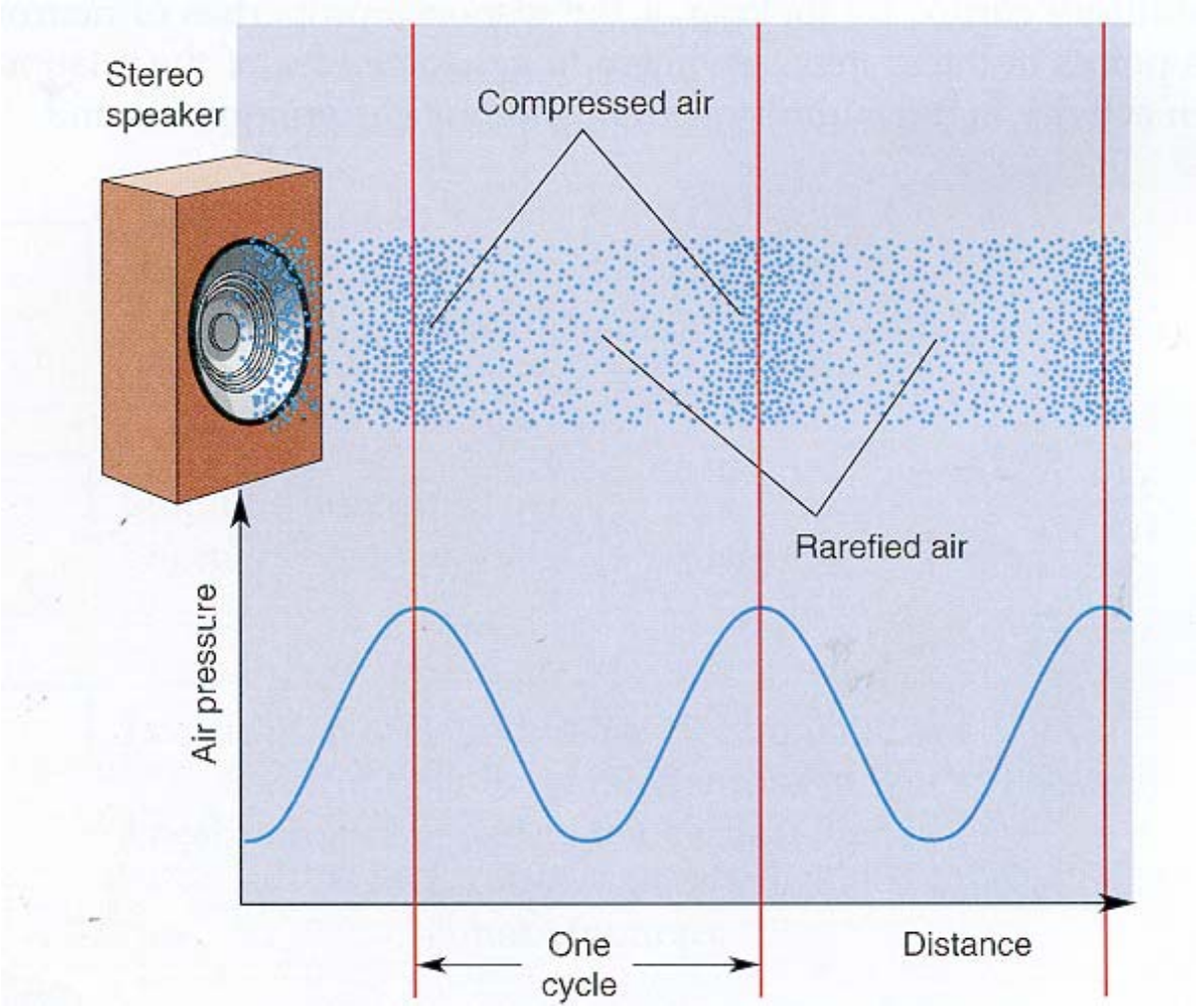
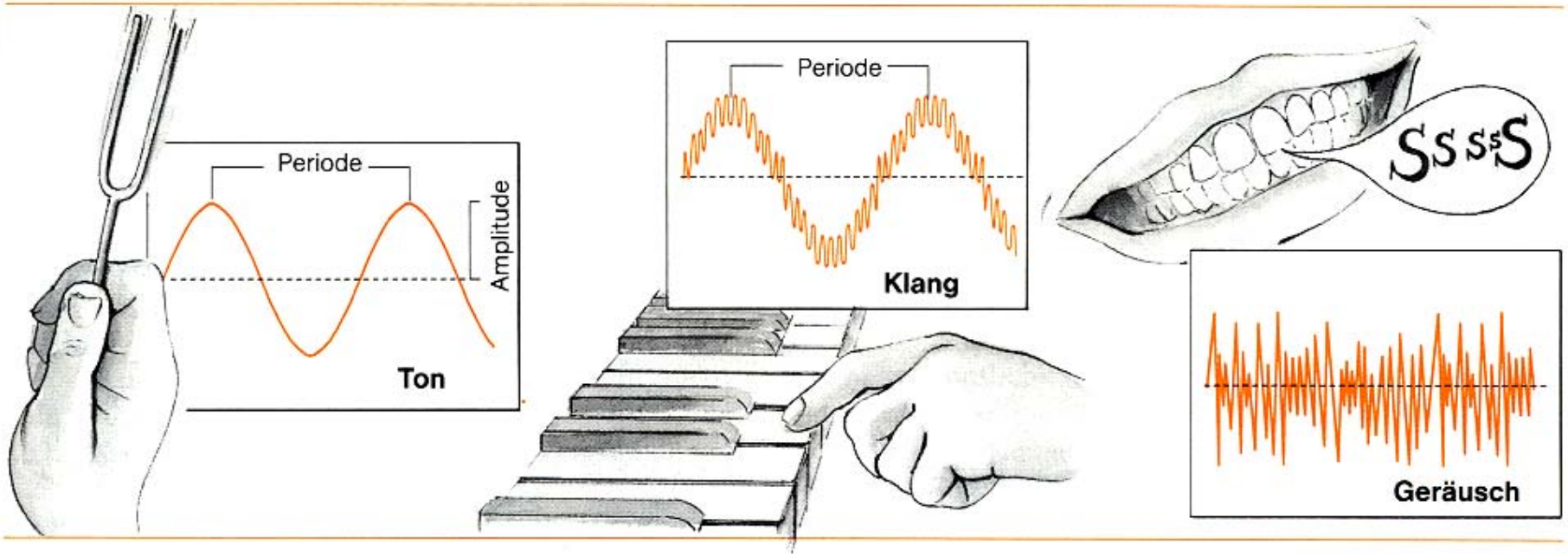
Gehör



Schall: Longitudinalwelle periodischer Verdichtungen und Verdünnungen des Mediums

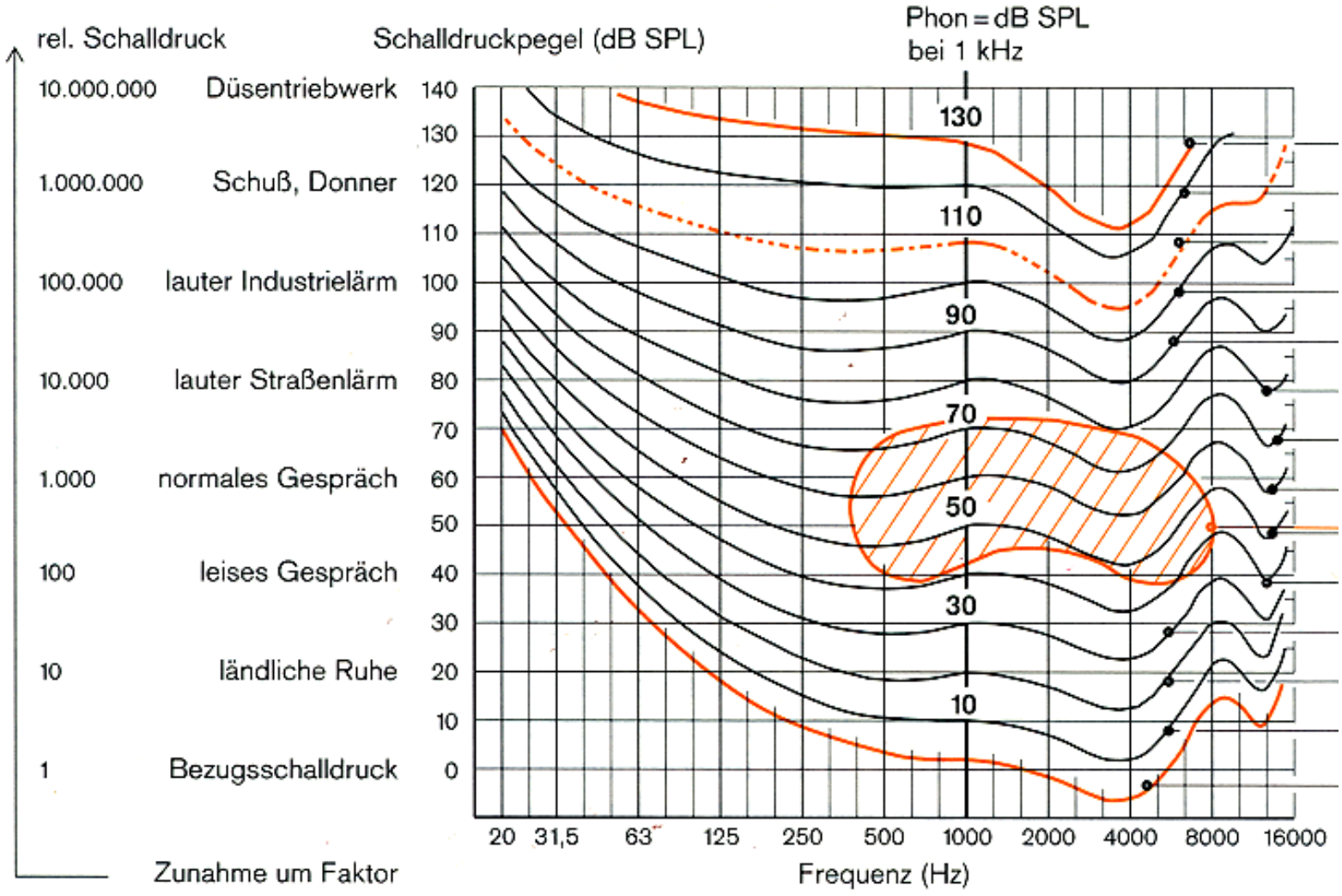
Schall



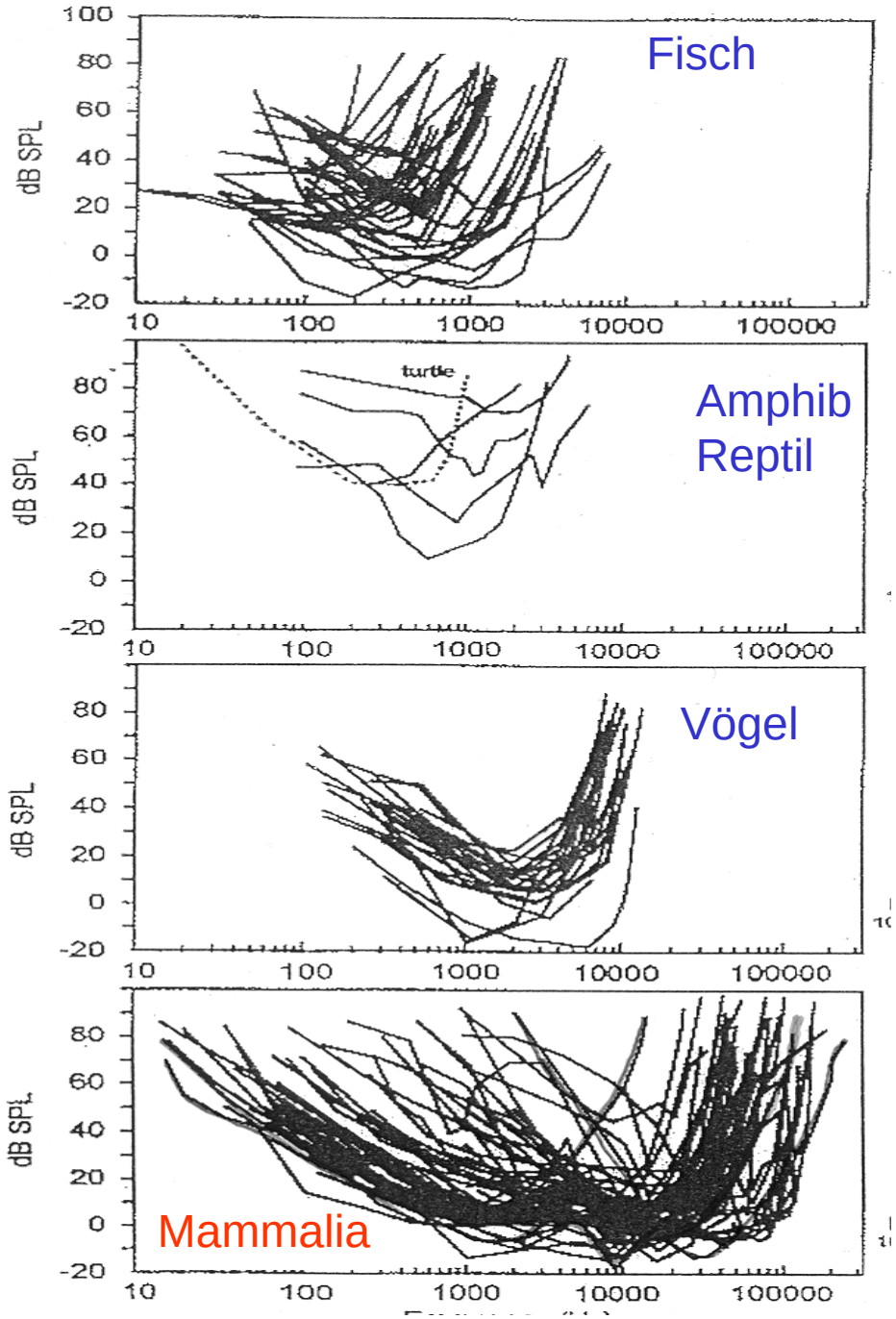
Parameter von Schall

Frequenz	f Anzahl Schwingungen/sec [Hz]
Schalldruck	P (Pascal) Kraft /Fläche [N/m^2]
Schalldruckpegel	dB SPL = 20 logP/P_0 (P_0=20µP)
Schallschnelle	v (Partikelgeschwindigkeit) [m/s]
Schallgeschwindigkeit	c [m/s] in Luft: 330 m/s H_2O: 1500 m/sec Holz 3800 m/s

Hörbereich des Menschen



Hörbereiche der Wirbeltiere



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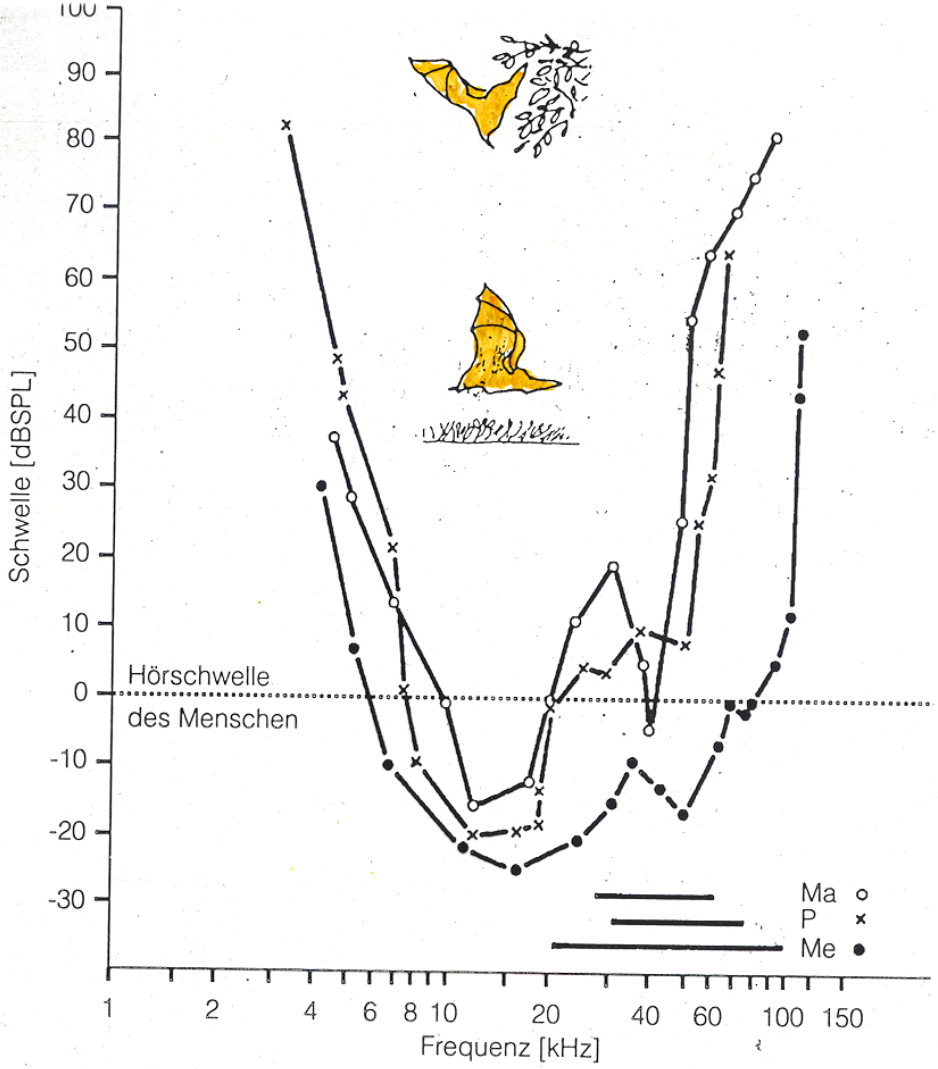
Mammalia

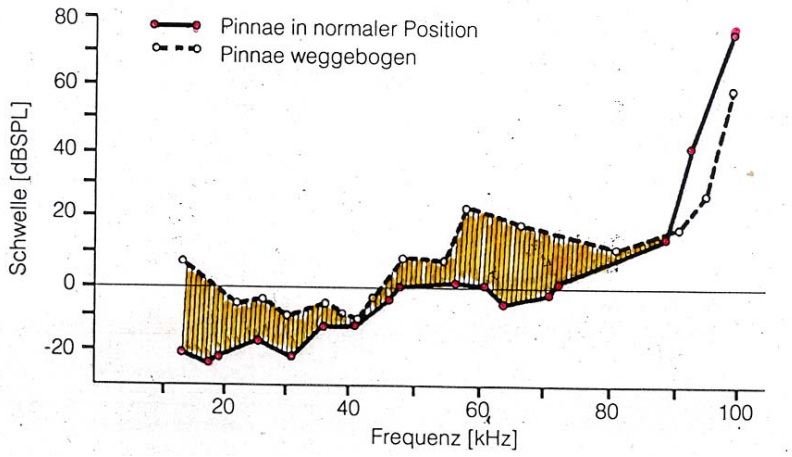
Tieffrequenzspezialisten:
Elefant, Mensch, Graumull

Generalisten: Katze, Gerbil

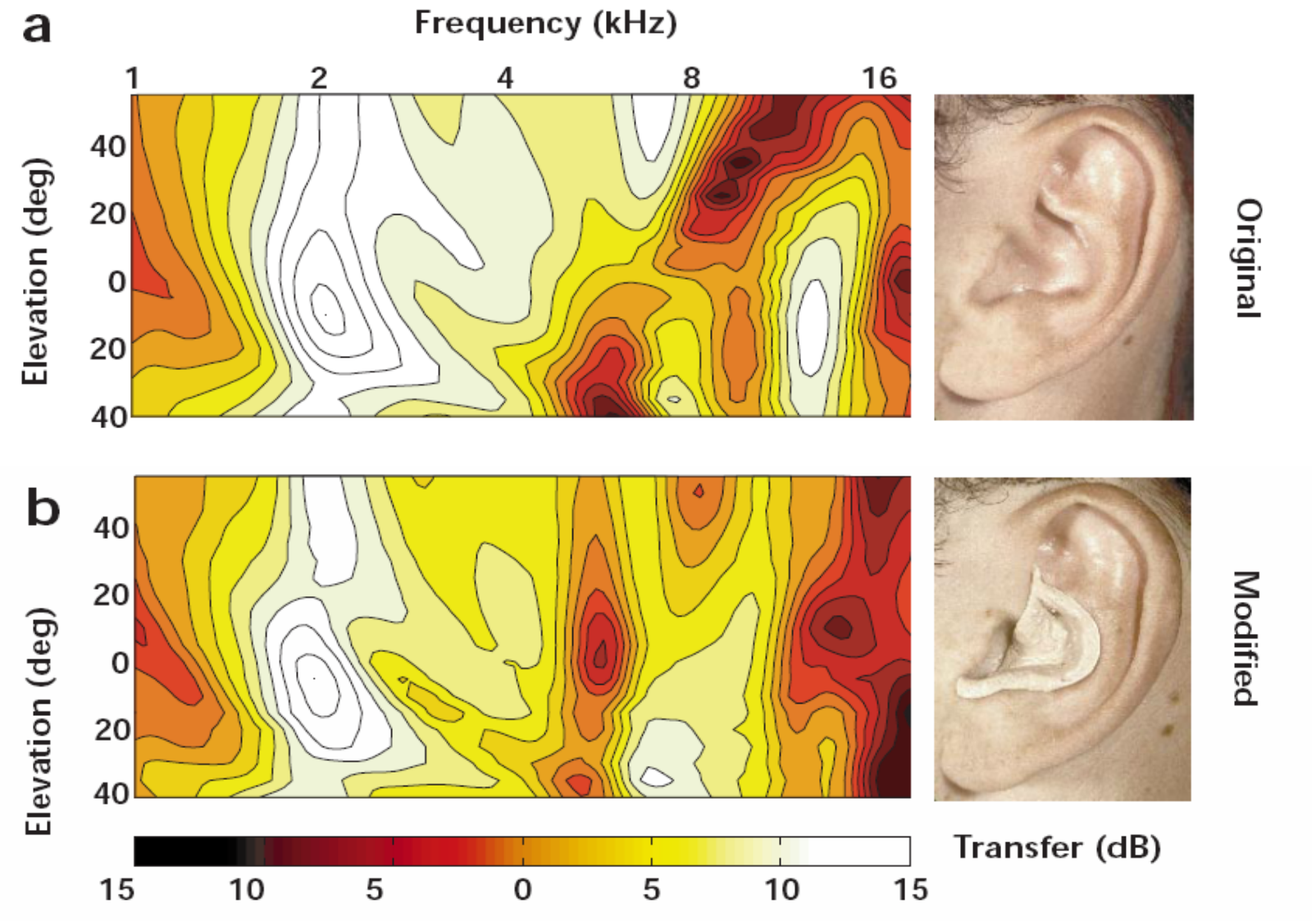
Hochfrequenzspezialisten:
Fledermäuse; Zahnwale

Ohren als Richtantennen und Verstärker





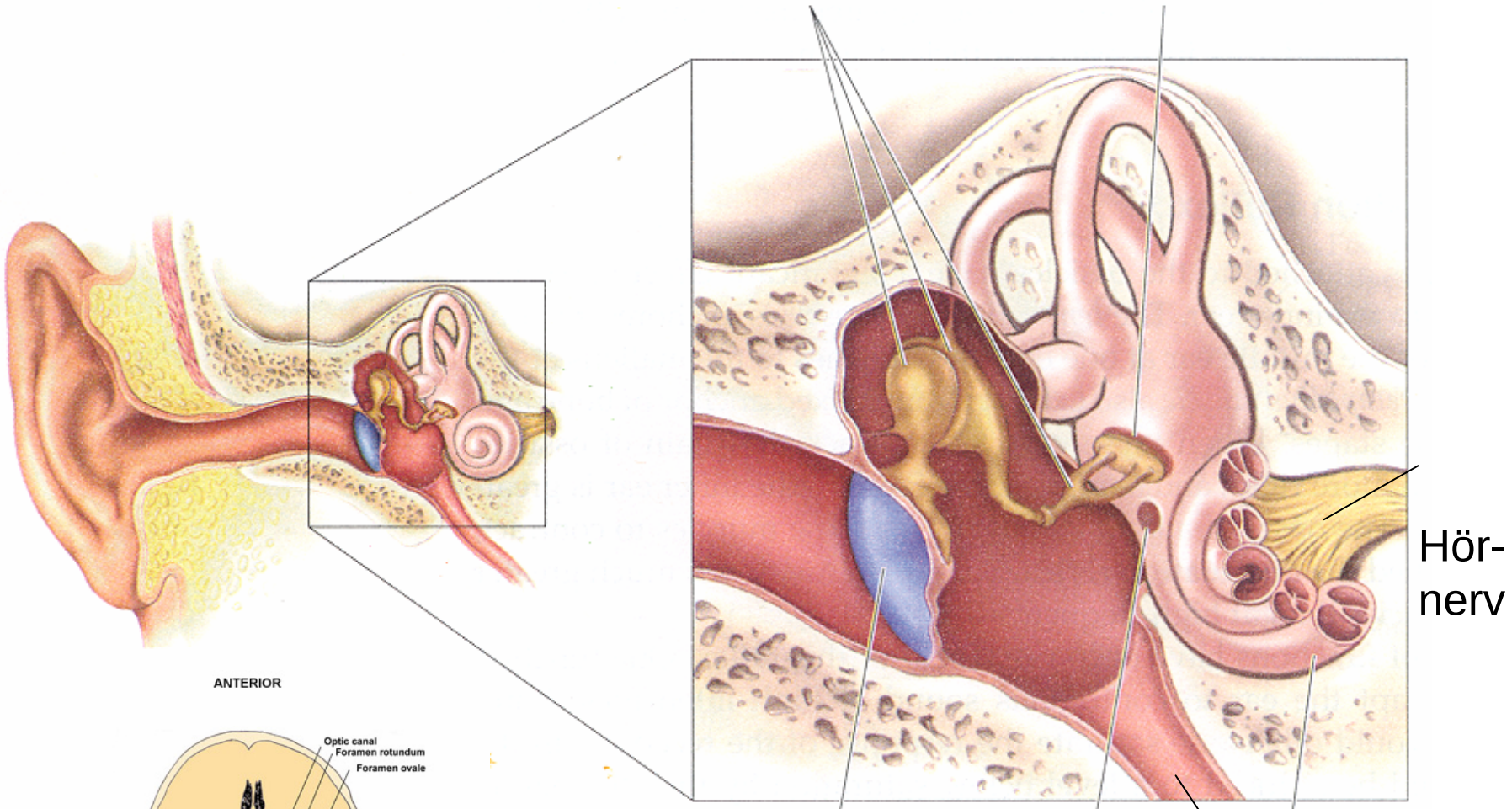
Mensch: monaurale Lokalisation mit den Ohrmuscheln



Hofmann et al. (1998) Nature Neuroscience 1,p418

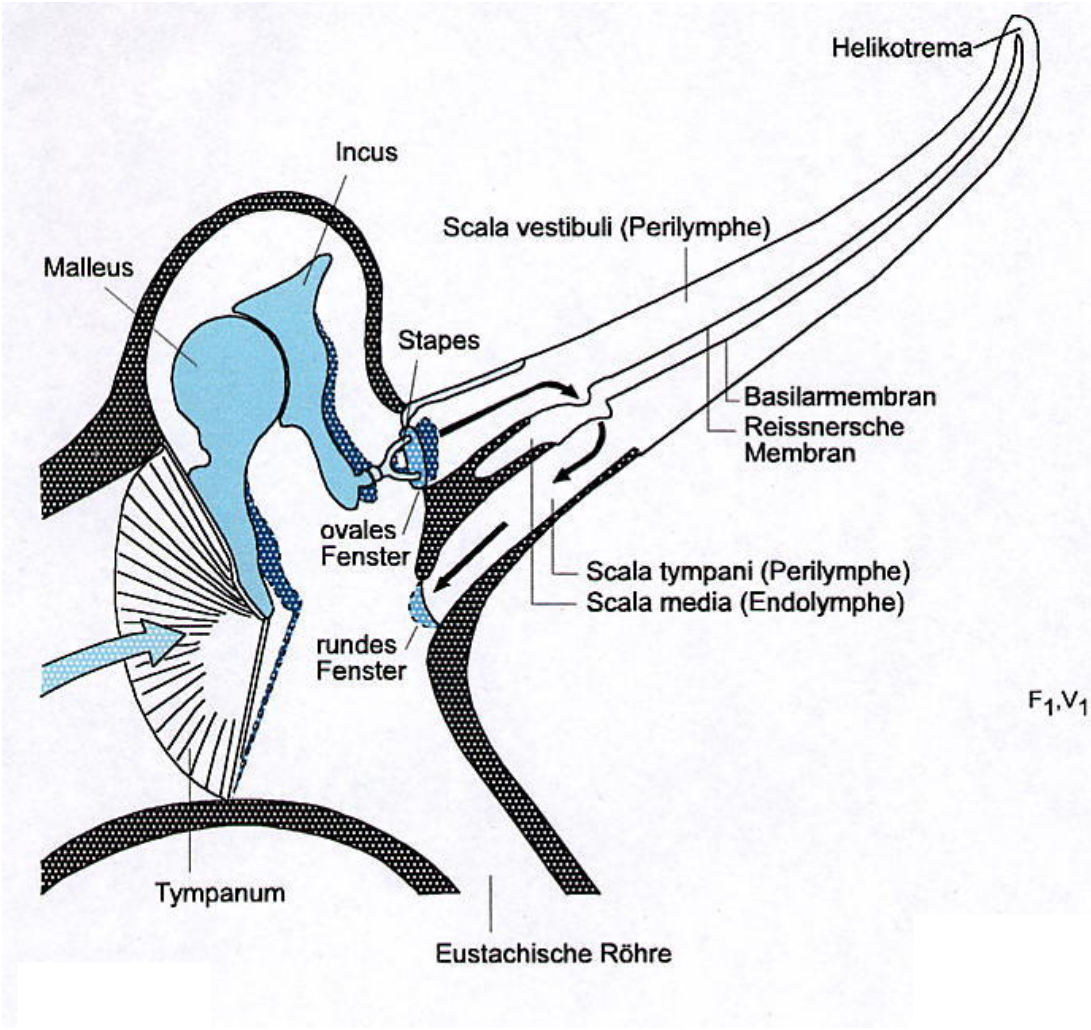
Säuger Gehör

- **Mittelohr**


Hammer, Amboß, Steigbügel
Ovales Fenster
Hör-
nerv
Trommelfell
Rundes
Fenster
Cochlea
Tuba
eustachii
ANTERIOR
Optic canal
Foramen rotundum
Foramen ovale
Cochlea
Foramen spinosum
Anterior semicircular
canal
Horizontal semicircular
canal
Posterior semicircular
canal
Foramen lacerum
Internal acoustic
meatus
Jugular foramen
CN VIII
Foramen magnum
Propst '00
POSTERIOR

Mittelohrmechanik (Säuger)

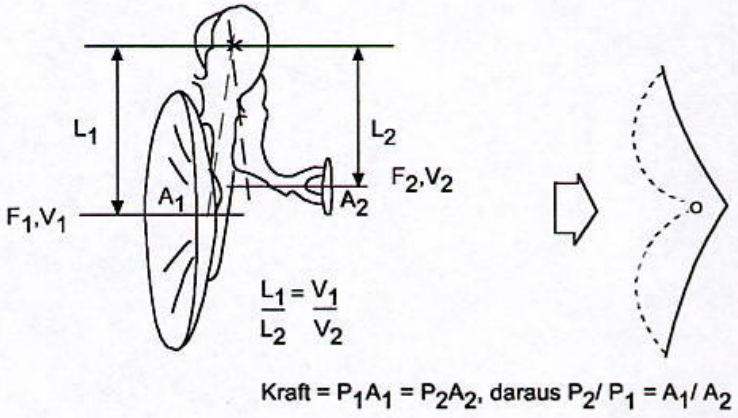
„Impedanzanpassung“
Umwandlung von Luftschall in Flüssigkeitsschall



$A_F \rightarrow {}_AF$

Wichtige Faktoren:

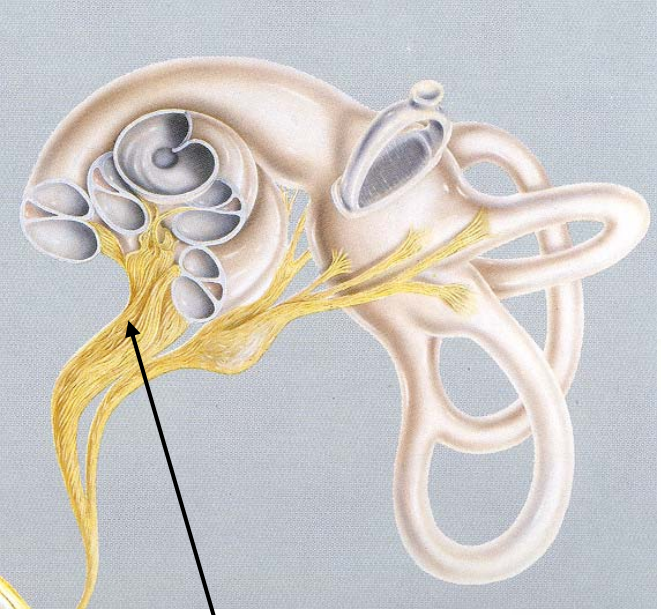
- Hornform des Trommelfells
- Hebelwirkung der Knöchelchen
- Trommelfellfläche sehr viel größer als Fläche des ovalen Fensters



Säuger Gehör

- **Innenohr**

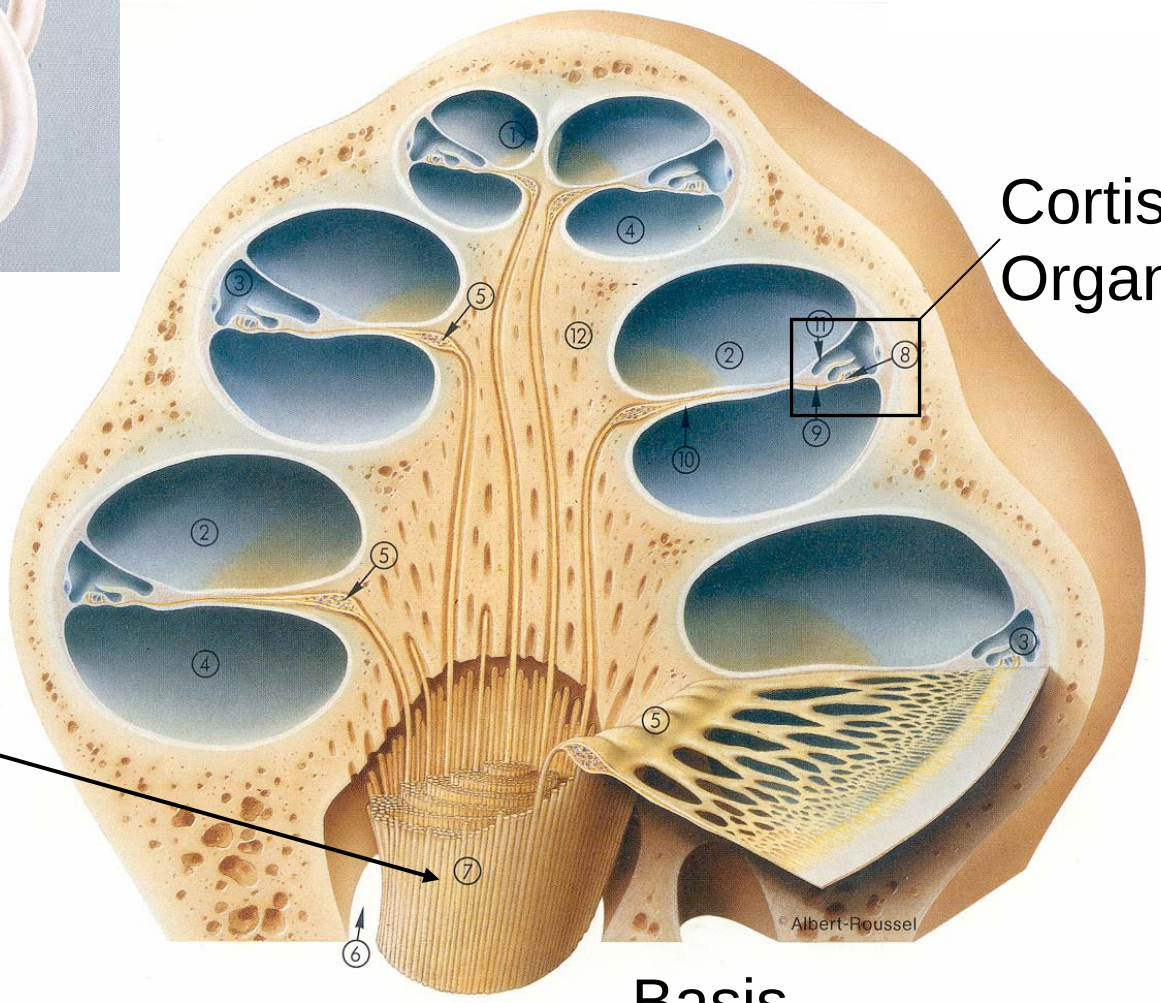
Cochlea quer



Apex

Cortisches Organ

Hörnerv



Basis

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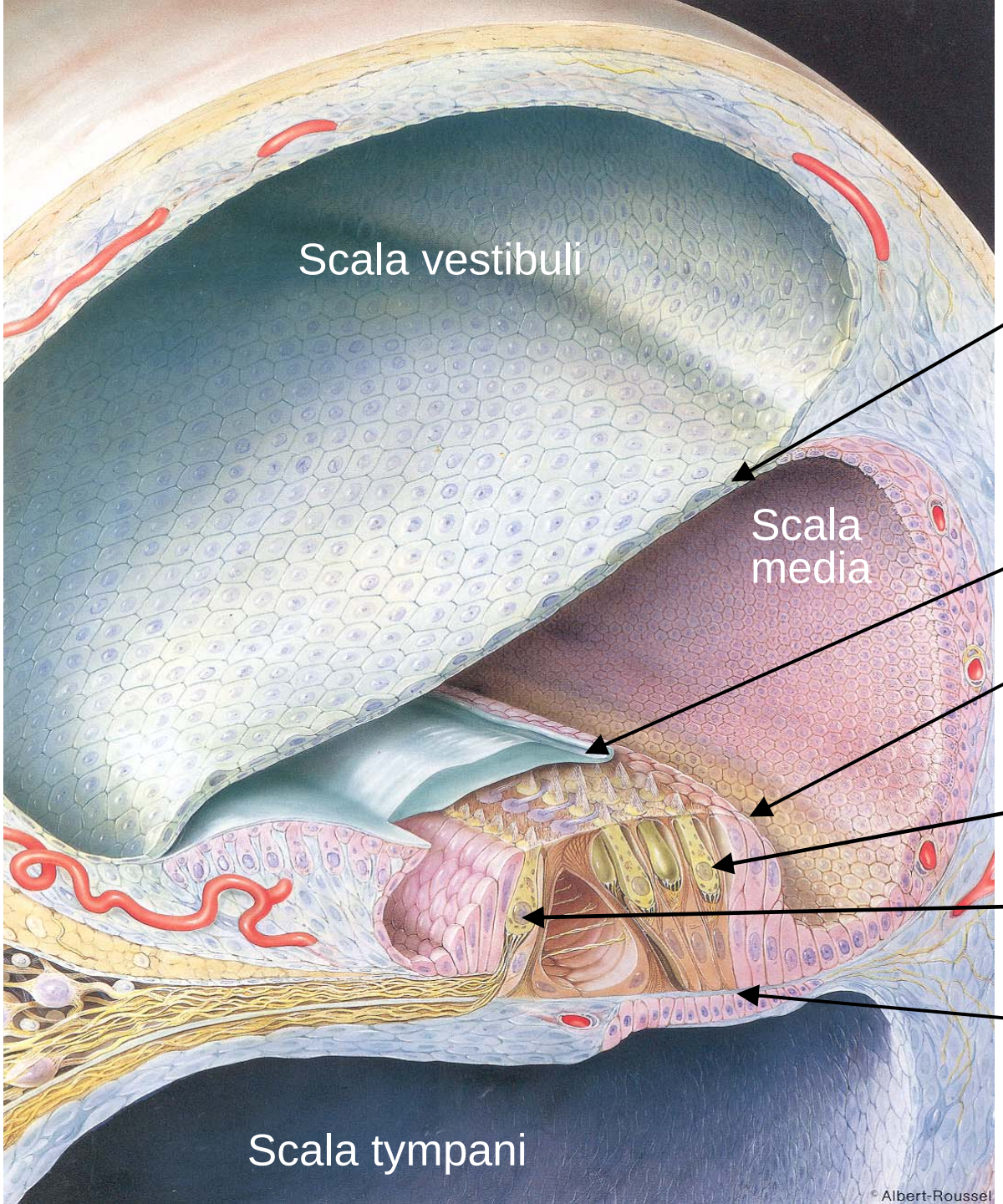


Reissner membrane

Tectorial membrane

Corti Organ

outer hair cell

inner hair cell

Basilar membrane

Albert-Roussel Bildatlas Innenohr

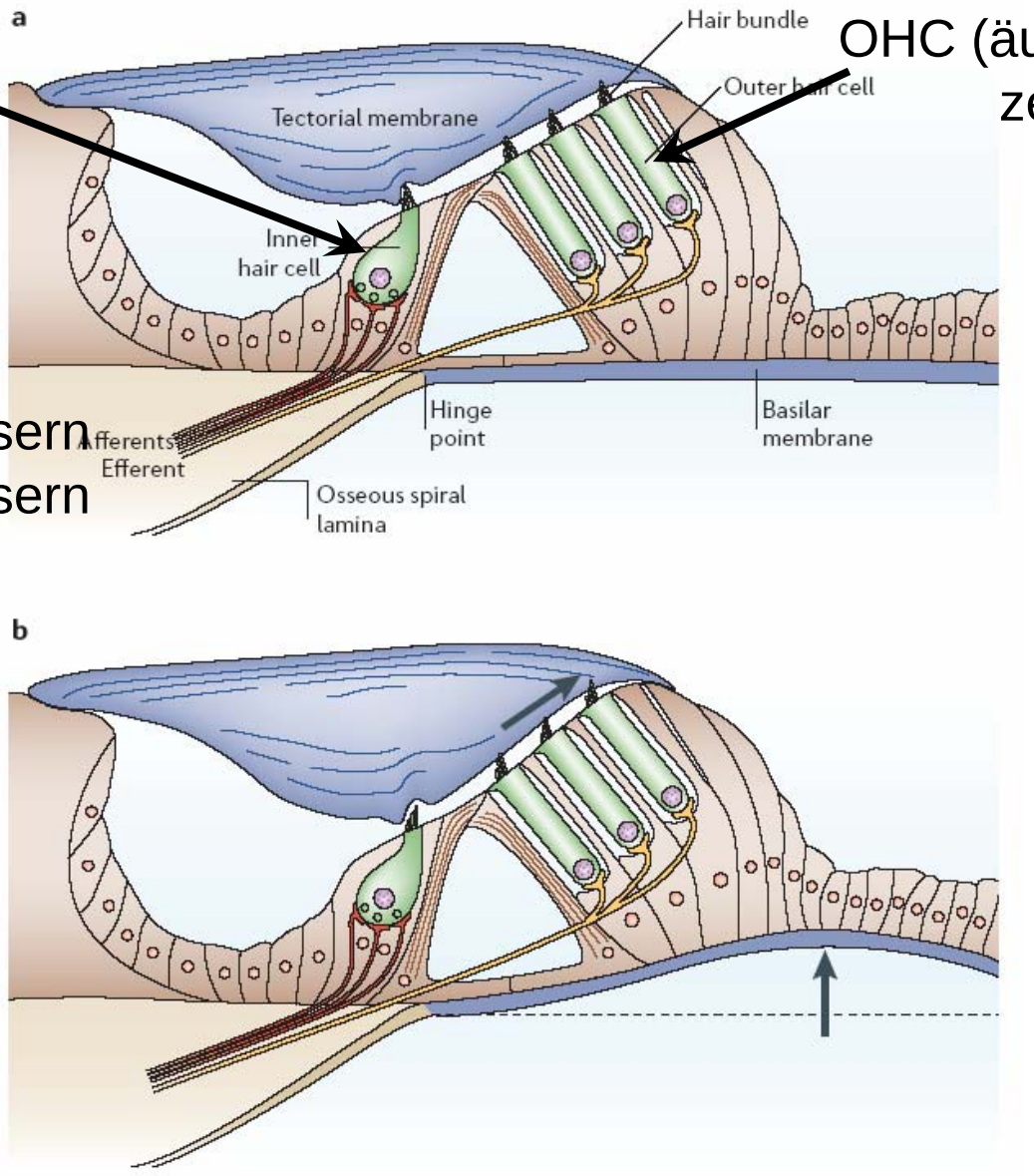
Cortiorgan

IHC (innere Haarzellen)

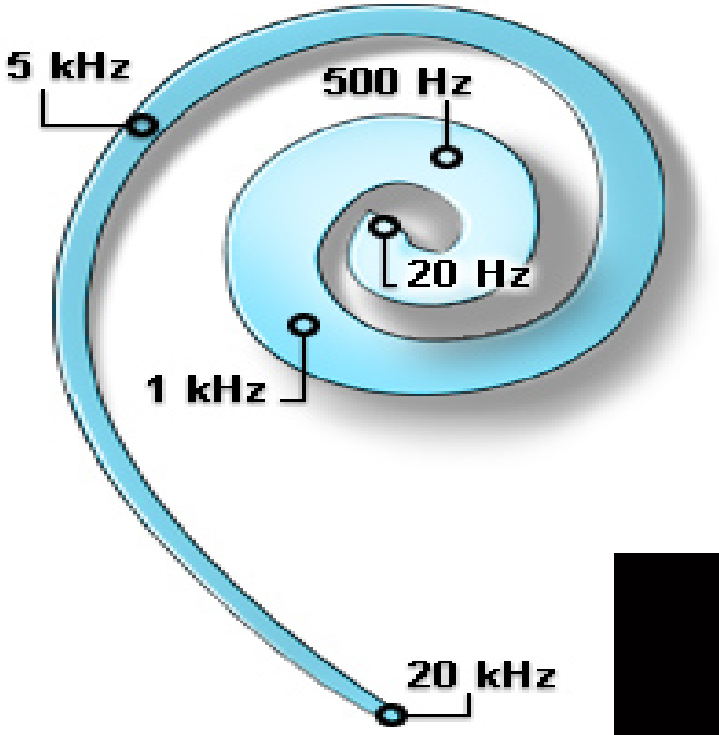
OHC (äußere Haar-zellen)

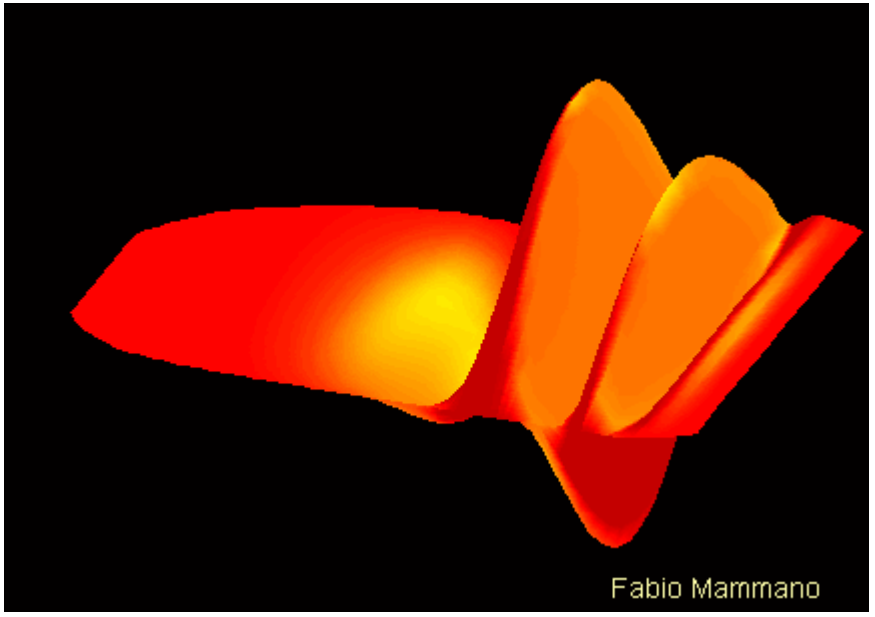
Afferente Nervenfasern

Efferente Nervenfasern

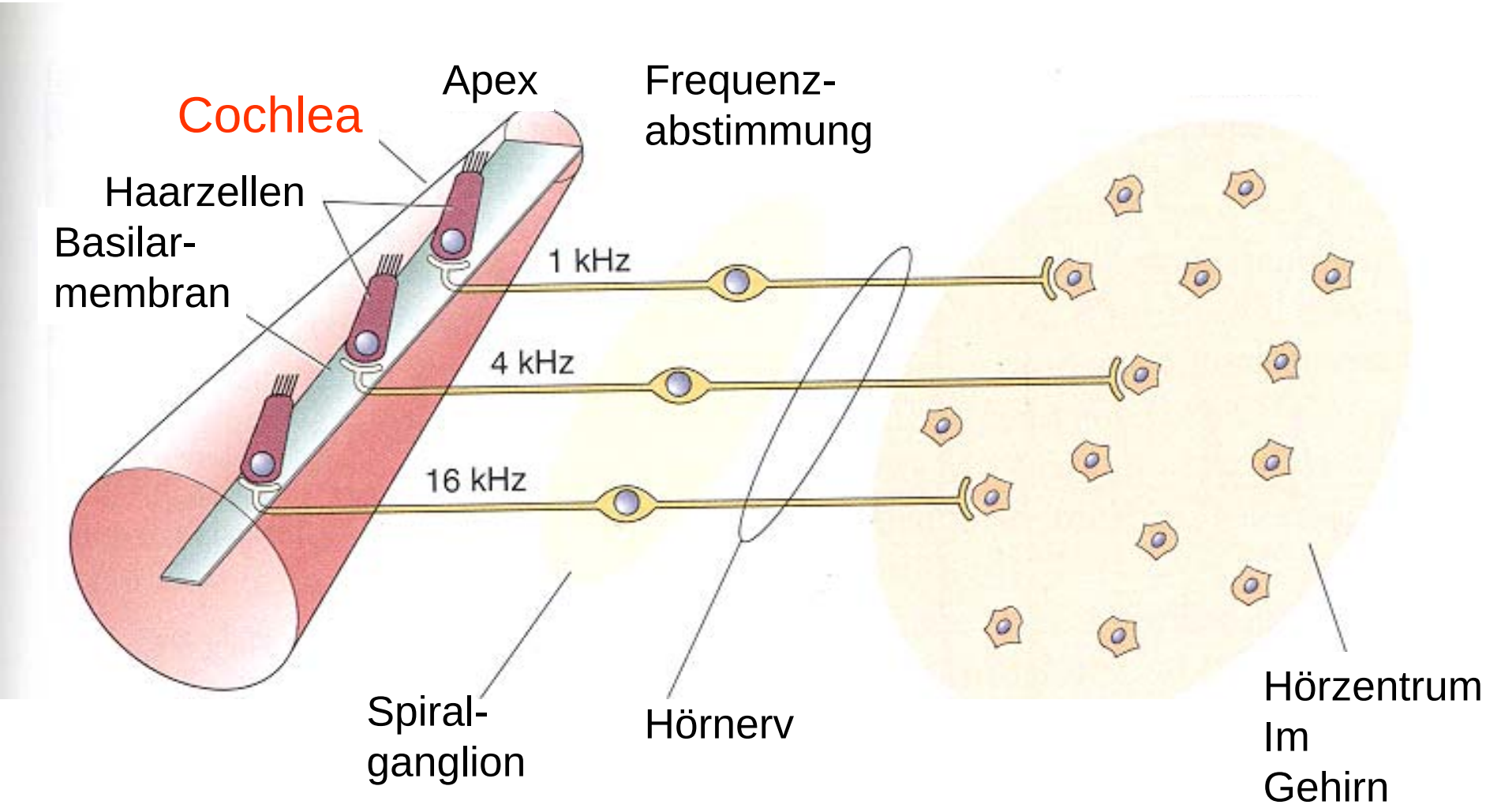


Wanderwelle





Tonotopie

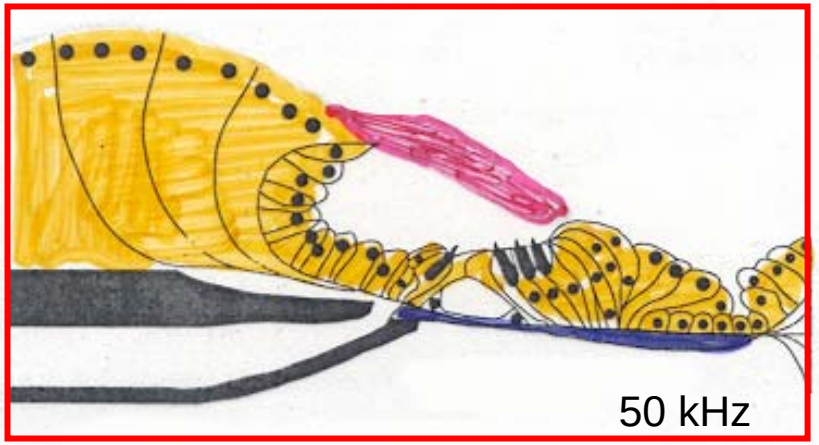

Cochlea
Apex
Frequenz-
abstimmung
Haarzellen
Basilar-
membran
1 kHz
4 kHz
16 kHz
Spiral-
ganglion
Hörnerv
Hörzentrum
Im
Gehirn

Cortisches Organ der Basalwindung

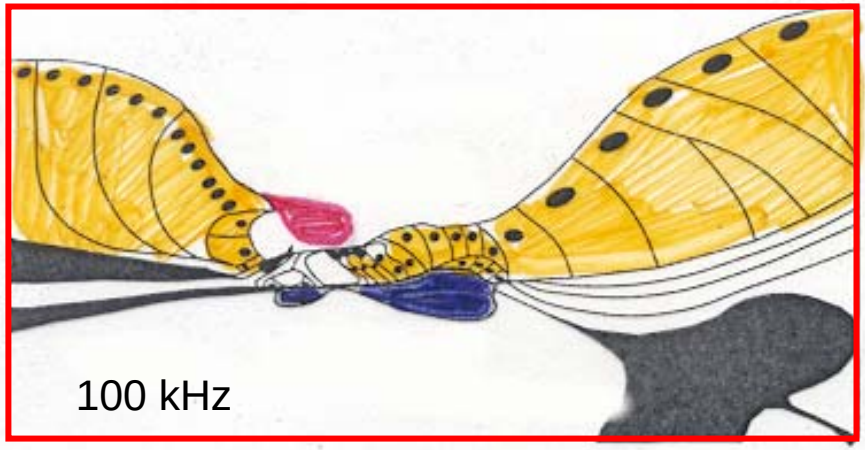
Variationen des Grundbauplans korrelieren mit Hörbereich

Mensch

Katze



Hufeisennase



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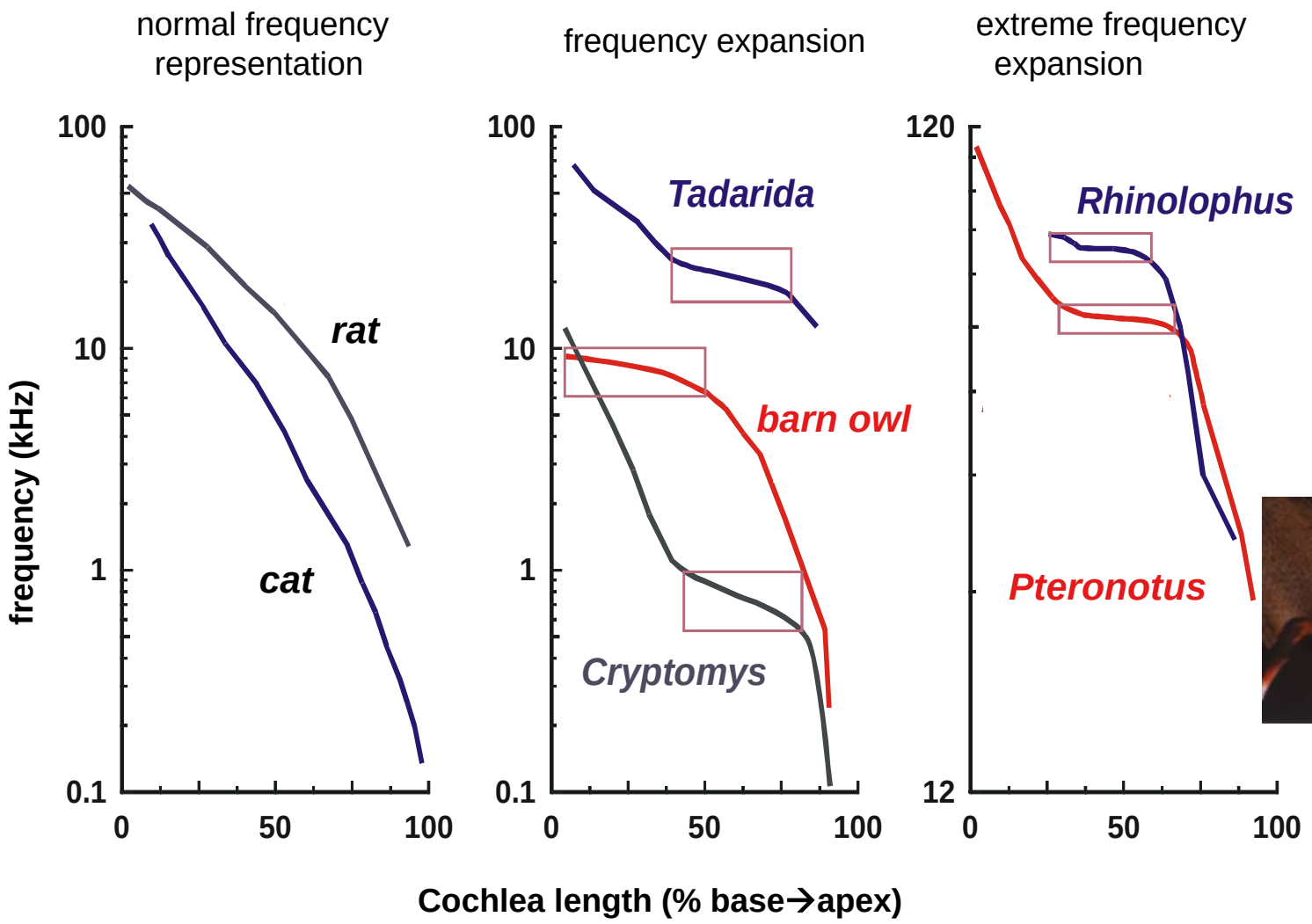
Auditorische Fovea im Innenohr



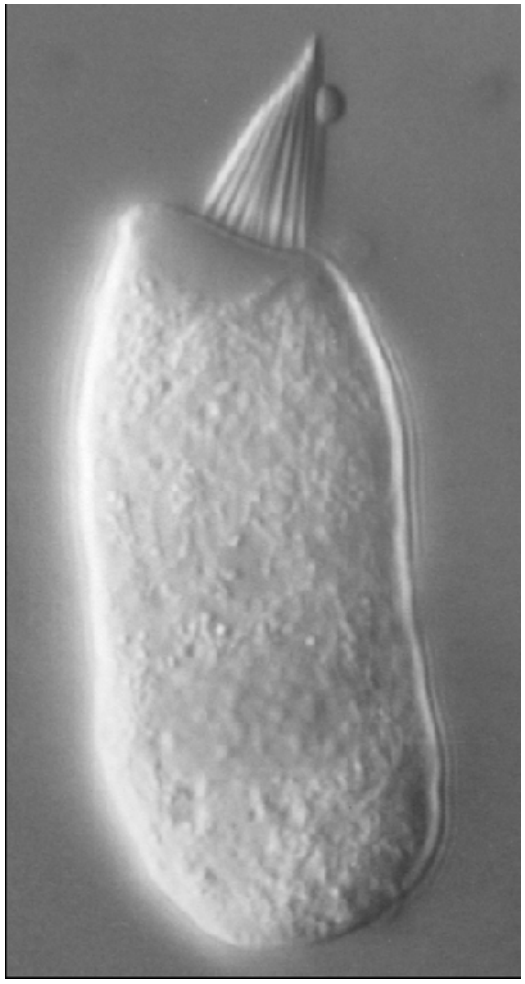
2-4 mm/octave

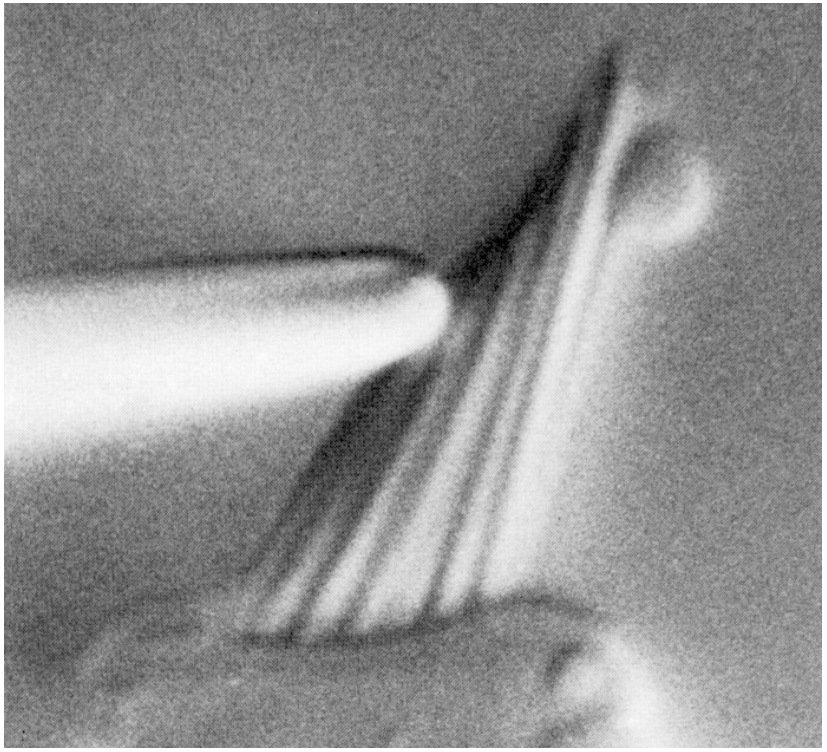
4-10 mm/octave

50-150 mm/octave

Haarzellen:
Mechanotransduktion

Haarzellen reagieren auf Stereozilienauslenkung





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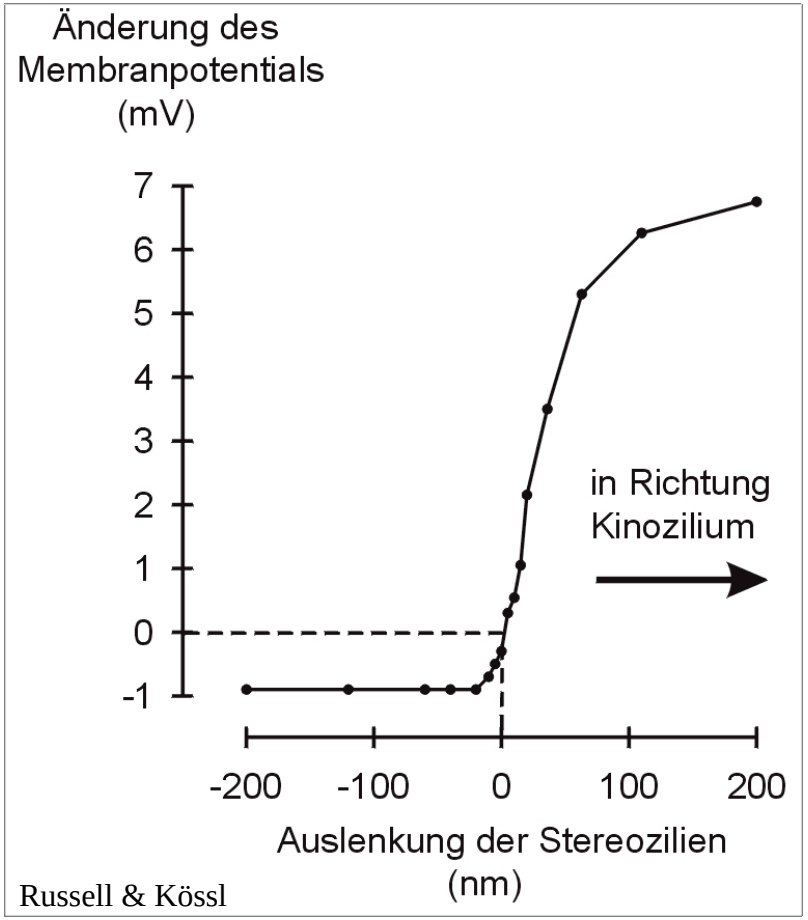
Haarzellen reagieren auf Stereozilienauslenkung



threshold:

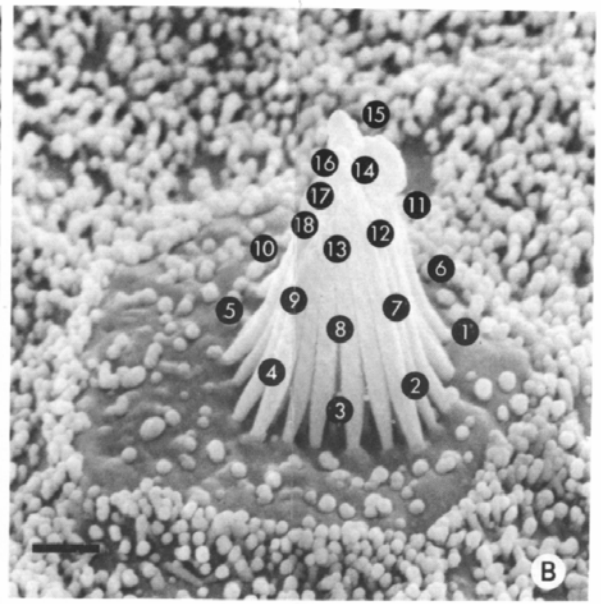
0.1 mV

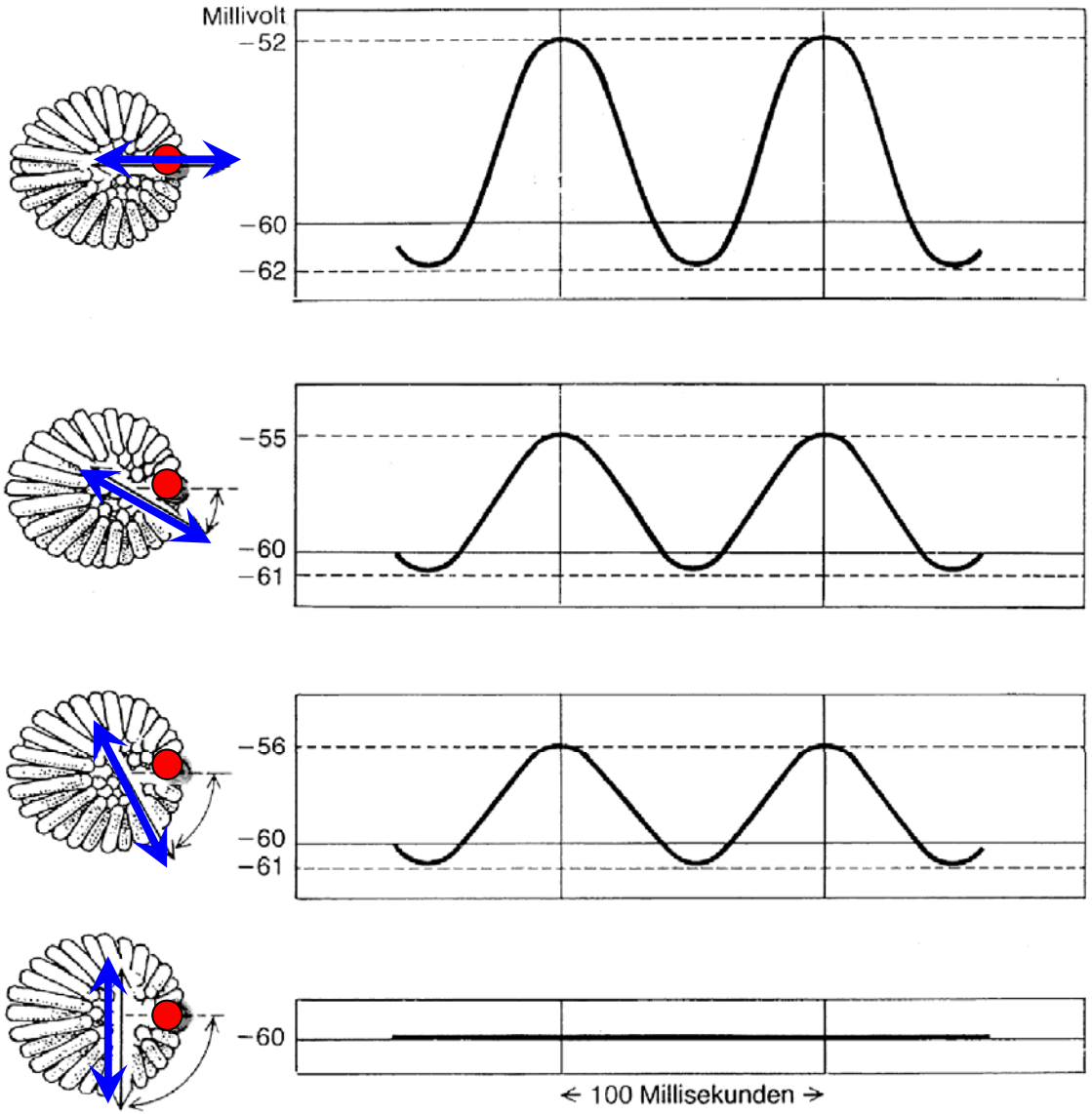
0.3 nm

0.003°

20 mm

Wo sitzen die Transduktionskanäle?





Die Richtung ist entscheidend!

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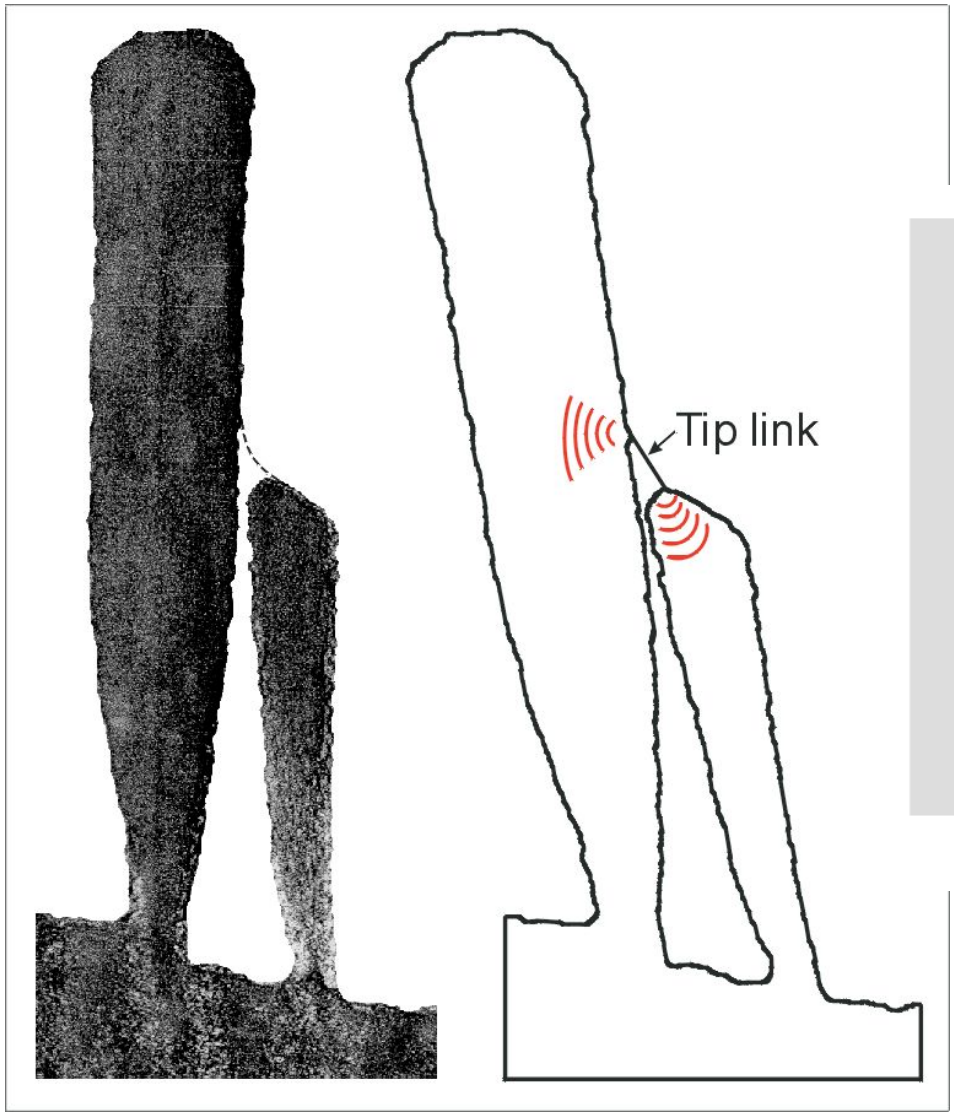
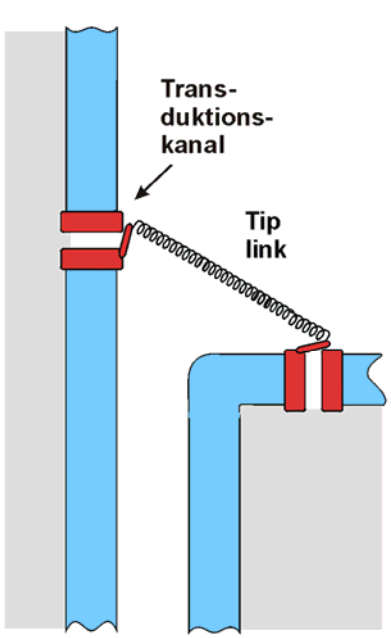
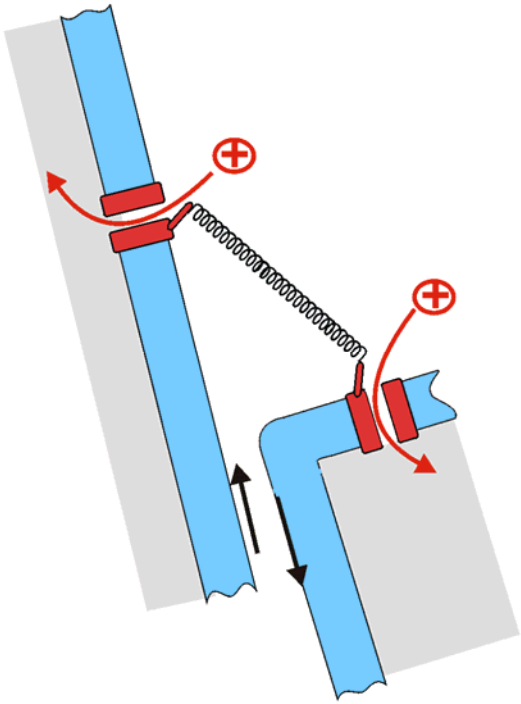
Tip Links kontrollieren Transduktionskanäle







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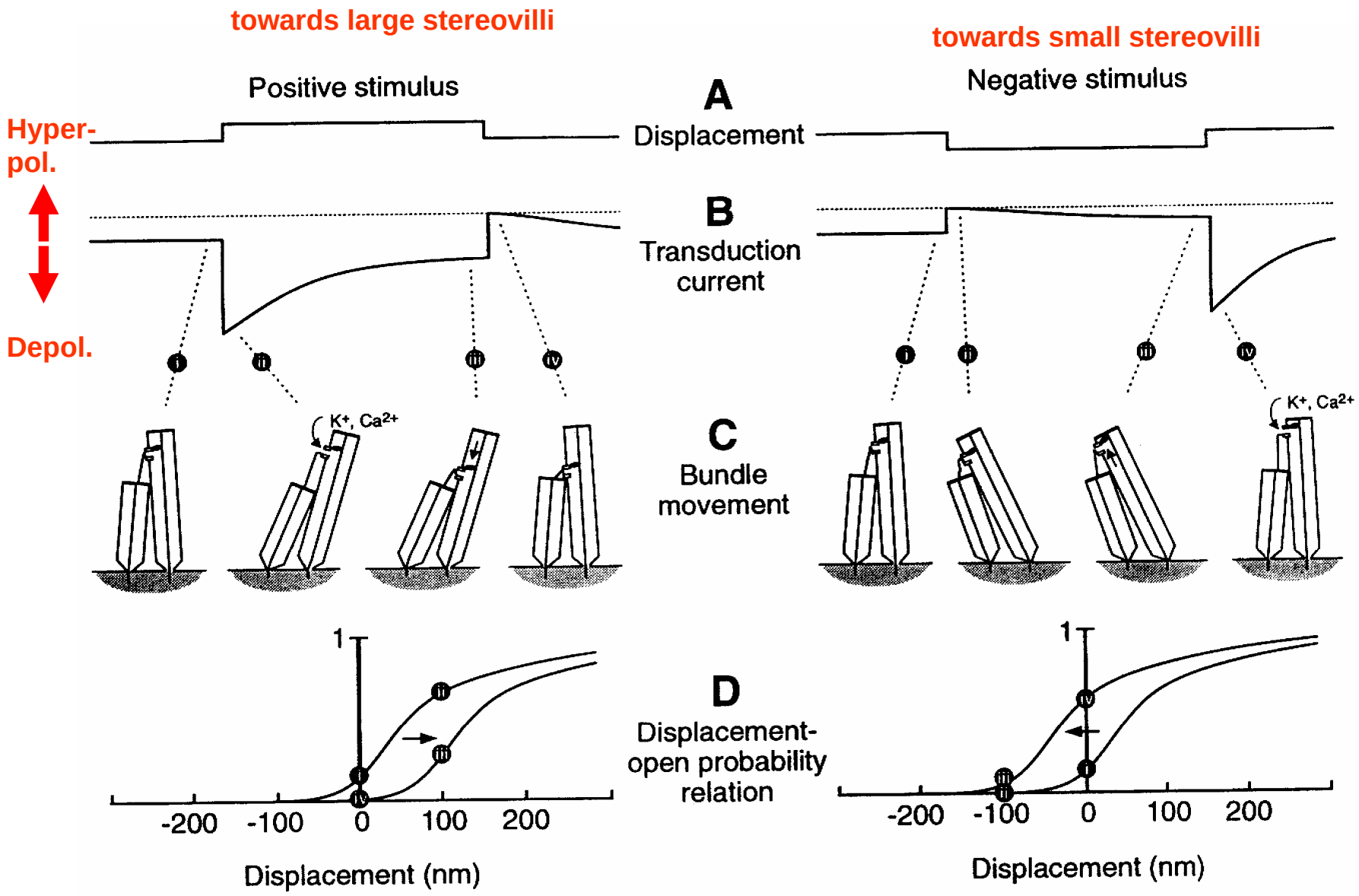
Adaptation durch Auf-Ab Gleiten des Transduktionskanals



Mechanismen der Adaptation

adaptation in hyperpolarizing direction:

active upward movement

- **actin-myosin interaction**
- **additional spring**

adaptation in depolarizing direction:

downward pull by tip-link

opening of actin-myosin linkage necessary, Ca^{2+} required, comes in through transduction channel