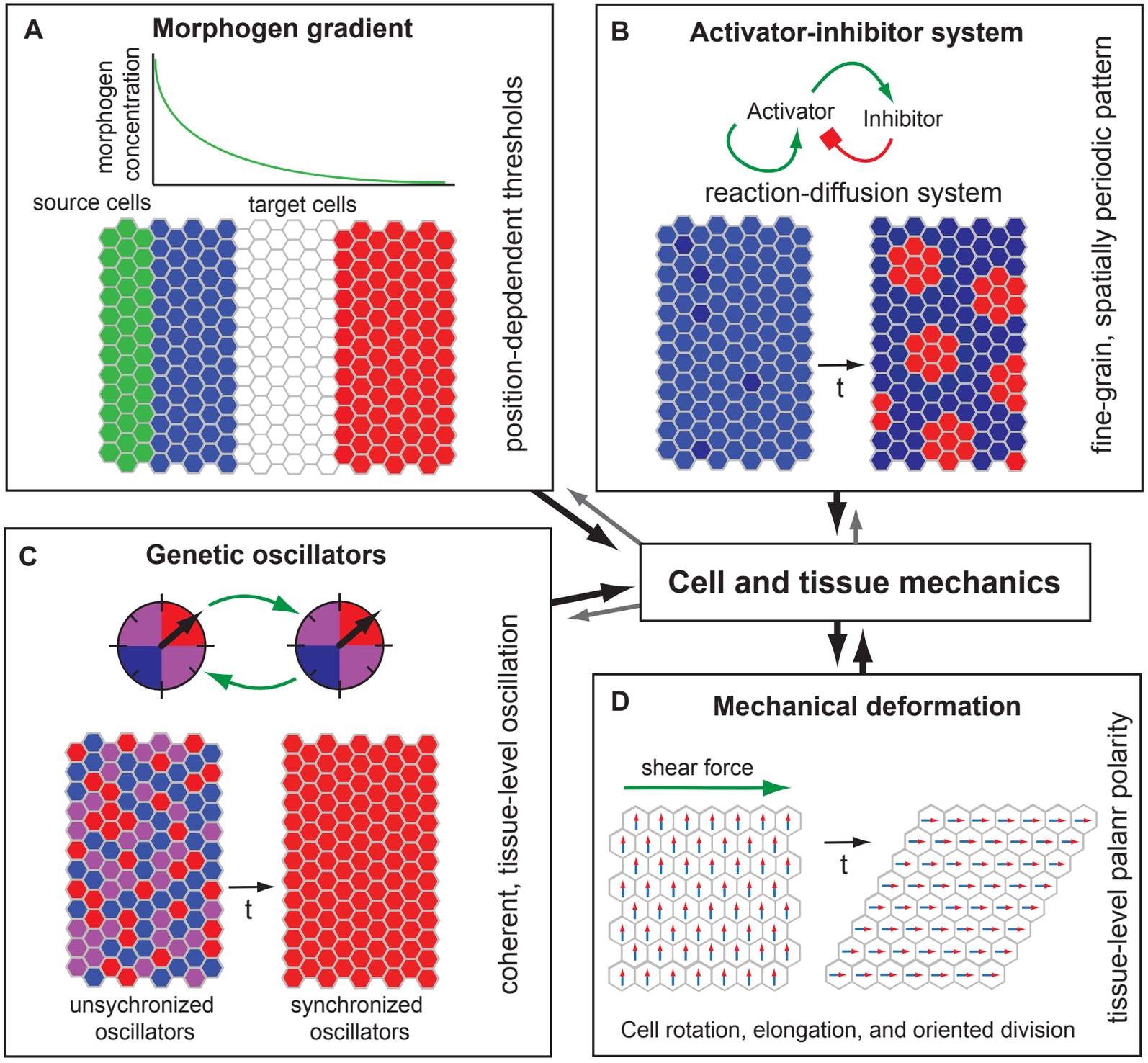
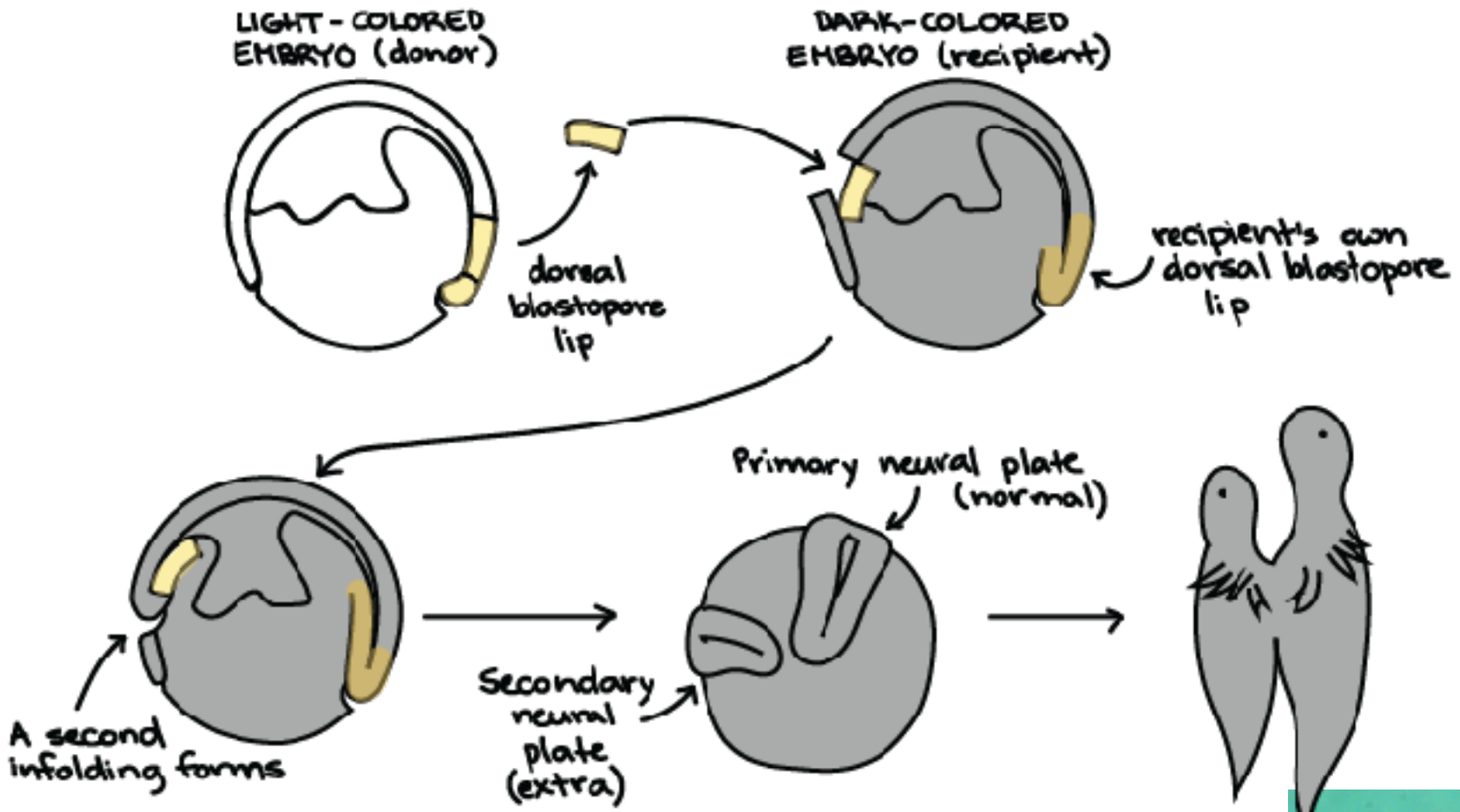
Patterning strategies

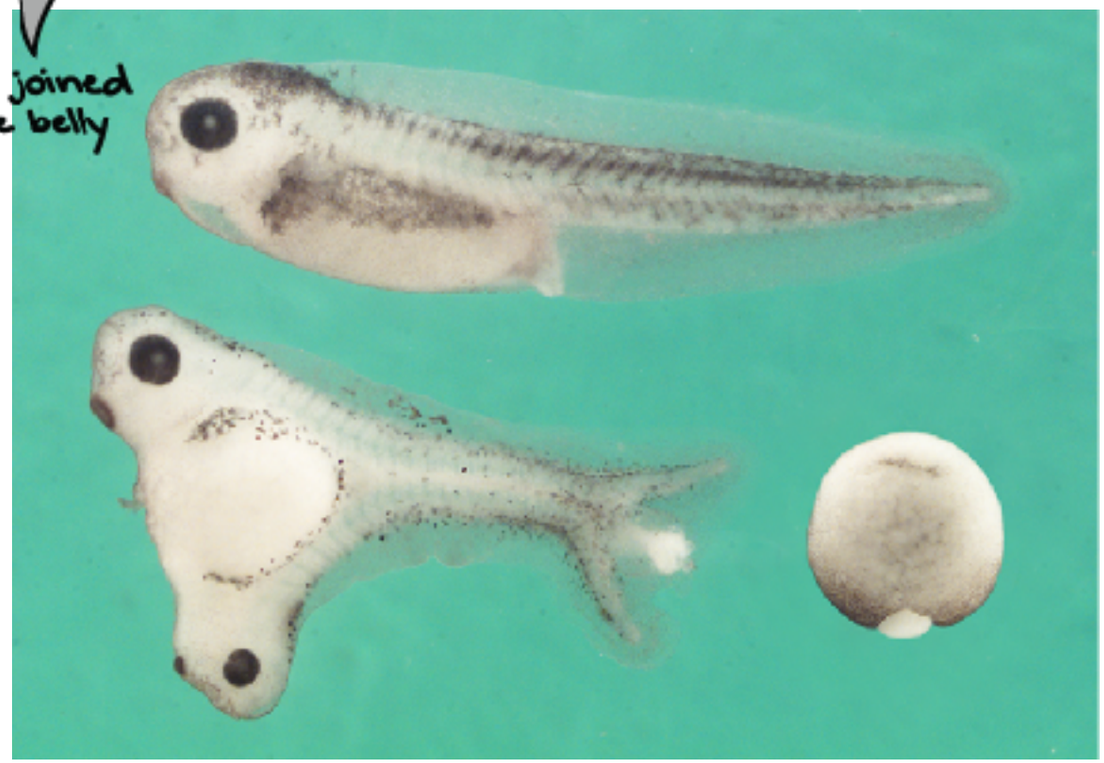


Morelli et al., *Science* 2012.

Embryonic Induction: Spemann and Mangold, 1924



A signal from the light-coloured embryo instructed the dark-coloured embryo's cells to change their behaviour: "organizer" of a new blastopore

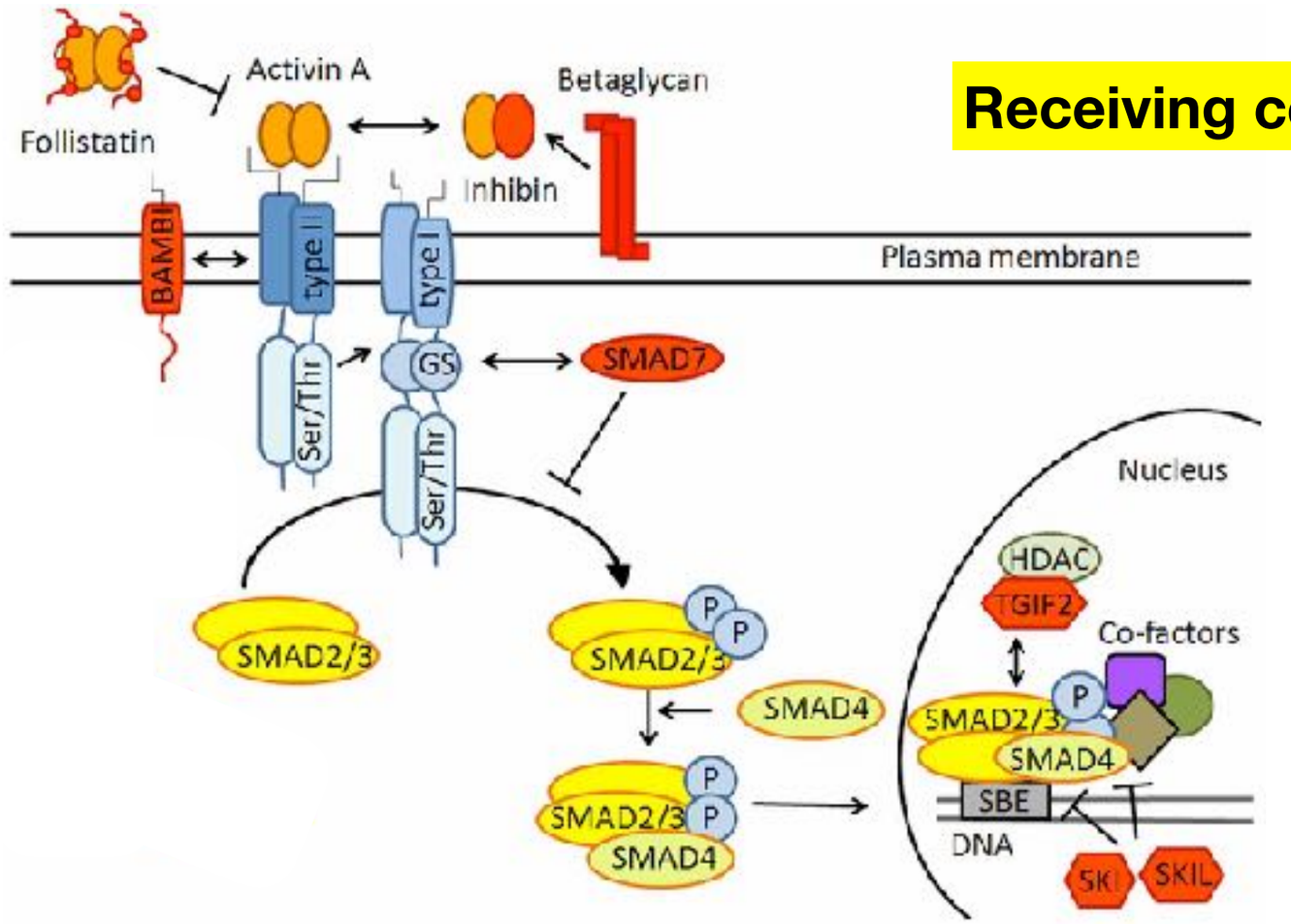


Signal transduction - Activin (TGF-beta family)

Signals from one cell can cause dose-dependent changes in gene expression in another cell

Sending cell

Receiving cell



Activin concentration

Gene X

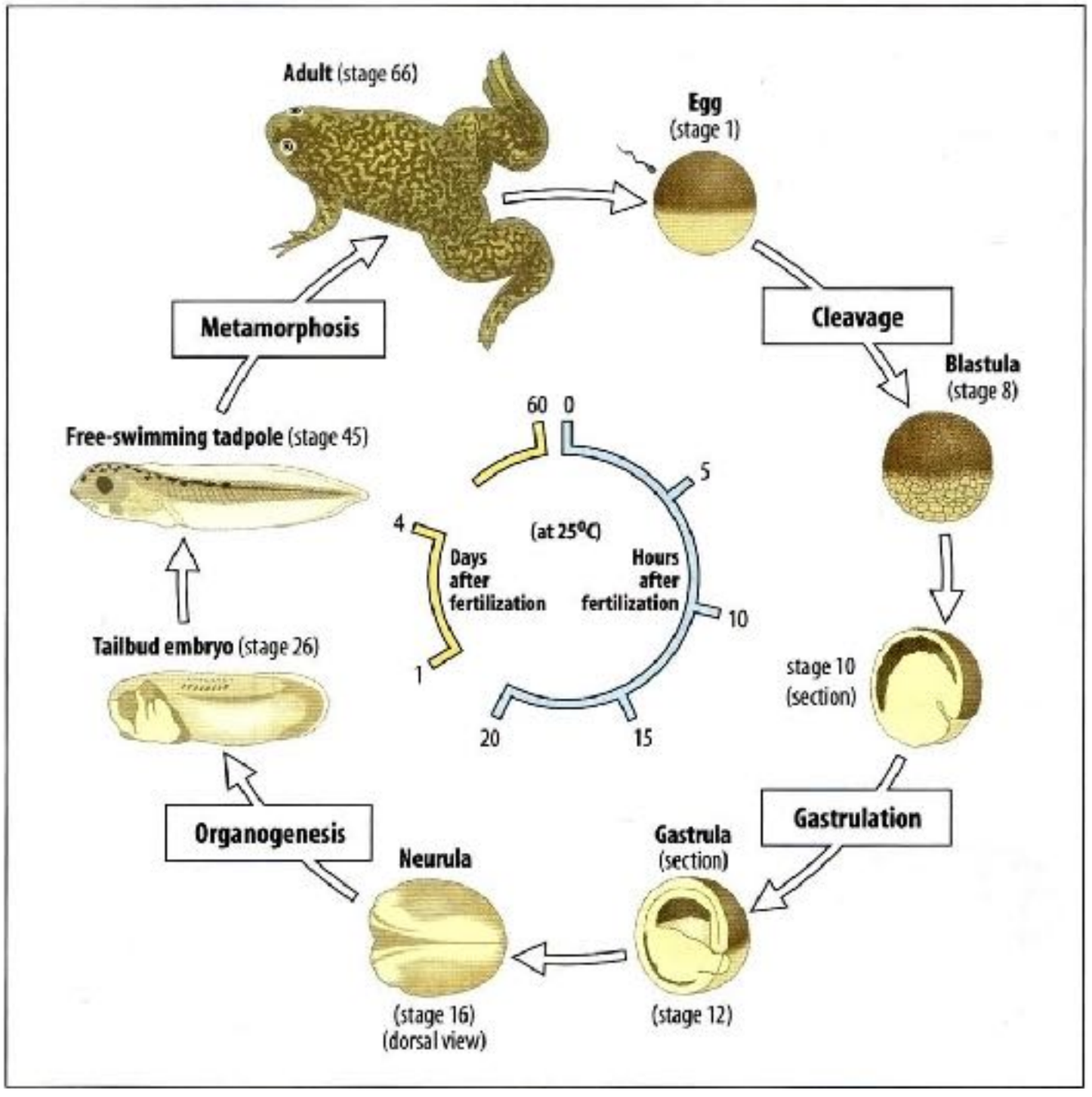
Gene A

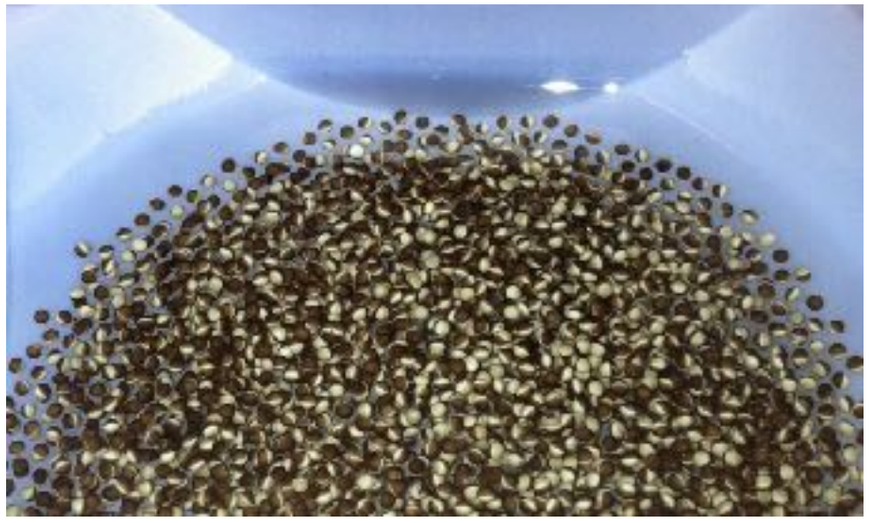
Gene B

Gene C

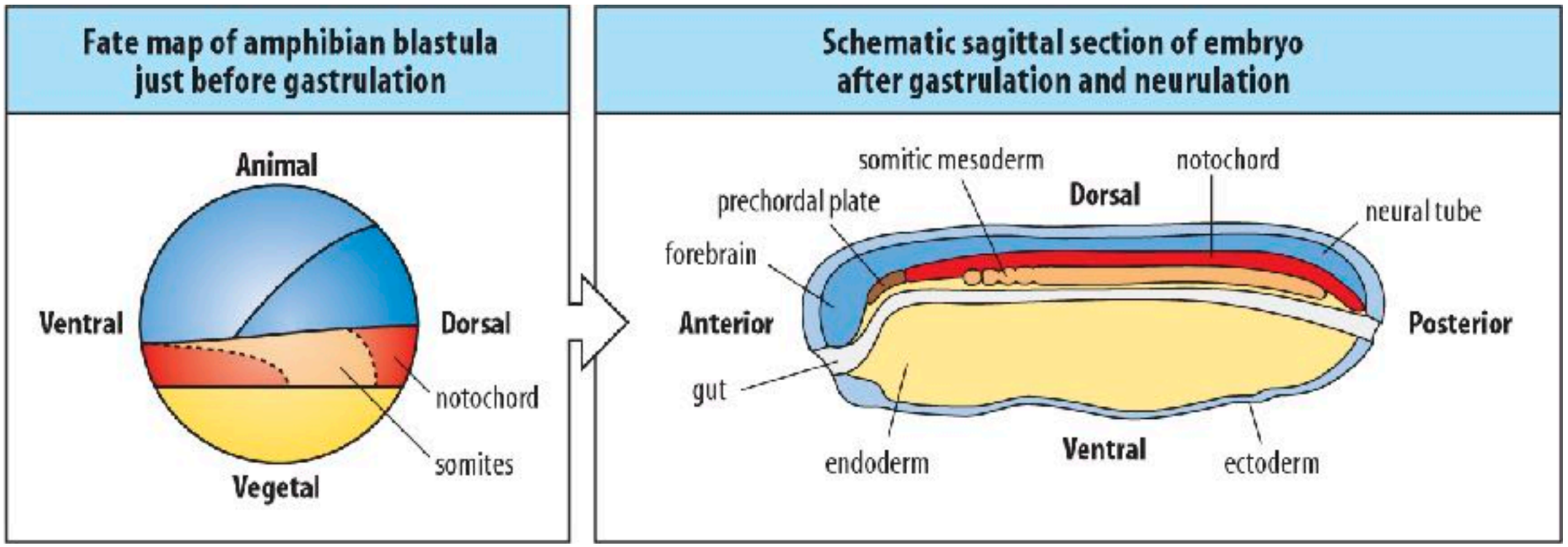
Link, Zheng, Alzheimer, 2016

Xenopus laevis - disgusting and useful

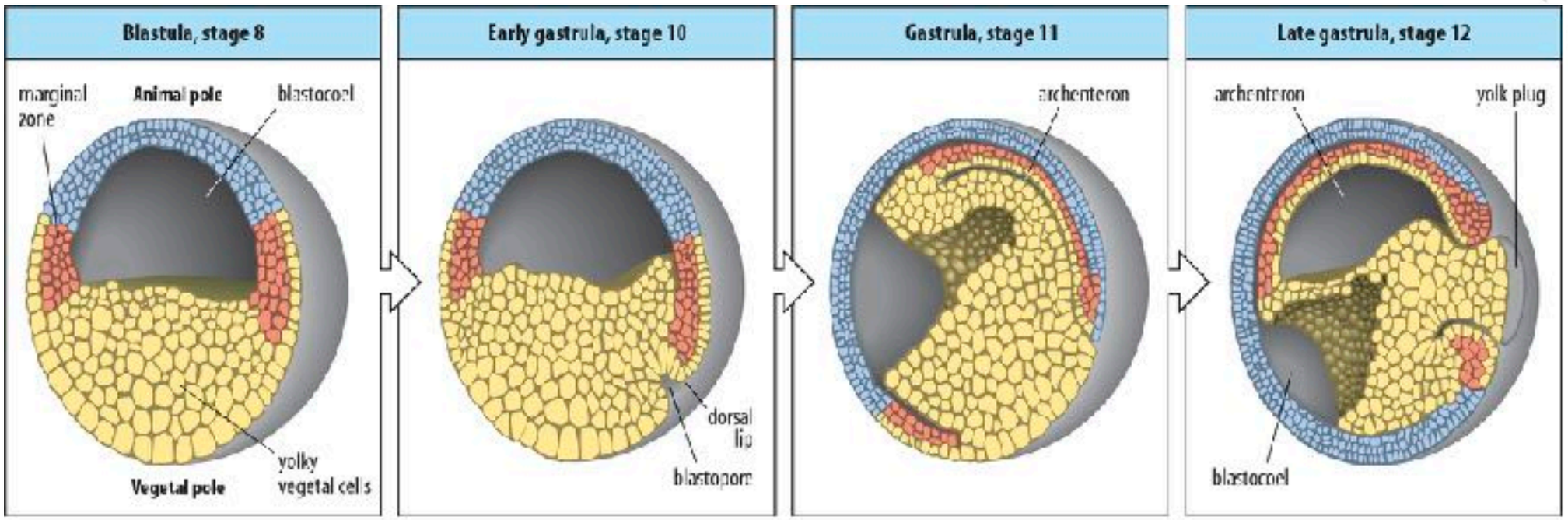


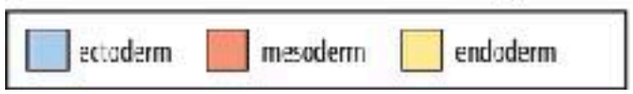


Fate map - the spatial origin of the mature tissues



Gastrulation - generation of the three “germ” layers

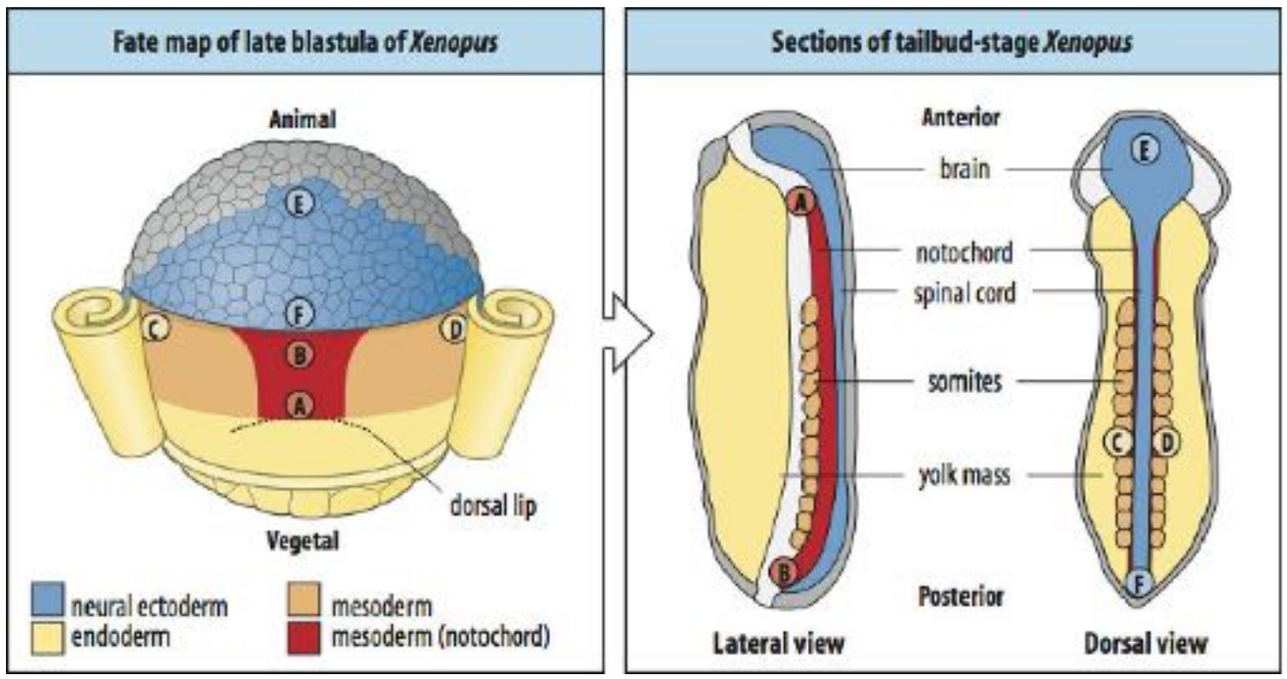




Nerves, skin

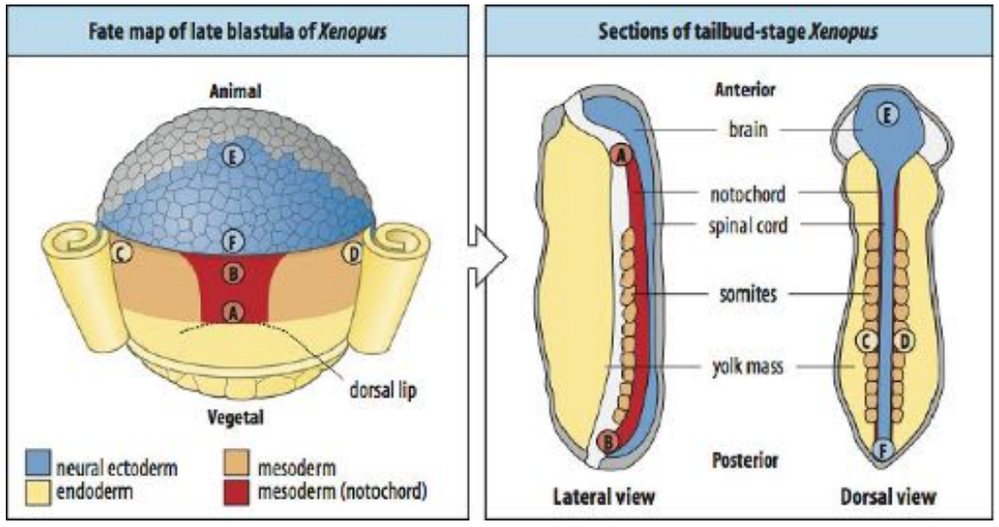
Notochord, Muscle

Gut

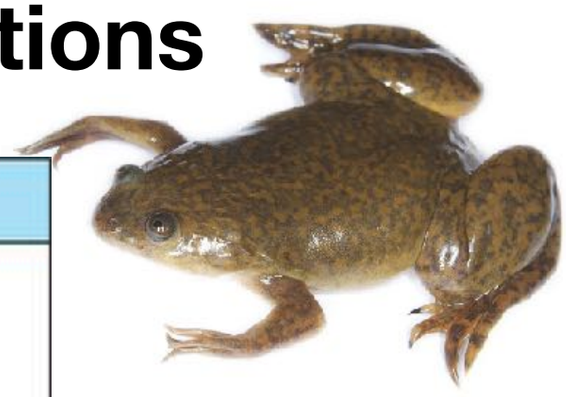


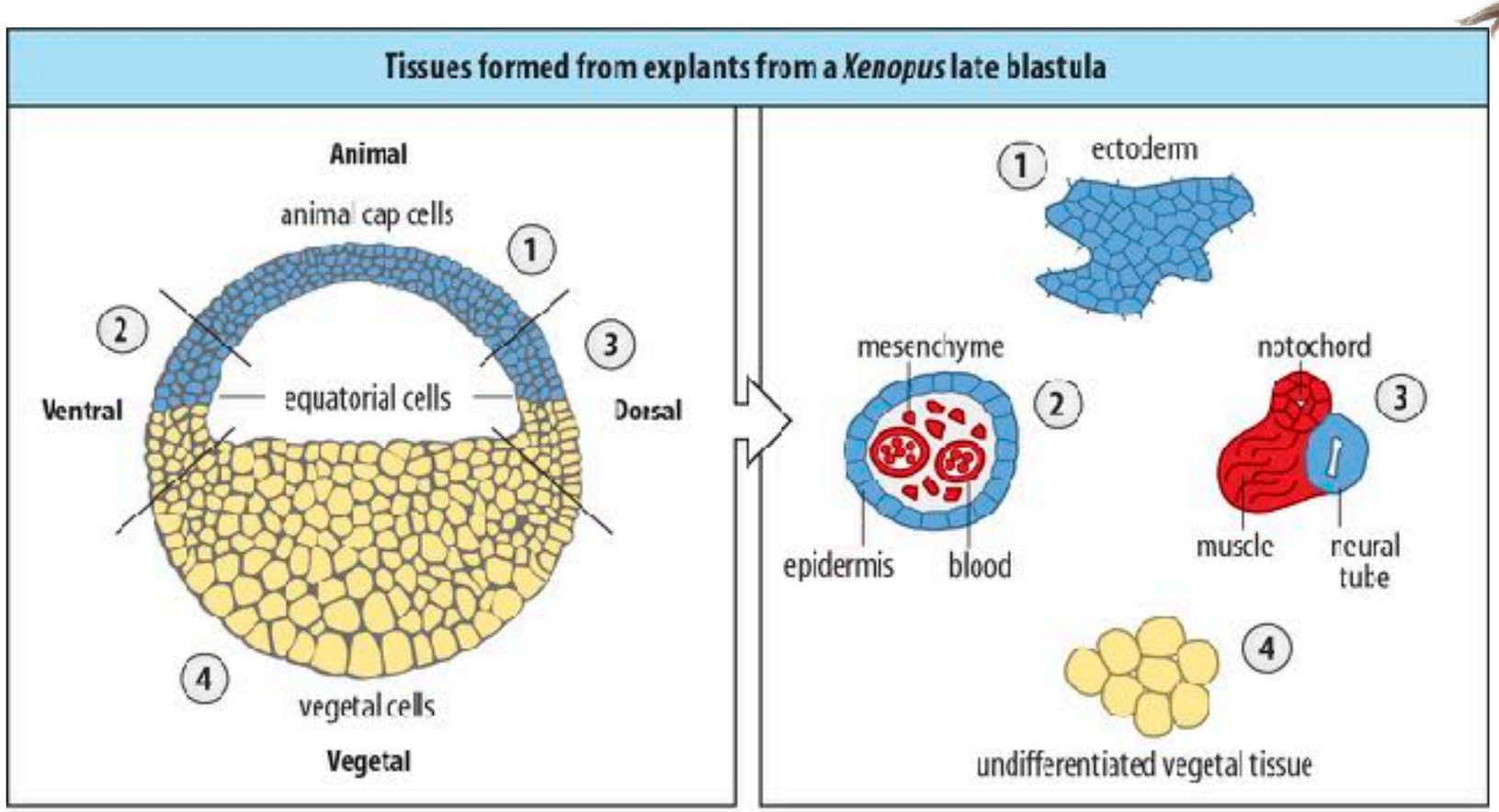
Wolpert, Principles of Development

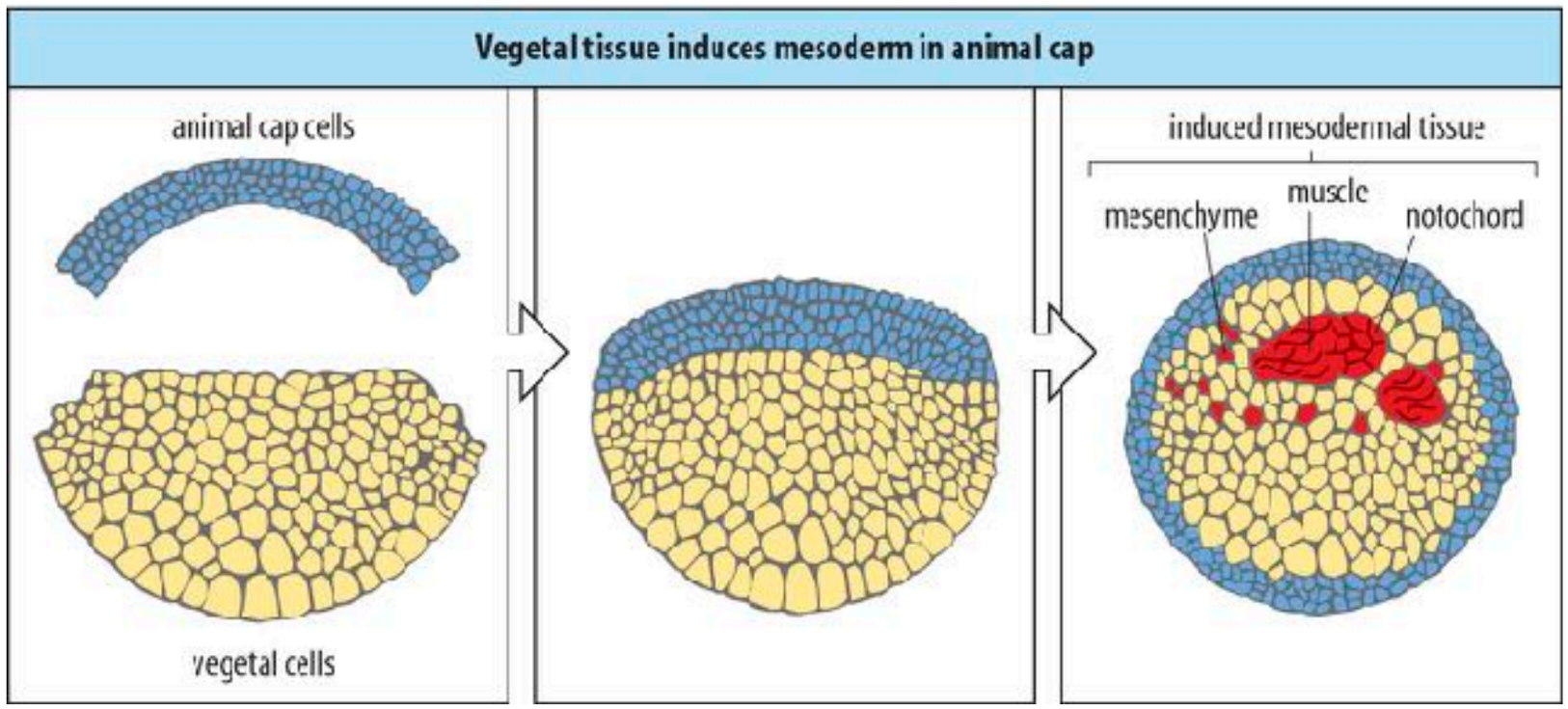
Early expression - XBra, Xnot, Goosecoid



Animal caps - a model for inductive interactions

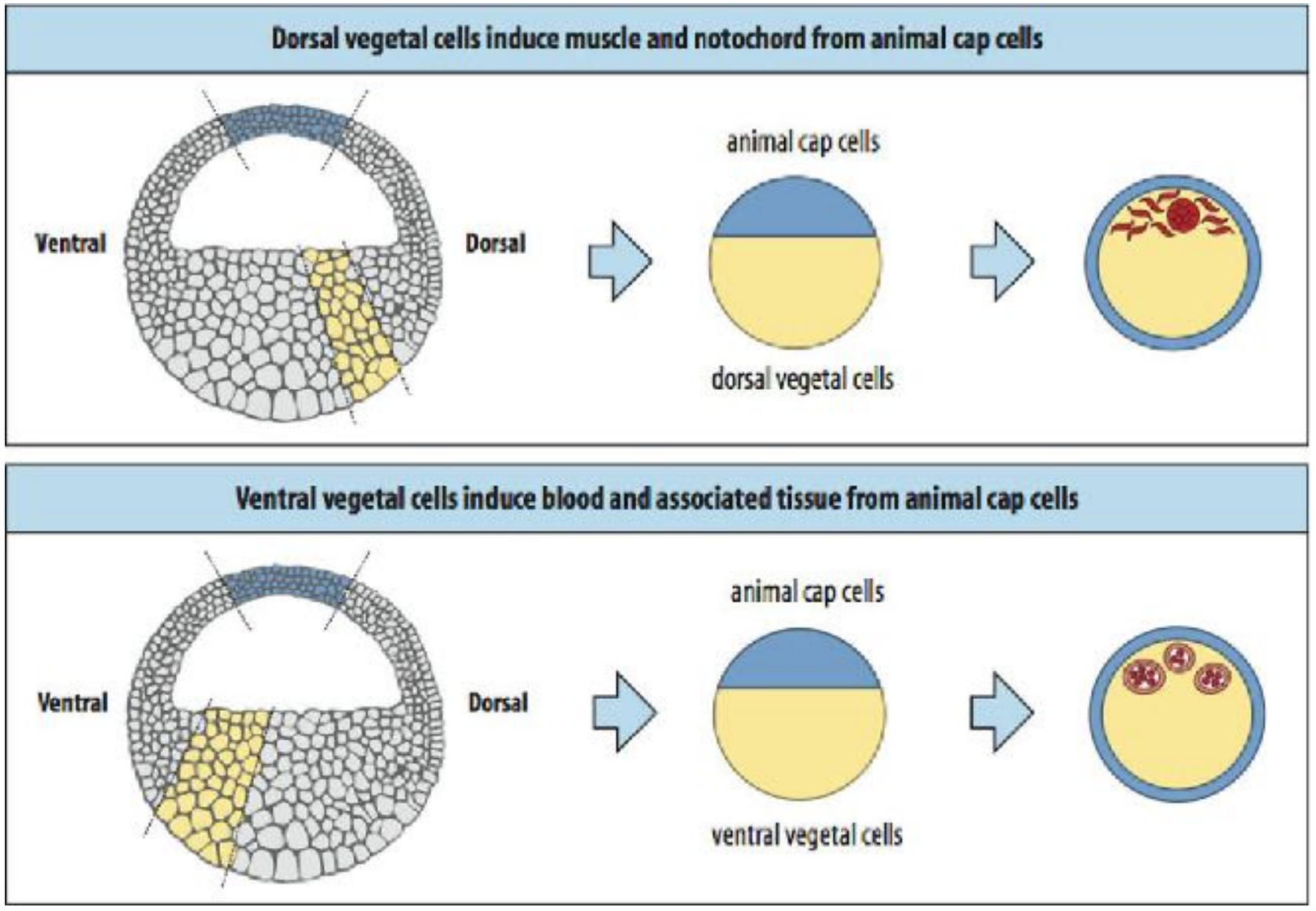




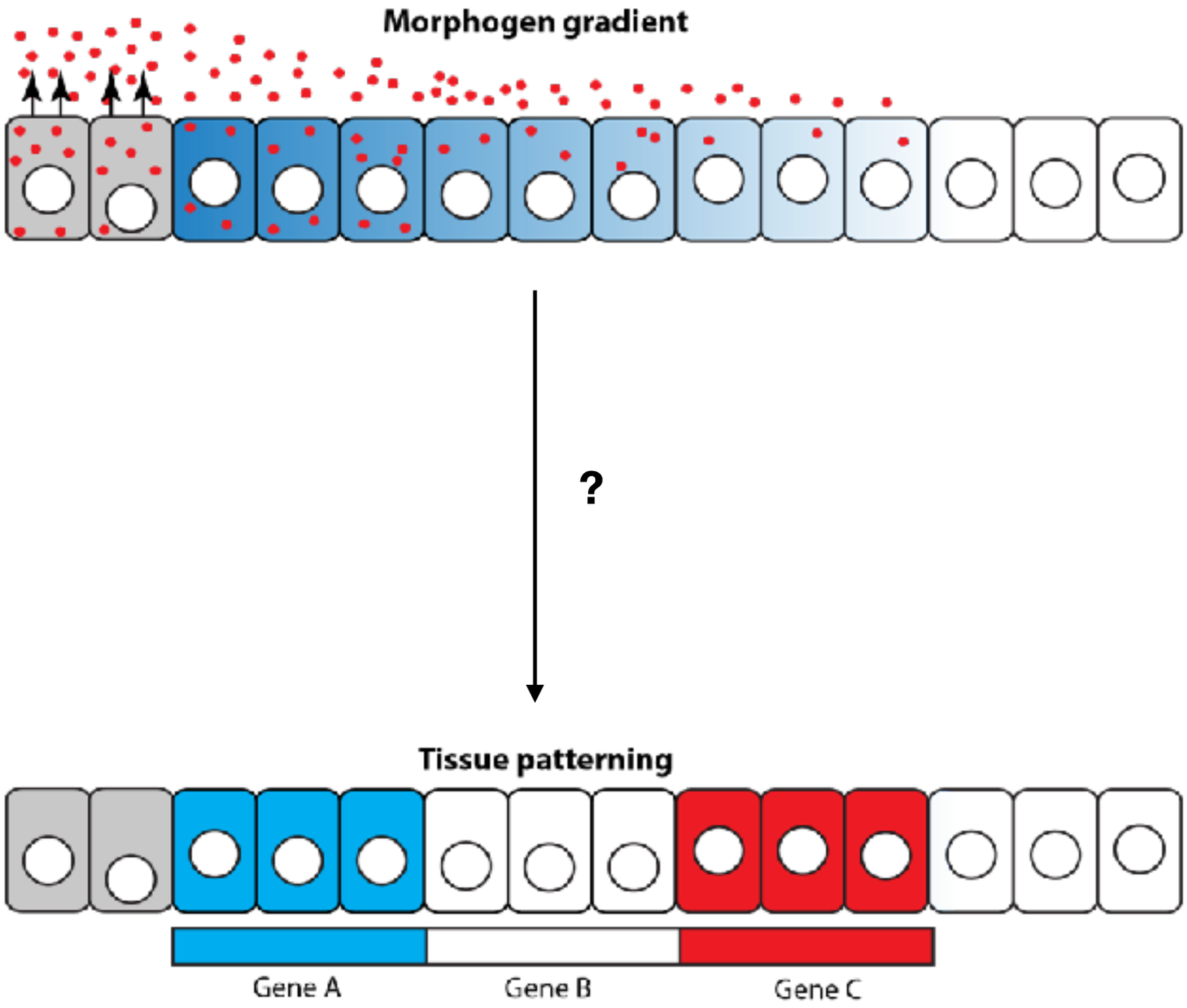


Wolpert, Principles of Development

Different vegetal cells induce different mesoderm

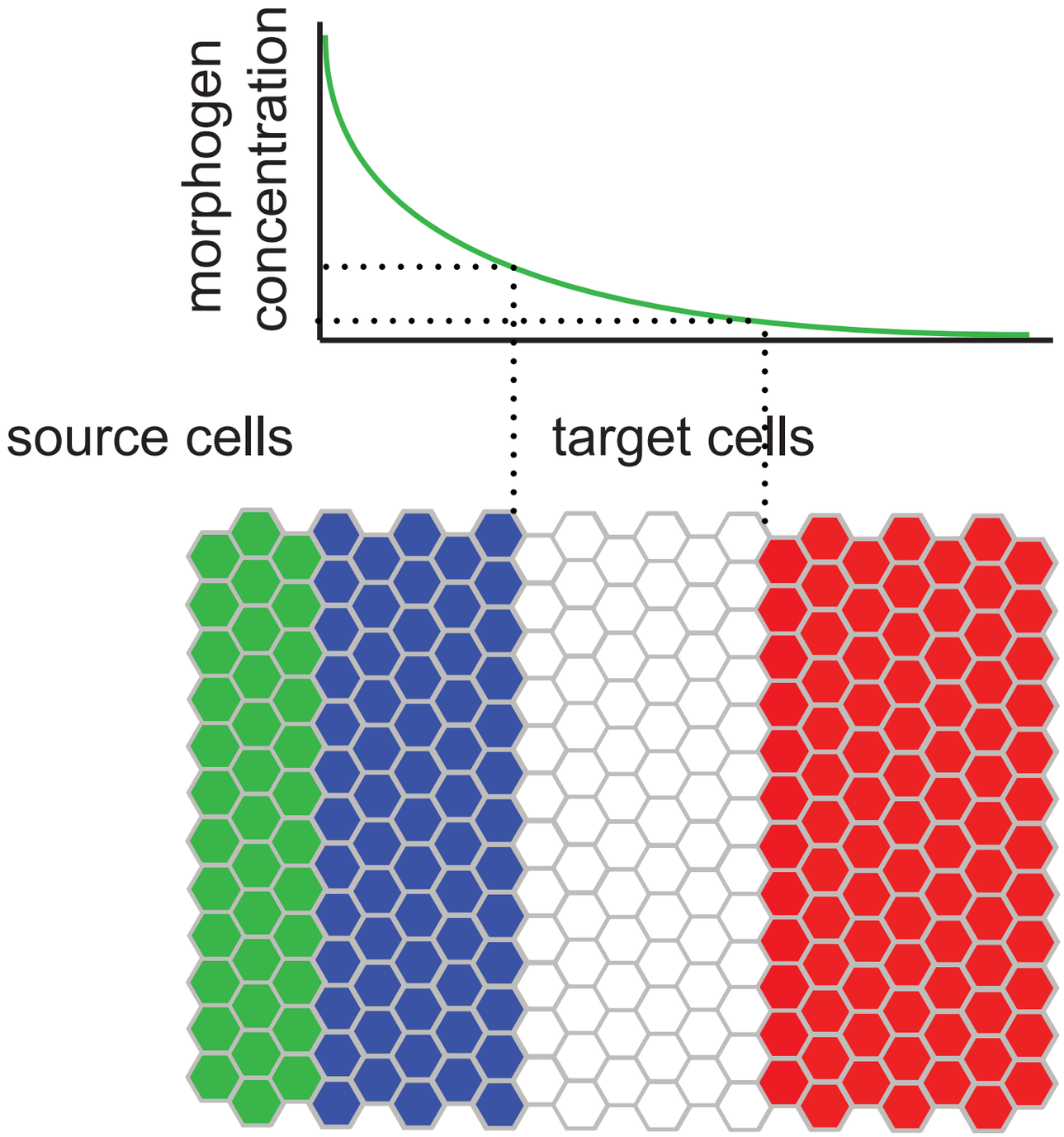


The French Flag problem (classical)



James Briscoe

Morphogen gradient



Positional information

Lewis Wolpert, 1969

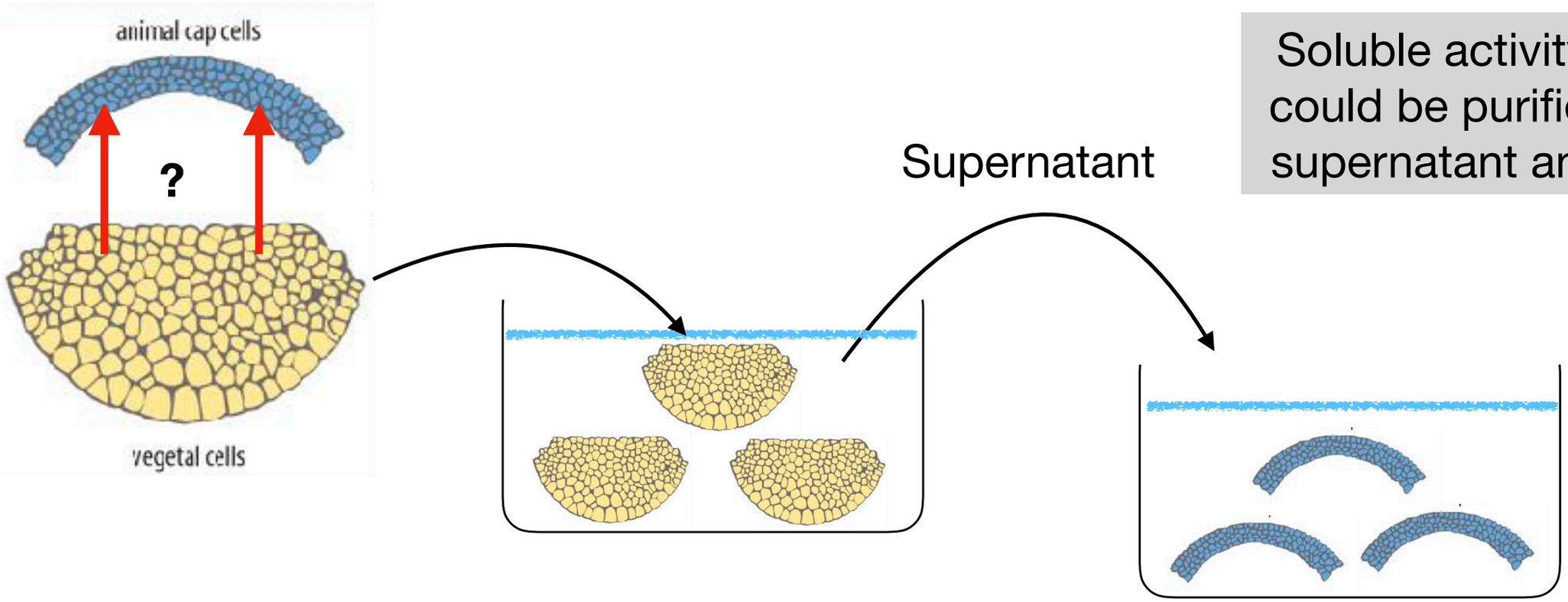
Classical Morphogen properties

1. Sharp concentration thresholds

2. Three (or more) stable cell states

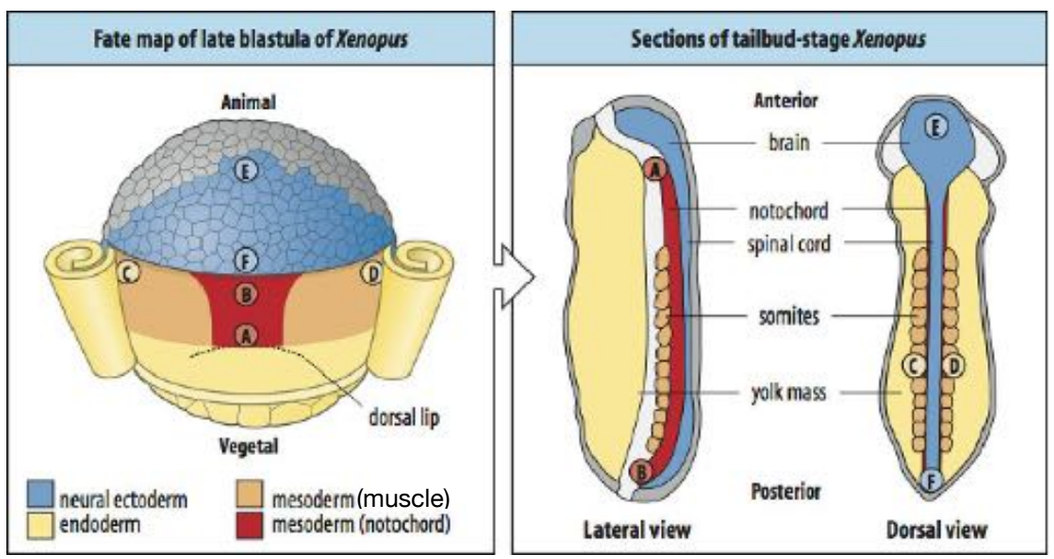
Morelli et al., *Science* 2012

XTC-MIF mesoderm inducing factor / Activin



Soluble activity (proteins) could be purified from the supernatant and cell lines

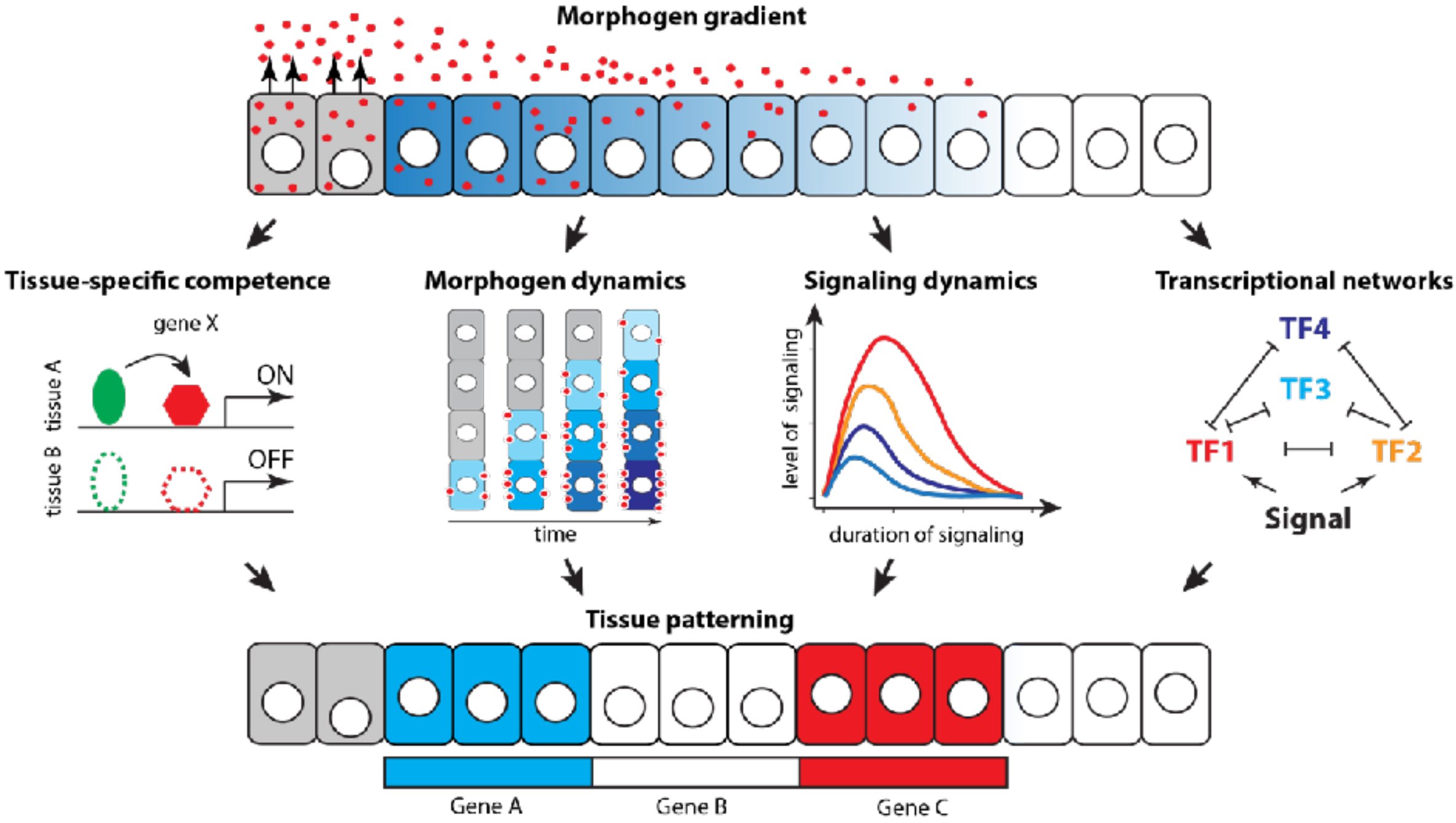
Blood, muscle, notochord
Some dose dependence…



Activin - a morphogen?

Activin: expressed in the vegetal cells, and induces several mesoderm cell-types

A French Flag solution (modern version)

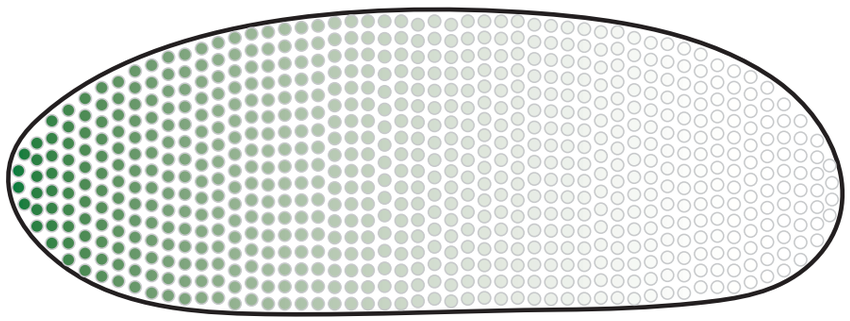


James Briscoe

Bicoid patterns the fly embryo as a morphogen

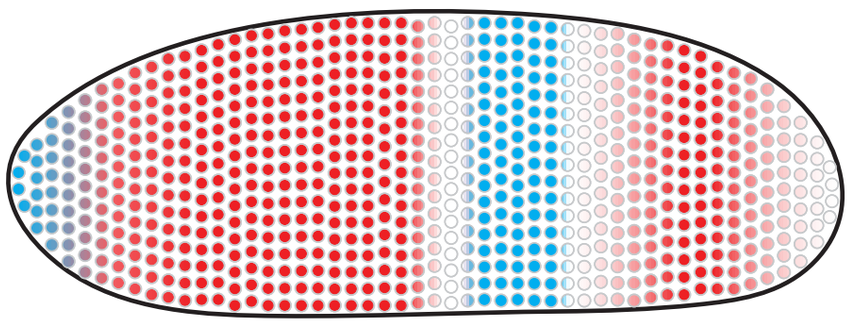
Early *Drosophila* embryo

Bicoid protein gradient

Anterior  Posterior

t

Hunchback and Knirps protein domains



Morelli et al., *Science* 2012.

Fate map - the spatial origin of the mature tissues