

Model organisms and developmental biology

仲寒冰

zhong.hb@sustc.edu.cn

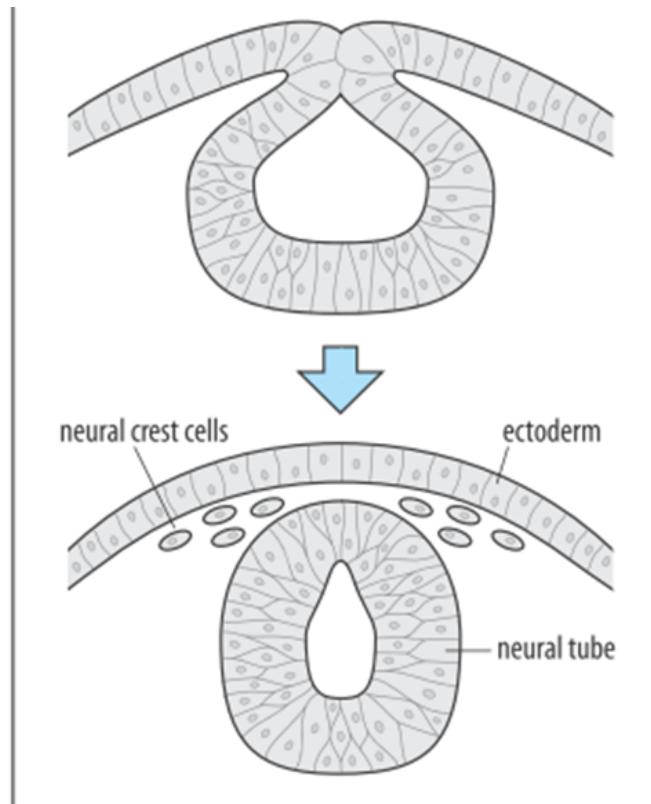
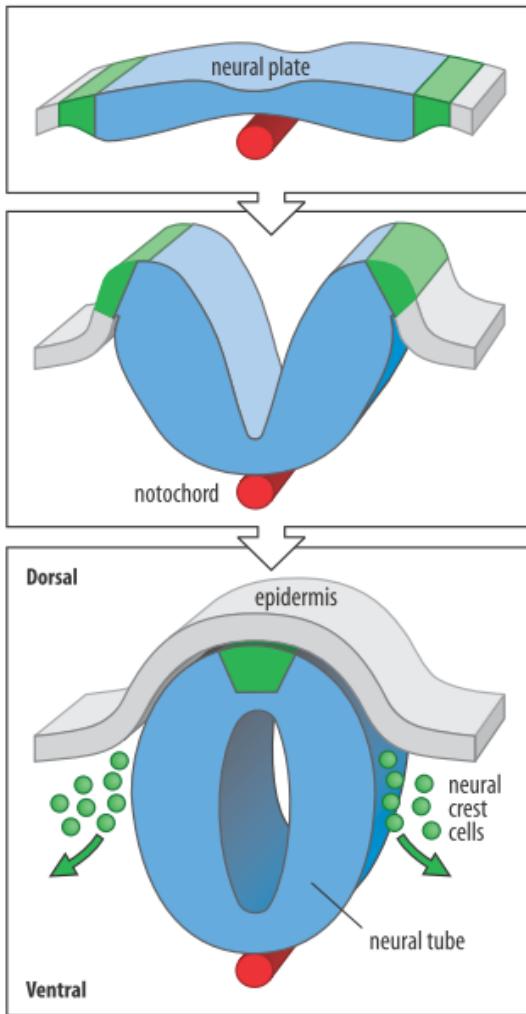
Neural crest cells

The only interesting thing about vertebrates
is the neural crest.

---- Peter Thorogood 1989

Peter Victor Thorogood, developmental biologist: born Ilford, Essex 23 July 1947; Lecturer, then Senior Lecturer in Biology, Southampton University 1979-89; Professor of Oral Biology, Institute of Dental Surgery, London 1989-92; Professor of Developmental Biology, Institute of Child Health, London 1992-98; married 1979 Lyn Robertson (two sons); died Jungfrau, Switzerland 25 August 1998.

Neural crest cells are from ectoderm

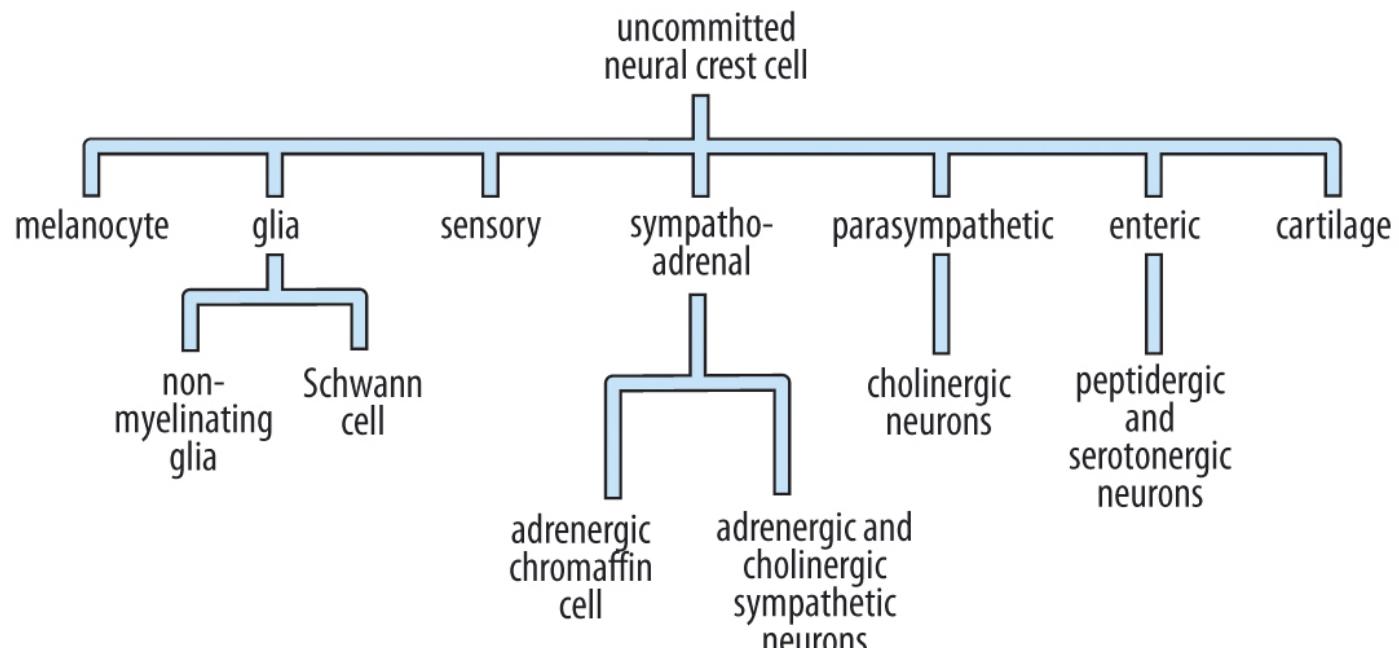


Neural crest cells detach from the dorsal neural tube and migrate away from it.

Derivatives of the neural crest

Migration and determination

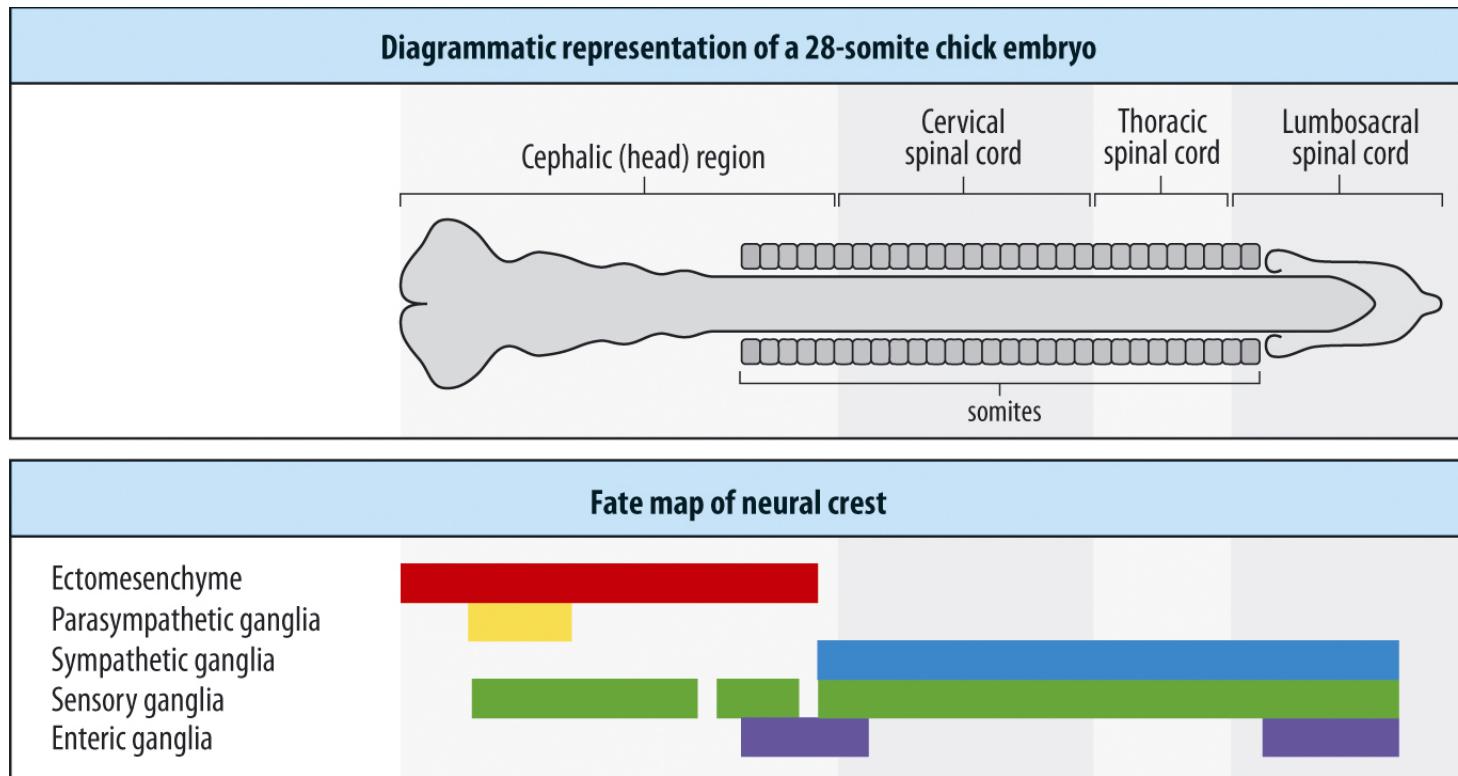
Terminally differentiated derivatives



Neural crest cells, the fourth germ layer?

Derivative	Cell type or structure derived
Peripheral nervous system (PNS)	Neurons, including sensory ganglia, sympathetic and parasympathetic ganglia, and plexuses Neuroglial cells Schwann cells
	Neuroglial cells
	Schwann cells
Endocrine and paraendocrine derivatives	Adrenal medulla
	Calcitonin-secreting cells
	Carotid body type I cells
Pigment cells	Epidermal pigment cells
Facial cartilage and bone	Facial and anterior ventral skull cartilage and bones
Connective tissue	Corneal endothelium and stroma
	Tooth papillae
	Dermis, smooth muscle, and adipose tissue of skin of head and neck
	Connective tissue of salivary, lachrymal, thymus, thyroid, and pituitary glands
	Connective tissue and smooth muscle in arteries of aortic arch origin

Fate and developmental potential of neural crest cells



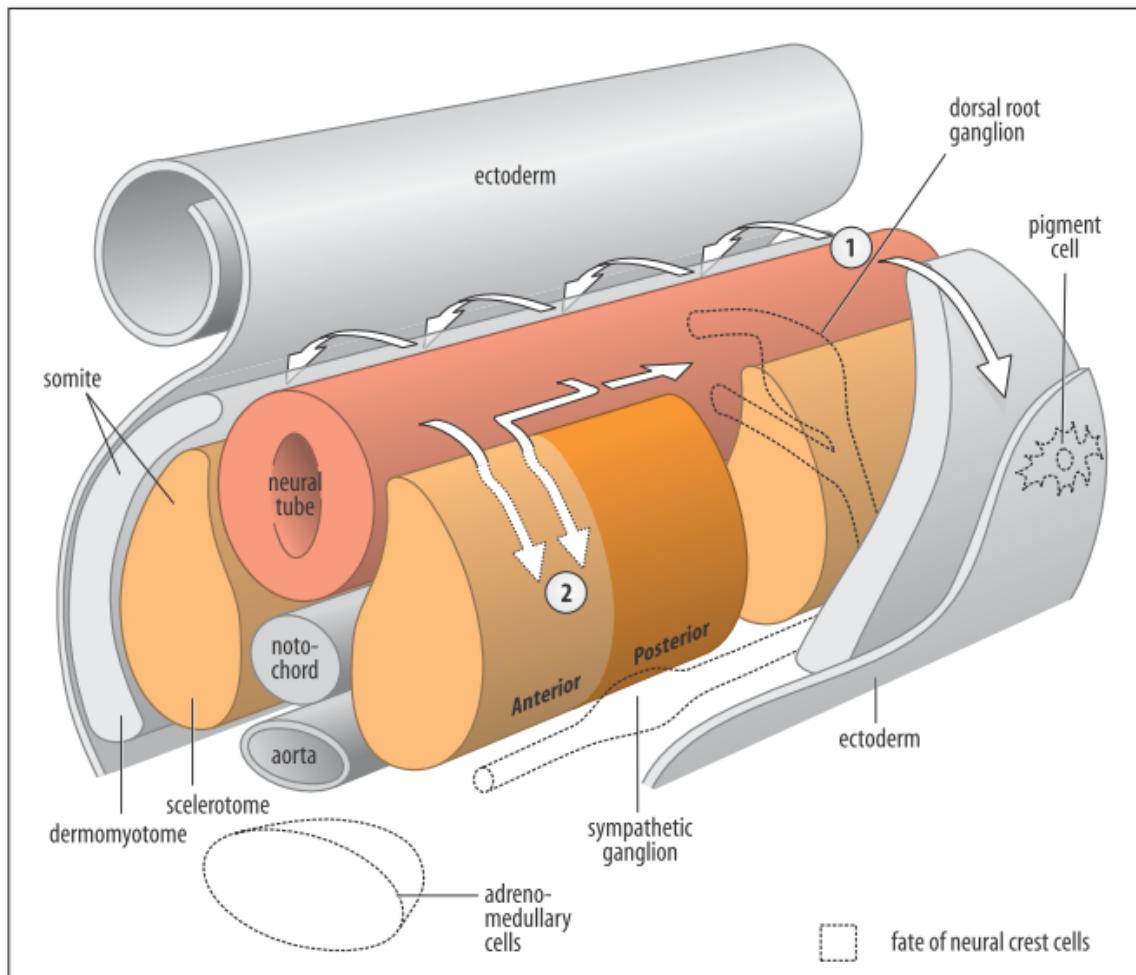
Enteric ganglia, 肠神经节

Neural crest with potential to form mesodermal as well as ectodermal derivatives is called the **mesectoderm**.

Some crest cells are unquestionably multipotent

- Single neural crest cells injected with a tracer shortly after they have left the neural tube can be seen to give rise to a number of different cell types, both neuronal and non-neuronal.
- Also, by changing the position of neural crest before cells start to migrate, it has been shown that the developmental potential of these cells is greater than their normal fate would suggest.

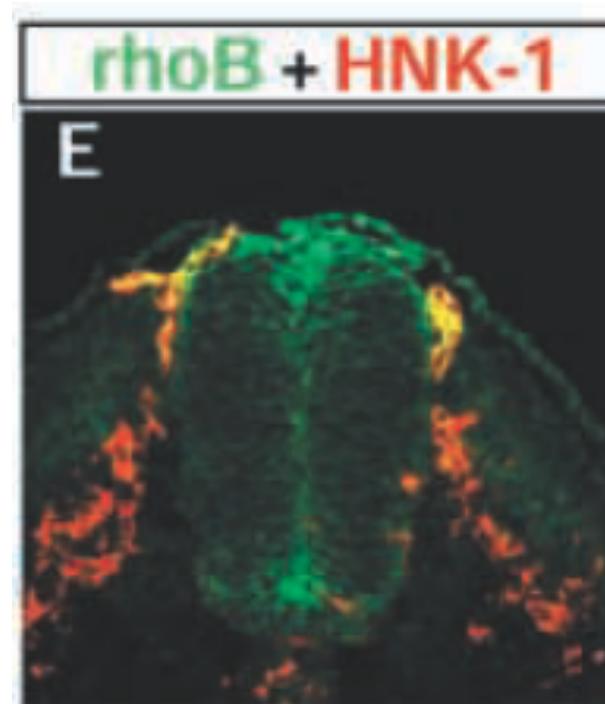
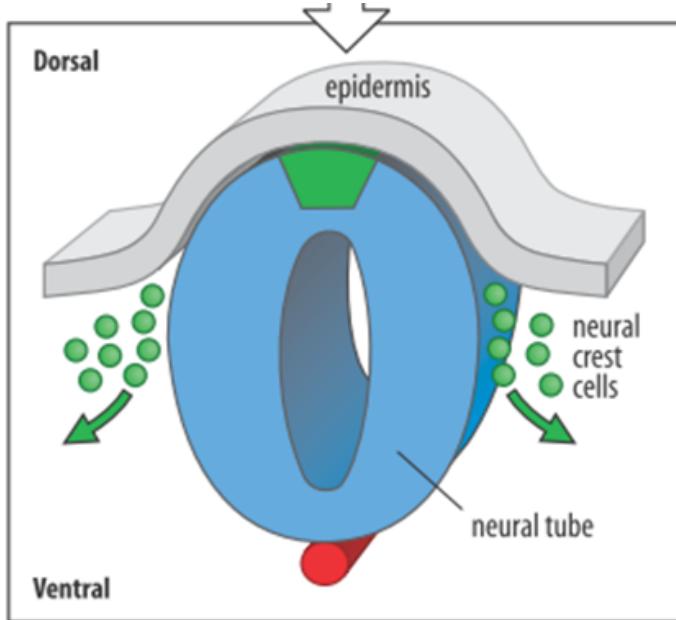
Neural crest cell migration in the trunk of the chick embryo



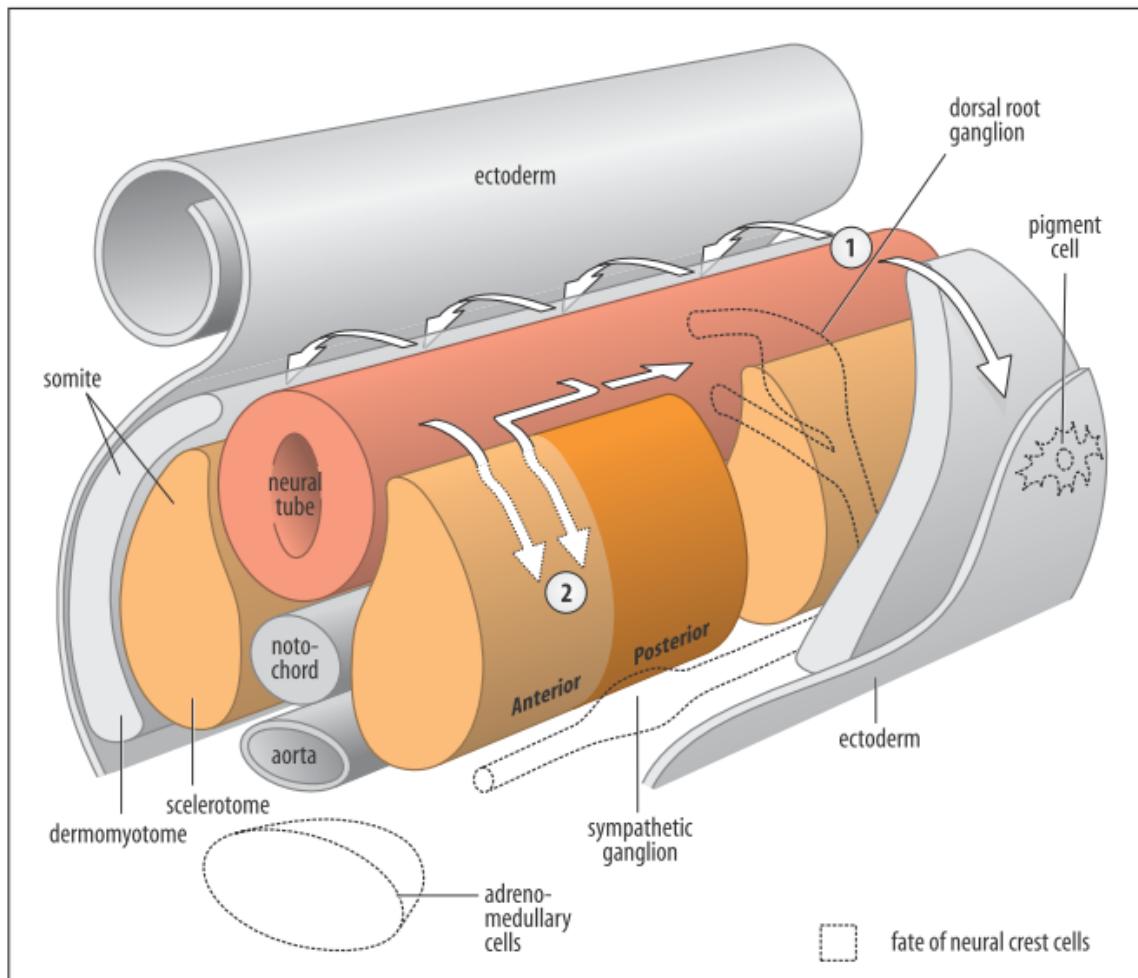
Any analysis of migration of neural crest
has to ask four questions:

- 1. How is migration initiated?
- 2. How do the migratory cells know the route on which to travel?
- 3. What signals indicate that the destination has been reached and that migration should end?
- 4. When does the migrating cells become competent to respond to these signals?

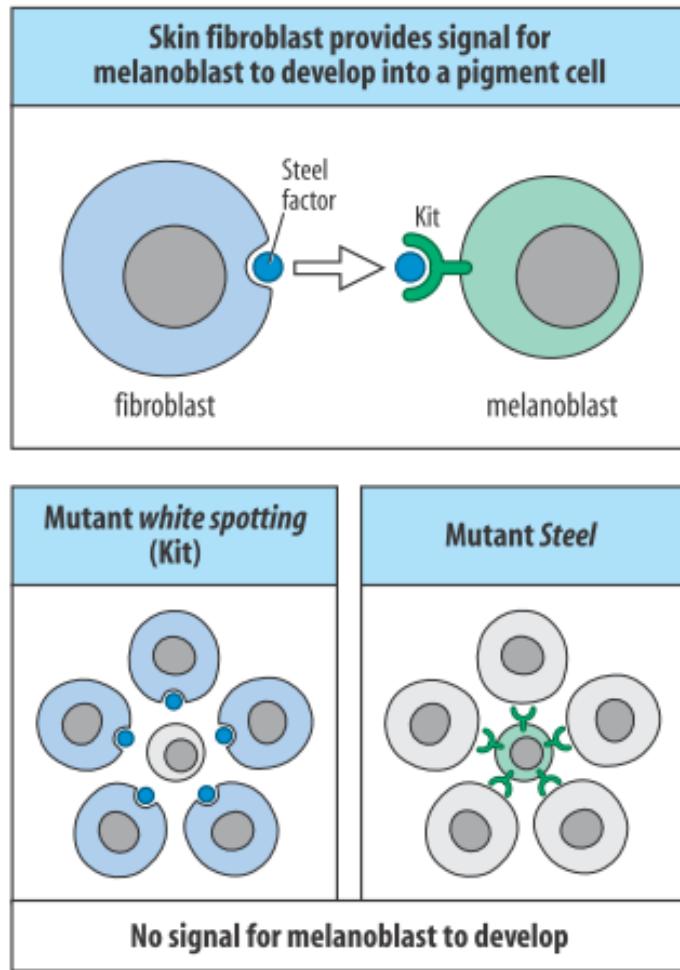
All migrating neural crest cells express HNK-1 (red stain)



Neural crest cell migration in the trunk of the chick embryo



The receptor Kit and its ligand the Steel factor are involved in melanoblast differentiation



C57BL/6J



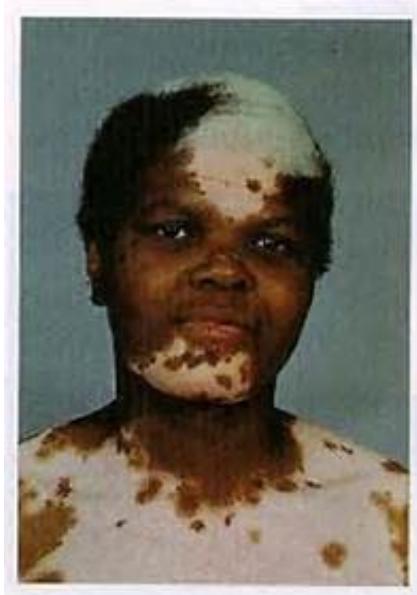
Kit^{W-v}/+



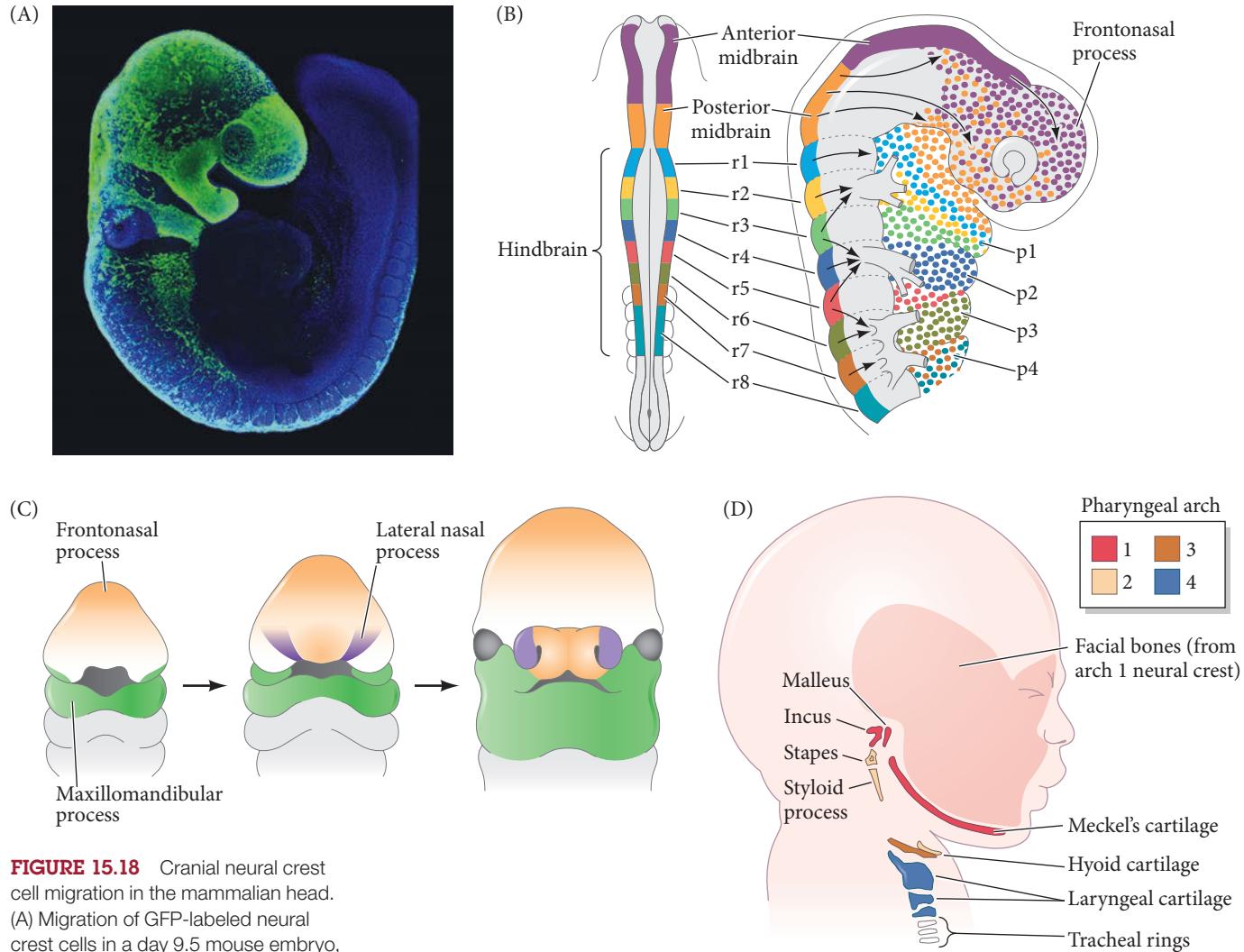
Kit^{SI}/Kit^{SI-d}

Kitl = Steel factor

Piebaldism in mammals

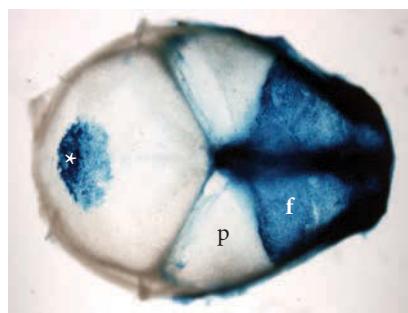


Cranial neural crest cell migration in the mammalian head

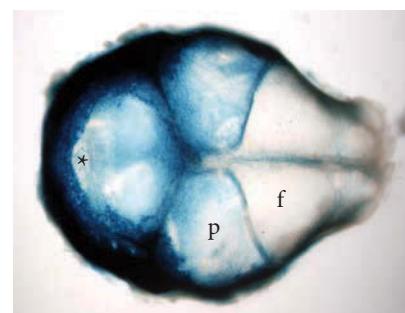


Cranial neural crest cells in embryonic mice, stained for β -galactosidase expression

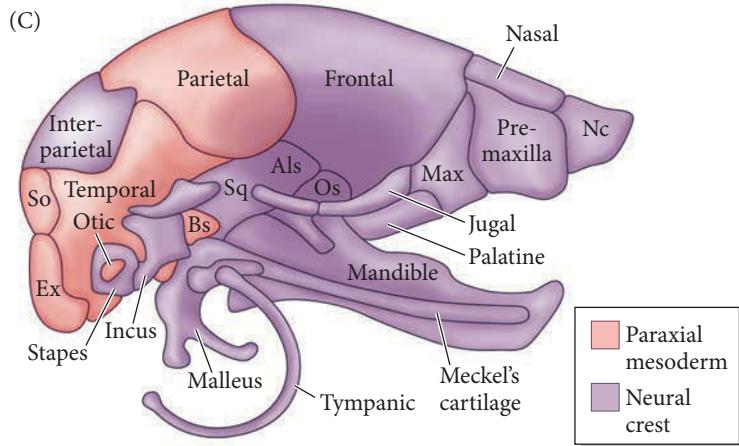
(A) *Wnt1-Cre*: Neural crest-derived bone



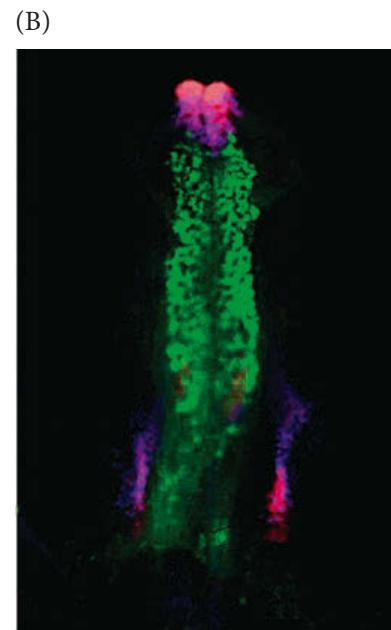
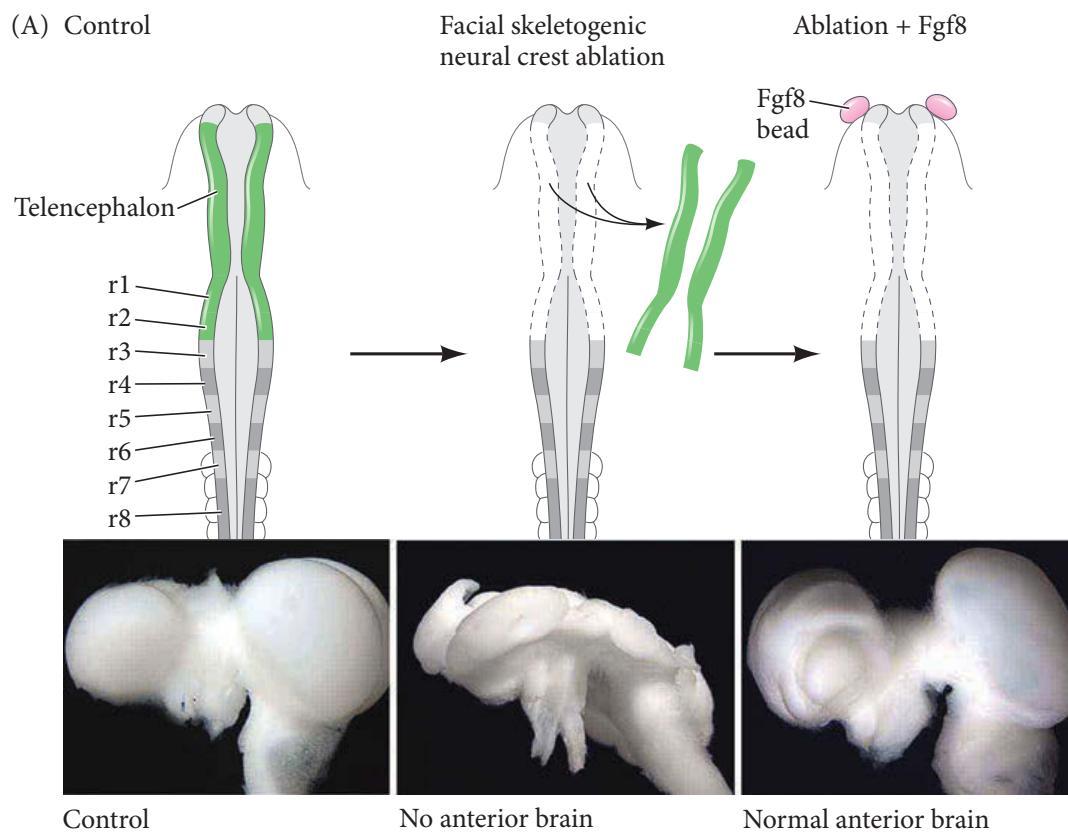
(B) *Mesp-Cre*: Mesoderm-derived bone



(C)



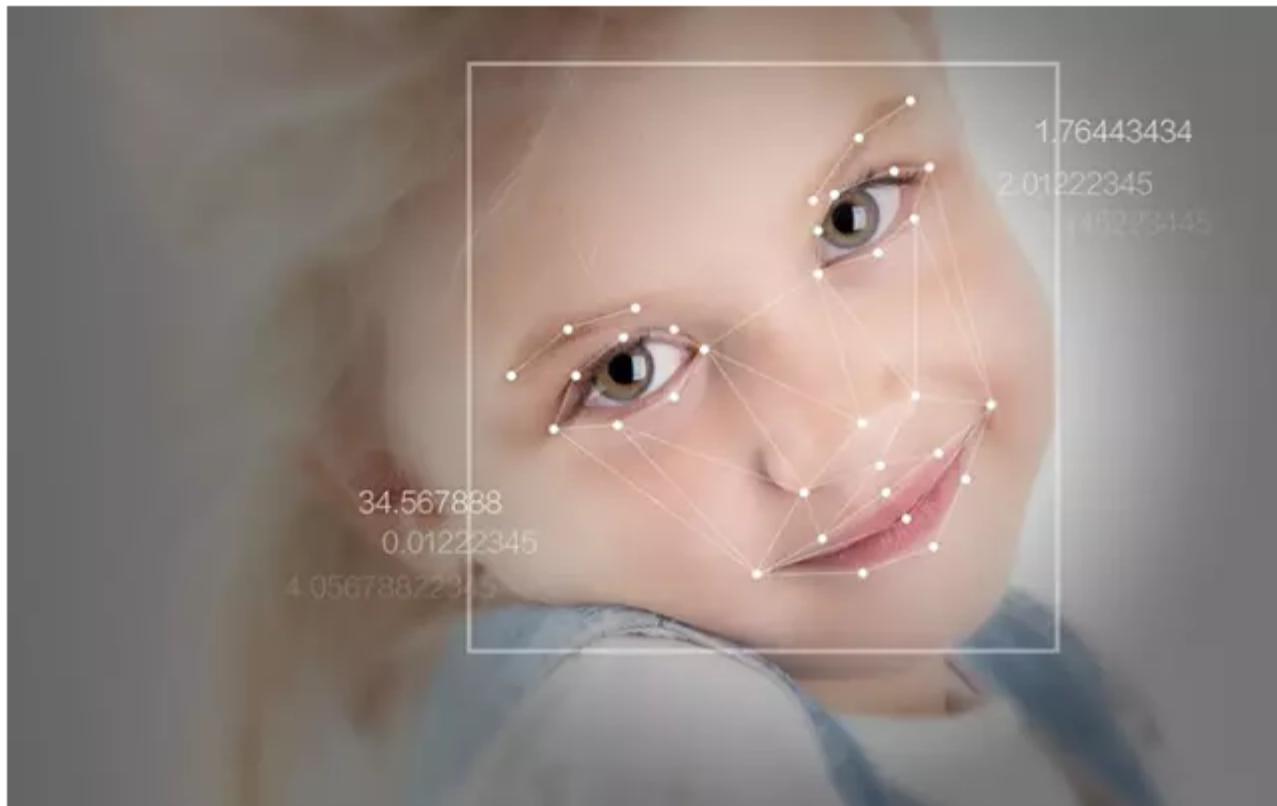
The cranial neural crest that forms the facial skeleton is also critical for the growth of the anterior region of the brain



Thanks!

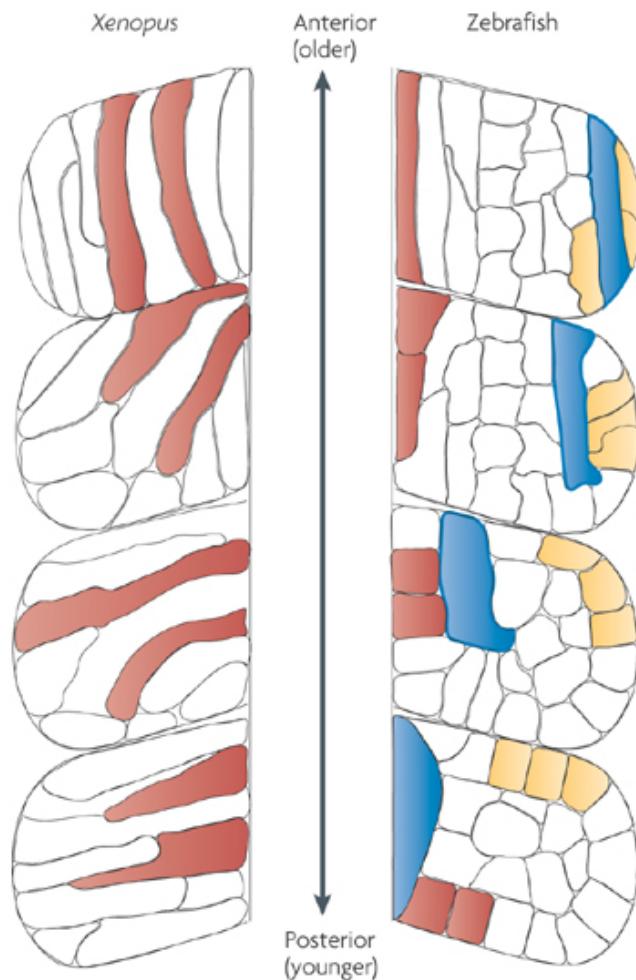
Science : 不同的面孔是怎样形成的 ?

2017-04-01 生物探索

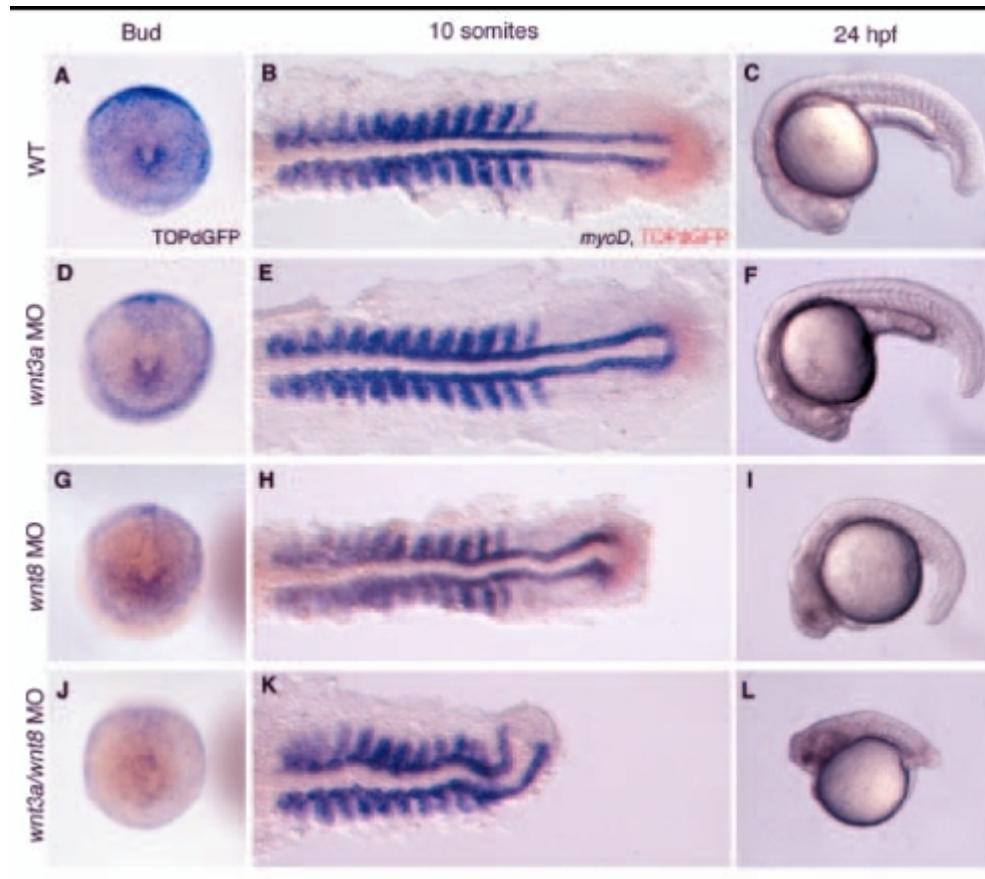


每一张脸都是独一无二的，尽管控制颅骨面部形状的基因在每个人身上几乎都是相同的。那么，这些独特的特征是如何从相同的基因子集中产生的呢？瑞士Friedrich Miescher生物医学研究所（FMI）的Filippo Rijli团队发现了调节面部形态的表观遗传学机制。相关文章发表在3月31日的Science上。

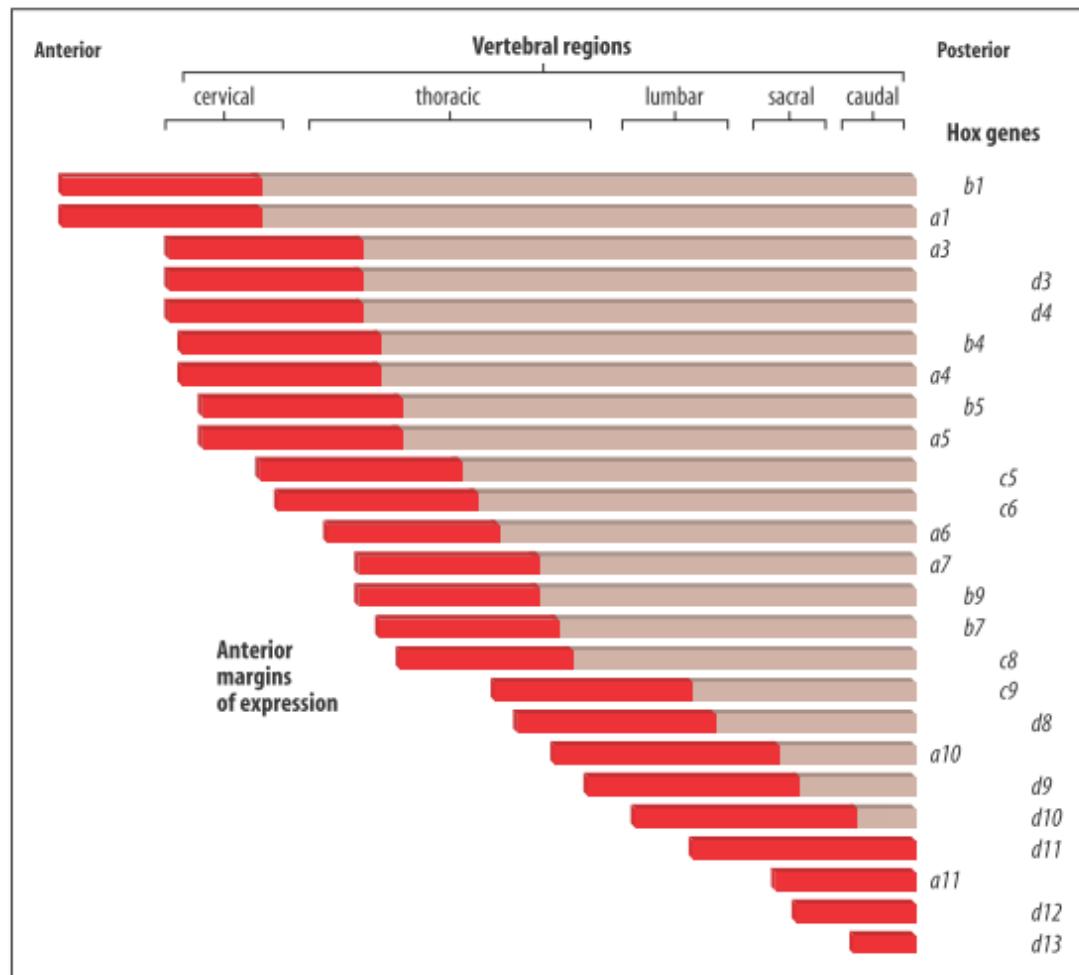




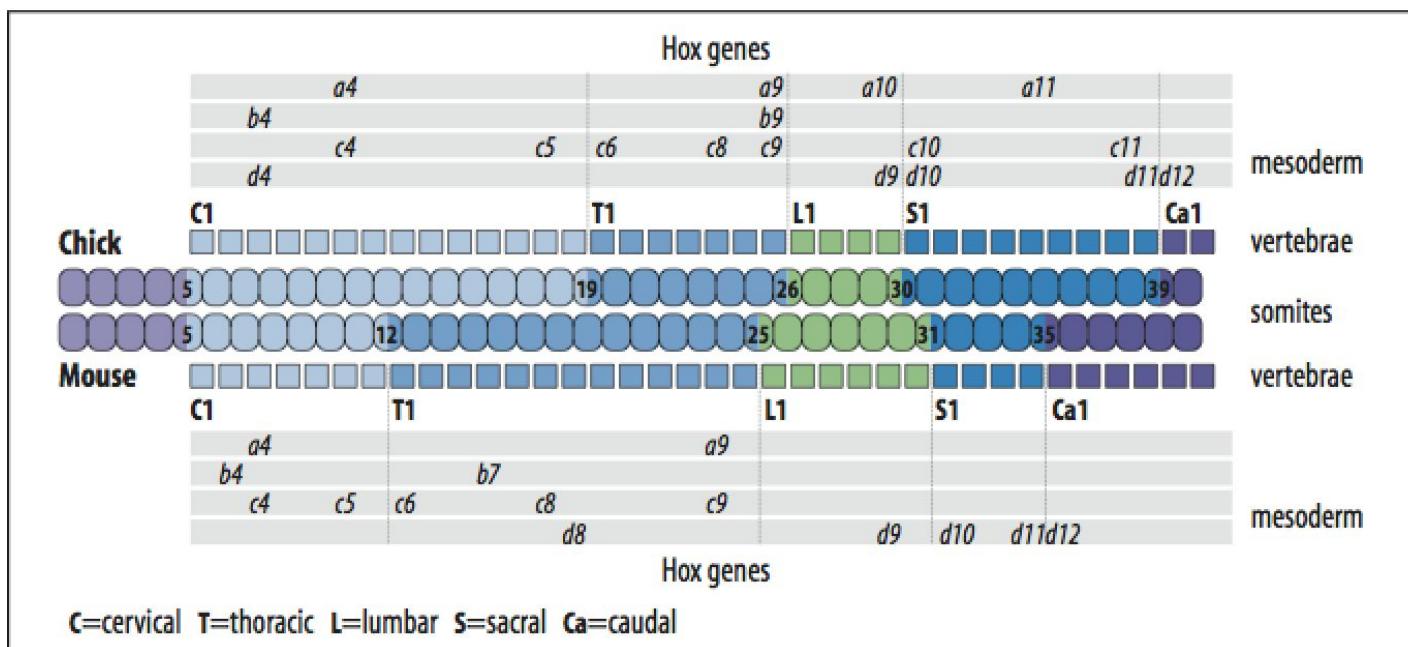
Expression pattern of *myoD*



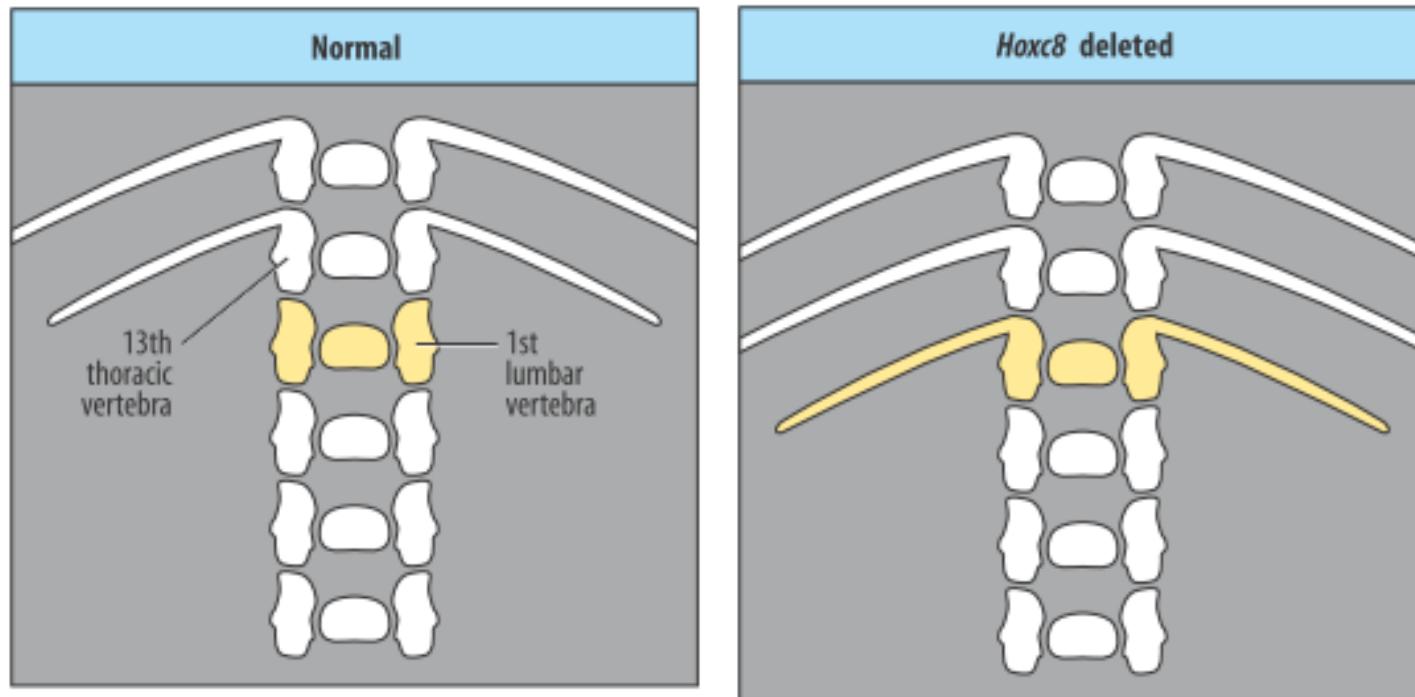
A summary of *Hox* gene expression in the mouse mesoderm



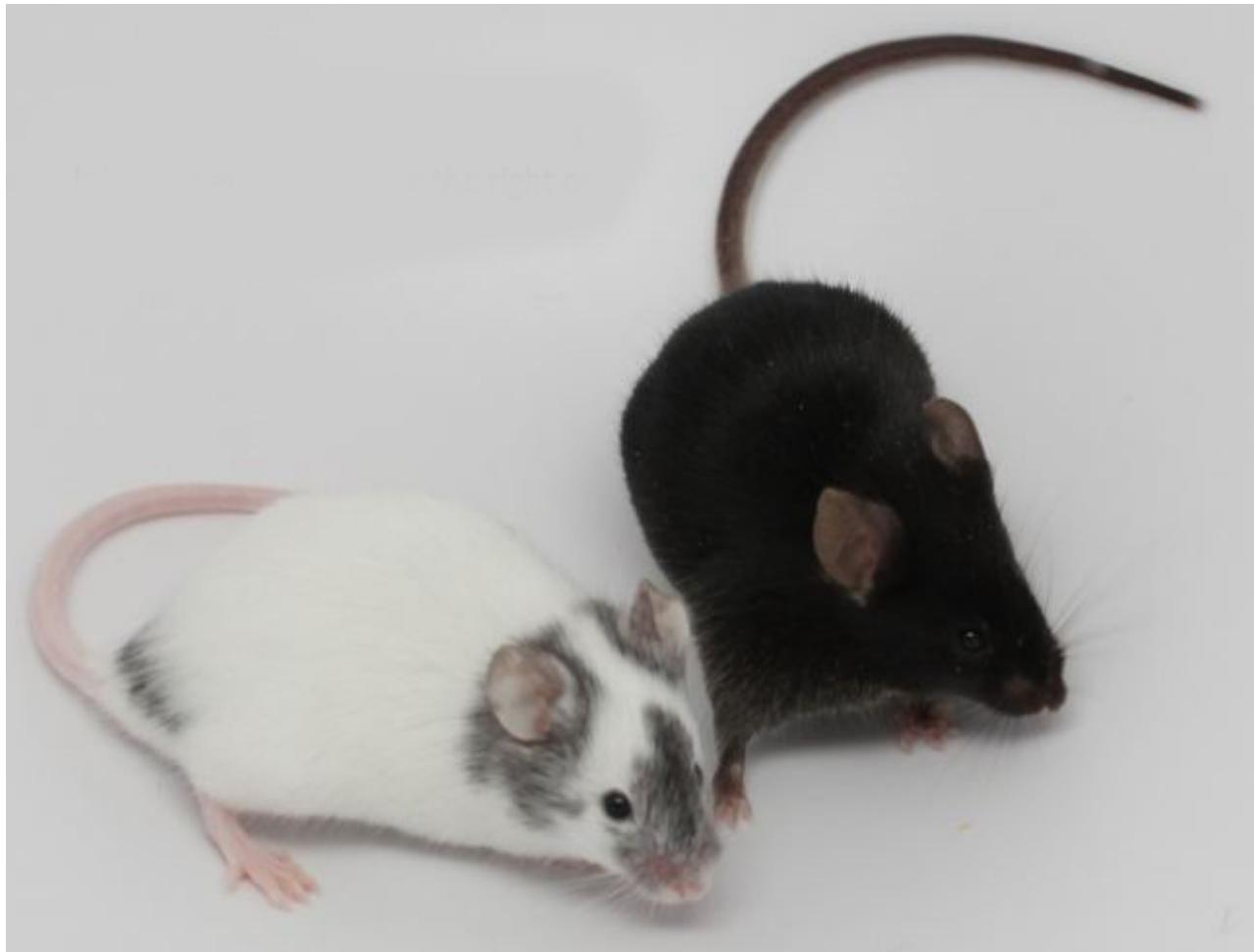
Patterns of *Hox* gene expression in the chick and mouse embryos



Homeotic transformation of vertebrae due to deletion of *Hoxc8* in the mouse



Diluted color in heterozygous steel mutant



$\text{Kitl}^{\text{sl-24J}}/\text{Kitl}^{\text{sl-24J}}$ on the left, heterozygote on the right



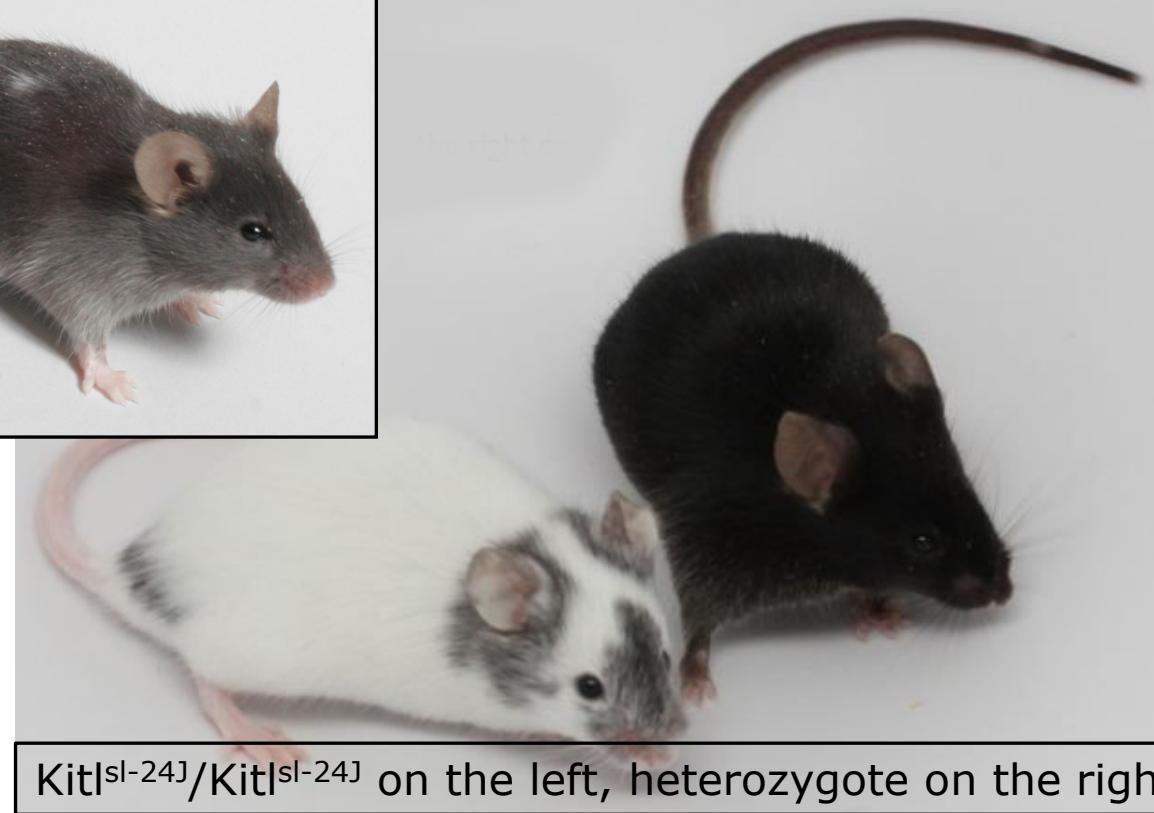
C57BL/6J



Kit^{W-v/+}



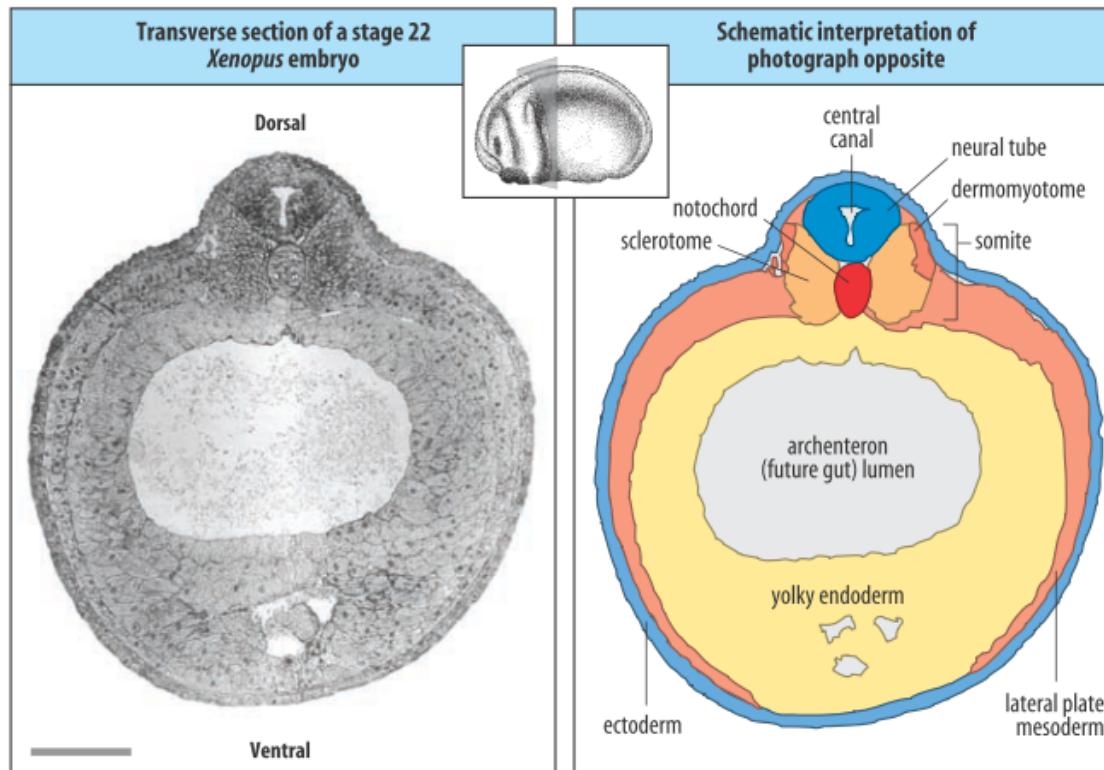
Kit^{SI/Kit^{SI-d}}



Kit^{lsl-24J/lsl-24J} on the left, heterozygote on the right

Somites

A cross-section through a *Xenopus* embryo



paraxial mesoderm

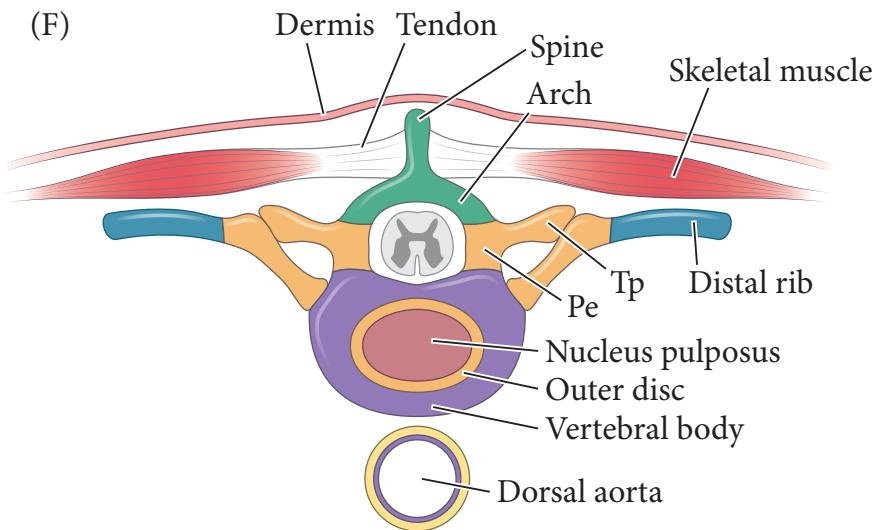
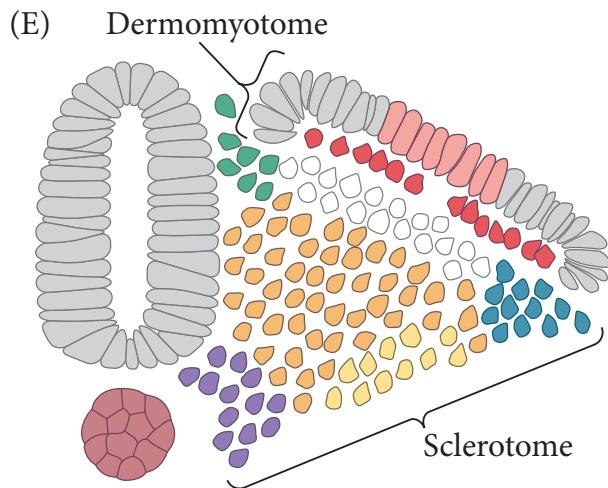
intermediate mesoderm

lateral plate mesoderm

Sclerotome -> cartilage and bone.

Dermomyotome = dermo + myo -> dermis + muscle.

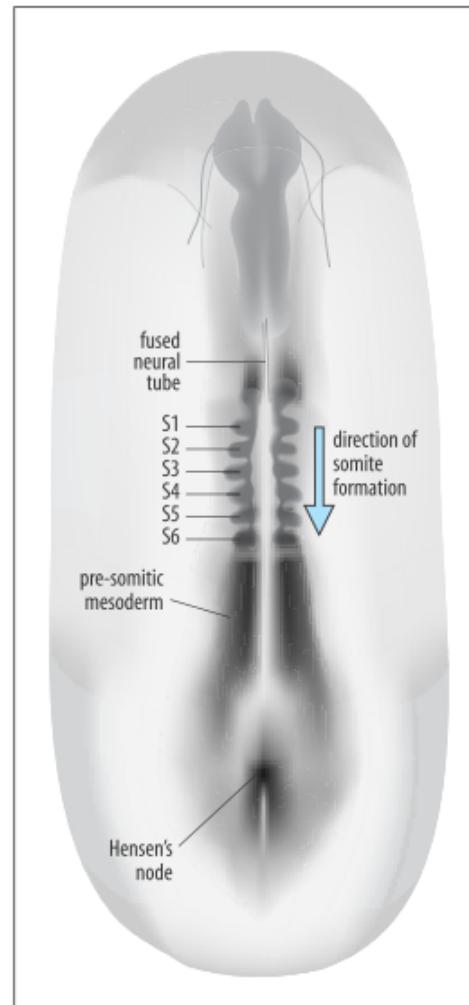
Color-coded schematic of one half of a somite from a 48-hour embryo in cross section



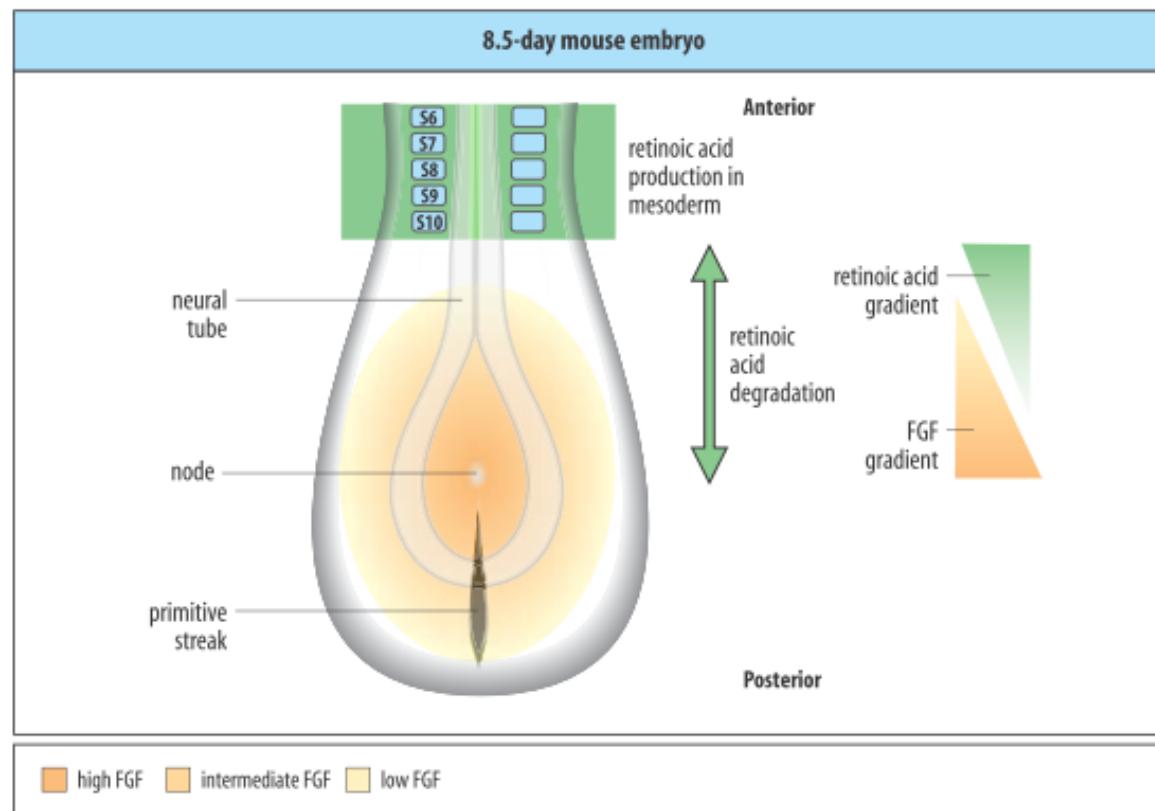
- Arthrotome: vertebral joints (Pe, Tp), proximal rib, outer disc
- Dorsomedial sclerotome: spine, arch
- Ventrolateral sclerotome: distal rib
- Ventromedial sclerotome: vertebral body
- Notochord: inner disc/nucleus pulposus

- Ventral posterior sclerotome: endothelial precursor: outer dorsal aorta
- Syndetome: tendons
- Myotome
- Dermatome: dermis

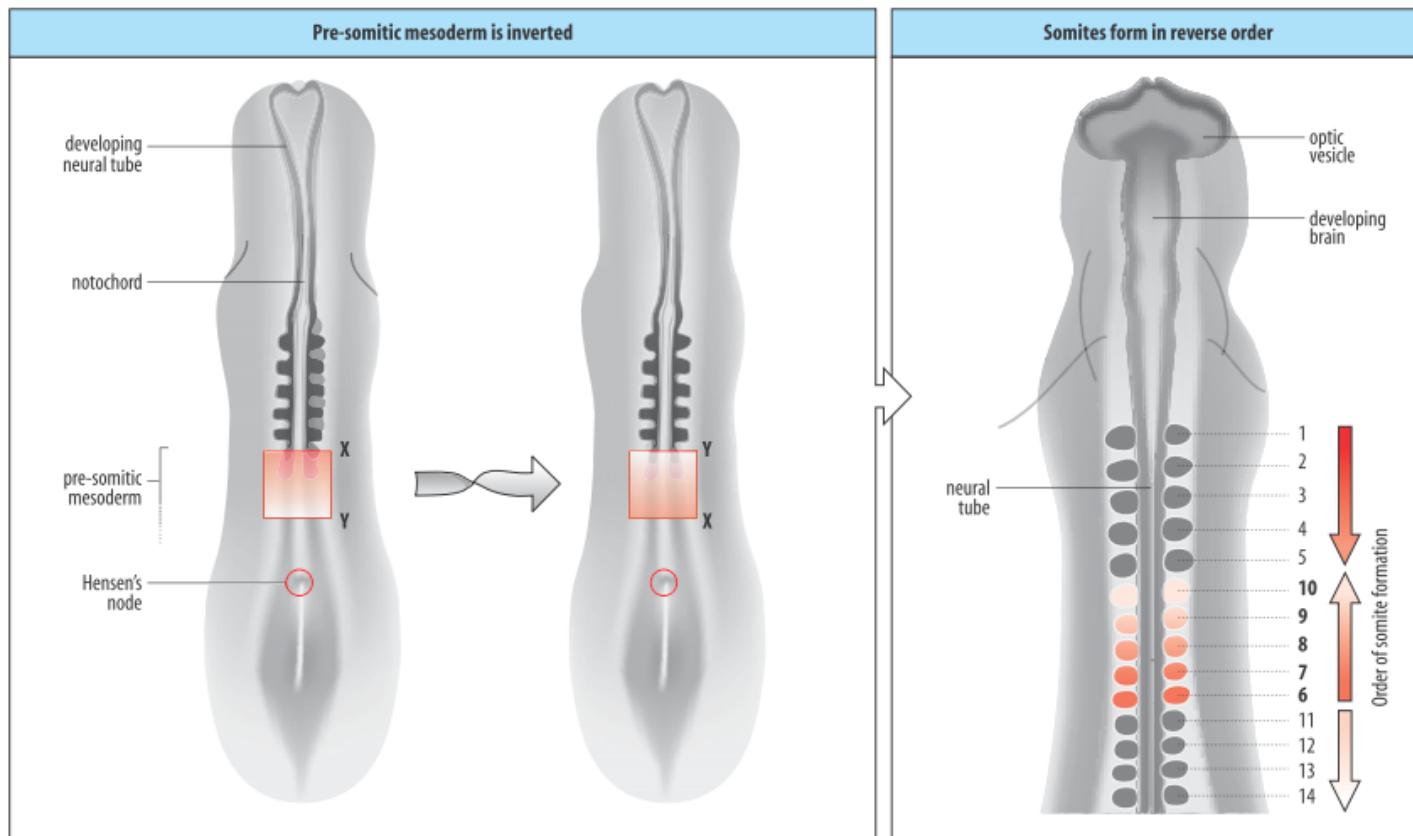
Somites form in pairs from the paraxial mesoderm



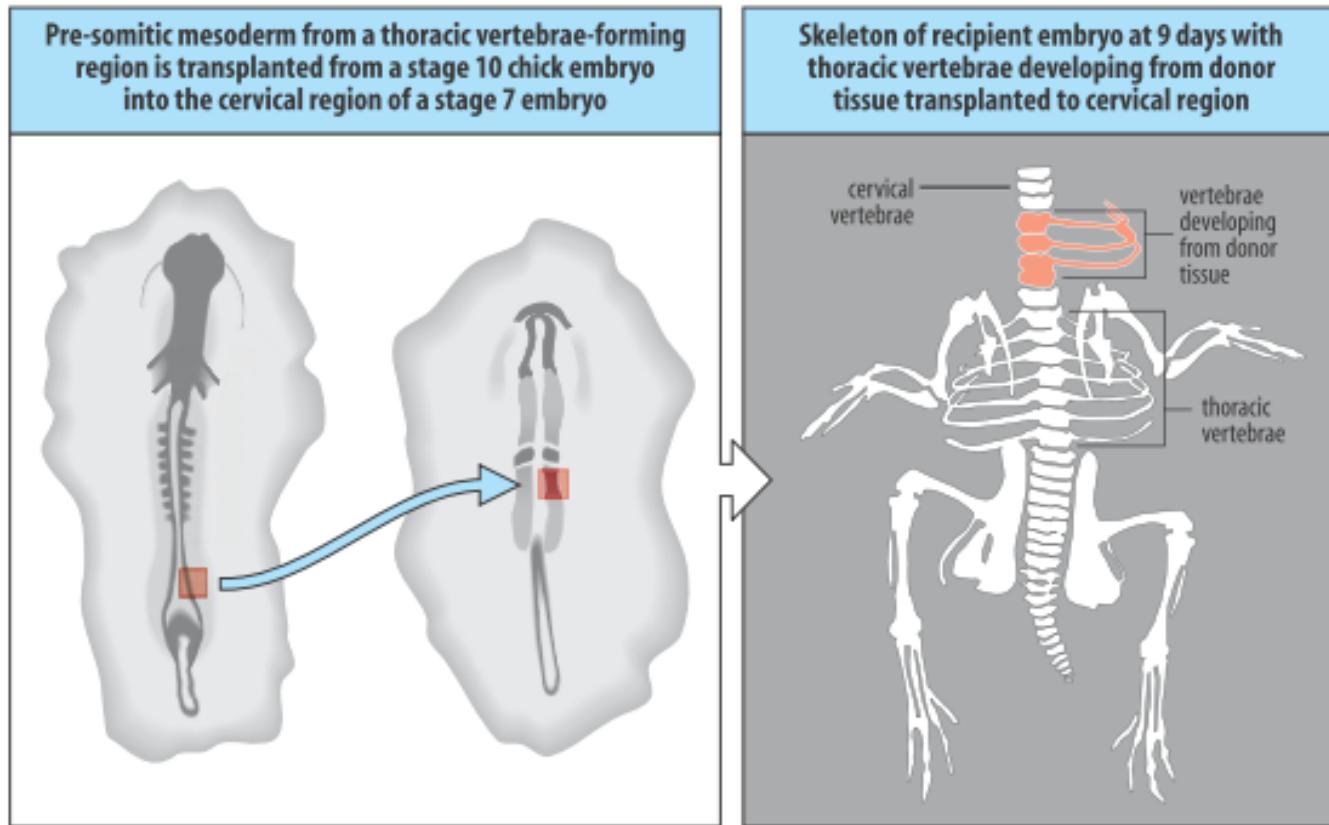
FGF and retinoic acid gradients help to pattern AP axis in the mouse embryo



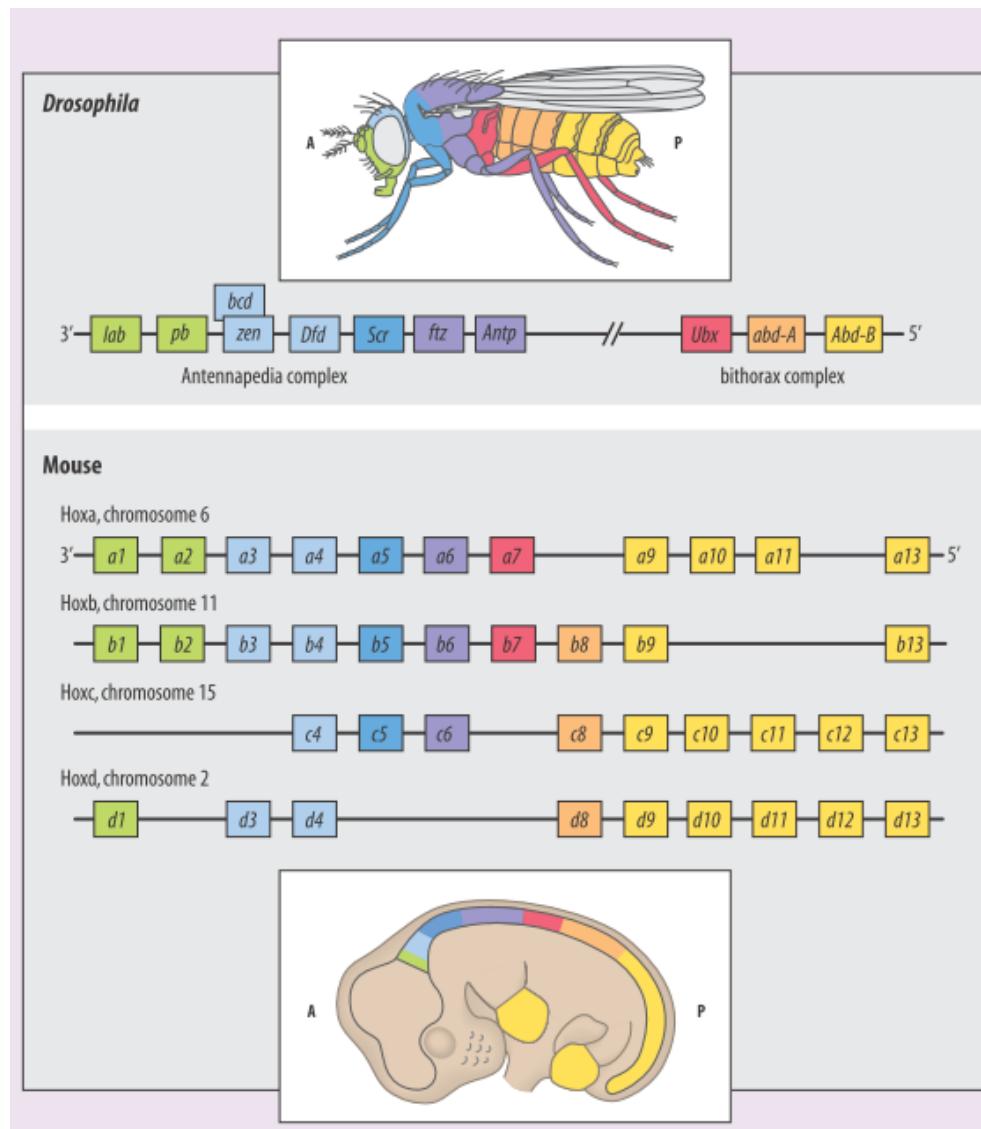
The temporal order of somite formation is specified early in embryonic development



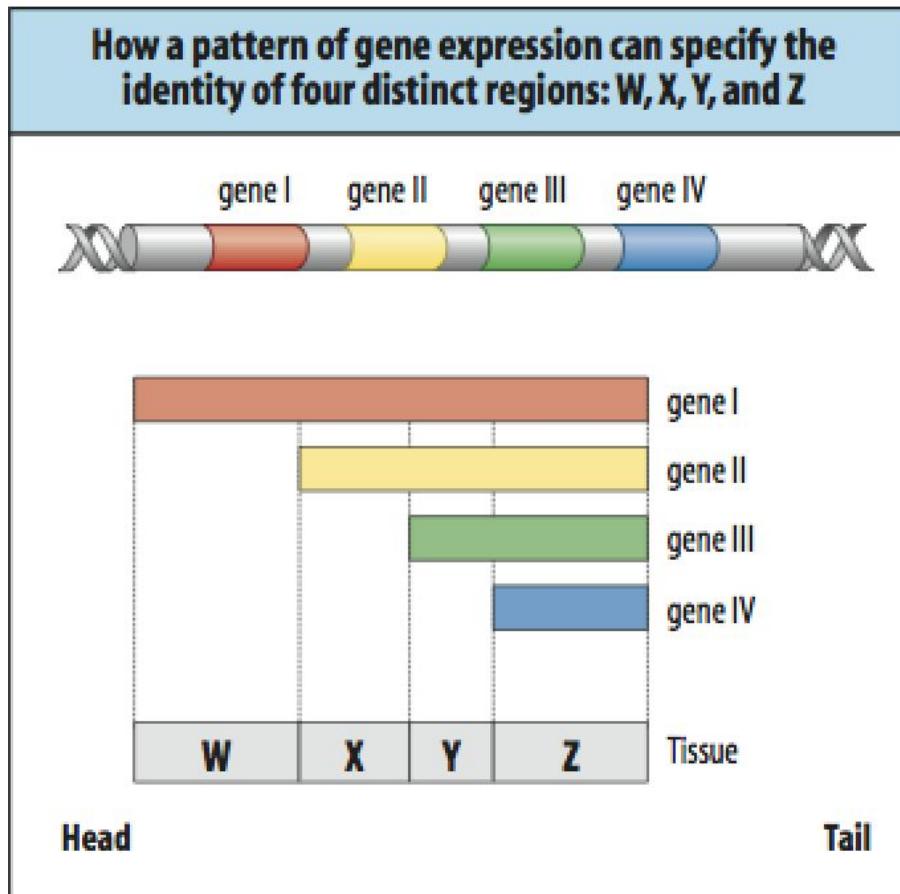
The pre-somatic mesoderm has acquired a positional identity before somite formation



The *Hox* genes



Gene activity can provide positional values



Hox gene expression in the mouse embryo

