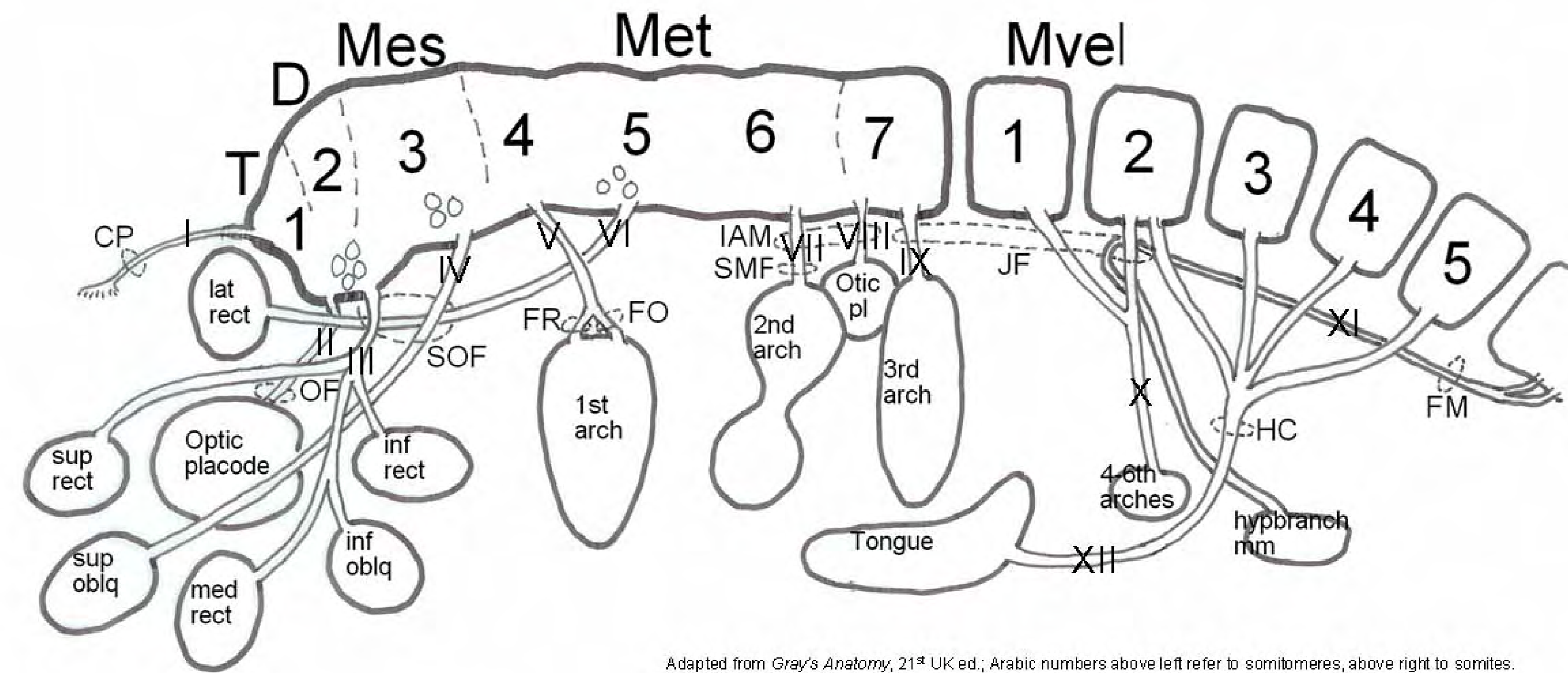


# Bristle through Bone: An Osteological Model Approach to Teaching the Cranial Nerves and their Foramina

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An evolutionary developmental approach to teaching gross anatomy offers the advantages of imparting process and pattern to a student's learning and tends to counteract rote memorization without understanding. Anatomical segmentation of the head and neck is a powerful paradigm for learning. We constructed a detailed model of articulated cranial bones with anatomically correct foramina for the 12 cranial nerves and their branches. A teaching module that uses this model with color-coded bristles for self-directed learning is presented. Cranial nerve branches are characterized by reference to the fibers that they carry, as lost or elaborated during embryogenesis from a primitive spinal-nerve-like pattern, and they are identified as somitomere-related cranial nerves, pharyngeal arch nerves, pretrematic branches, or autonomic nerves and ganglia. The bony foramina of the skull are related to the cranial nerve branches that they transmit via their embryological development and these are explored with the appropriate color-coded bristles. An understanding of the underlying osteology imparts an appreciation of the soft-part anatomical patterns of the head and neck that the student subsequently encounters in the gross anatomy laboratory.



Adapted from Gray's Anatomy, 21<sup>st</sup> UK ed.; Arabic numbers above left refer to somitomeres, above right to somites. Abbreviations in tables.

VESICLE /ADULT DERIVATIVE	CRANIAL NERVE(S)	CRANIAL FORAMINA FOR MAIN BRANCHES
Telencephalon/ Olfactory bulbs	I – synapses with vesicle	Cribriform plate of ethmoid (CP)
Diencephalon/ Optic tracts	II – part of vesicle	Optic foramen (canal) of sphenoid (OF)
Mesencephalon/ Cerebral peduncles	III, IV – attach to vesicle	Superior orbital fissure (SOF)
Metencephalon/Pons	V,VI,VII,VIII – attach to vesicle	Foramen rotundum (FR; V <sub>2</sub> ), foramen ovale (FO; V <sub>3</sub> ), SOF (VI), internal auditory meatus (IAM; VII, VIII), stylomastoid foramen (SMF; VII)
Myelencephalon/ Medulla oblongata	IX,X,XI,XII – attach to vesicle	Jugular foramen (JF, IX, X, XI), foramen magnum (FM, XI), hypoglossal canal (HC, XII)

## CN I CN II CN V<sub>2</sub> CN V<sub>3</sub> CN VII CN VIII CN X CN XII



Bristle through cribriform plate



Bristle through optic canal



Bristle through foramen rotundum



Bristle through foramen ovale



Bristle entering internal auditory meatus and exiting stylomastoid foramen



Bristle entering internal auditory meatus



Bristle entering jugular foramen



Bristle passing through hypoglossal canal

## CN III



Bristle through superior orbital fissure

## CN IV



Bristle through superior orbital fissure



Bristle through sphenopalatine foramen



Bristle through mandibular canal



Bristle through nasopalatine foramen



Bristle through zygomaticofacial foramen

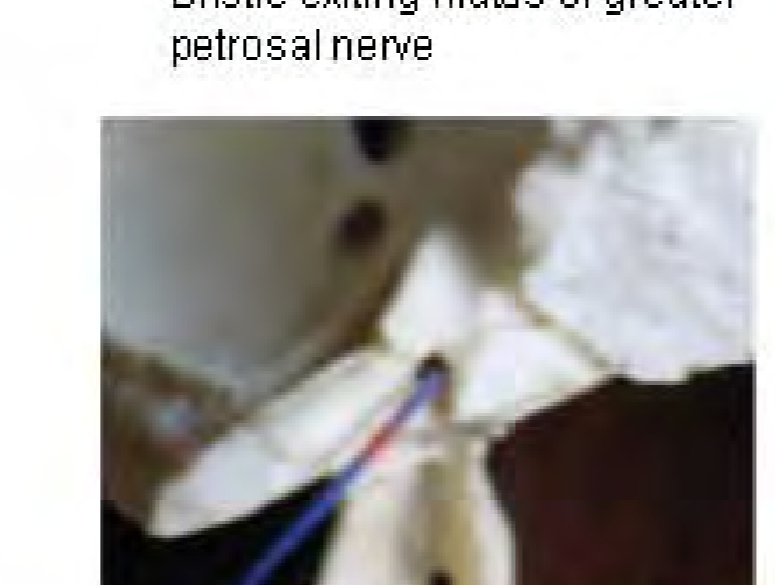


## CN VI

Bristle through superior orbital fissure



Bristle exiting hiatus of greater petrosal nerve



Bristle exiting pterygoid canal (nerve of pterygoid canal incorporates sympathetic from deep petrosal nerve as well)



Bristle entering jugular foramen



Bristle exiting hiatus of lesser petrosal nerve



Bristle passing through foramen magnum

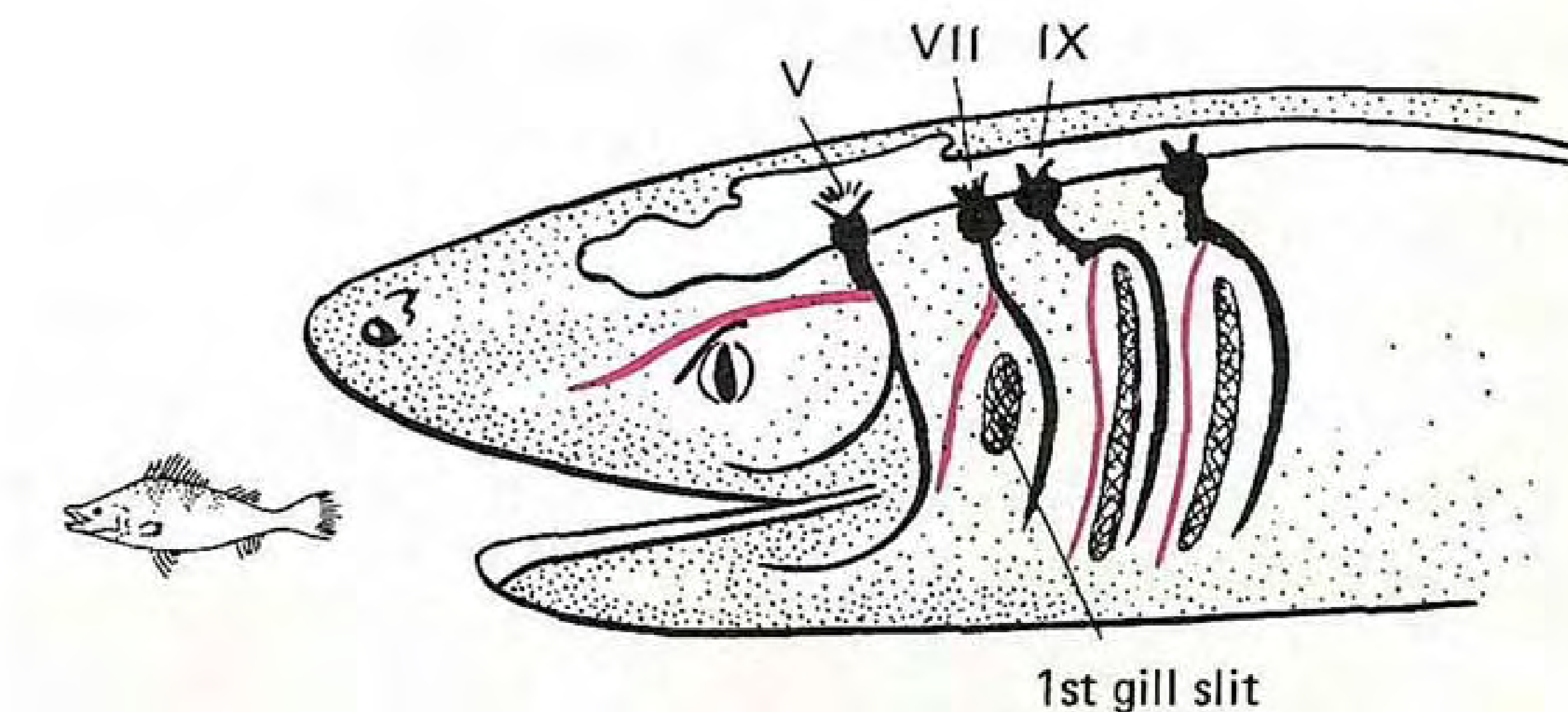


Bristle entering jugular foramen

## CN IX

## CN XI

## Pretrematic Nerves



From Langebartel, DA 1977 The Anatomical Primer, Baltimore: University Park Press.

## CN V<sub>1</sub>

## Chorda Tympani (VII)

## Tympanic Nerve (IX)

## Auricular Nerve (X)



Bristle entering superior orbital fissure



Bristle in petrotympanic fissure



Bristle in tympanic canalculus



Bristle in mastoid canalculus



Bristle passing through supraorbital notch



Bristle exiting tympanomastoid fissure

PARASYMPATHETIC NUCLEI FOR HEAD & NECK	CRANIAL NERVE OF ORIGIN AND EXITING FORAMINA	PARASYMPATHETIC GANGLIA	TERMINAL DISTRIBUTARY BRANCH OF TRIGEMINAL NERVE
Oculomotor (Edinger-Westphal) Nucleus	III/ Superior orbital fissure	Ciliary	Short ciliary nerves (V <sub>2</sub> ) to constrictor pupillae and ciliary muscle
Superior salivatory nucleus	VII/Internal auditory meatus+hiatus of greater petrosal nerve+pterygoid canal+inferior orbital fissure	Pterygopalatine	Zygomatic nerve (V <sub>2</sub> ) to lacrimal nerve (V <sub>1</sub> ) to lacrimal gland
Superior salivatory nucleus	VII/Internal auditory meatus+petrotympanic fissure (for chorda tympani)	Submandibular	Lingual nerve (V <sub>3</sub> ) to submandibular and sublingual glands
Inferior salivatory nucleus	IX/Jugular foramen+tympanic canaliculus+hiatus of lesser petrosal nerve+foramen ovale	Otic	Auriculotemporal nerve (V <sub>3</sub> ) to parotid gland