679
- TA, 刘瑶函, 13246682592, liuyh@mail.sustc.edu.cn

Principles of Development by Lewis Wolpert

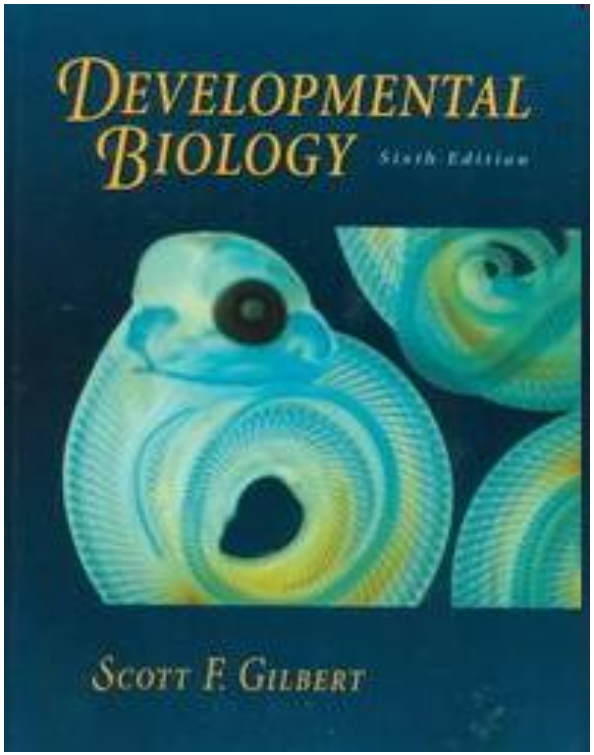




Reference Books

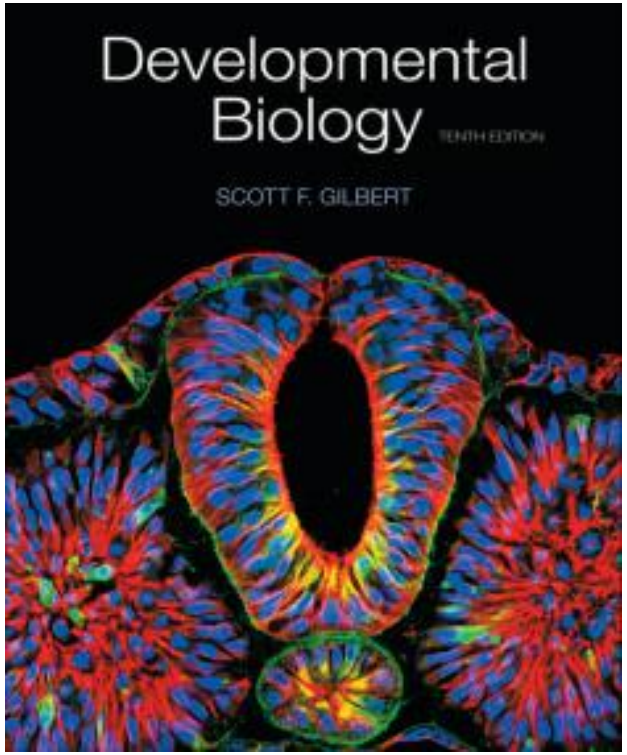
- *Developmental Biology* Gilbert 6th Edition
- 《发育生物学原理》 樊启昶、白书农 编著 高等教育出版社
- 《动物发育的分子原理》 樊启昶、滕俊琳 主译 高等教育出版社

Developmental Biology by Scott Gilbert



6th, 2000
NCBI Bookshelf
UTSZ

9th, 2006
9e.devbio.com



10th, 2013

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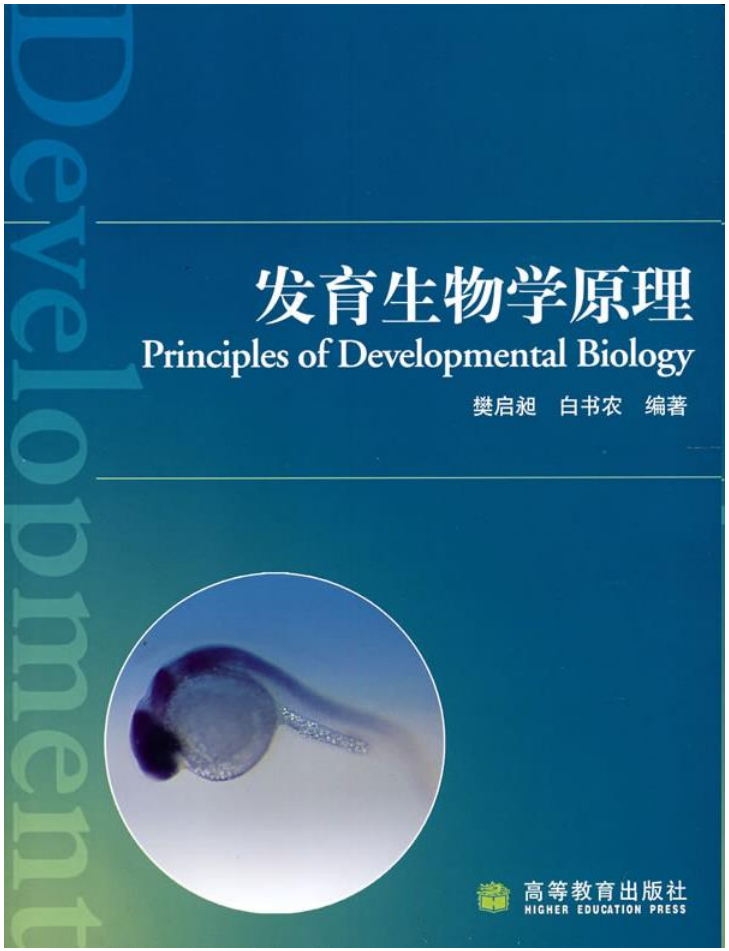
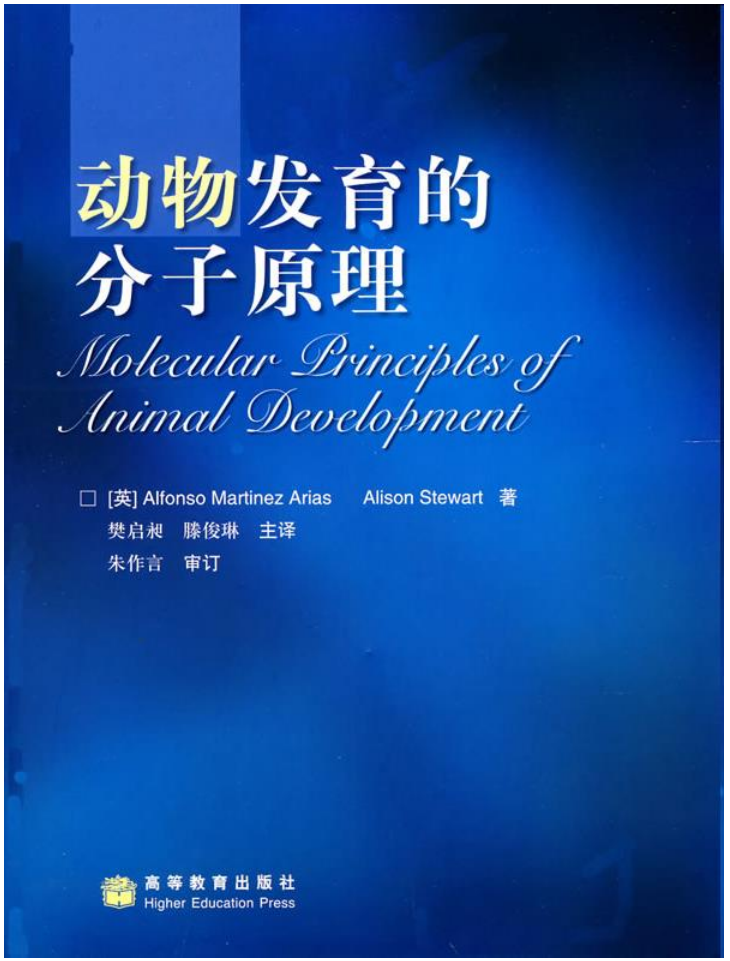

Development
发育生物学原理
Principles of Developmental Biology
樊启昶 白书农 编著
高等教育出版社
HIGHER EDUCATION PRESS


动物发育的
分子原理
Molecular Principles of
Animal Development
[英] Alfonso Martinez Arias Alison Stewart 著
樊启昶 滕俊琳 主译
朱作言 审订
高等教育出版社
Higher Education Press

Journals

- *Cell*
- *Nature*
- *Science*
- *Development*
- *Developmental Cell*
- *Developmental Biology*

125 big questions by *Scicence*

About Our Sites
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- About *ScienceNOW*
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- About *Science Translational Medicine*
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- About Multimedia
- About Collections

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- E-mail Alerts
- RSS Feeds

In a special collection of articles published beginning 1 July 2005, *Science* Magazine and its online companion sites celebrate the journal's 125th anniversary with a look forward -- at the most compelling puzzles and questions facing scientists today. A special, free news feature in *Science* explores 125 big questions that face scientific inquiry over the next quarter-century; accompanying the feature are several online extras including a reader's forum on the big questions. The Signal Transduction Knowledge Environment highlights some classic *Science* papers that have influenced the study of cell signaling. The Science of Aging Knowledge Environment looks at several important questions confronting researchers on aging. And *Science*'s Next Wave introduces us to four young scientists building their careers grappling with some of the very questions that *Science* has identified.

Jump to Features in This Special Collection:

In *Science* Magazine
In *Science*'s STKE
In *Science*'s SAGE KE
In *Science*'s Next Wave

Model organisms

Biodiversity and model organisms

From stanford.edu

Characteristics of Model Organisms

- 1. a non-human species
- 2. small adult size
- 3. rapid development with short life cycles
- 4. ready availability

Ensembl Species

Alpaca
Vicugna pacos
vicPac1

Anole lizard
Anolis carolinensis
AnoCar2.0

Armadillo
Dasypus novemcinctus
dasNov2

Baboon (preview - assembly only)
Papio hamadryas
Pham

Budgerigar (preview - assembly only)
Melopsittacus undulatus
MelUnd6.3

Bushbaby
Otolemur garnettii
OtoGar3

Ciona intestinalis
Ciona intestinalis
KH

Ciona savignyi
Ciona savignyi
CSAV2.0

Caenorhabditis elegans
Caenorhabditis elegans
WBcel235

Cat
Felis catus
Felis_catus_6.2

Gibbon
Nomascus leucogenys
Nleu1.0

Gorilla
Gorilla gorilla gorilla
gorGor3.1

Guinea Pig
Cavia porcellus
cavPor3

Hedgehog
Erinaceus europaeus
HEDGEHOG

Horse
Equus caballus
EquCab2

Human
Homo sapiens
GRCh37

Hyrax
Procavia capensis
proCap1

Kangaroo rat
Dipodomys ordii
dipOrd1

Lamprey
Petromyzon marinus
Pmarinus_7.0

Lesser hedgehog tenrec
Echinops telfairi
TENREC

Platyfish
Xiphophorus maculatus
Xipmac4.4.2

Platypus
Ornithorhynchus anatinus
OANA5

Rabbit
Oryctolagus cuniculus
oryCun2

Rat
Rattus norvegicus
Rnor_5.0

Saccharomyces cerevisiae
Saccharomyces cerevisiae
EF4

Sheep (preview - assembly only)
Ovis aries
Oar_v3.1

Shrew (preview new assembly SorAra2.0)
Sorex araneus
COMMON_SHREW1

Sloth
Choloepus hoffmanni
choHof1

Spotted Gar (preview - assembly only)
Lepisosteus oculatus
LepOcu1

Squirrel
Ictidomys tridecemlineatus
spetri2

Ensembl Species


Alpaca
Vicugna pacos
vicPac1


Anole lizard
Anolis carolinensis
AnoCar2.0


Armadillo
Dasypus novemcinctus
dasNov2


Baboon (preview - assembly only)
Papio hamadryas
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Budgerigar (preview - assembly only)
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Otolemur garnettii
OtoGar3


Ciona intestinalis
Ciona intestinalis
KH


Ciona savignyi
Ciona savignyi
CSAV2.0


Caenorhabditis elegans
Caenorhabditis elegans
WBcel235


Cat
Felis catus
Felis_catus_6.2


Gibbon
Nomascus leucogenys
Nleu1.0


Gorilla
Gorilla gorilla gorilla
gorGor3.1


Guinea Pig

Popular genomes


Human
GRCh37


Mouse
GRCm38


Zebrafish
Zv9

proCap1


Kangaroo rat
Dipodomys ordii
dipOrd1


Lamprey
Petromyzon marinus
Pmarinus_7.0


Lesser hedgehog tenrec
Echinops telfairi
TENREC


Platyfish
Xiphophorus maculatus
Xipmac4.4.2


Platypus
Ornithorhynchus anatinus
OANA5


Rabbit
Oryctolagus cuniculus
oryCun2


Rat
Rattus norvegicus
Rnor_5.0


Saccharomyces cerevisiae
Saccharomyces cerevisiae
EF4


Sheep (preview - assembly only)
Ovis aries
Oar_v3.1


Shrew (preview new assembly SorAra2.0)
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COMMON_SHREW1


Sloth
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Spotted Gar (preview - assembly only)
Lepisosteus oculatus
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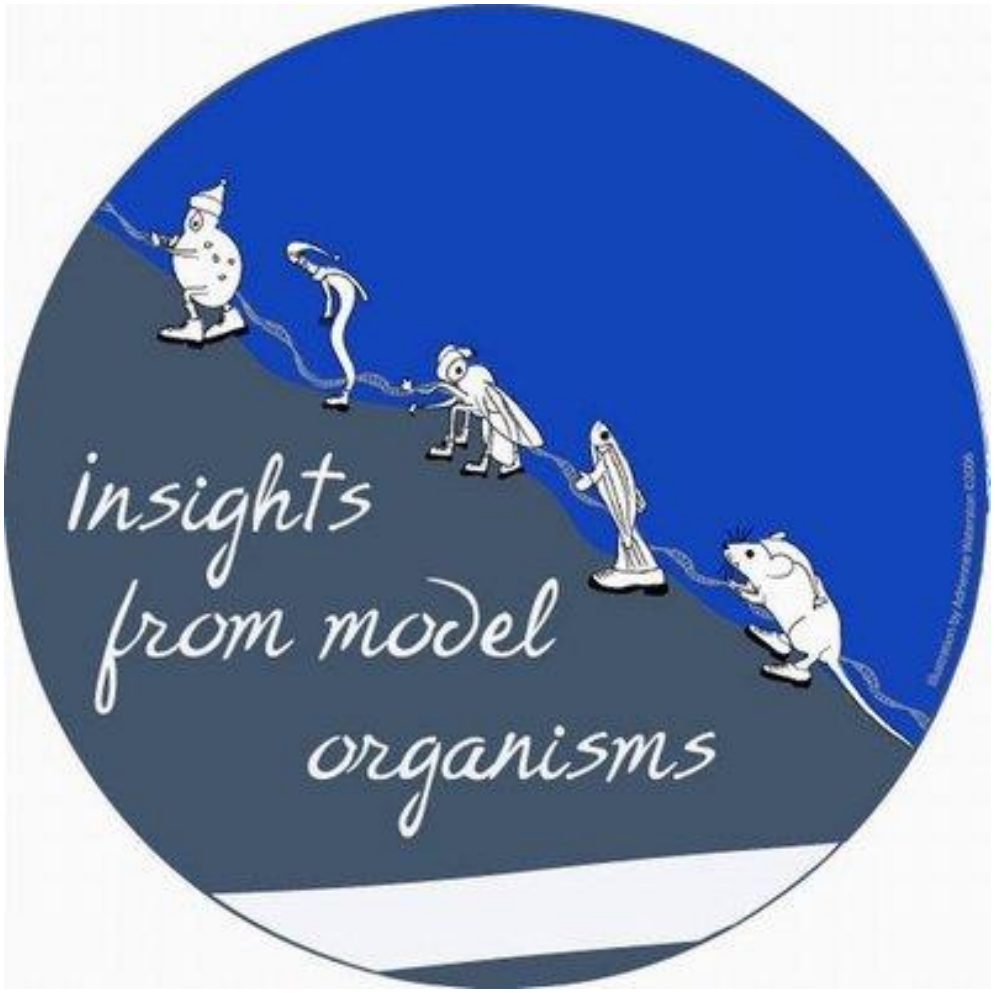


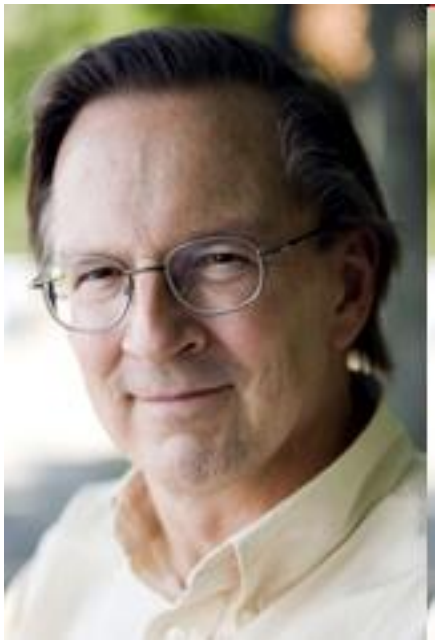
By Adrienne Waterston

A nice example of choosing a model organism

Telomere and telomerase, an example of how to choose a model organism

Elizabeth H. Blackburn

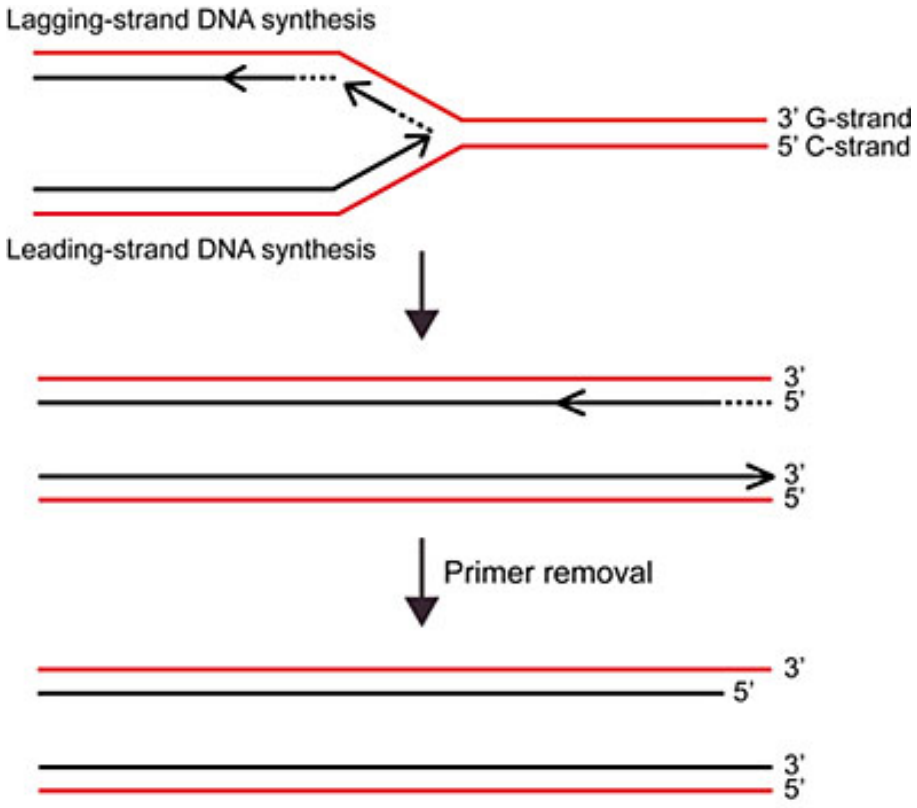
Carol W. Greider



Jack W. Szostak

The winners of Nobel Prize in Physiology or Medicine 2009

DNA replication



Origin of Concatemeric T7 DNA

J. D. WATSON

The Biological Laboratories, Harvard University, and the Cold Spring Harbor Laboratory

b

impossible and we are left with a 3′ ended single-stranded tail projecting from one end of each daughter double helix. One of each pair of daughter helices will have a tail on its left end, the other half on its right end (Fig. 4).

We get the same result if an RNA primer does the job.

Watson 1972 Nature

Telomere was named by Hermann Muller

Famous students

A.H. Sturtevant

C.B. Bridges

H.J. Muller

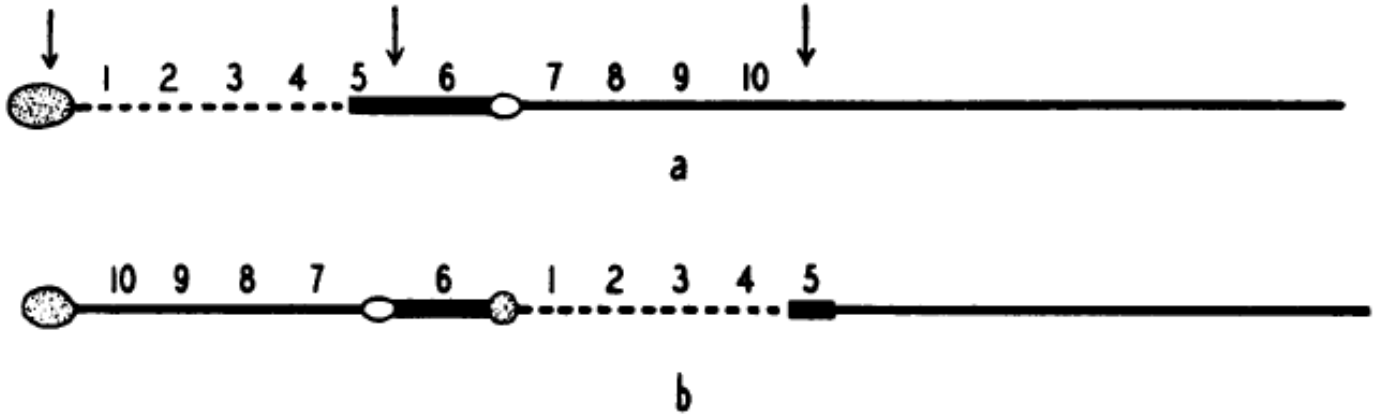
Hermann J. Muller

- In 1919, Muller made the important discovery of a mutant (later found to be a chromosomal inversion) that appeared to suppress crossing-over, which opened up new avenues in mutation rate studies and leaded to generation of balancer chromosomes.

- Balancer chromosomes always contain a lethal recessive allele.

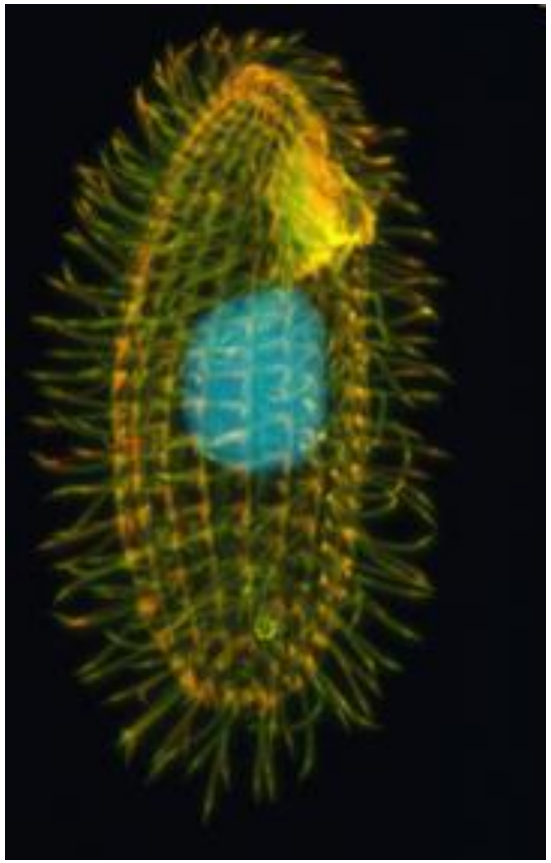
- X-ray mutagenesis.

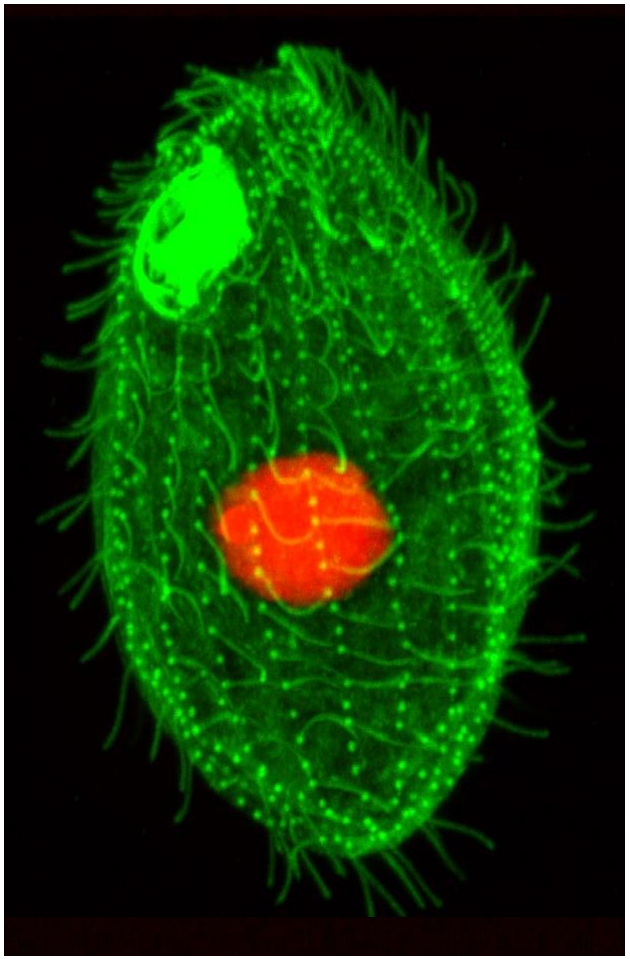
The Behavior in Successive Nuclear Divisions of a Chromosome Broken at Meiosis



McClintock 1939 PNAS

Tetrahymena (四膜虫)





Tetrahymena thermophile (嗜热四膜虫)

- Size ~ 50 um, close to Paramecium.
- Short life cycle, doubling time is about 2 hours.
- Cell synchronization achieve *in vitro*.
- Two types of cell nuclei: a big, non-germline macronucleus, and a small, germline micronucleus.
- rDNA in macronucleus breaks and replicates to form ~10000 minichromosomes.

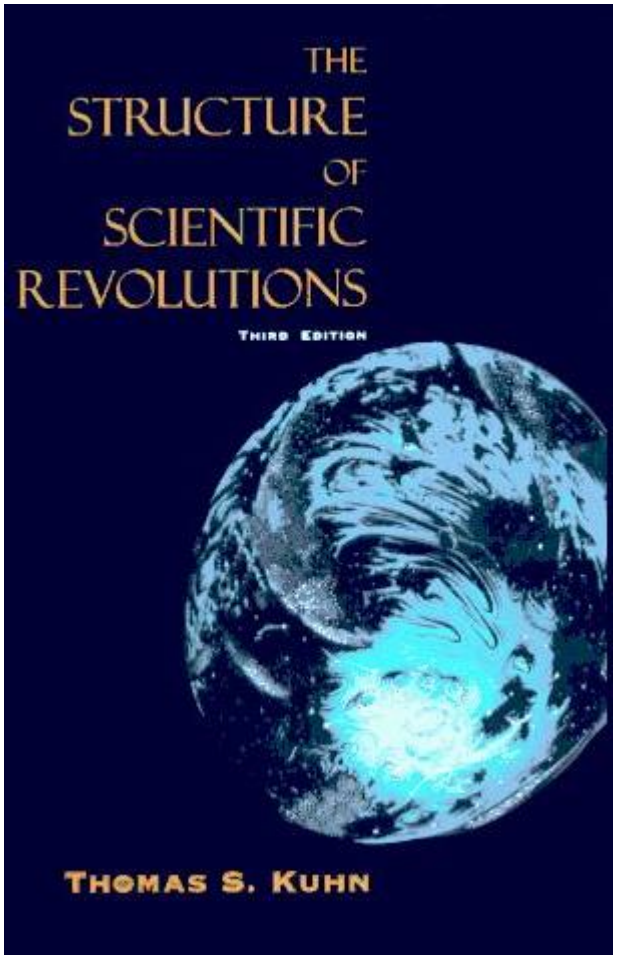
- 1978, Elizabeth H. Blackburn isolated rDNA and revealed the 5’-CCCCAA-3’ repeat sequences in telomere.
- 1980, Jack W. Szostak added 5’-CCCCAA-3’ to the ends of a linear DNA fragment. And it replicated in yeast.
- 1984, Carol W. Greider and Elizabeth H. Blackburn proved the existence of telomerase.
- 1996, the catalytic subunit of telomerase was purified.
- The story continues.

Acknowledgement

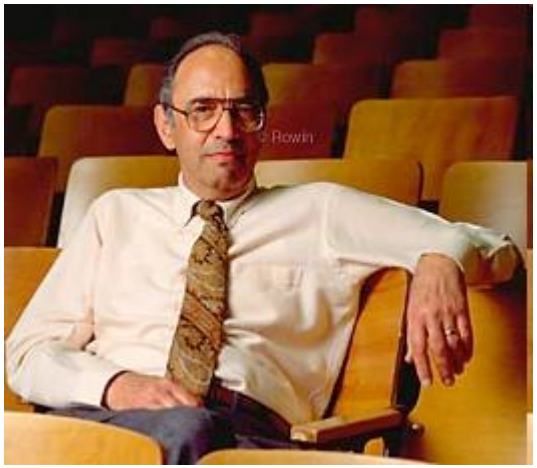
- Telomere and telomerase

toptip@mitbbs.com

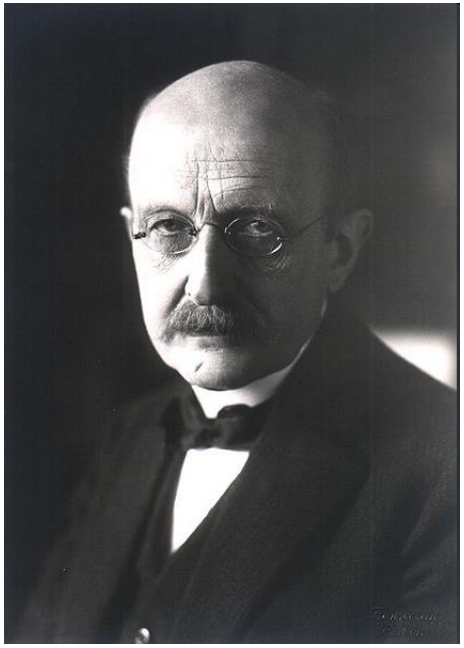
Paradigm and paradigm shift



3rd, 中译本
UTSZ



Thomas Samuel Kuhn

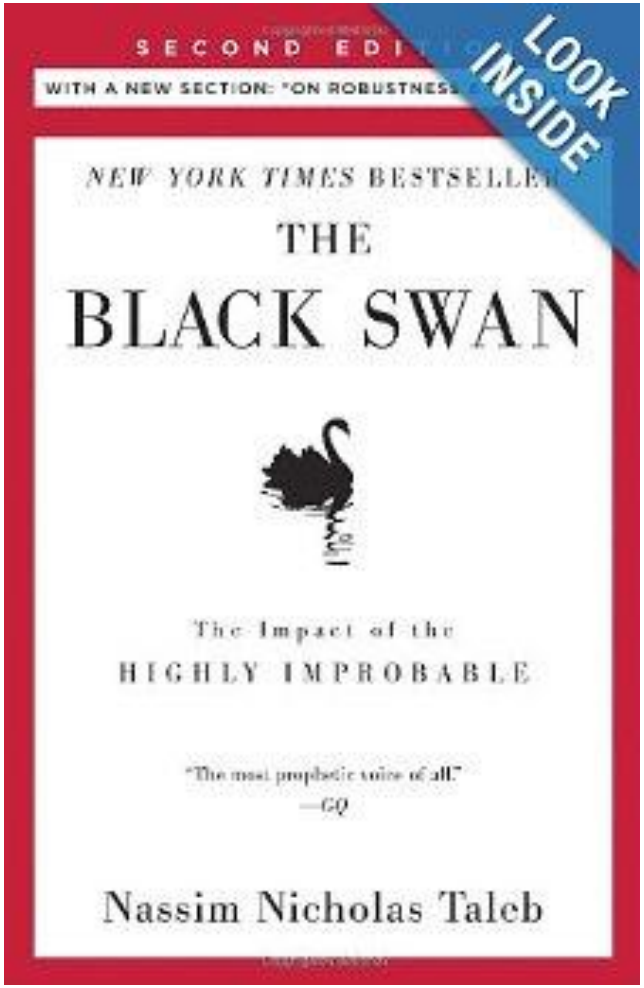


Max Planck
(1858-1947)
Photo from www.sil.si.edu

A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it.

Wissenschaftliche Selbstbiographie. Mit einem Bildnis und der von Max von Laue gehaltenen Traueransprache., Johann Ambrosius Barth Verlag, (Leipzig 1948), p. 22, as translated in Scientific Autobiography and Other Papers, trans. F. Gaynor (New York, 1949), pp.33-34

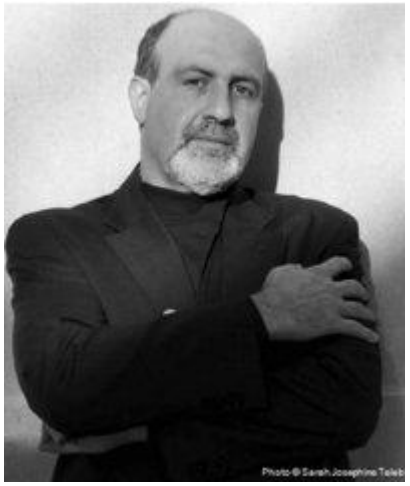
The Black Swan by Nassim Nicholas Taleb



The Impact of the Highly Improbable

A black swan is an event, positive or negative, that is deemed improbable yet causes massive consequences. In this groundbreaking and prophetic book, Taleb shows in a playful way that Black Swan events explain almost everything about our world, and yet we—especially the experts—are blind to them.

- Nassim Nicholas Taleb is a bestselling author.
- A professor at several universities, currently at Polytechnic Institute of New York University and Oxford University.
- A practitioner of mathematical finance, a hedge fund manager, a derivatives trader.
- A scientific adviser at Universa Investments and the International Monetary Fund.



From wikipedia and amazon

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The Exception: Common Knowledge
Other Scenarios to Avoid
Why Does it Matter if You Plagiarize?
How to Avoid Plagiarism
Harvard Plagiarism

What Constitutes Plagiarism?

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Verbatim plagiarism | Mosaic plagiarism | Inadequate paraphrase
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In academic writing, it is considered plagiarism to draw any idea or any language from someone else without adequately crediting that source in your paper. It doesn't matter whether the source is a published author, another student, a Web site without clear authorship, a Web site that sells academic papers, or any other person: Taking credit for anyone else's work is stealing, and it is unacceptable in all academic situations, whether you do it intentionally or by accident.

The ease with which you can find information of all kinds on the Internet means that when you use online sources, you need to be extra vigilant about keeping track of where you are getting information and ideas, and about giving proper credit to the authors of the sources you use. If you cut and paste from an electronic document into your notes and forget to clearly label the document in your notes, or if you draw information from a series of Web sites without taking careful notes, you may end up taking credit for ideas that aren't yours, whether you mean to or not.

It's important to remember that every Web site is a document with an author, and therefore every Web site must be cited properly in your paper. For example, while it may seem obvious to you that an idea drawn from Professor Steven Pinker's book *The Language Instinct* should only appear in your paper if you include a

George H. Heilmeier 乔治·哈利·海尔迈耶

From Wikipedia, the free encyclopedia

George Harry Heilmeier (May 22, 1936 – April 21, 2014) was an American engineer, manager, and a pioneering contributor to liquid crystal displays (LCDs), for which he was inducted into the National Inventors Hall of Fame. Heilmeier's work is an IEEE Milestone.[1][2]

Contents [hide]

Biography [edit]

Heilmeier was born in Philadelphia, Pennsylvania, graduated from Abraham Lincoln High School there, received his BS in Electrical Engineering from the University of Pennsylvania in Philadelphia, and his M.S.E., M.A., and Ph.D. degrees in solid state materials and electronics from Princeton University.

In 1958 Heilmeier joined RCA Laboratories in Princeton, New Jersey, where he worked on parametric amplification, tunnel diode down-converters, millimeter wave generation, ferroelectric thin film devices, organic semiconductors and electro-optic effects in molecular and liquid crystals. In 1964 he discovered several new

George H. Heilmeier

Born	May 22, 1936 Philadelphia, Pennsylvania
Died	April 21, 2014 (aged 77) Plano, Texas
Residence	United States
Nationality	American
Fields	Electrical engineering
Alma mater	University of Pennsylvania
Notable awards	IEEE Founders Medal (1986) National Medal of Science (1991) IRI Medal (1993) IEEE Medal of Honor (1997)

Heilmeier's Catechism

- What are you trying to do? Articulate your objectives using absolutely no jargon.
- How is it done today, and what are the limits of current practice?
- What's new in your approach and why do you think it will be successful?
- Who cares? If you're successful, what difference will it make? What are the risks and the payoffs?
- How much will it cost? How long will it take? What are the midterm and final "exams" to check for success?

Thanks!