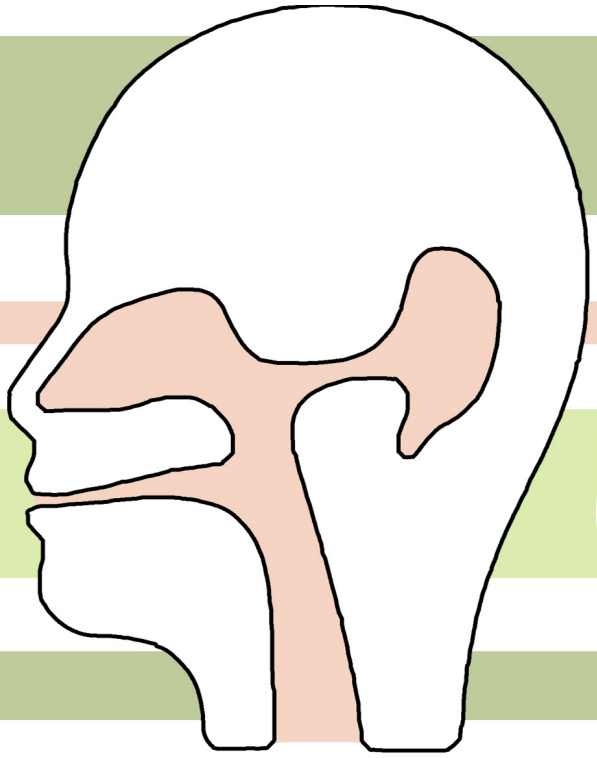


EAR, NOSE AND THROAT

(1) Ear I: Anatomy and Physiology of the ear

Leader: Maha Allhaidan

Done by: Arwa Almashaan

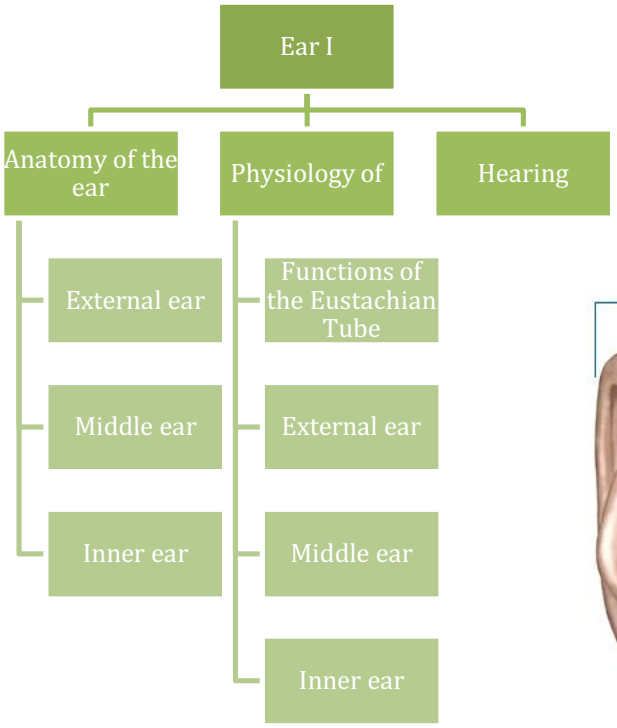
Revised by: Reem Aljubab

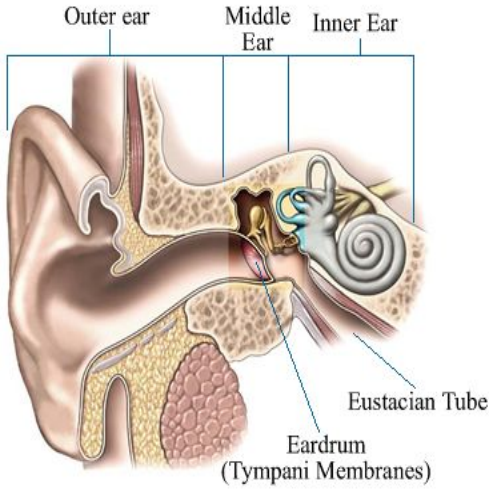
Doctor's note Team's note Not important Important 431 teamwork

(431 teamwork do not highlight it in yellow, but put it in a yellow "box")

Objectives:

- Anatomy and physiology of the ear, gross anatomy of the external, middle and inner ears, nerve supply and earache in brief.
- Physiology of hearing and balance.
- Function of the Eustachian tube in brief.





Highly recommended videos

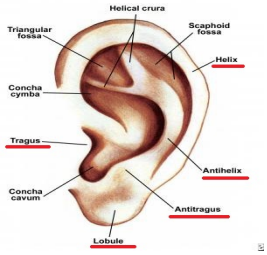
https://www.youtube.com/watch?v=46aNGGNPm7s
https://www.youtube.com/watch?v=qYv9V2qna6I
https://www.youtube.com/watch?v=-OuFKmZSZoY

Anatomy of the ear:

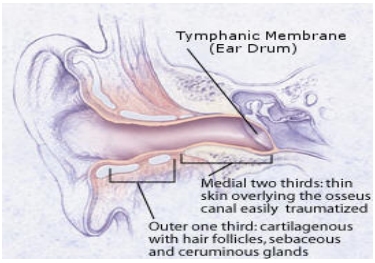
The ear consists of:

1) External ear: From the outer part till the eardrum (tympanic membrane)
2) Middle ear (tympanic cavity): From the eardrum till the stapes footplate
3) Internal ear: Cochlea and semicircular canals.

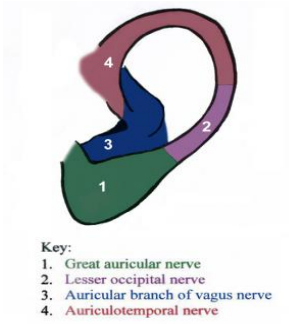
A- External ear:



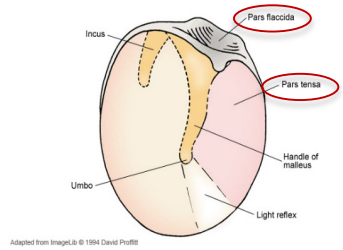
- Formed of Auricles and External auditory meatus (auditory canal).
- Both of them are lined by skin
- The external auditory meatus (2.5 cm) is an S shape canal (to protect the ear drum and middle ear. So, at examination you should pull the auricle posteriorly and superiorly to straighten the canal).
- **Auditory canal consists of:**
  A. Cartilaginous part (outer 1/3): formed by elastic cartilage and contains hair follicles, sebaceous and ceruminous glands (secrete wax).
  B. Bony part (inner 2/3): The narrowest portion is at the bony-cartilaginous junction. The skin is thin and easy to be injured during examination.

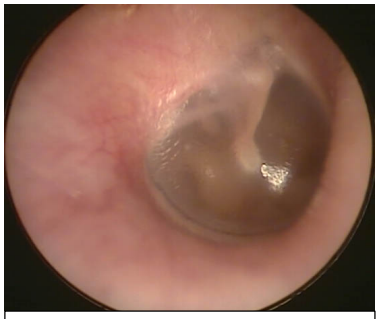


- **Nerve Supply of External Ear:**
  - ✓ Cervical II & III (greater auricular and lesser occipital)
  - ✓ V cranial nerve (auriculotemporal)
  - ✓ X cranial nerve (auricular or Arnold's)
  - ✓ Fibres from VII cranial nerve

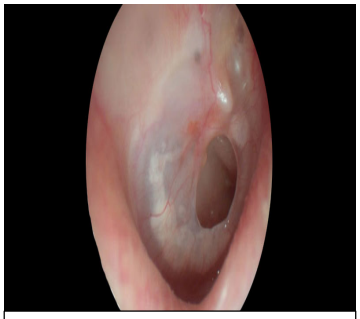


- **Tympanic Membrane**
  - It forms the partition between the external auditory canal and the middle ear.
  - Parts :
    A. Pars Tensa.
    B. Pars Flaccida.
  - The Tympanic membrane consist of three layers:
    1. Outer layer stratified squamous epithelium (skin), ectodermal origin.
    2. The middle layer or lamina propria fibrous layer, mesodermal origin.
    3. The inner layer, of endodermal origin, comprising the middle ear mucosa.





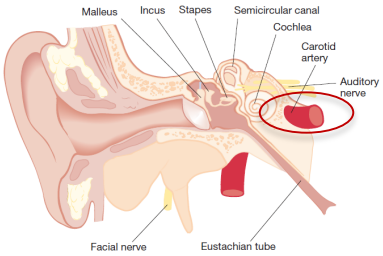
Normal tympanic membrane



Perforation

Cholesteatoma develop in superior posterior portion of tympanic membrane especially in Pars Flaccida which doesn't have middle fibrous layer

Tympanic membrane: (Team 430)
It is a thin fibrous membrane that is pearly gray in color.
1) Umbo: Tip of handle of Malleus
2) Cone of light (reflex from otoscope): anteriorly and inferiorly from the Umbo.
3) Pars Flaccida: slack part bounded by posterior and anterior mallear folds and it has no fibrous "middle layer".
4) Pars tensa: the reminder tense part of the membrane.



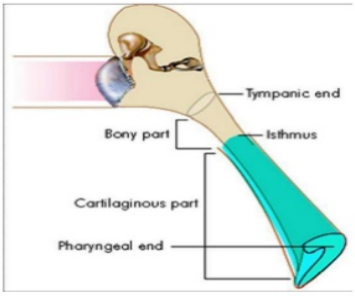
B- Middle Ear:

1. Eustachian (Pharyngo-tympanic) Tube
2. Tympanum (Middle Ear Cavity)
3. Mastoid Antrum and Air Cells

- **Lining of the middle ear:**
  - Mucous membrane of the middle ear space consists of stratified cuboidal epithelium, which changes to pseudostratified ciliated epithelium around the mouth of the eustachian tube.
- **Eustachian (Pharyngo-Tympanic) Tube**
  - Connect the middle ear cavity with nasopharynx. Lies adjacent to the ICA (internal carotid artery- see the image)
  - Parts of Eustachian Tube:
    A. Lateral 1/3 is bone.
    B. Medial 2/3 is fibro-cartilaginous.
  - Junction between 2 parts is isthmus, narrowest part of the tube.

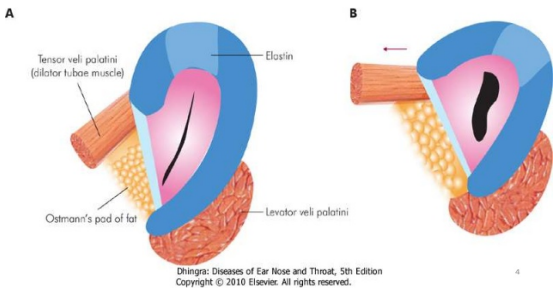
Adult vs INFANT

	ADULT	INFANT
Length	36 mm	18 mm
Angle with horizontal	45 ^{0}	10 ^{0}
Lumen	Narrower	Wider
Angulation at isthmus	Present	Absent
Cartilage	Rigid	Flaccid
Elastic recoil	Effective	Ineffective
Ostmann's fat	More	Less



- Physiology of Eustachian tube:
  - Opens actively by contraction of tensor veli palatine and passively by contraction of levator veli palatine (it releases the tension in tubal cartilage).
  - Closed by elastic recoil of elastin hinge + deforming force of Ostmann's fat pad.

Muscles Related to E.T

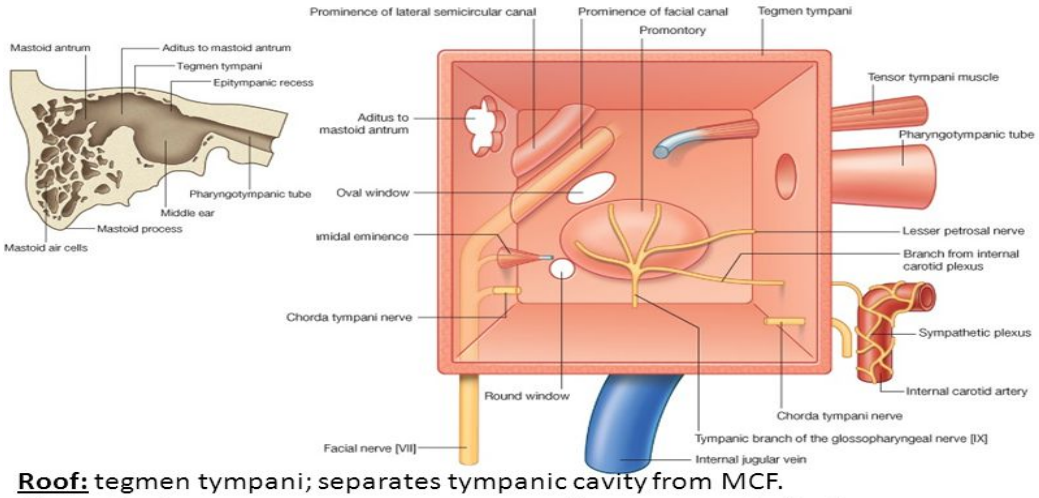


- **The tympanic or middle ear cavity:**
  - Contents of tympanic cavity
  - Ossicles: the malleus, incus and stapes.
  - Intratympanic muscles: "Tensor tympani, Stapedius", chorda tympanim and tympanic plexus.

The Stapes receives the insertion of stapedius muscle. Handle of Malleus receives the insertion of Tensor tympani muscle. Contraction of the stapedius muscle restrict the movement of the stapes (this is considered as a physiologic reflex that protects the inner ear from very loud sounds (Attenuation reflex). (Team 431)

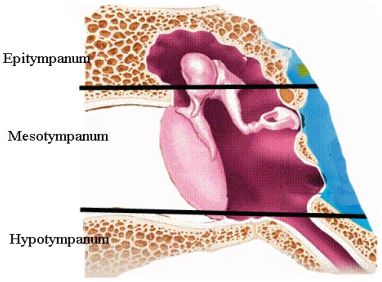
- **Mastoid antrum and air cells**
  - Air-containing cells of the mastoid process are continuous with the air in the middle ear.
  - Pneumatization is complete between the sixth and twelfth years of life.
  - Normal tubal function is a prerequisite for biologically active, healthy middle ear mucosa, and thus for the normal process of pneumatization.

Boundaries of Middle Ear



Roof: tegmen tympani; separates tympanic cavity from MCF.
Floor: Thin bone separates tympanic cavity from superior bulb of IJV.
Anterior wall: Thin bone; separates tympanic cavity from ICA and at its upper part are openings into two canals (auditory tube & canal for tensor tympani).
Posterior wall: Aditus to the mastoid antrum superiorly & Pyramid inferiorly (for stapedius)
Lateral wall: tympanic membrane inferiorly & Lateral wall of attic superiorly.
Medial wall: Lateral wall of the inner ear.

Sensory nerve supply of the middle ear mucosa :	Motor nerve supply of the middle ear muscles :
1.Tympanic branch of the glossopharyngeal nerve. 2.Auriculotemporal branch of the trigeminal nerve.	1.Stapedius muscle supplied by the stapedial branch of the facial nerve. 2.Tensor tympani muscle supplied by the mandibular division of the trigeminal nerve.



Middle ear cavity divided into three parts

C- Inner ear:

- Consists of :

1. Labyrinth:

A. Bony Labyrinth,

- ❖ its parts:
  - Bony Cochlea
  - Vestibule
  - Bony semicircular canals
- ❖ Its contents :
  - Perilymph fluid
  - Membranous labyrinth

B. Membranous Labyrinth

- ❖ its parts:
  - Cochlear duct
  - Saccule and utricle
  - Membranous semicircular ducts
- ❖ Its contents :
  - Endolymph
  - Sensory epithelium:
    - ✓ Cochlea: organ of Corti
    - ✓ Utricle & saccule: maculae
    - ✓ Semicircular canals: cristae

2. Internal Auditory Canal.

- ❖ Contains:
  - Cochleovetibular nerve
  - Facial nerve

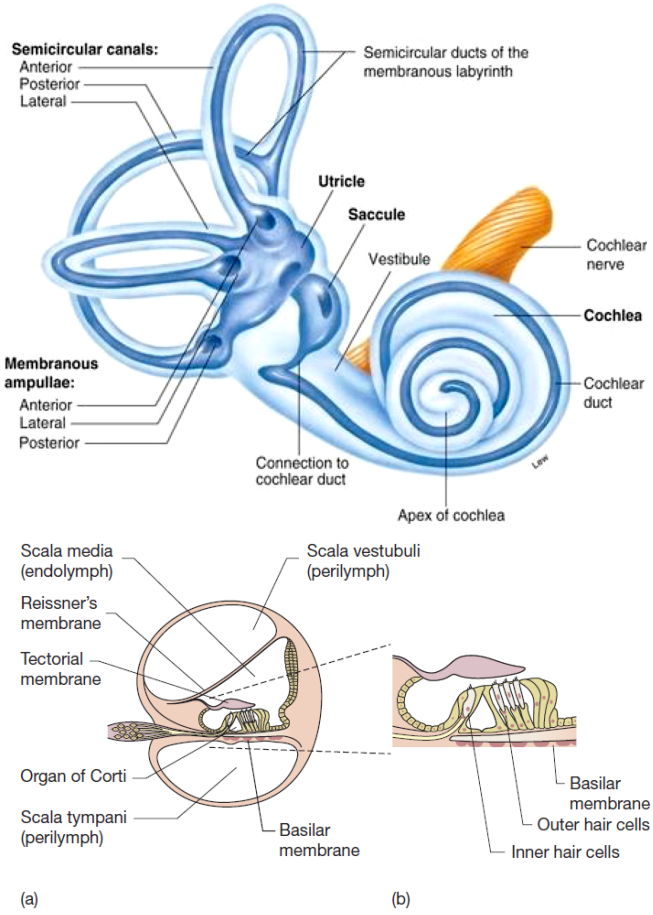
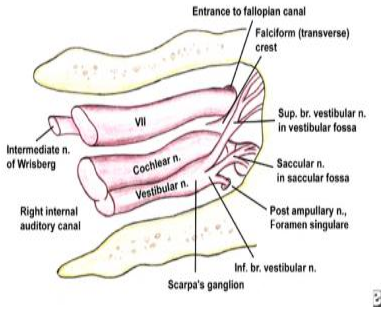
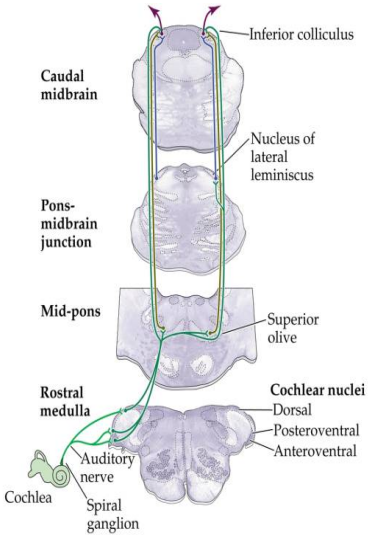


Figure 1.4 The inner ear and the mechanism of hearing. Source: Munir and Clarke 2013. *Ear, Nose and Throat at a Glance*. With permission of John Wiley & Sons Ltd.

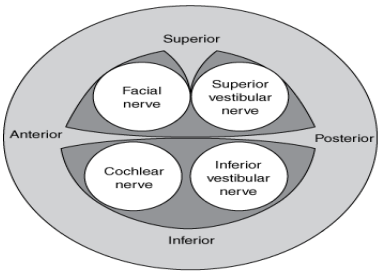




Central connections of cochlear nerve: Order of the Neural Pathway (with corresponding waves on ABR)

E COLI

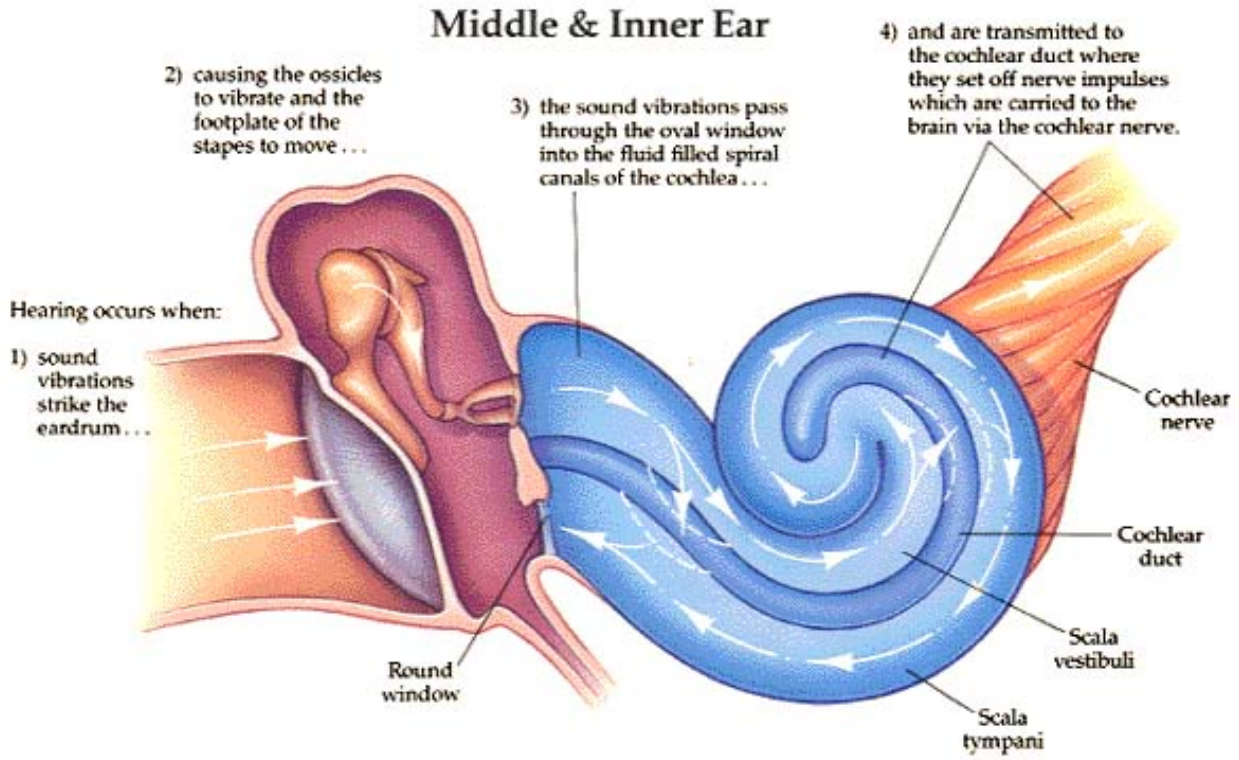
Eighth cranial nerve (I – II)
Cochlear nucleus (III)
Superior Olivary nucleus
Lateral leminiscus (IV – V)
Inferior colliculus (ENT Toronto Notes, 2014)



Nerves passes through internal auditory canal. Its importance in case of mass in CNS near to them you can know the relation during surgery excision.

Physiology of the ear:

Functions of the external ear	• Protection of the middle ear ✓ Curvature ✓ Cerumen • Auditory functions: ✓ Sound conduction ✓ Increase sound pressure by the resonance function
Functions of the eustachian tube	• Protection • Ventilation • Drainage (The tube is shorter, wider and more horizontal in the infant than in the adult. Secretions or food may enter the tympanic cavity more easily when the baby is supine particularly during feeding and they may develop otitis media as it is more common in children. The tube is normally closed and opens on swallowing because of movement of the muscles of the palate. (Lecture Notes Diseases of the Ear, Nose and Throat, 11th Edition - Clarke, Ray)
Functions of the middle ear	• Conduction of sound • Protection to the inner ear ✓ stapedial reflex. If the sound very loud it contract to reduce the sound energy
Functions of the inner ear	• Hearing Function: ✓ Transduction of sound to action potentials • Vestibular Function: ✓ Participate in maintaining body balance, the mechanisms of maintaining body balance: Brain stem: is the center of balance. It's connected to: Cerebellum to coordinate muscle tone and Cerebral cortex for the feeling of space. Input: Proprioceptive (sensation) Visiual Vestibular. Output: gives information to: Postural muscles Ocular muscle. (Team 431)



Hearing Function

Summary

-The ear consists of: 1- external ear 2-middle ear 3- internal ear.

-External ear is formed of Auricles and External Auditory meatus.

-Middle ear consists of: 1- Eustachian(pharyngo-Tymapnic) tube
2- Tympanum (middle ear cavity)
3-mastoid Antrum and Air cells

-Inner ear consists of 1- Labyrinth 2- Internal Auditory canal

MCQ's :

Q1: The outer layer of the Tympanic membrane is?

a)stratified squamous epithelium
b)fibrous layer
c)columnar epithelium

Q2: The lateral part of Eustachian tube??

A)1/3 is fibro-cartilaginous
b)1/3 is bone
c)2/3 is fibro-cartilaginous

Answers
1-A
2-B

For mistakes or feedback

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