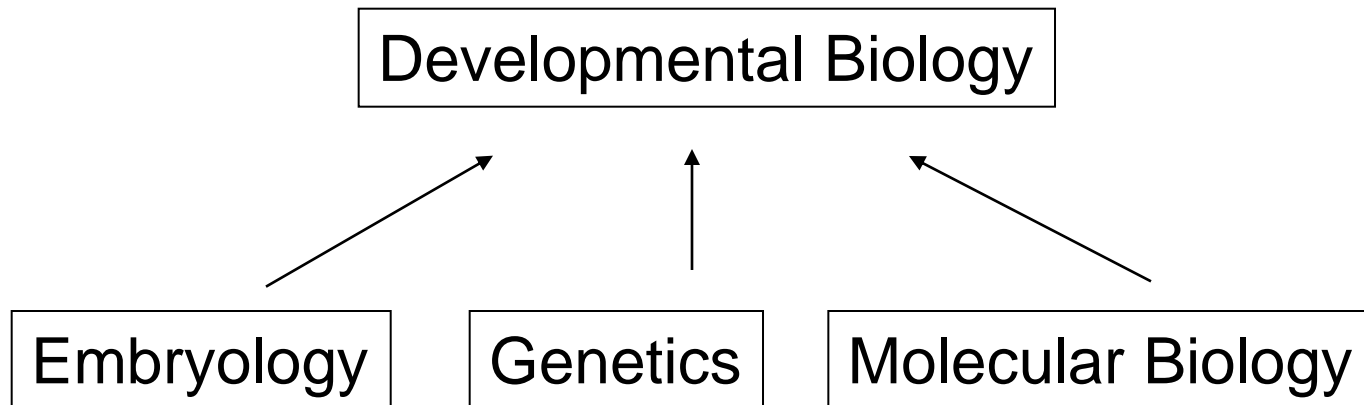


Model organisms and developmental biology

仲寒冰

zhong.hb@sustc.edu.cn

Developmental biology is the study of the process by which organisms grow and develop. Modern developmental biology studies the genetic control of cell growth, differentiation and morphogenesis on molecular level, which is the process that gives rise to tissues, organs and anatomy.

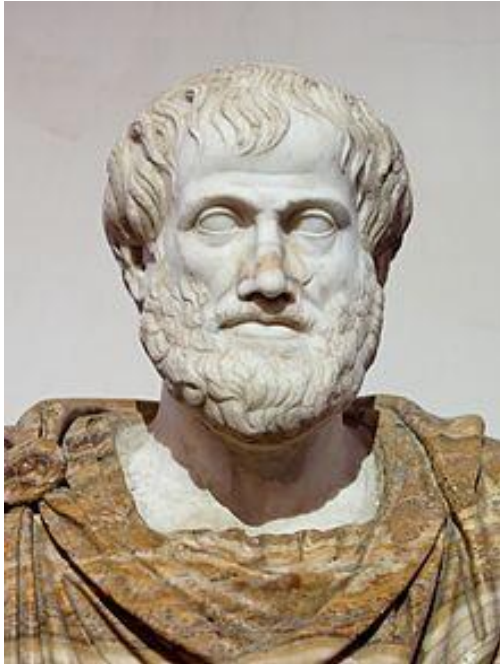


The History of Developmental Biology

- Embryology: descriptive stage
- Embryology: experimental stage
- Developmental biology

Descriptive Stage of Embryology —— the question of “what”

- Aristotle
- Marcello Malpighi
- Kaspar Friedrich Wolff
- Heinz Christian Pander
- Karl Ernst von Baer
- Theodore Schwann

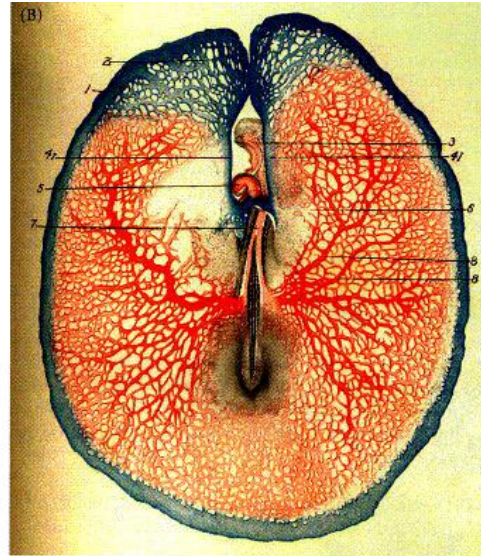
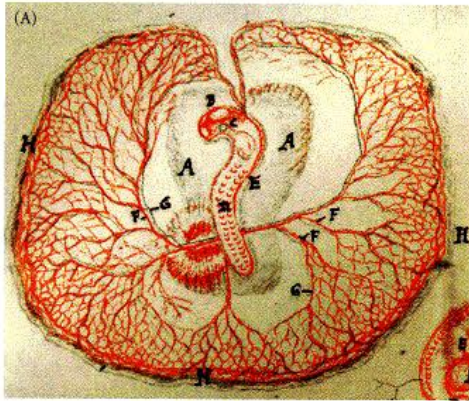


Aristotle
384-322 BC

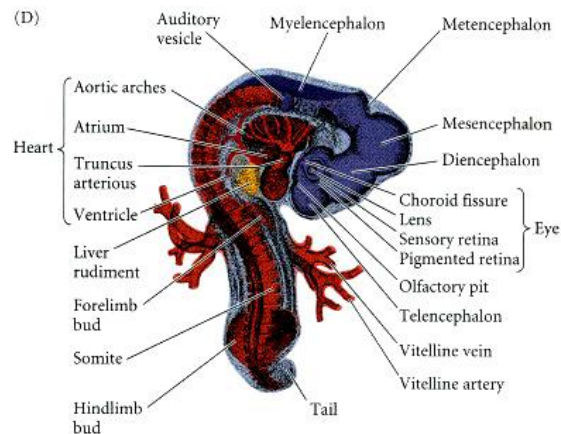
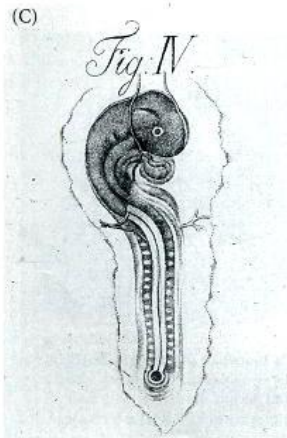
- *History of Animals*
- ***Generation of Animals***
- *Parts of Animals*

Preformation or epigenesis

Introduction of Microscope into Embryology (1672)



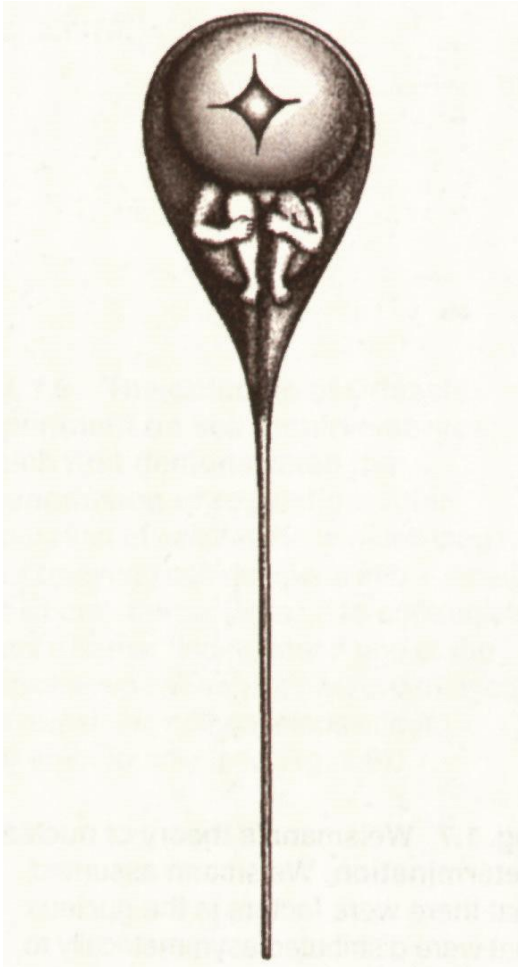
Marcello Malpighi
(Founder of histology)



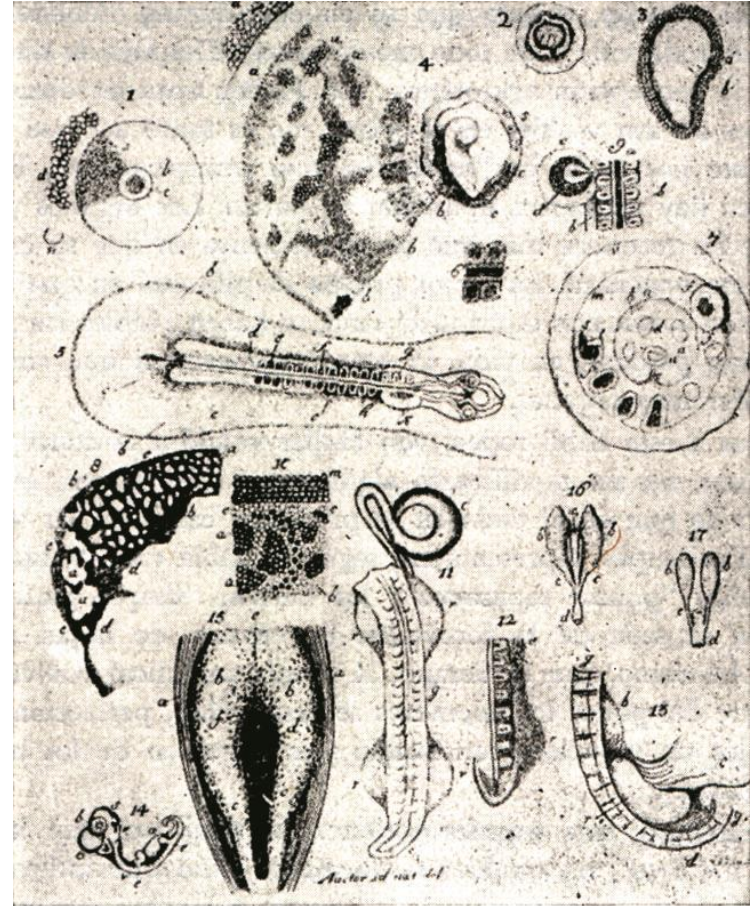
Preformation (先成论)

VS

Epigenesis (后生论)

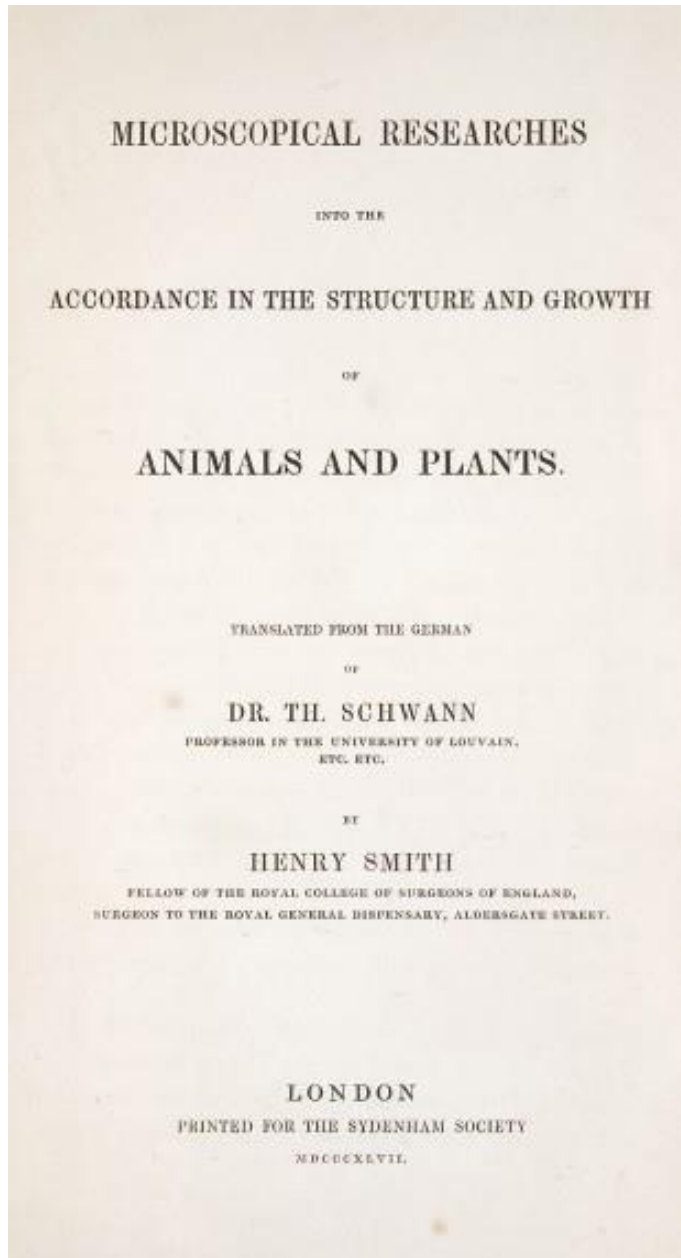


Nicholas Hartsoeker (1694)



Kaspar Friedrich Wolff (1759)

The Cell Theory (1847)

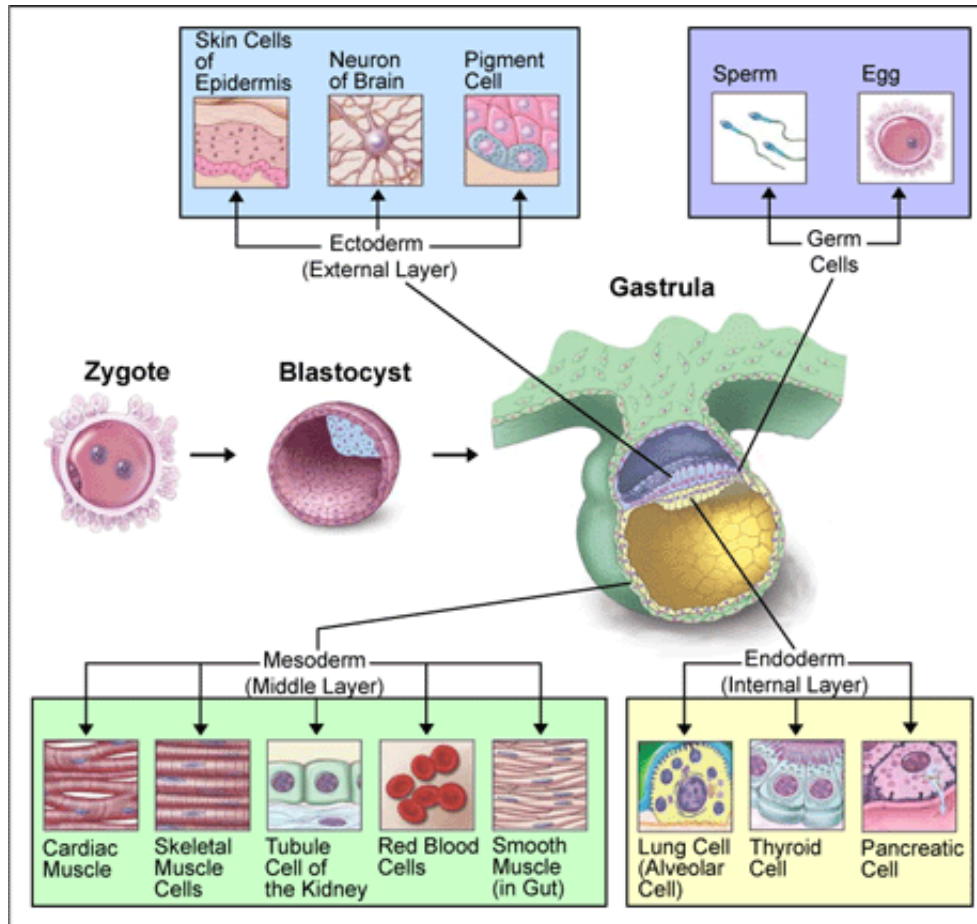


Theodore Schwann

Both animals and plants are multicellular composites that arise from a single cell, therefore development must be epigenetic and not preformational since a single cell (the fertilized egg) results in many different types of cells.

Comparative Embryology I

—— the discovery of “germ layer (胚层)” (1817)



Heinz Christian Pander

Comparative Embryology II

——the four principles of Karl Ernst von Baer (1828)



冯贝尔法则：

- 1. 越普遍的特征在发育过程中出现的越早。
- 2. 越特化的特征出现的越晚
(三个胚层 VS 脊索和神经管)。
- 3. 某一特定物种的发育并不经过比其低等动物发育的成体阶段，而是离其越来越远（鳃裂，真正的鳃，耳骨）。
- 4. 高等动物发育的早期阶段并不与低等动物相似，而与其胚胎相似。

Karl Ernst von Baer

Comparative Embryology II

——the four principles of Karl Ernst von Baer (1828)



Karl Ernst von Baer



Ernst Haeckel, *The evolution of man*, 1903

Recapitulation theory (重演率)

Ontogeny recapitulates phylogeny!

A surprising exception – the strange grow-down life of *Pseudis paradoxa* (paradoxical frog or shrinking frog, 奇异多指节蛙、萎缩蛙)



Adult ~ 7 cm

A surprising exception – the strange grow-down life of *Pseudis paradoxa* (paradoxical frog or shrinking frog, 奇异多指节蛙、萎缩蛙)



Adult ~ 7 cm

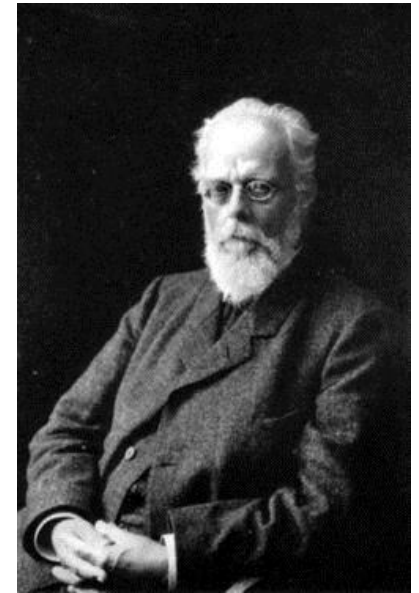
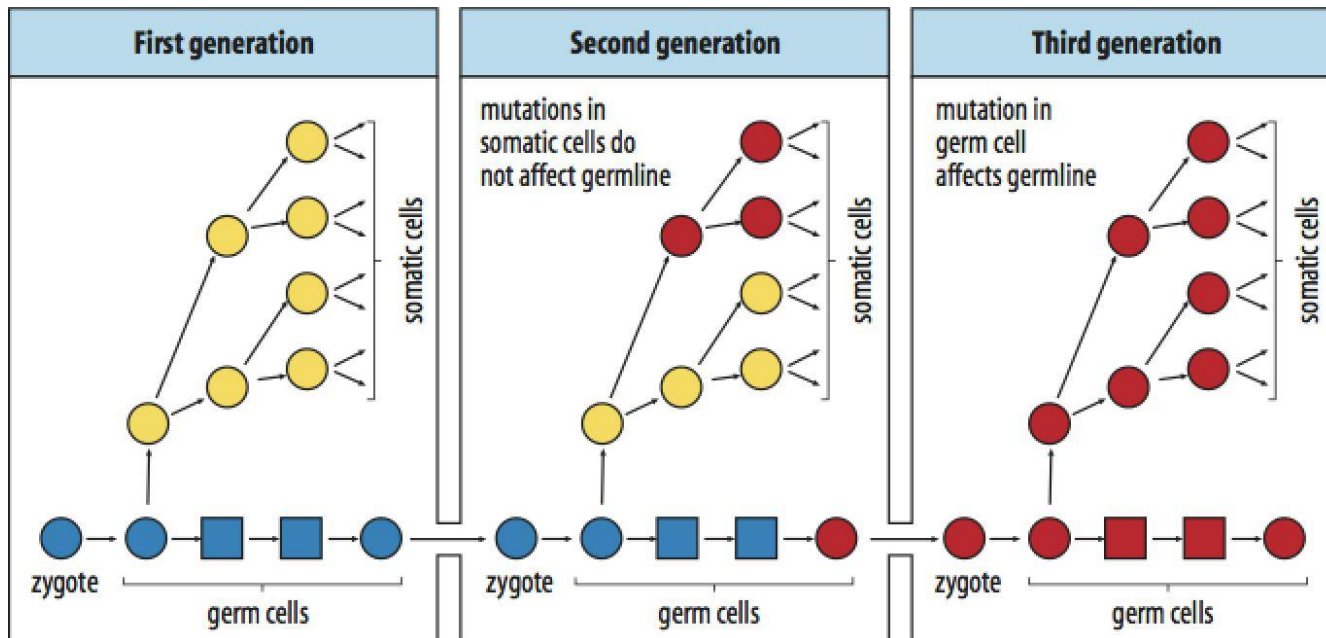


Tadpole ~ 25 cm

Experimental Stage of Embryology —— the question of “how”

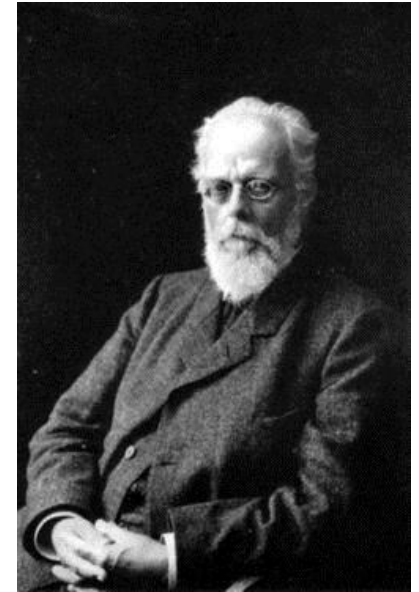
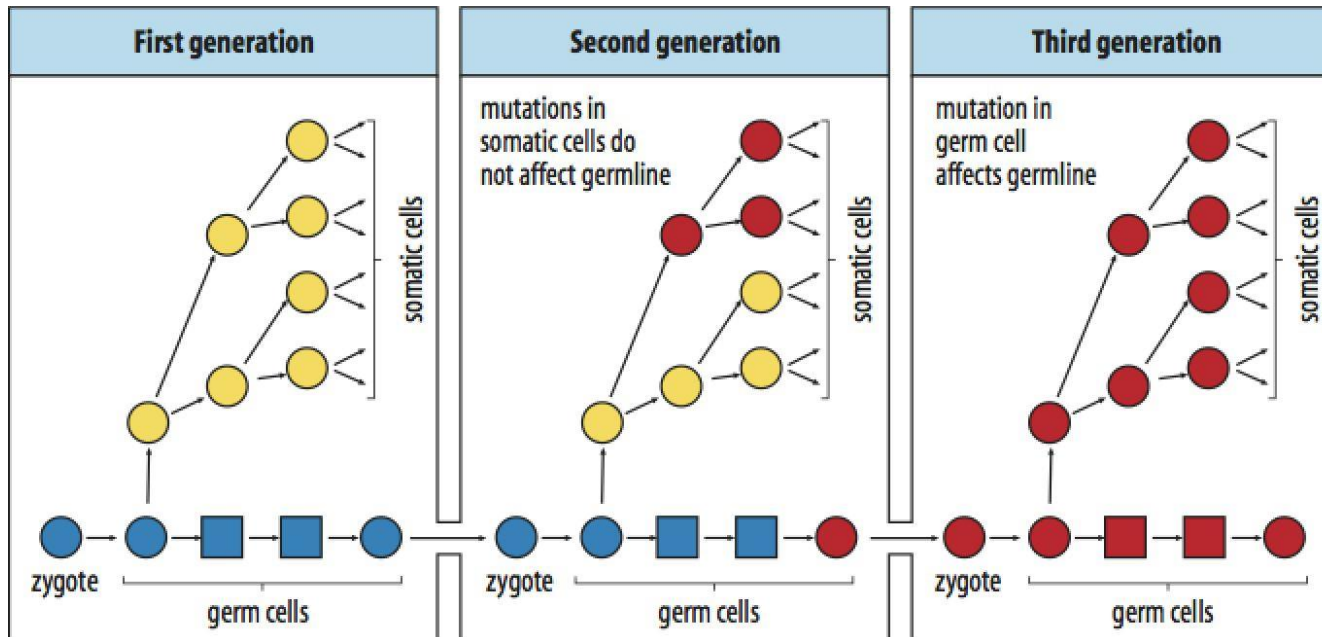
- August Weismann
- Wilhelm Roux
- Hans Driesch
- Hans Spemann

The Germ Plasm Theory (1893)



August Weismann

The Germ Plasm Theory (1893)

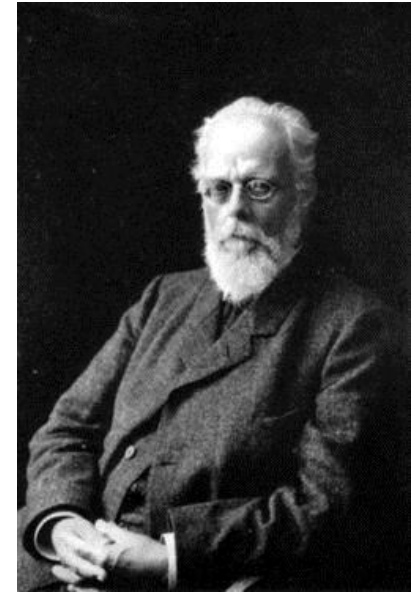
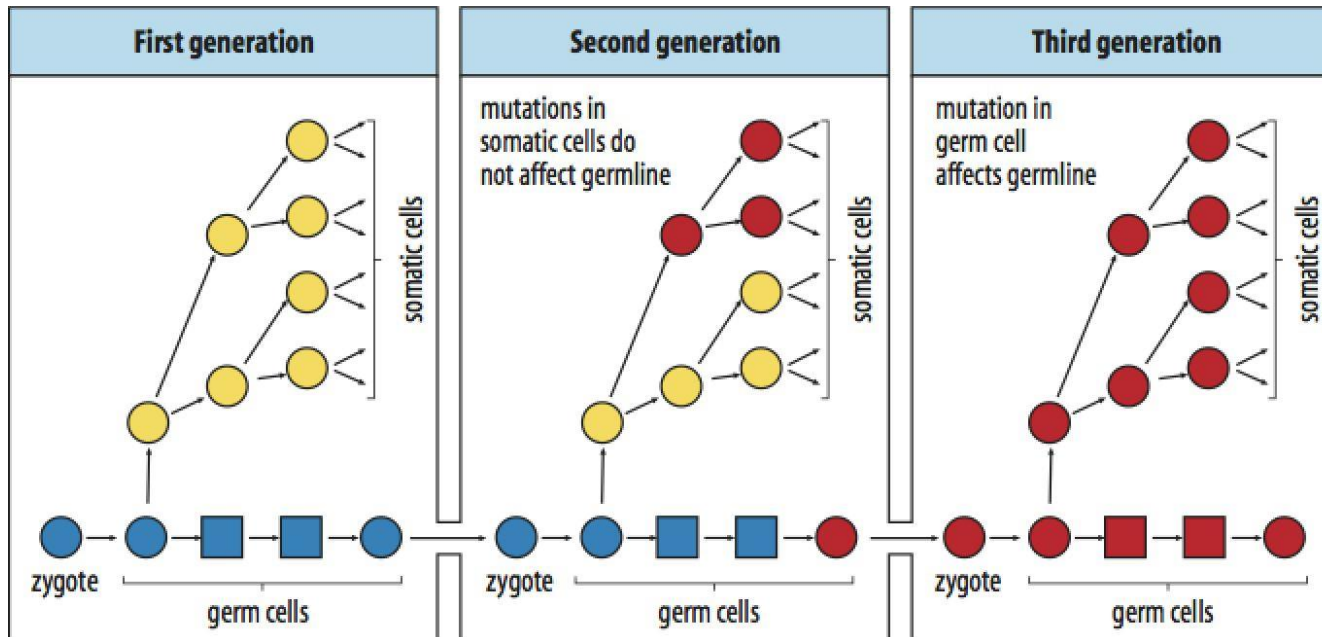


August Weismann

“A hen is only an egg’s way of making another egg.”

- Samuel Butler (1835--1902)

The Germ Plasm Theory (1893)

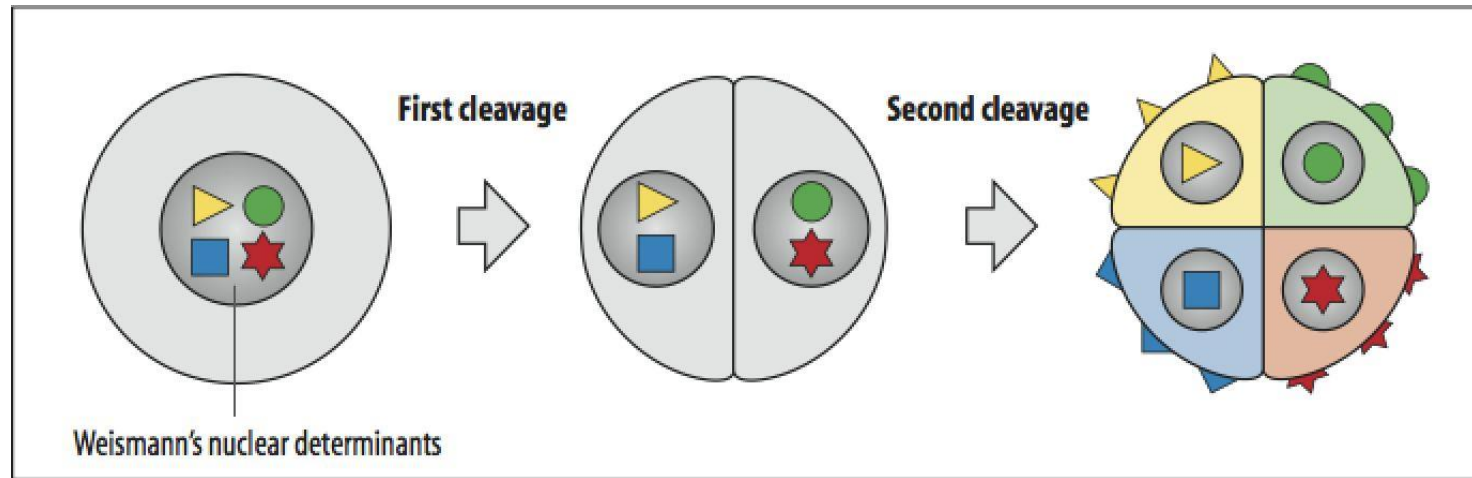


August Weismann

“We are survival machines – robot vehicles blindly programmed to preserve the selfish molecules known as genes.”

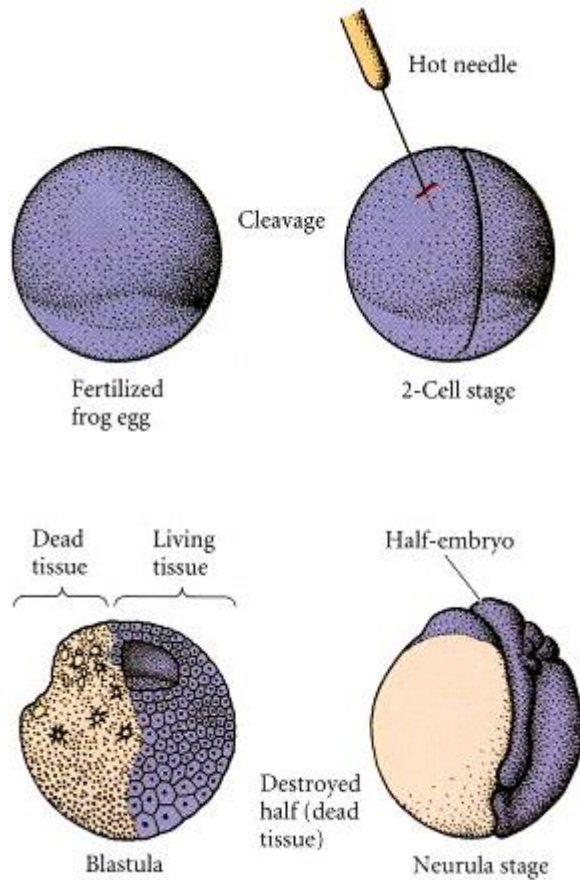
— Richard Dawkins, *The Selfish Gene*

Weismann's theory of nuclear determination



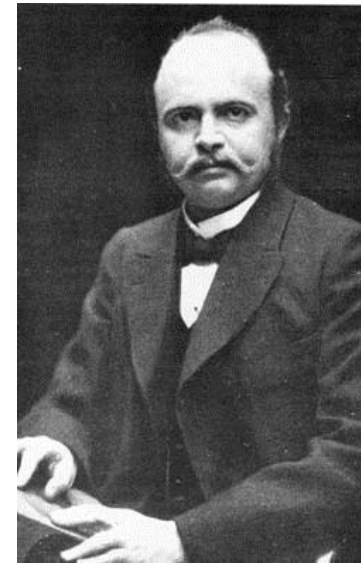
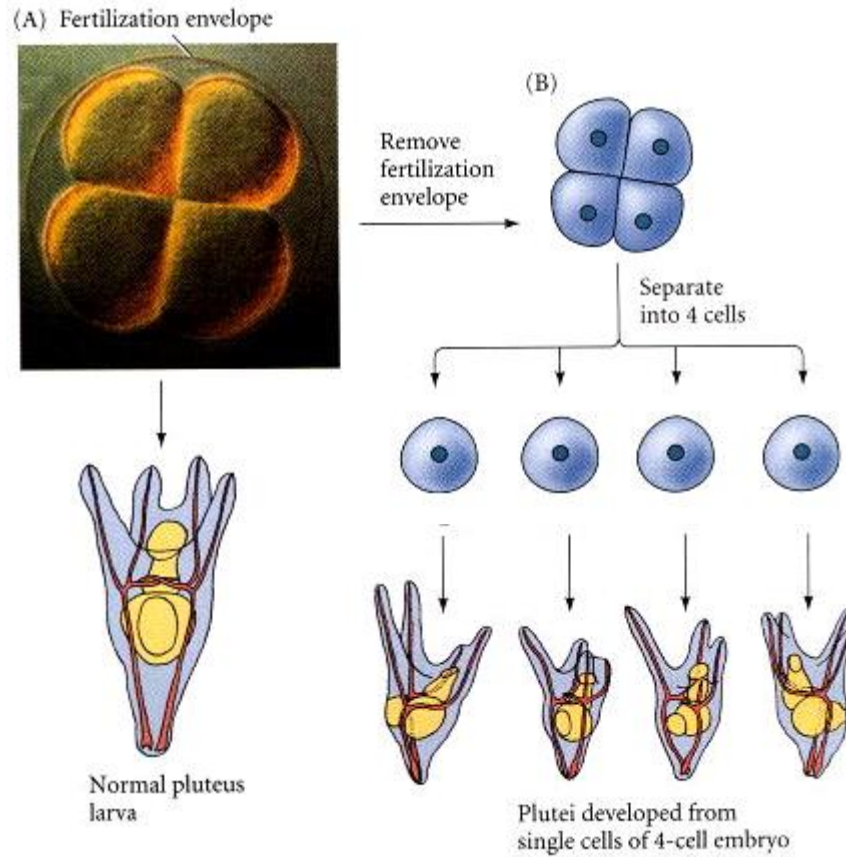
Determinants' distributes unequally to daughter cells.

Mosaic Model of Development (1888)



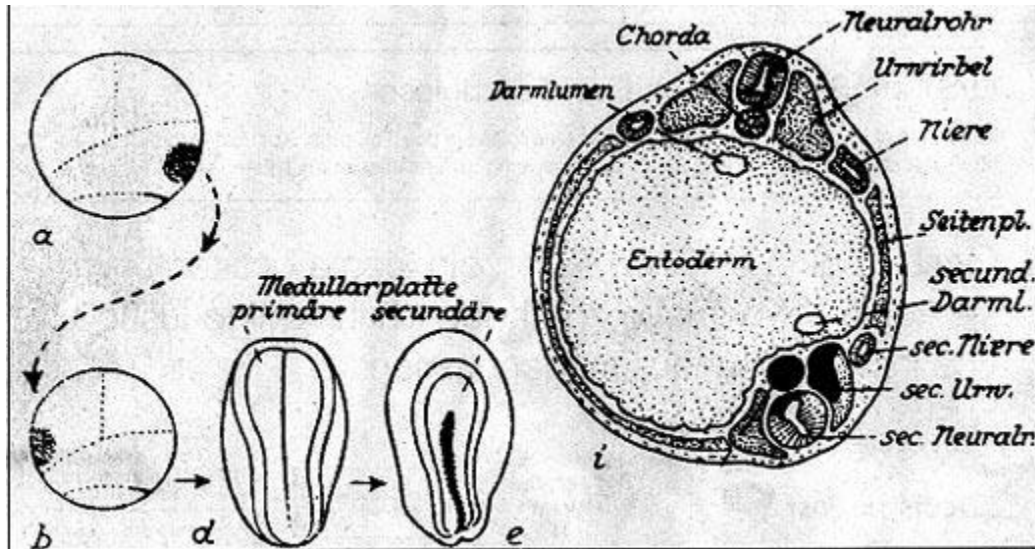
Wilhelm Roux

Regulative Model of Development (1892)



Hans Driesch

The Discovery of Induction (诱导) (1924)



Hans Spemann



Hilde Mangold



The Nobel Prize in Physiology or Medicine 1935
Hans Spemann

The Nobel Prize in Physiology or Medicine 1935



Hans Spemann

The Nobel Prize in Physiology or Medicine 1935 was awarded to Hans Spemann *"for his discovery of the organizer effect in embryonic development"*.

Silence in development
Advance in genetics and molecular biology
(1920s-1960s)

DNA double-helix : *J. Waston, F. Crick*

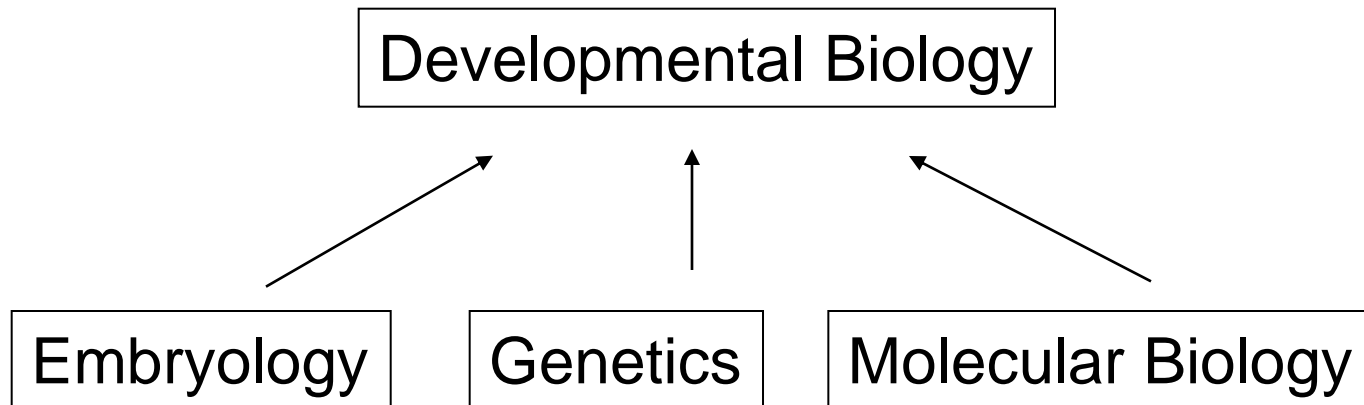
The central dogma: *F. Crick*

lac operon: *F. Jacob, J. Monod*

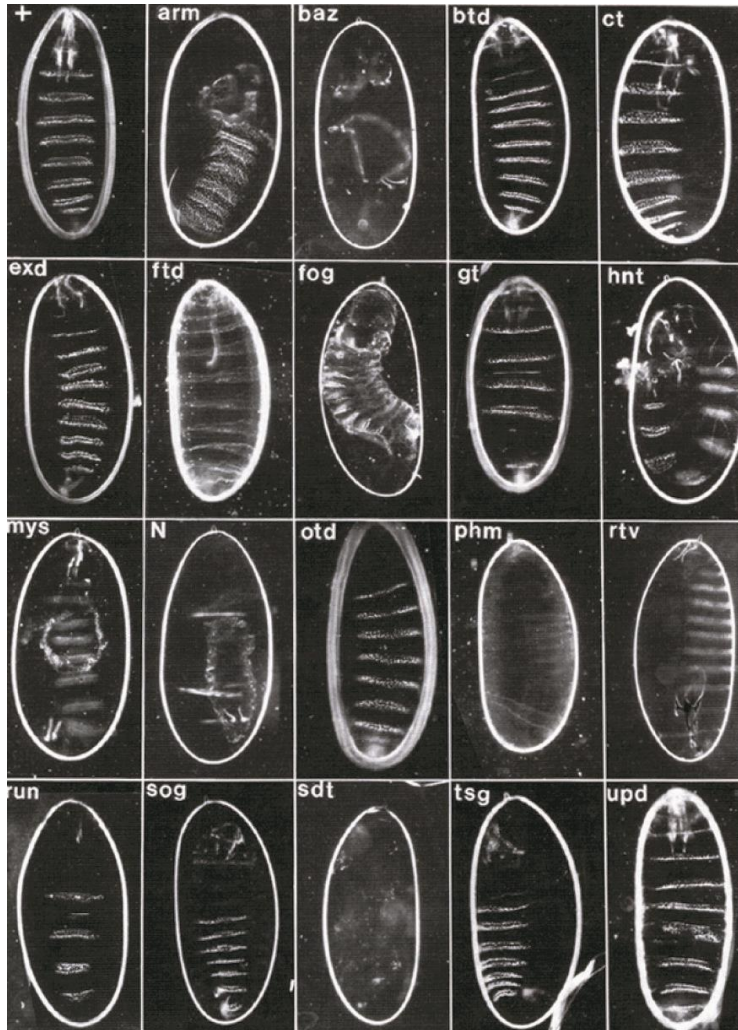
Systematic genetic analysis

Molecular manipulation

Developmental biology is the study of the process by which organisms grow and develop. Modern developmental biology studies the genetic control of cell growth, differentiation and morphogenesis on molecular level, which is the process that gives rise to tissues, organs and anatomy.



Screen for Genes essential for Embryonic Development



The Nobel Prize in Physiology or Medicine 1995

"for their discoveries concerning the genetic control of early embryonic development"



Edward B. Lewis

🏆 1/3 of the prize
USA

California Institute of
Technology (Caltech)
Pasadena, CA, USA

b. 1918
d. 2004



**Christiane
Nüsslein-Volhard**

🏆 1/3 of the prize
Federal Republic of
Germany

Max-Planck-Institut
für
Entwicklungsbiologie
Tübingen, Federal
Republic of Germany

b. 1942



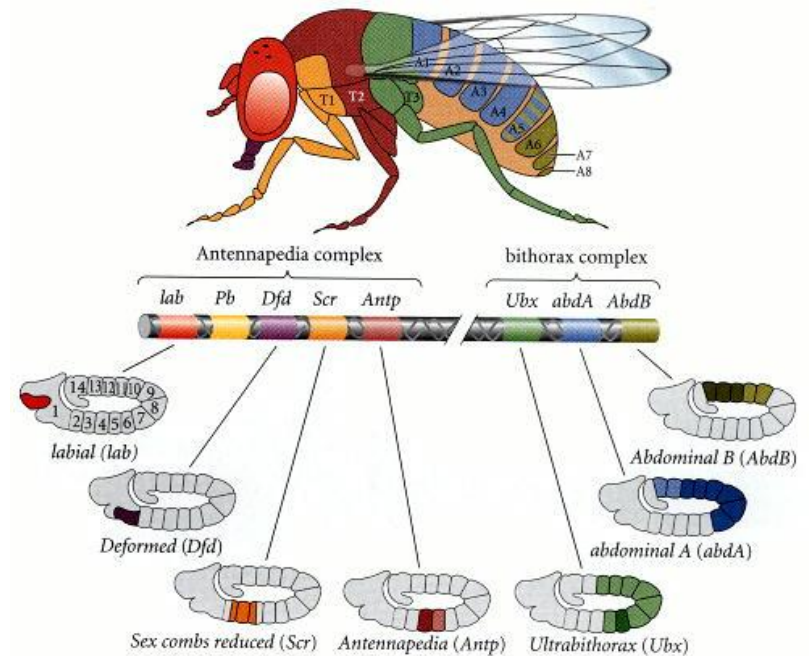
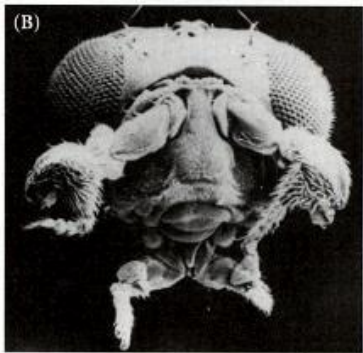
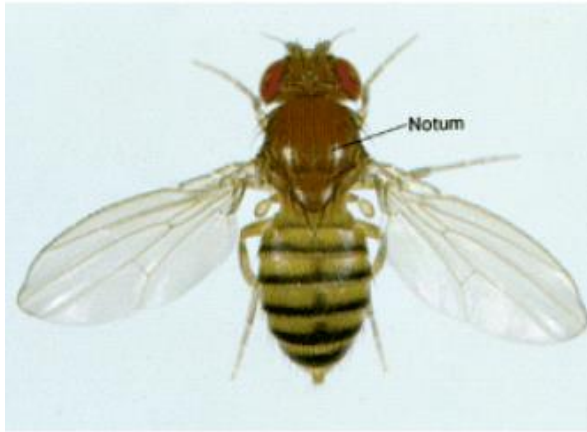
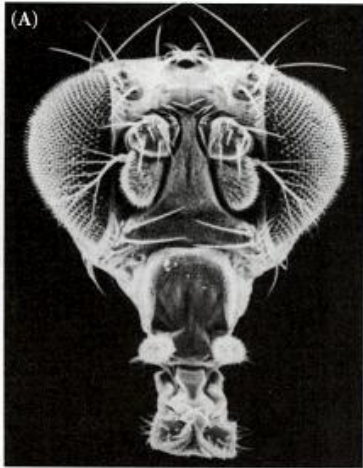
Eric F. Wieschaus

🏆 1/3 of the prize
USA

Princeton University
Princeton, NJ, USA

b. 1947

Homeotic selector genes



Thanks!