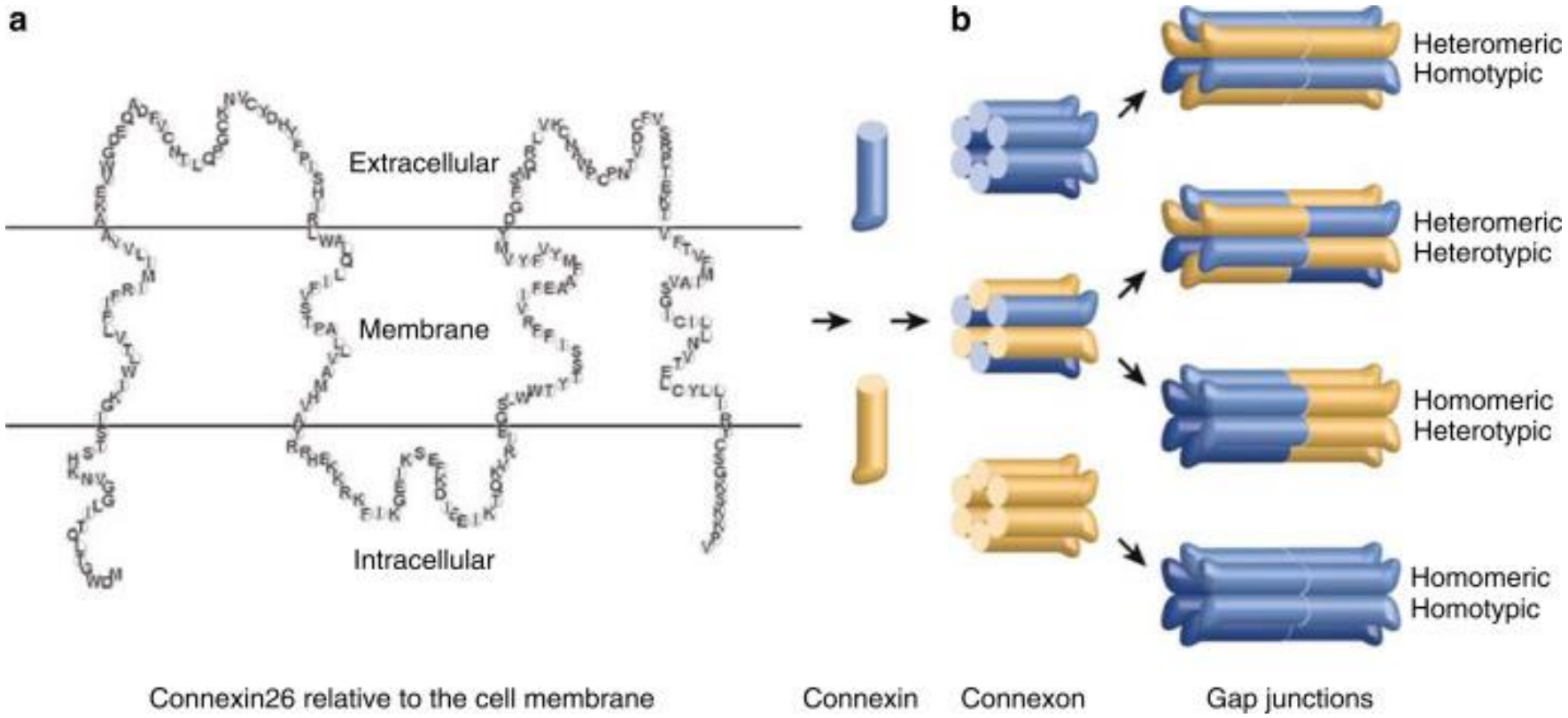
Gap junctions



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Perspective

Gap Junctions: Basic Structure and Function

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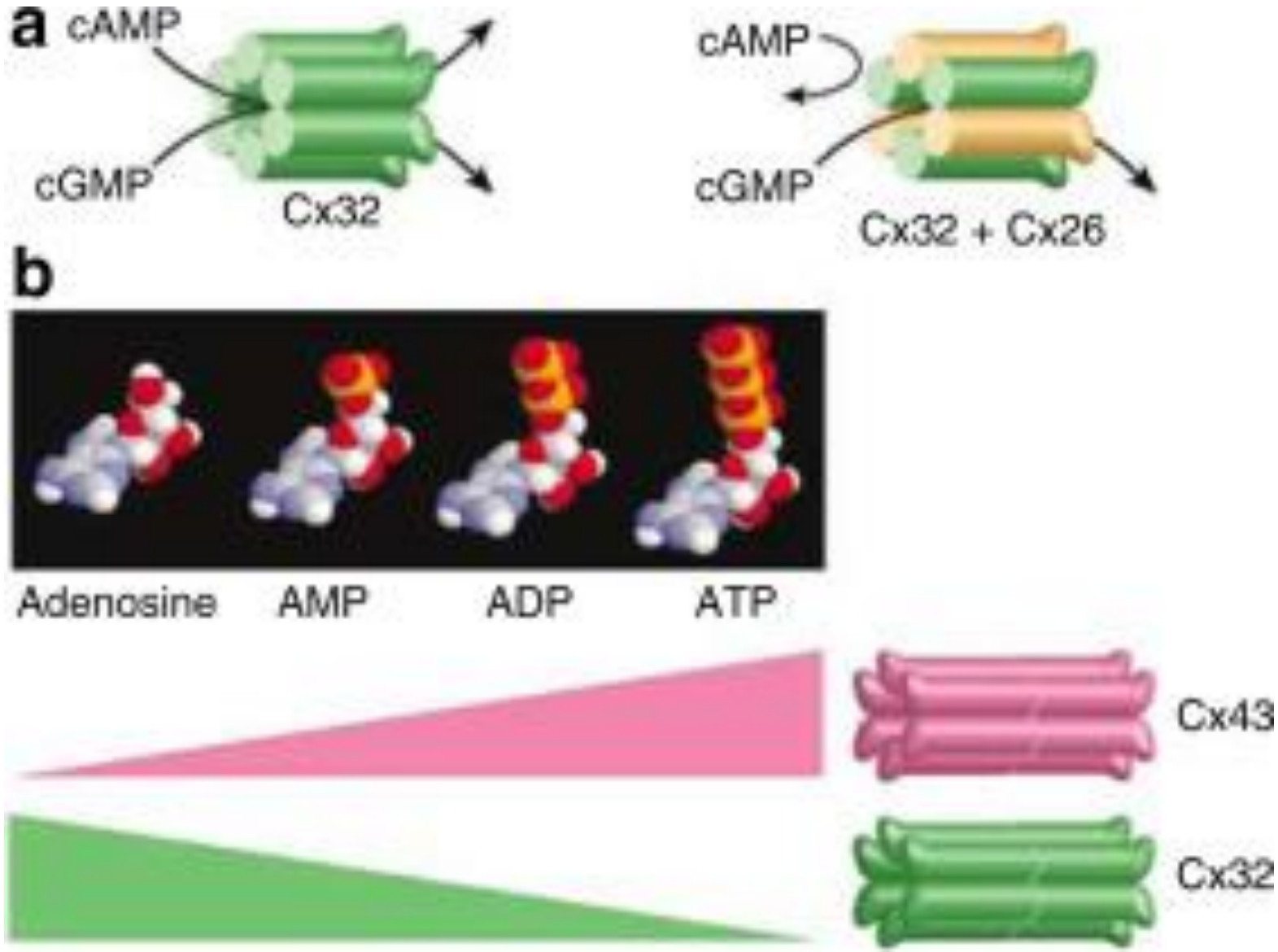
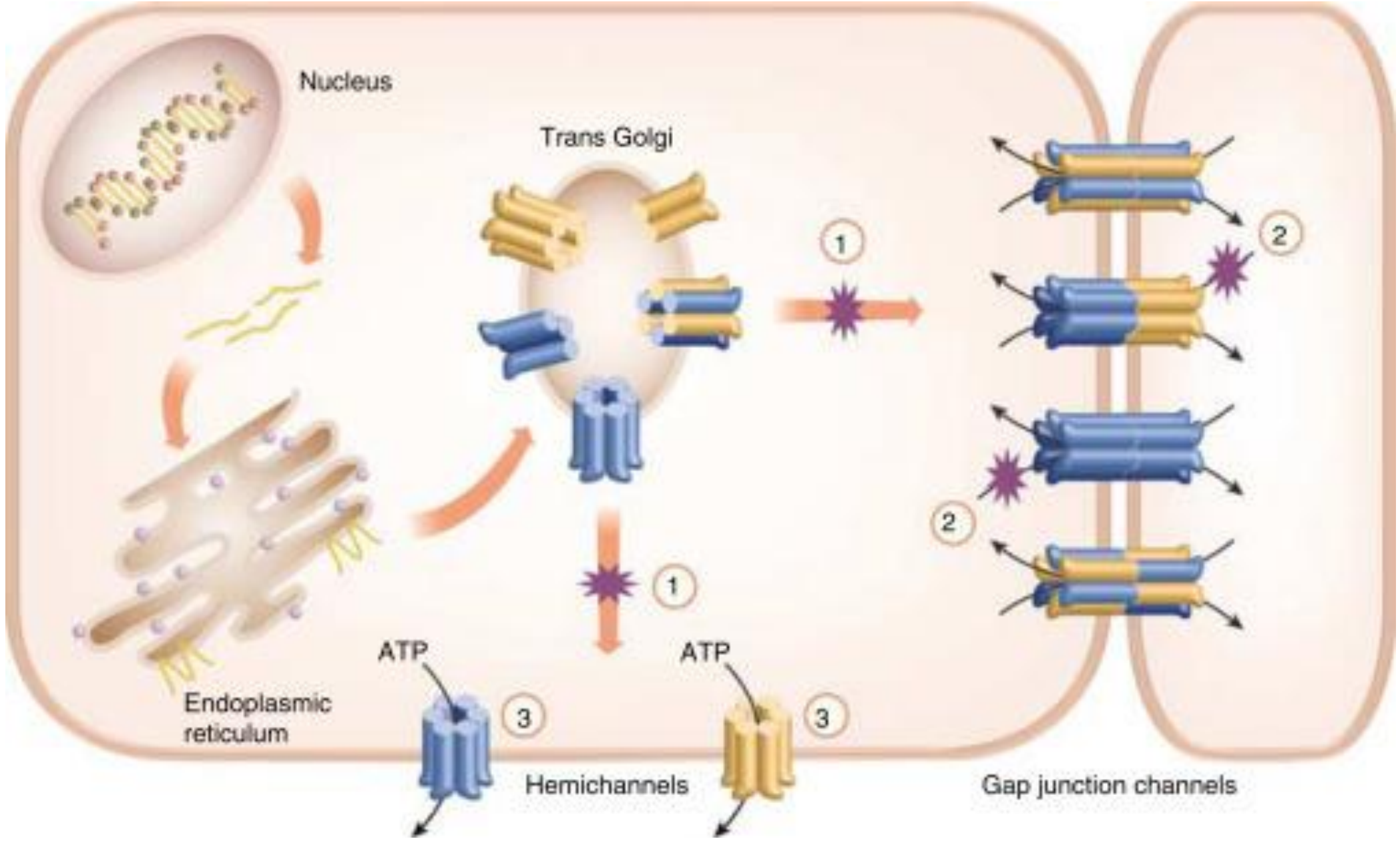

a
cAMP
cGMP
Cx32
cAMP
cGMP
Cx32 + Cx26
b
Adenosine
AMP
ADP
ATP
Cx43
Cx32

Table 1. Epidermal connexins and associated disorders

Gene	Hereditary disease	OMIM reference	Expression pattern
GJB4(Cx30.3)	Autosomal-dominant erythrokeratodermia variabilis	133200	Skin, kidney, and placenta
GJB3(Cx31)	Autosomal-dominant and -recessive erythrokeratodermia variabilis	133200	Skin, cochlea, placenta, kidney, testes, eye, and PNS
	Autosomal-dominant and -recessive nonsyndromic sensorineural hearing loss (DFNA3)	600101	
GJB2(Cx26)	Autosomal-recessive nonsyndromic sensorineural hearing loss (DFNB1)	220290	
	Autosomal-dominant nonsyndromic sensorineural hearing loss (DFNA3)	601544	Almost ubiquitous, including cochlea, skin, liver, placenta, breast, lung, and brain
	Vohwinkel syndrome	124500	
	Keratitis–ichthyosis–deafness syndrome	148210	
	Palmoplantar keratoderma associated with sensorineural hearing loss	148350	
	Bart–Pumphrey syndrome	149200	
GJB6(Cx30)	Autosomal-recessive nonsyndromic sensorineural hearing loss (DFNB1)	220290	
	Autosomal-dominant nonsyndromic sensorineural hearing loss (DFNA3)	601544	Skin, brain, cochlea, and cornea
	Clouston syndrome (Hidrotic ectodermal dysplasia)	129500	
GJA1(Cx43)	Oculo–dento–digital dysplasia	164200	Ubiquitous, including skin, heart, eye, and brain


Nucleus
Trans Golgi
1
2
2
1
ATP
ATP
3
3
Endoplasmic reticulum
Hemichannels
Gap junction channels

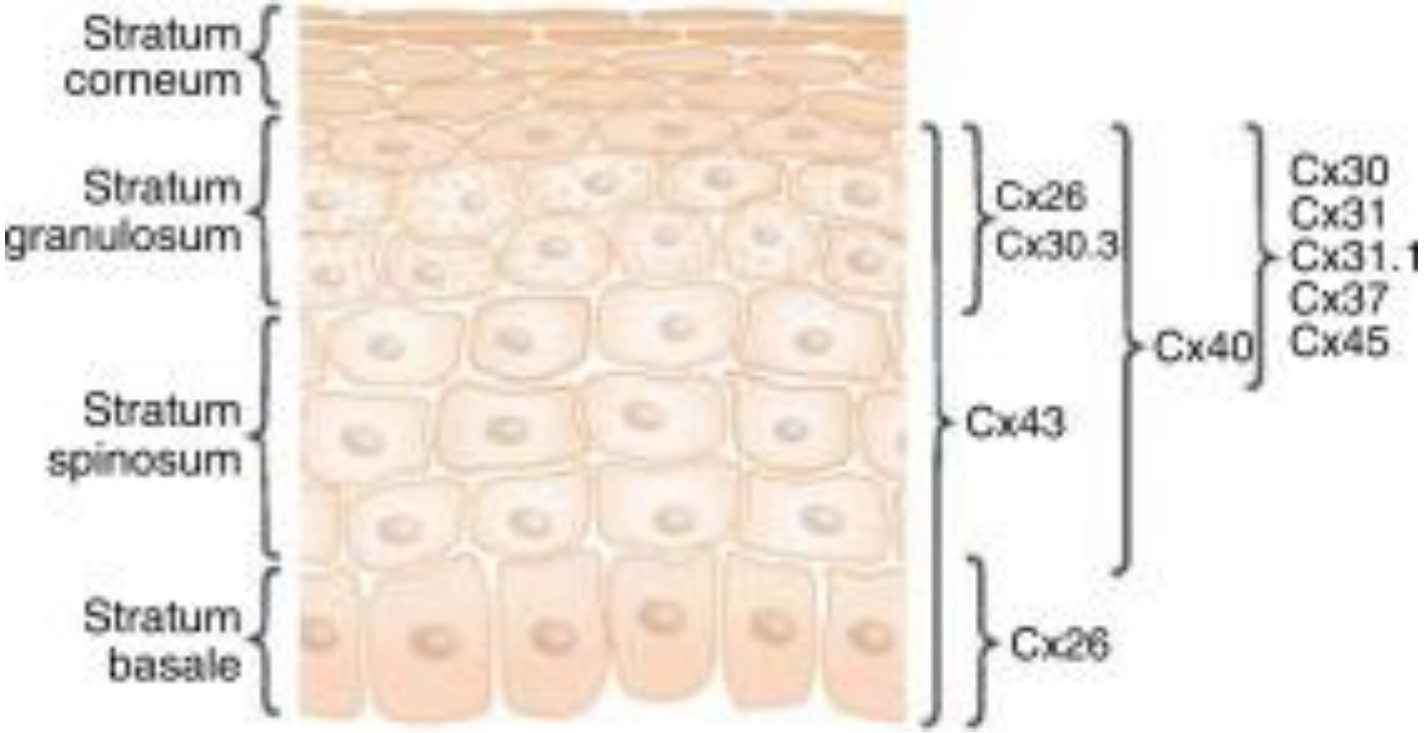
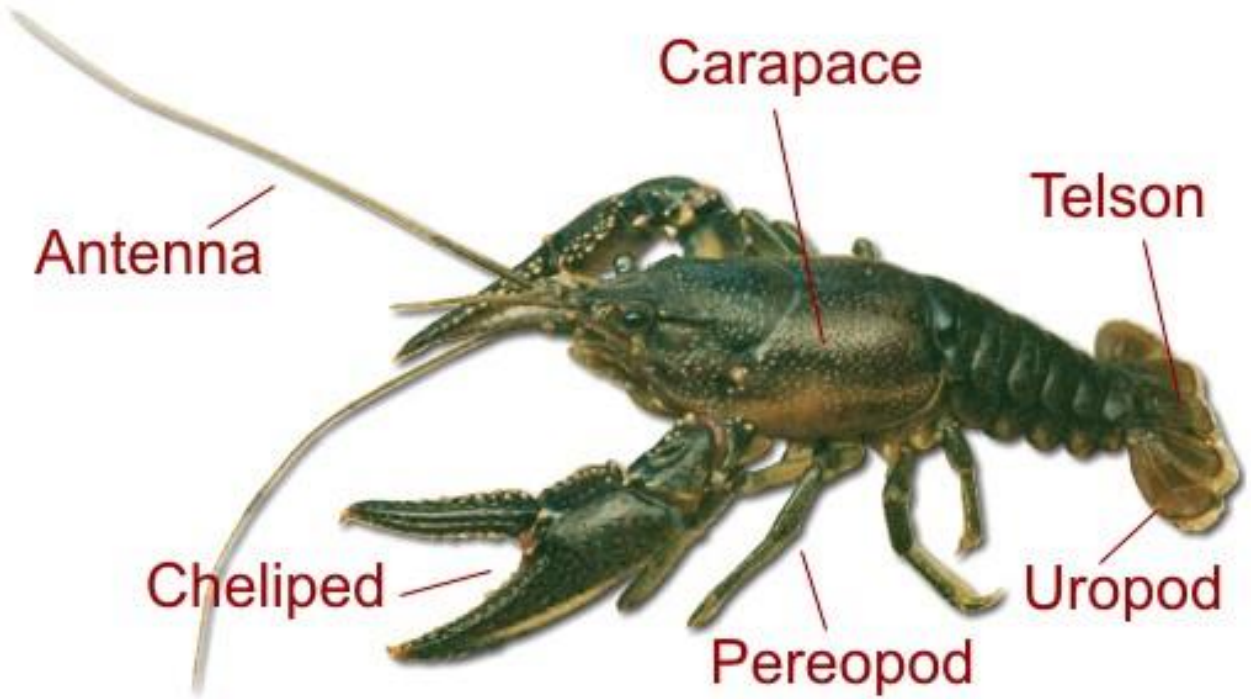
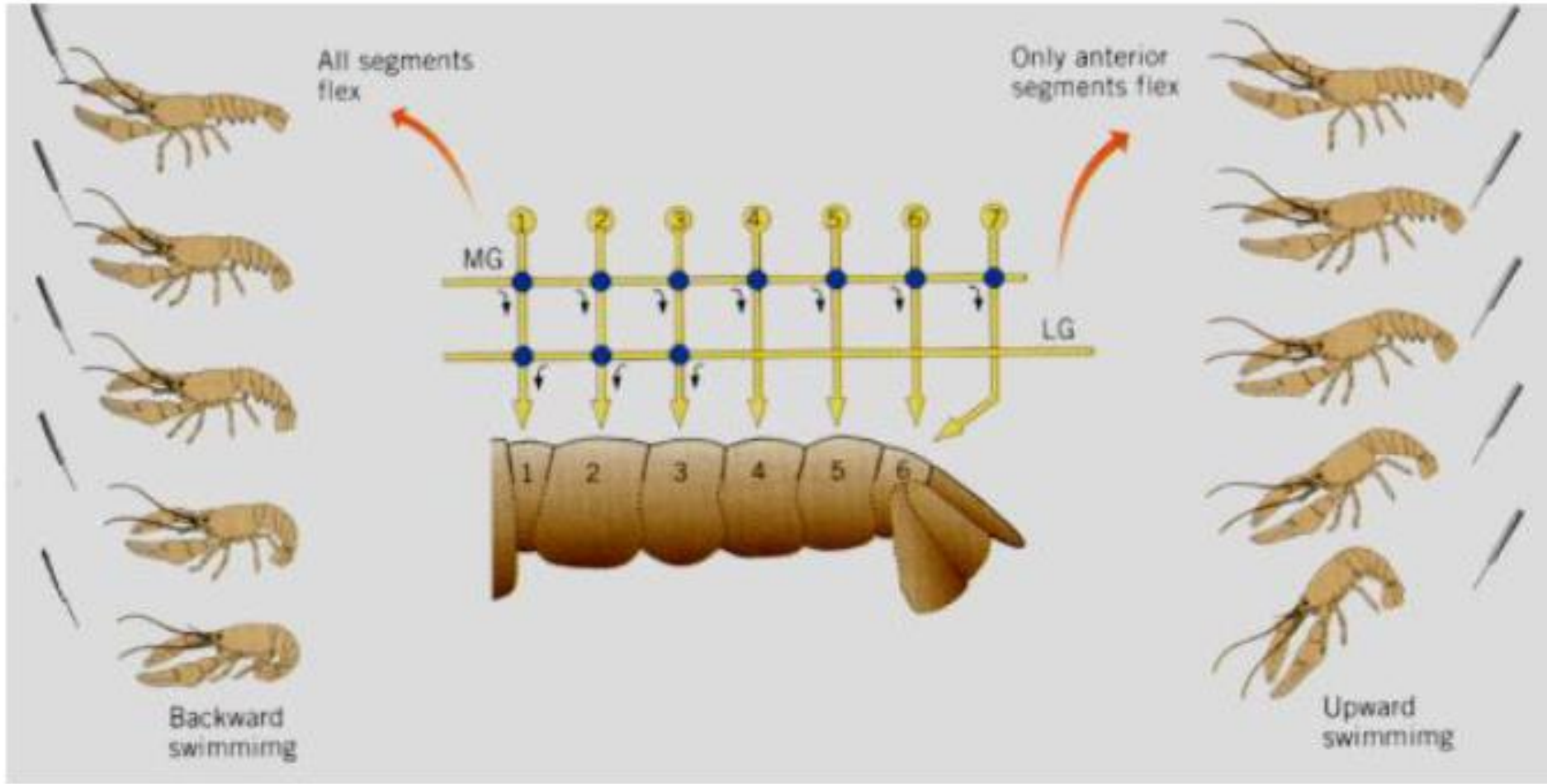
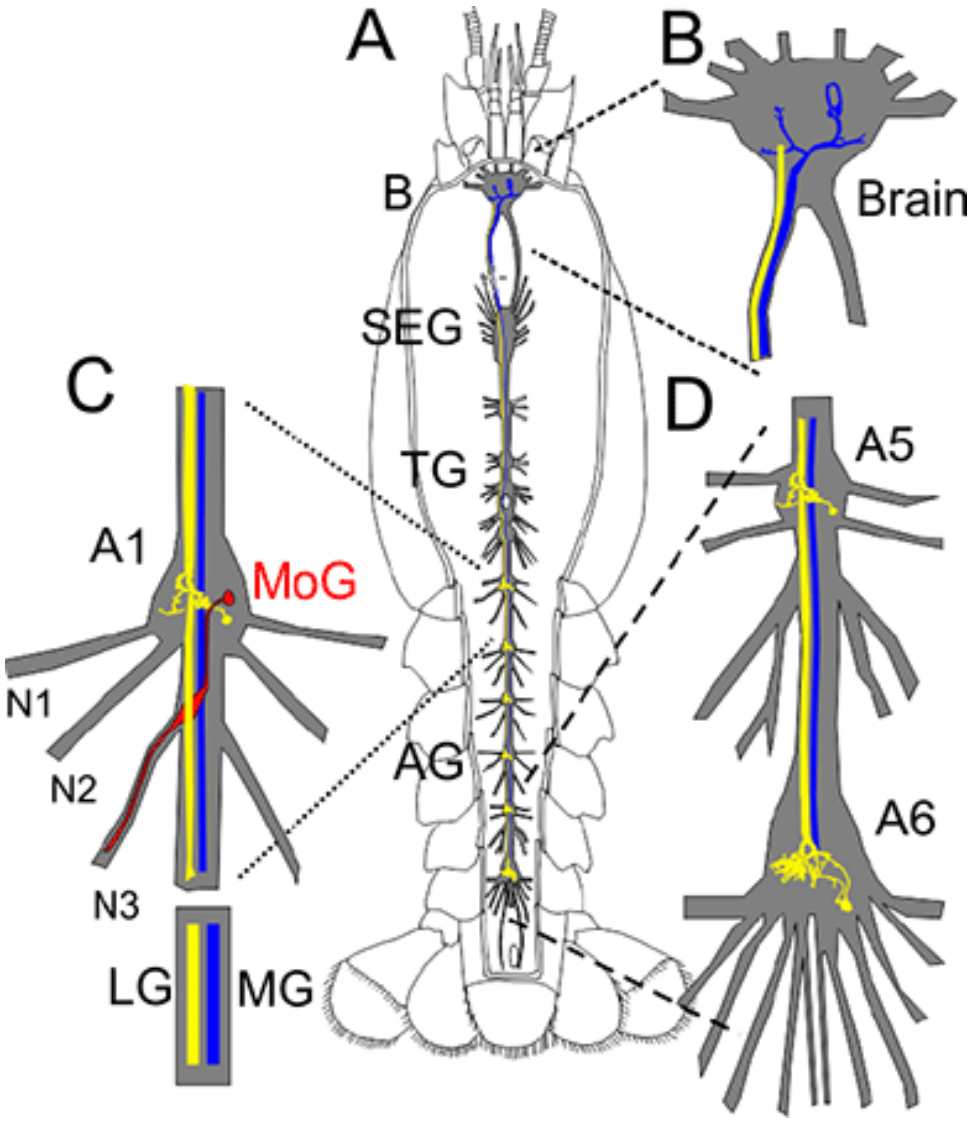


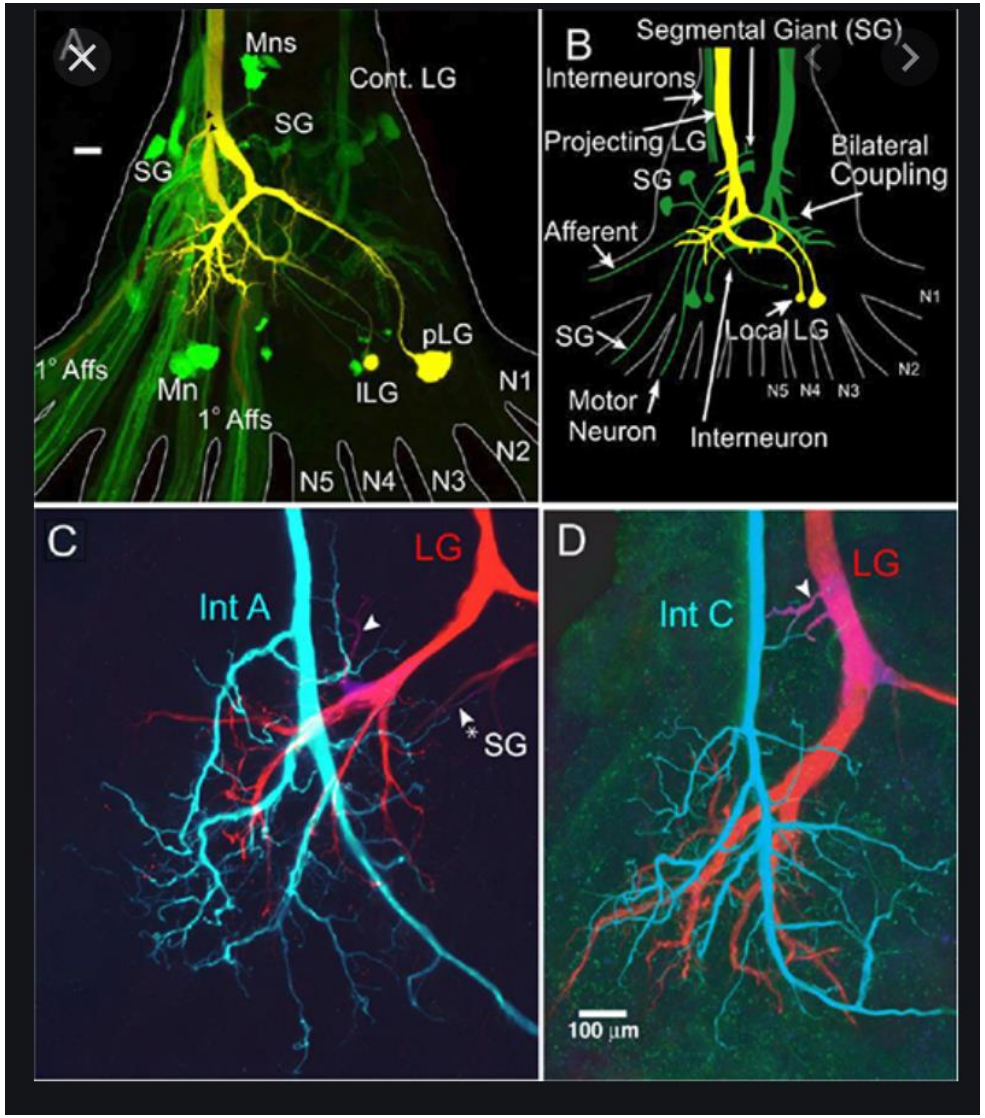
Figure 4. Expression pattern of connexins in the epidermis. At least nine connexin isoforms have been shown to be expressed during epidermal morphogenesis with distinct spatial and temporal expression pattern as well as some overlapping distribution. Cx43 is the most broadly expressed, whereas Cx26 is limited to basal keratinocytes in palms and soles, or occasionally cells in the granular layer. Cx40 is present throughout the spinous and granular layers, whereas the remaining six connexins are restricted to the upper spinous and granular layers.


Carapace
Antenna
Telson
Cheliped
Uropod
Pereopod

LGI vs. MGI Escape







Edwards, D. (2017, May 24). Crayfish Escape. *Oxford Research Encyclopedia of Neuroscience.* Retrieved 4 Jan. 2021, from https://oxfordre.com/neuroscience/view/10.1093/acrefore/9780190264086.001.0001/acrefore-9780190264086-e-158.

TABLE 1 The characteristics of polyethylene glycols as neutral probes

Probe	Molecular Weight	Number of -(C_2H_4O)- Unit	Concentration (w/w %) Used in Perfusion Solution	Hydrodynamic Diameter* (Å)
PEG 3500	3500	~79	10	~30
PEG 1000	1000	~22	5.5	17.8
PEG 600	600	~13	4.0	13.8
PEG 400	400	~8	3.1	11.2
PEG 300	300	~6	2.35	9.6
PEG 200	200	~4	1.86	8.0
TriEG	150	3	1.5	6.8
DiEG	106	2	1.06	5.8
EG	62	1	0.62	4.4

*The hydrodynamic diameters of PEGs were measured by size exclusion chromatography, including gel permeation chromatography (GPC), single-point method (equilibrium partitioning) and column method (inverse GPC) (Kuga 1981).

Where else are gap junctions used ?
In humans ?

Given the important role of gap junctions in animal cells, you might wonder if they also exist in plant cells. However, gap junctions are absent in plant cells.

Plant cells contain channels called **plasmodesmata**. Edward Tangl first discovered these in 1885. Animal cells do not harbor any plasmodesmata per se, but scientists have discovered a similar channel that is not a gap junction. There are a number of structural differences between plasmodesmata and gap junctions.

(https://sciencing.com/difference-between-gap-junctions-plasmodesmata-8714824.html)

Crayfish:

“Increase in gap junction resistance with acidification in crayfish septate axons is closely related to changes in intracellular calcium but not hydrogen ion concentration”

The data indicate that the increase in junctional resistance induced by acidification is more closely related to $[Ca^{2+}]_i$ than to $[H^+]_i$.

In conclusion, this study shows lack of a direct relationship between intracellular pH and channel gating in crayfish septate axons. In these cells intracellular acidification causes an increase in [Ca2+]i that closely matches a parallel increase in junctional resistance. This suggests that acidification may **close these gap junction channels via changes in internal free calcium**. Whether the same mechanism takes place in other cell systems remains to be proven.

Peracchia, C. Increase in gap junction resistance with acidification in crayfish septate axons is closely related to changes in intracellular calcium but not hydrogen ion concentration. *J. Membrain Biol.* **113,** 75–92 (1990). https://doi-org.ezproxy.uky.edu/10.1007/BF01869608