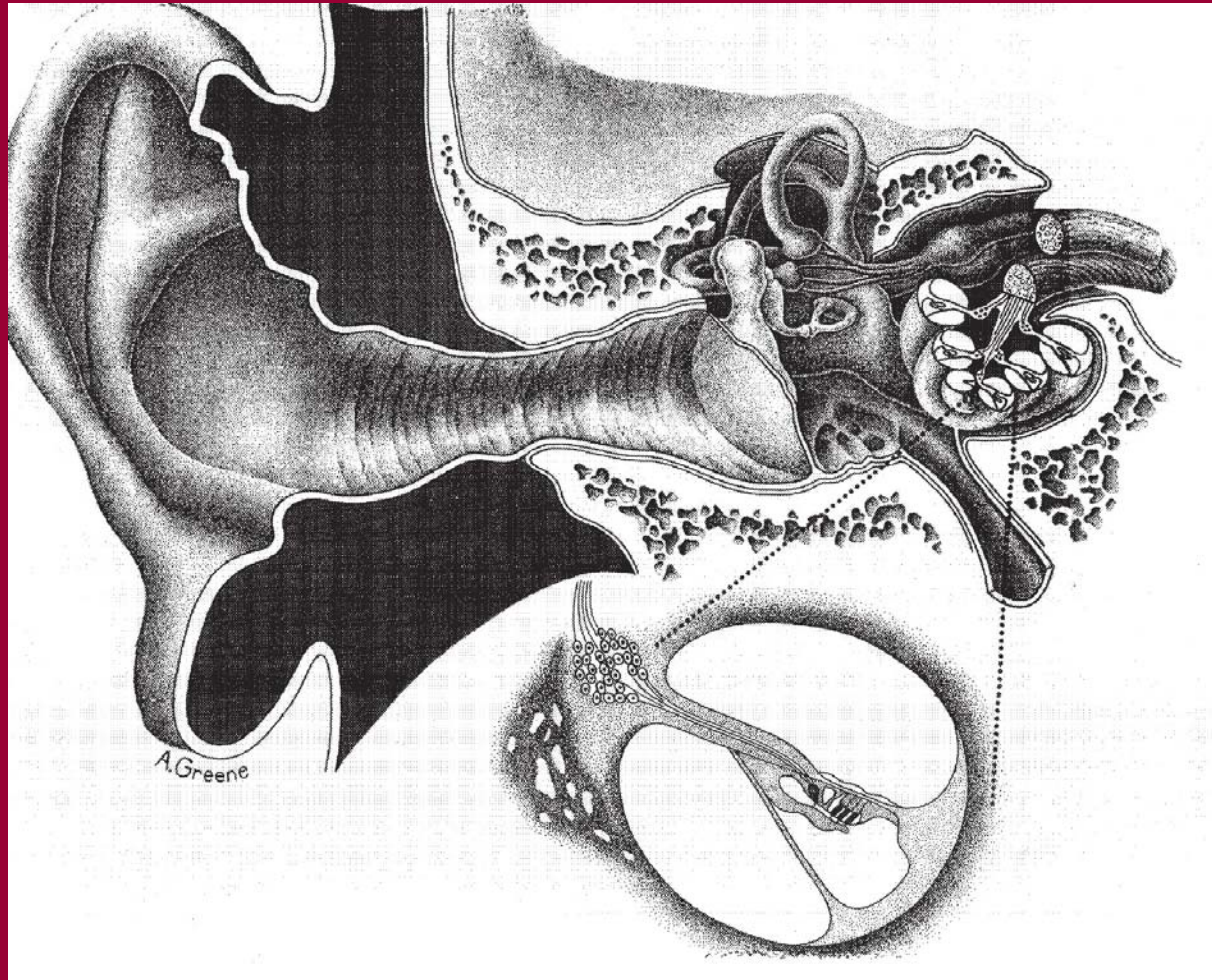
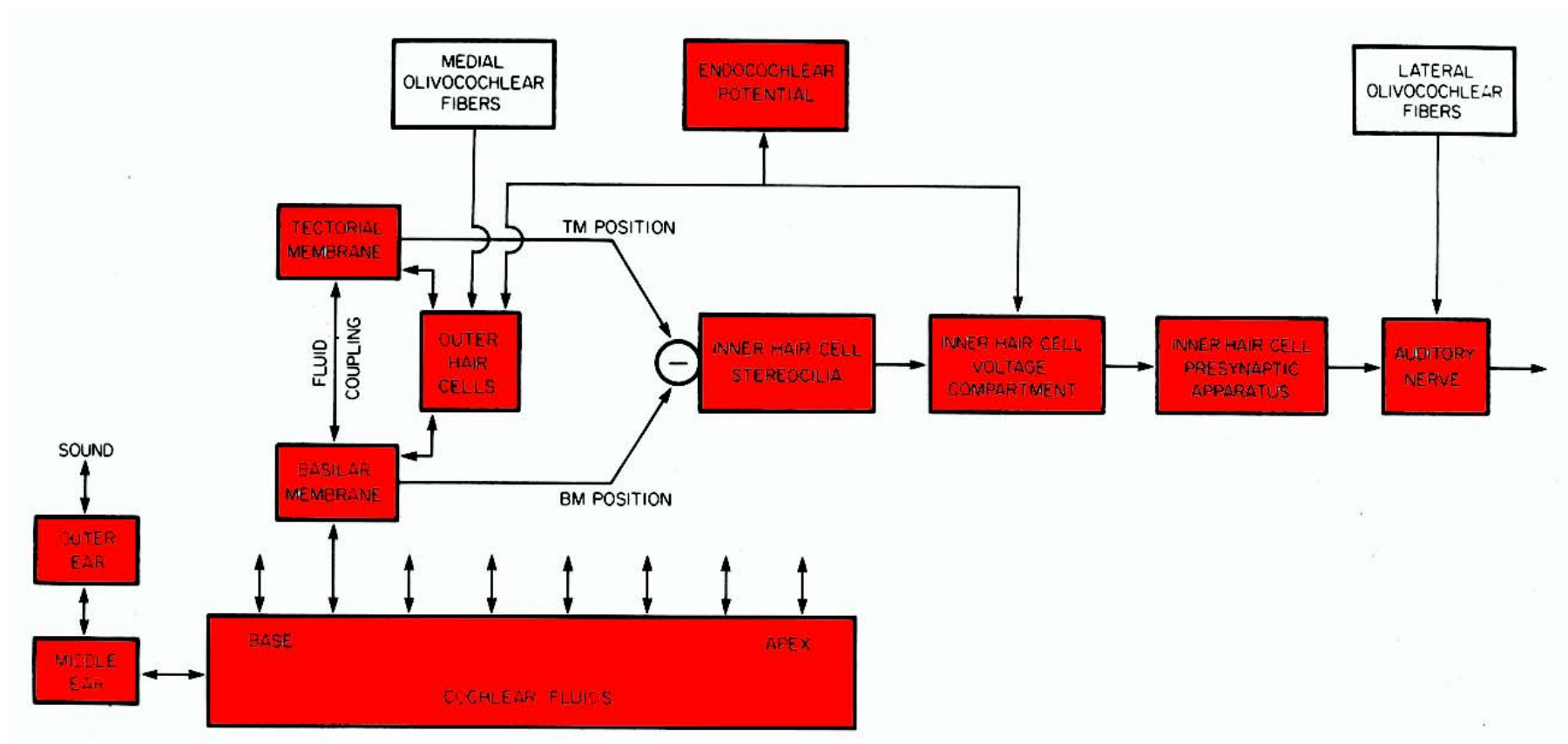


# HST 721 Mouse Lab: Noninvasive Assessment of Cochlear Function



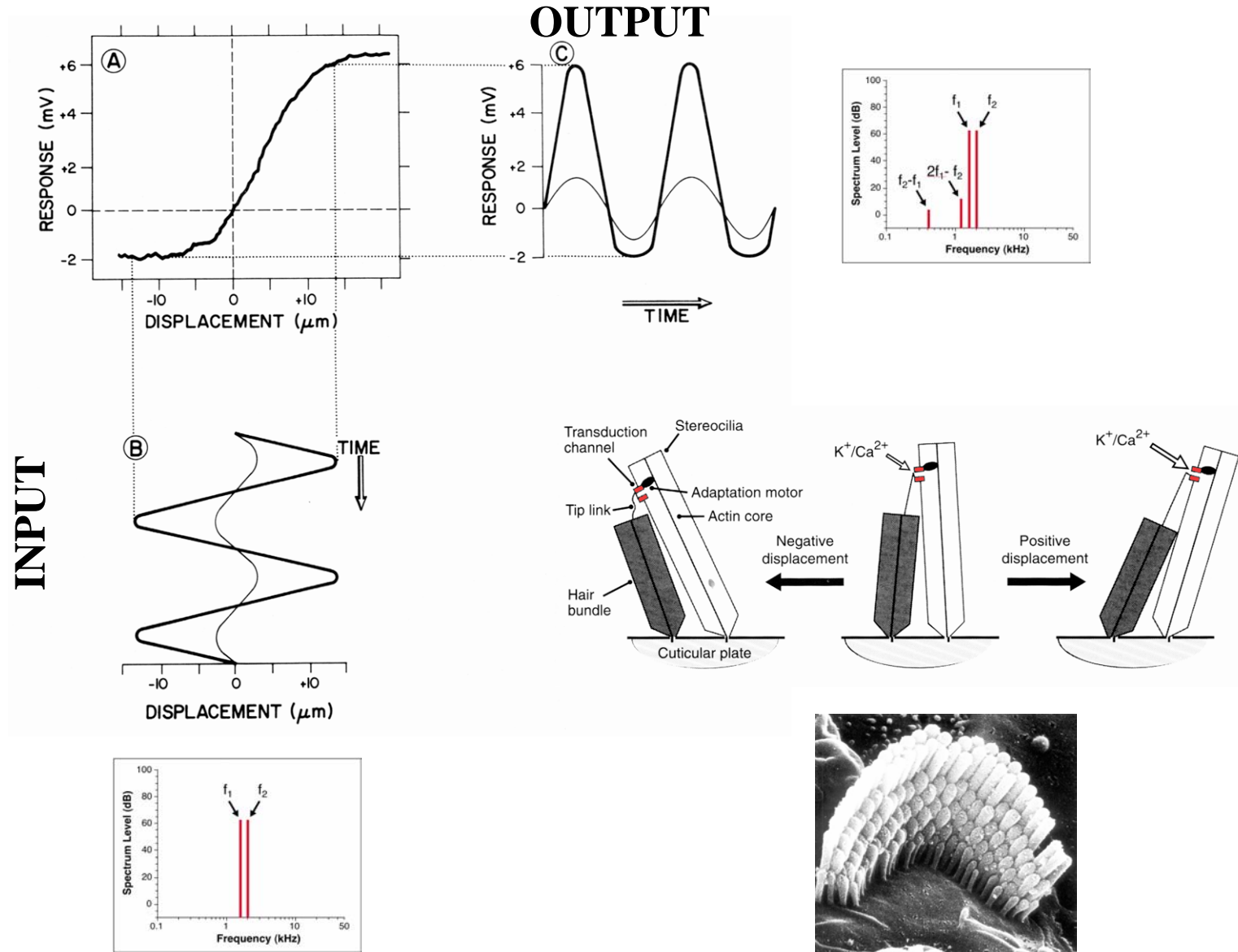
# ABRs vs. DPOAEs

## ABRs assess all structures

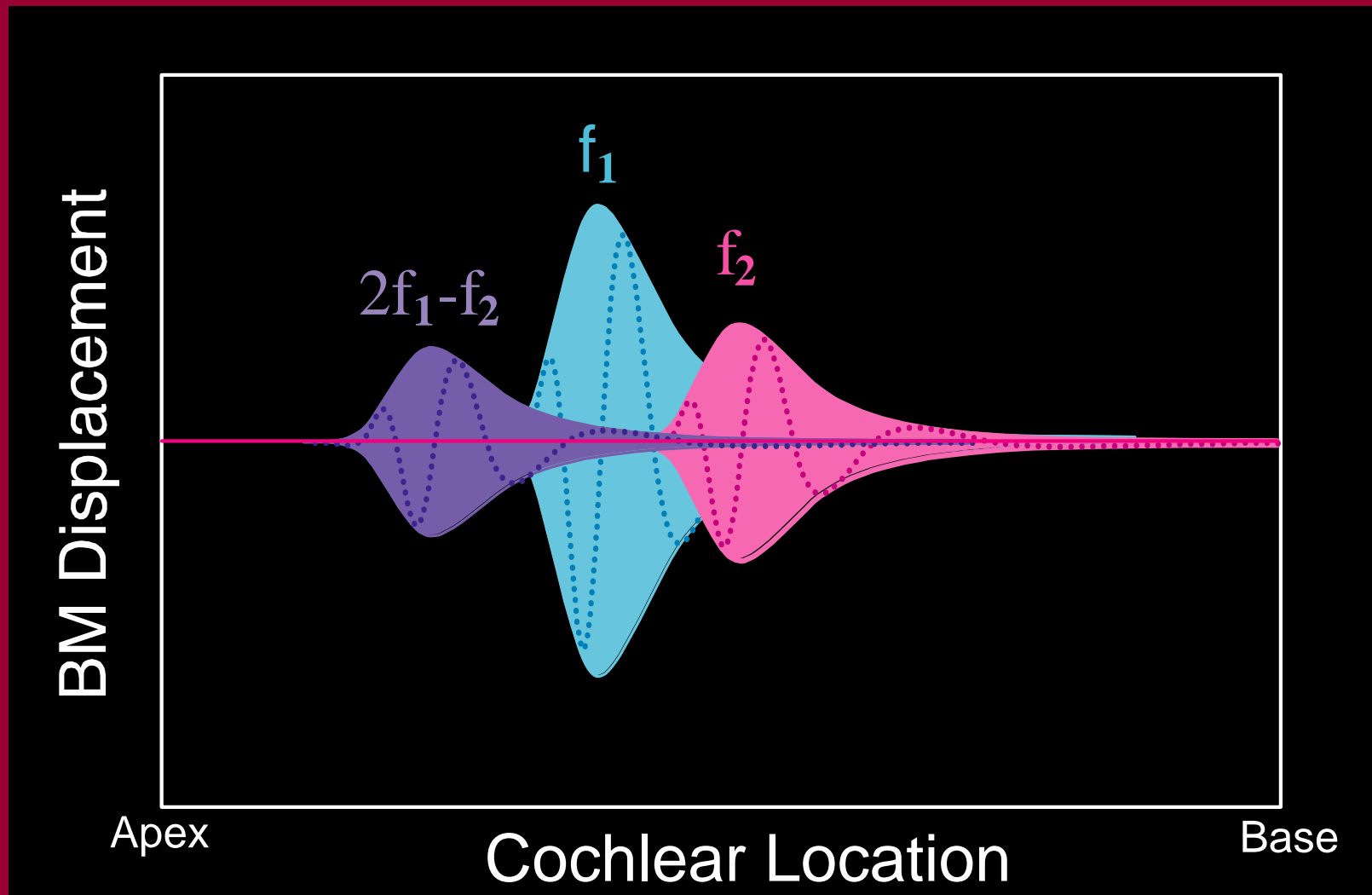


# **DPOAEs:** **Distortion Product Otoacoustic Emissions**

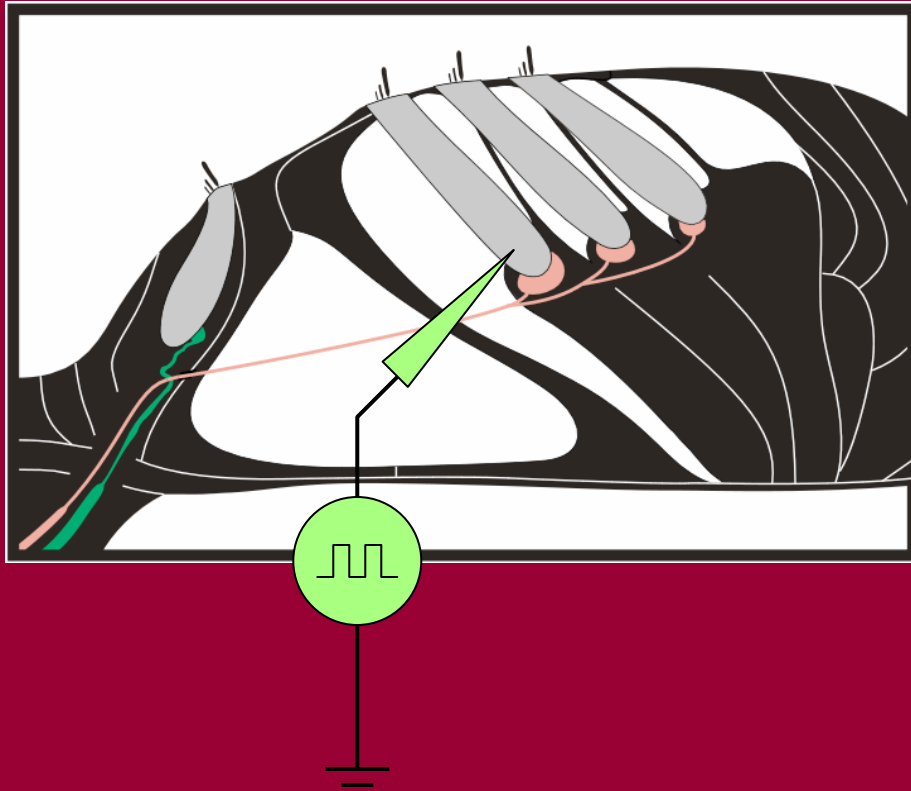
# DPOAEs: Source of the Nonlinearity



# DPOAEs: Place of cochlear generation

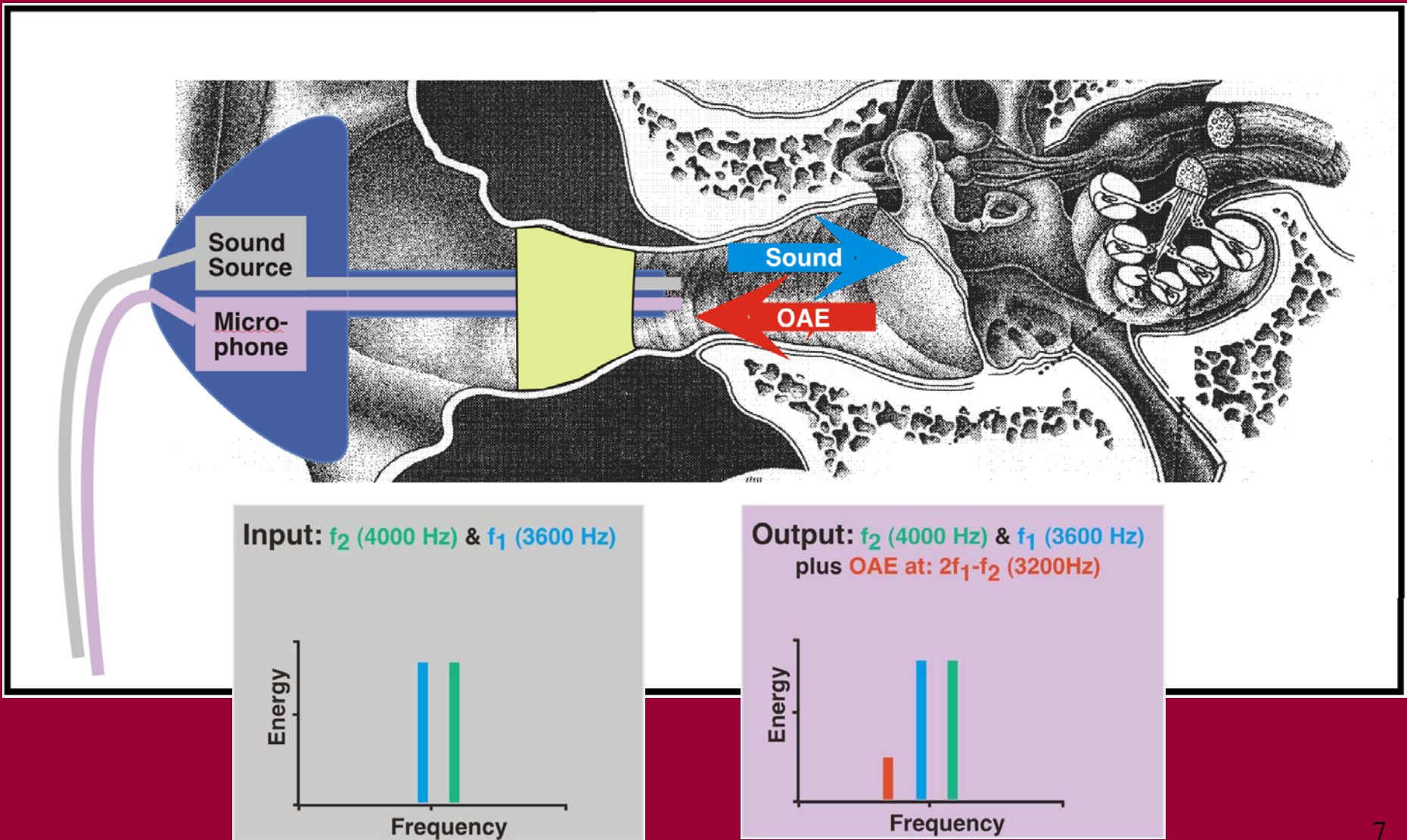


# DPOAEs: Source of Amplification

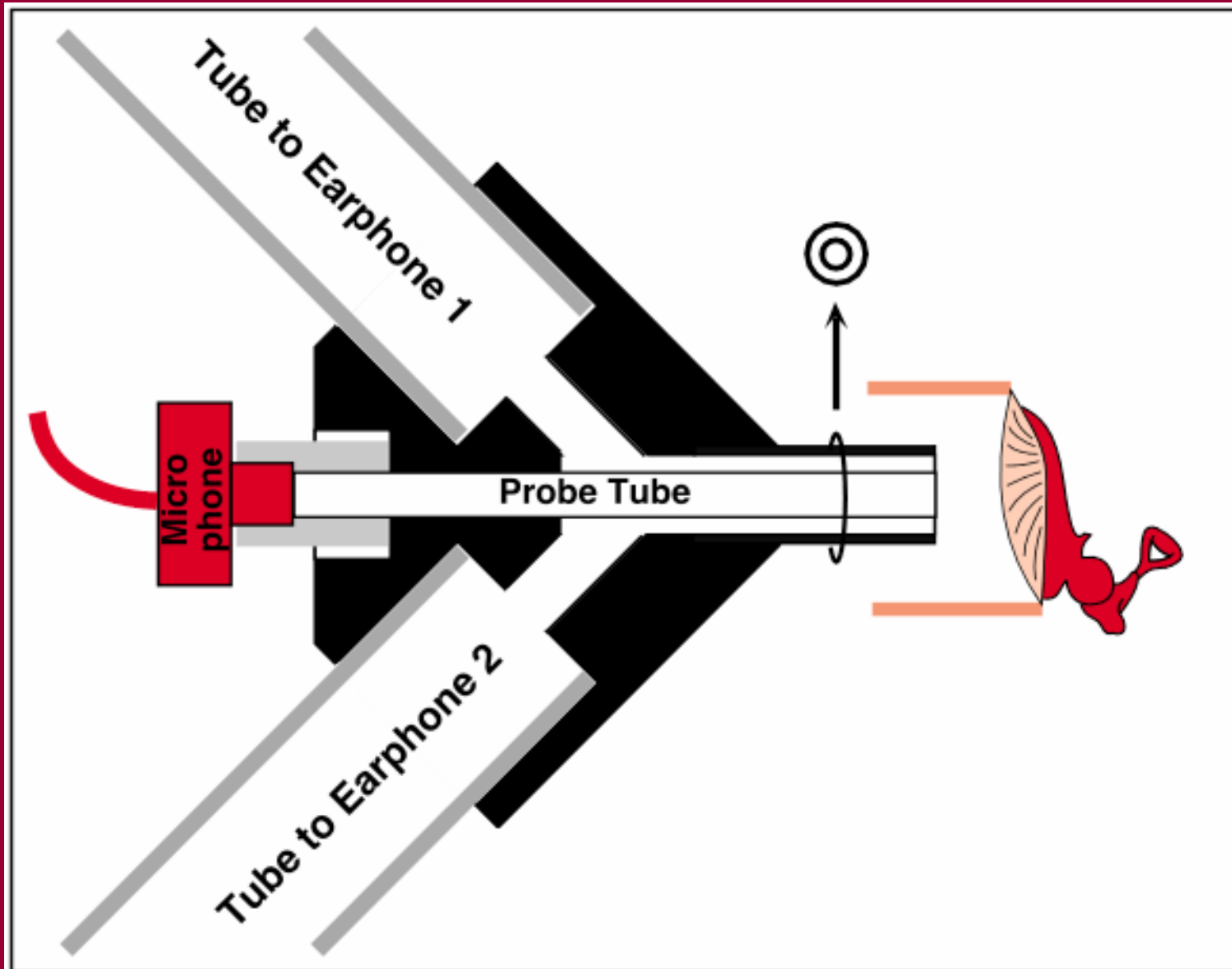


QuickTime™ and a YUV420 codec decompressor are needed to see this picture.

# DPOAEs: How they are measured in humans

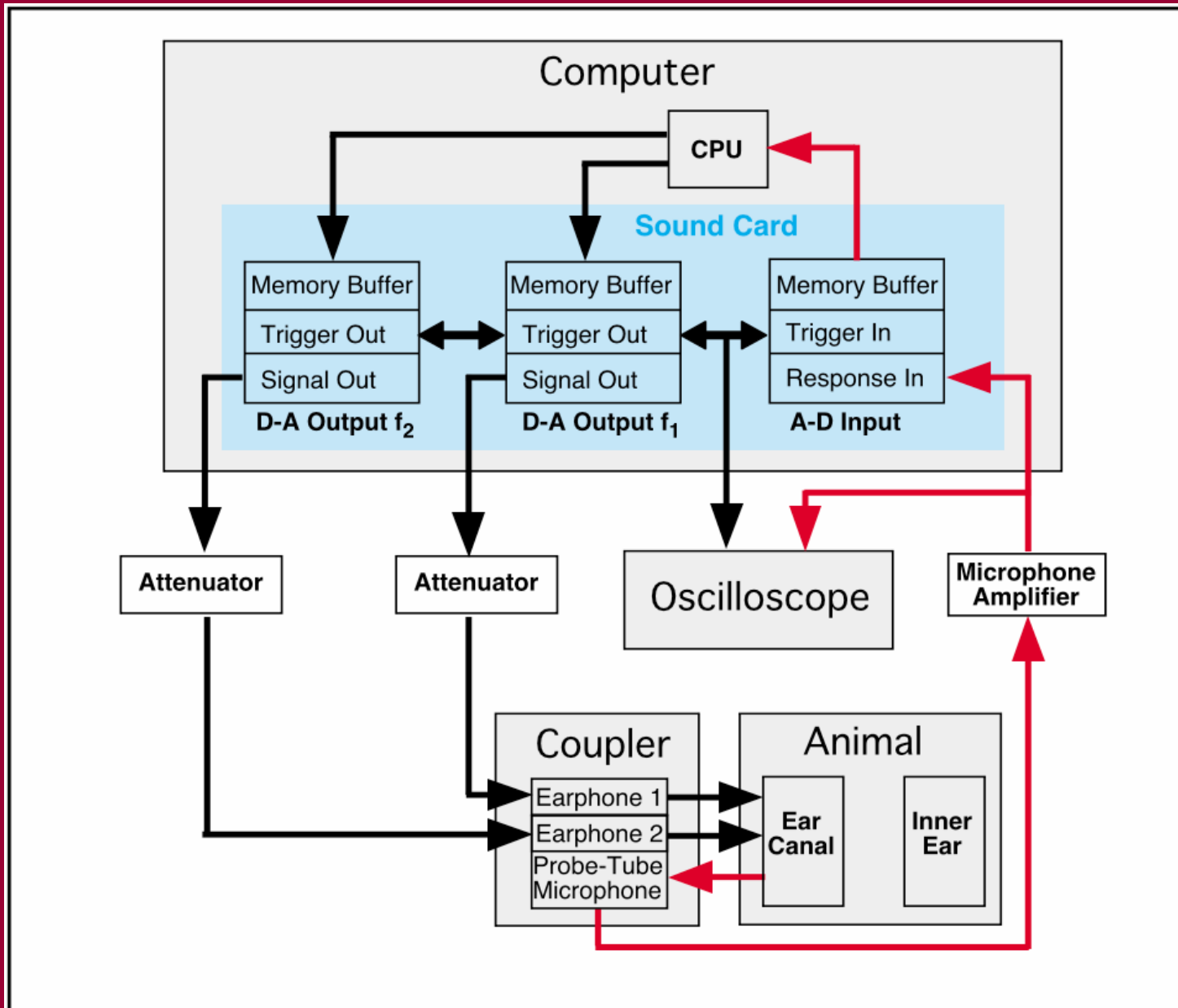


# DPOAEs: How they are measured in the lab



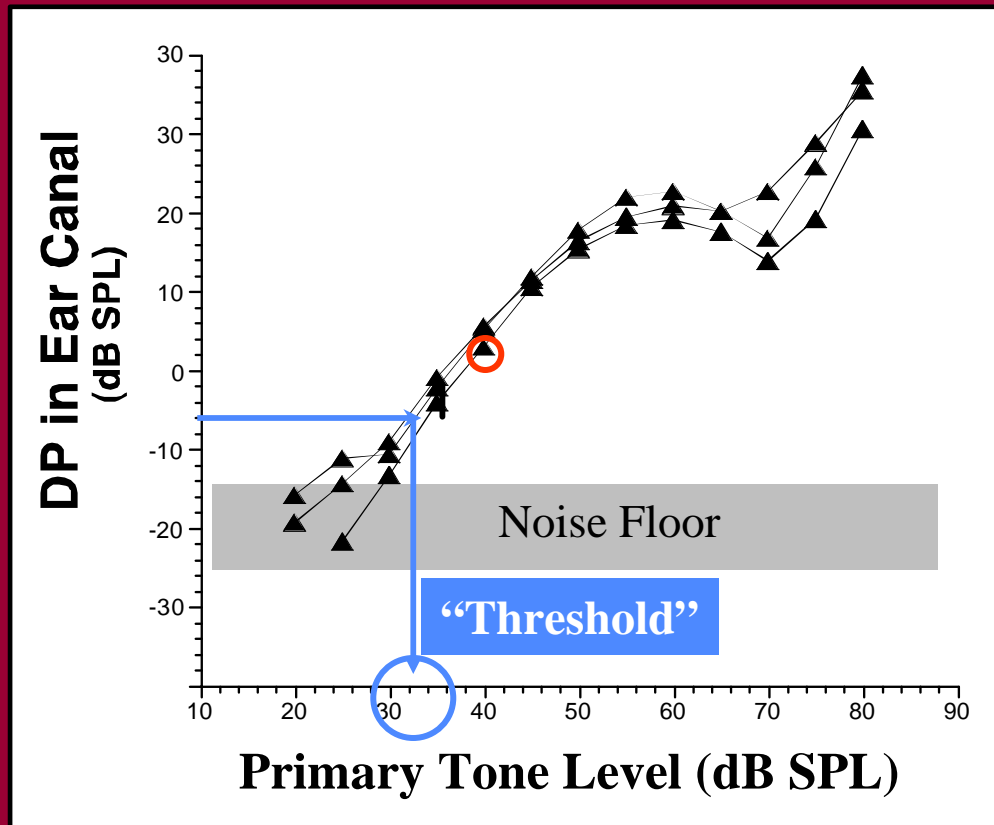


# DPOAEs: How they are measured in the lab

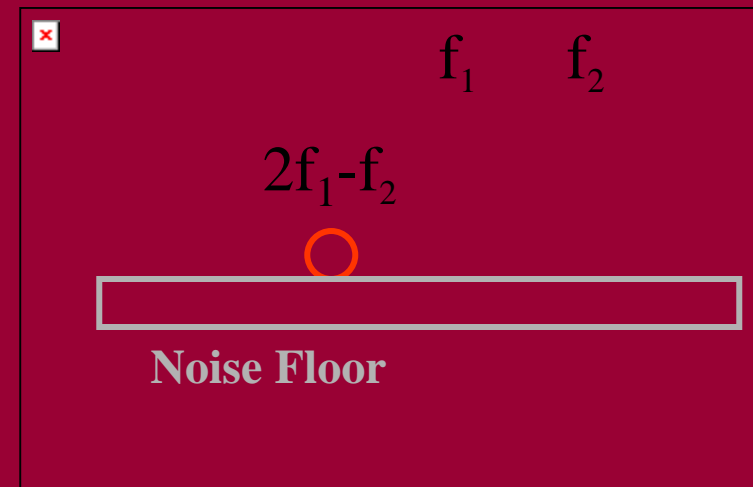


# DPOAEs: What you will see in mice

DP amplitude vs. level functions in 3 ears  
1 pair of primaries at many SPLs

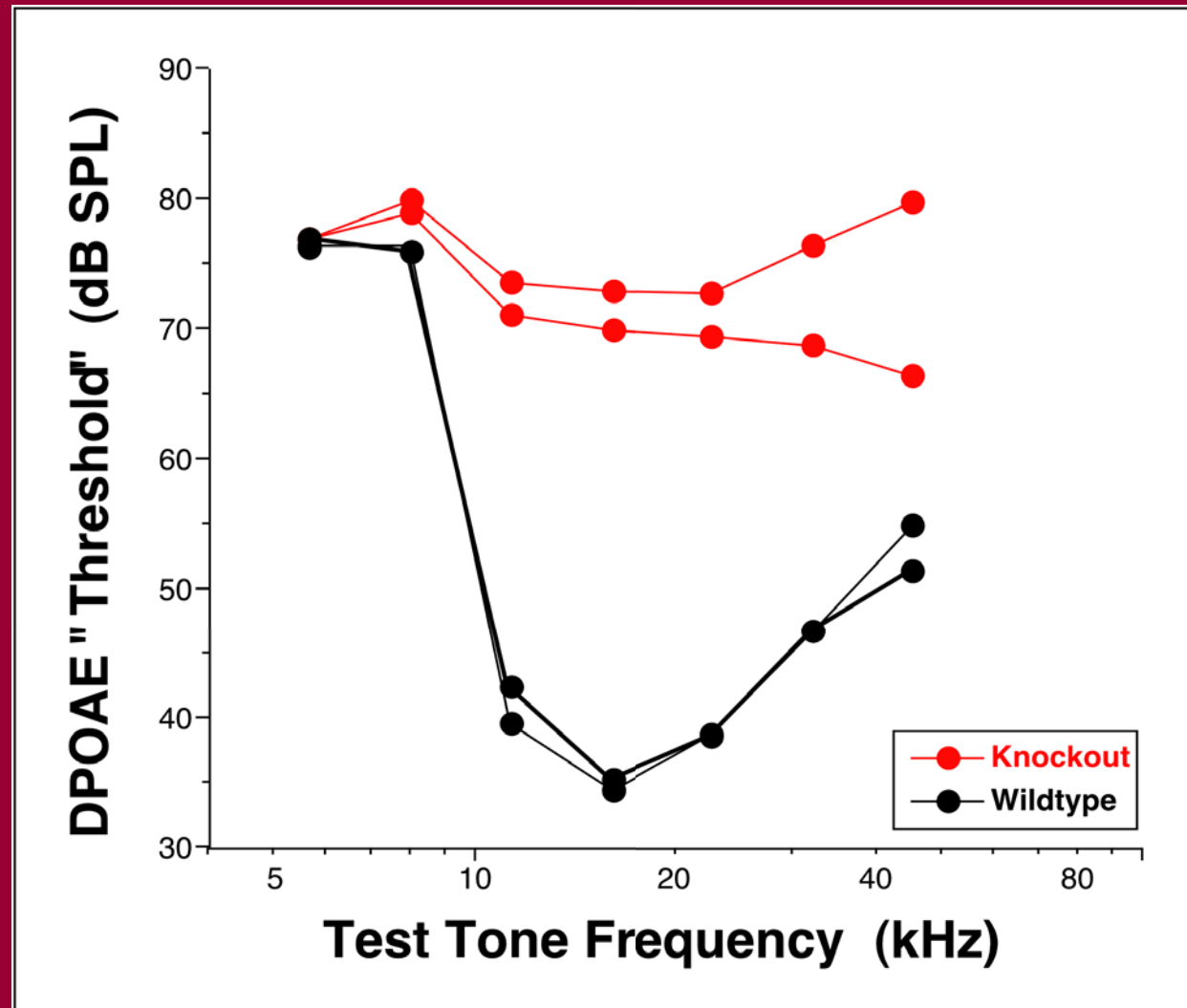


Ear-canal spectrum for 1 pair of primaries at 1 SPL

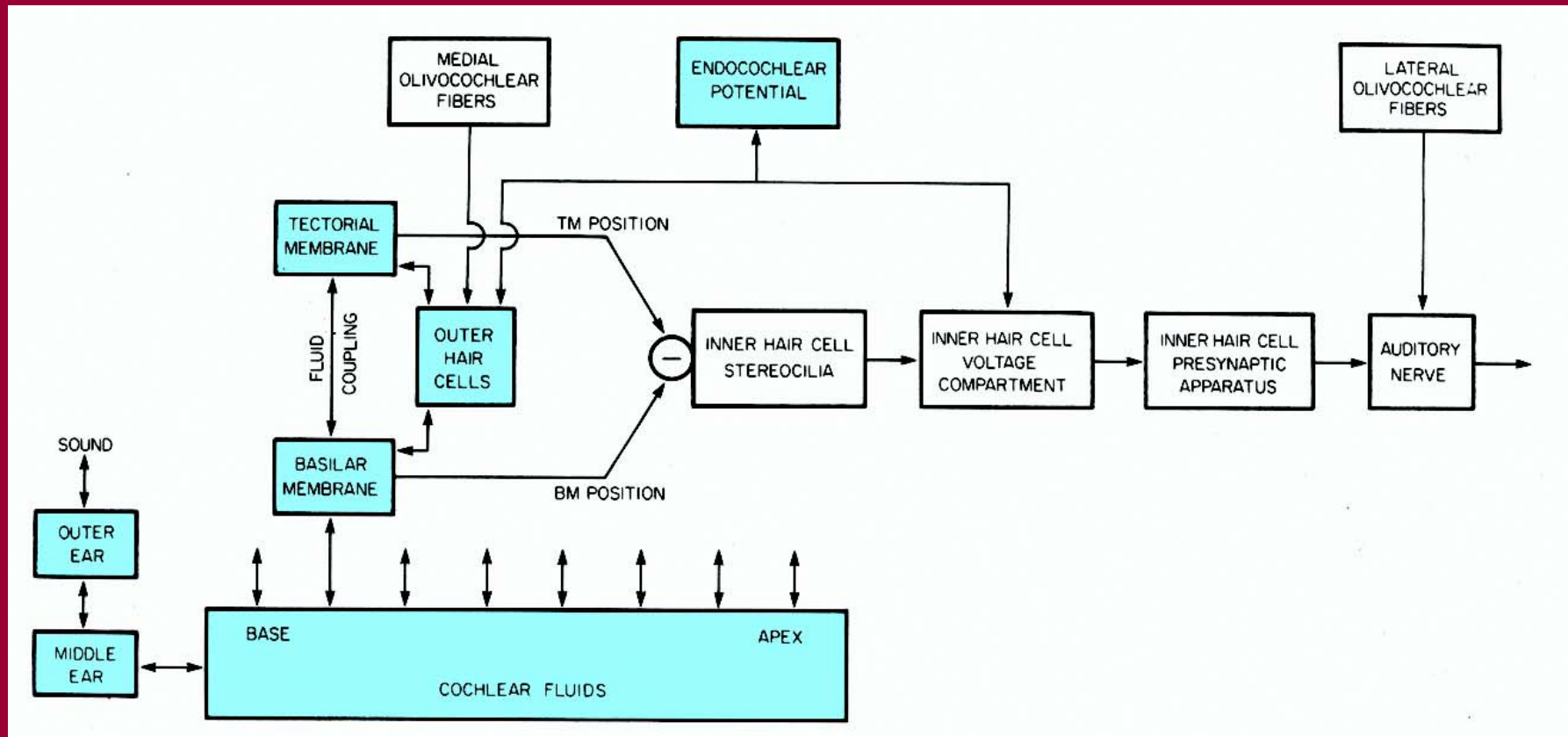


# DPOAEs: What you can compute in mice

DP iso-response functions  
“Threshold” vs frequency



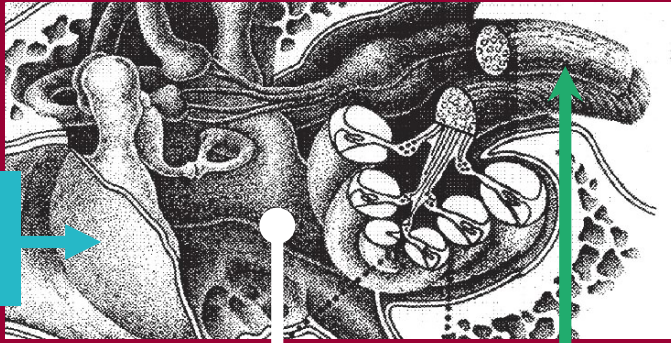
# DPOAEs: Assess OHCs and all “upstream elements”



# **ABRs: Auditory Brainstem Responses**

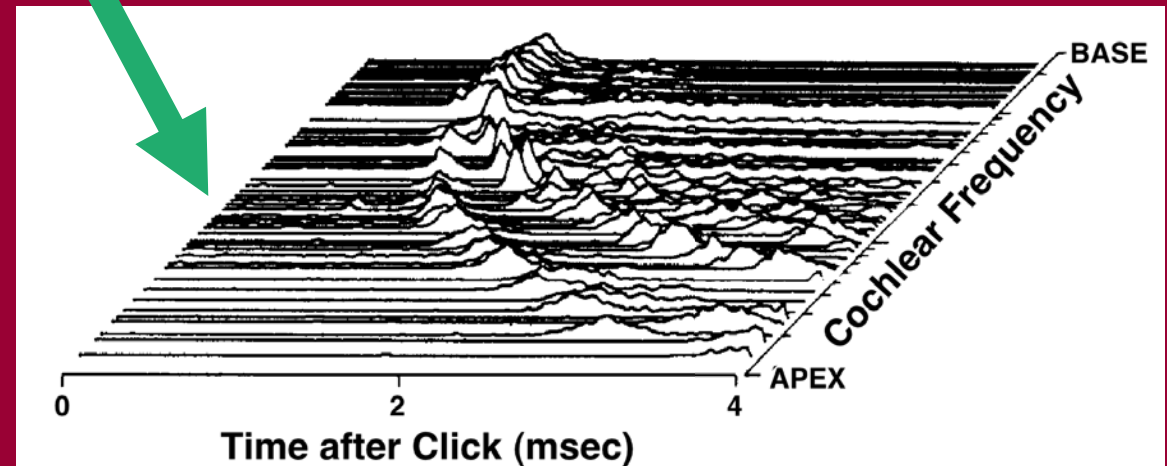
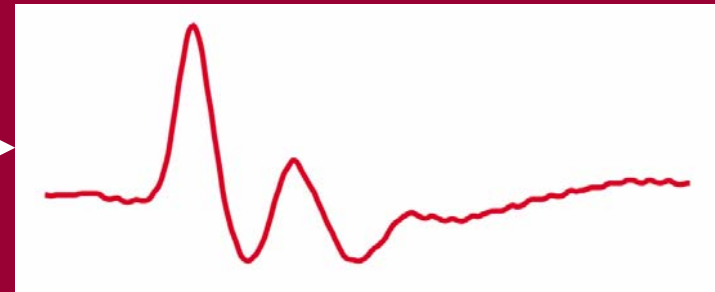
# CAPs: Dominated by auditory nerve response

Click  
Stimulus

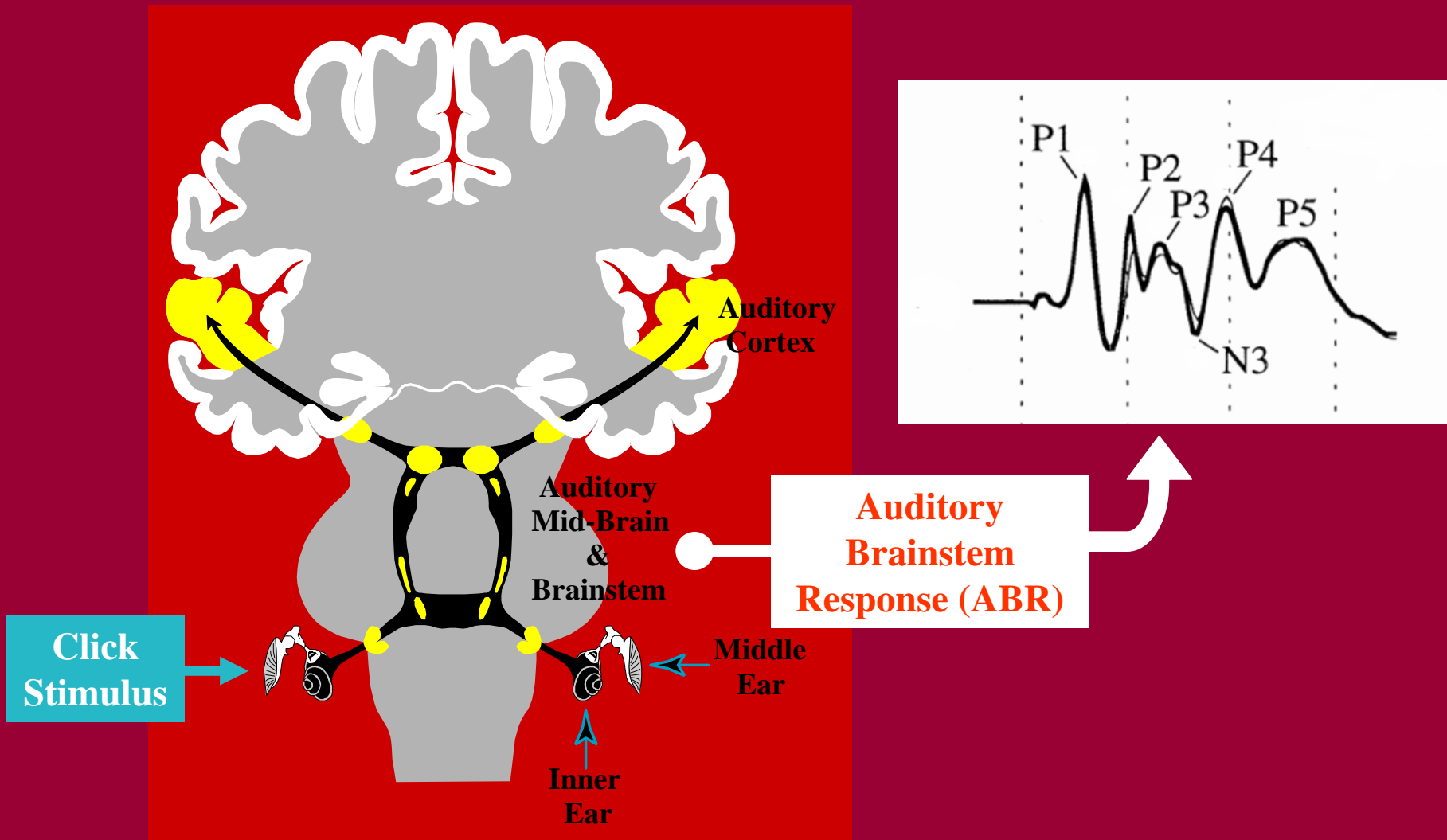


Compound  
Action  
Potential (CAP)

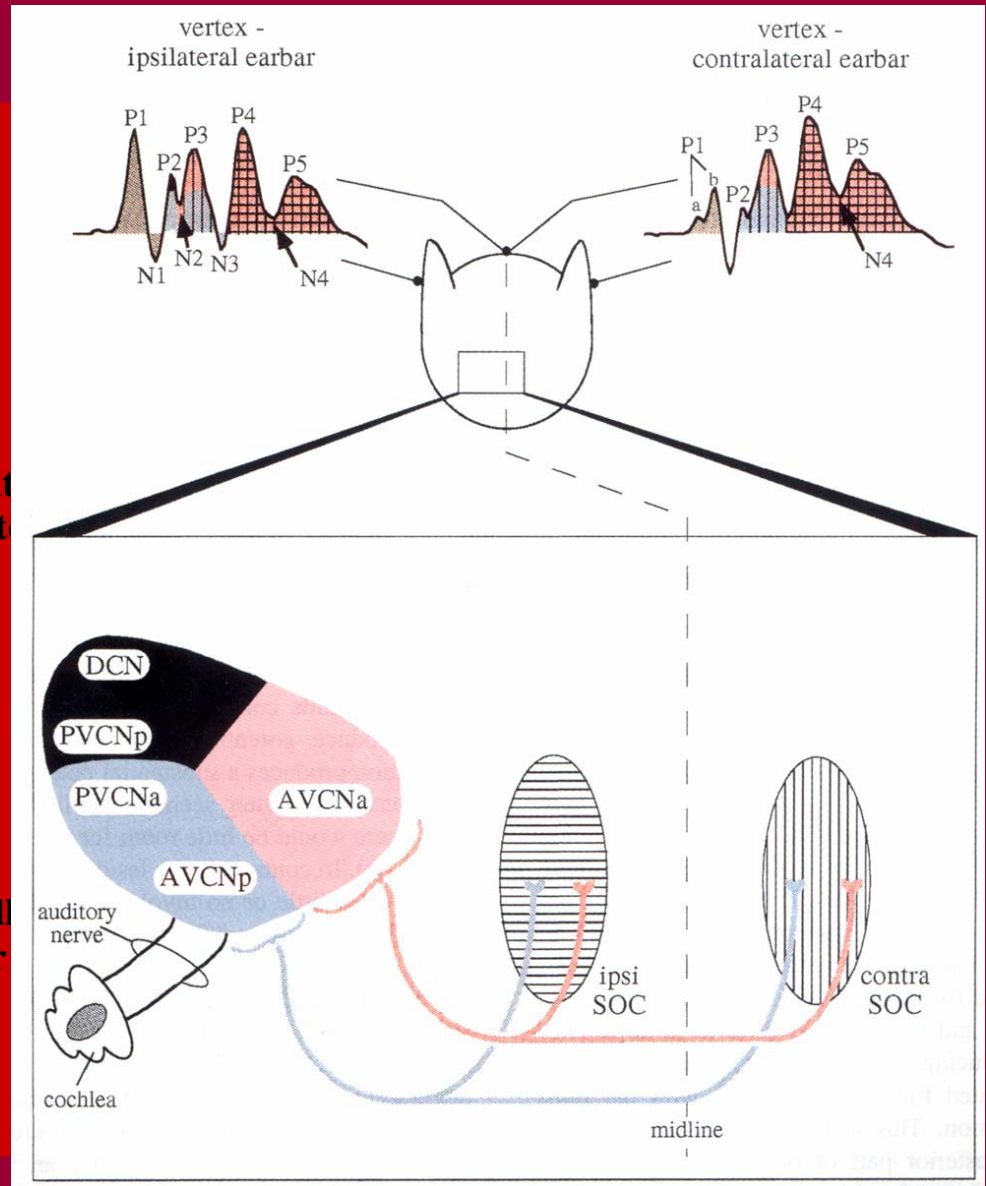
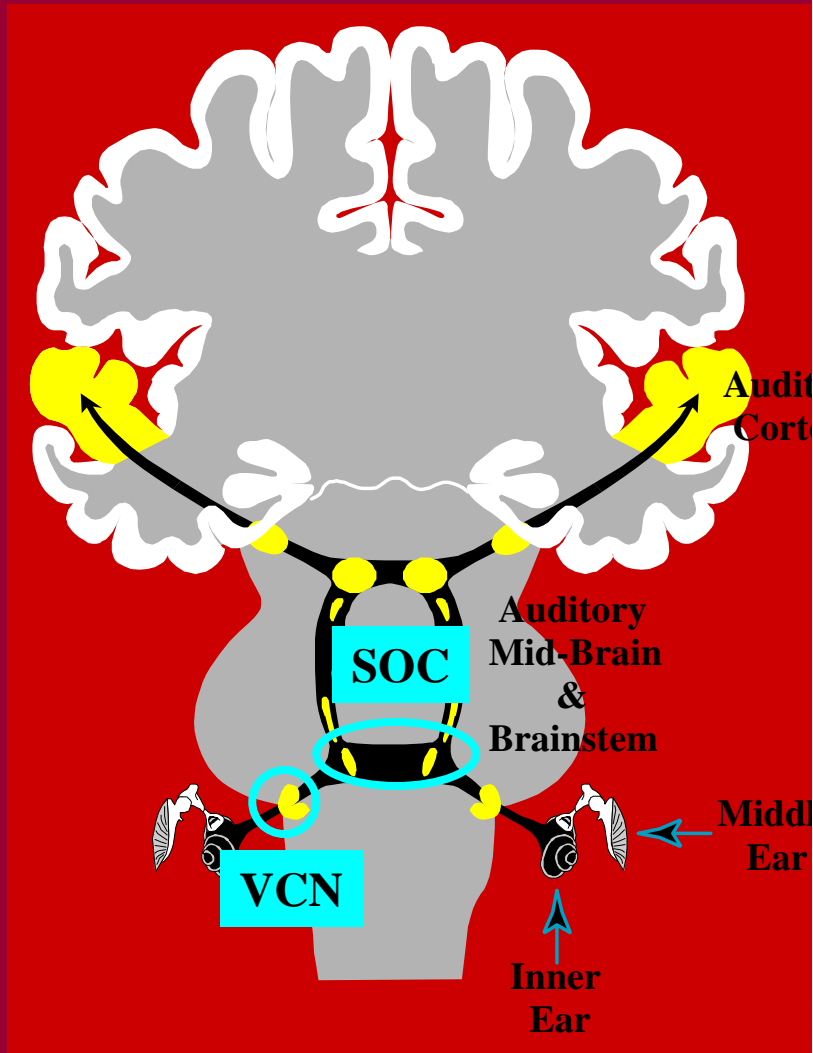
Responses



# ABRs: Include potentials from several brainstem nuclei

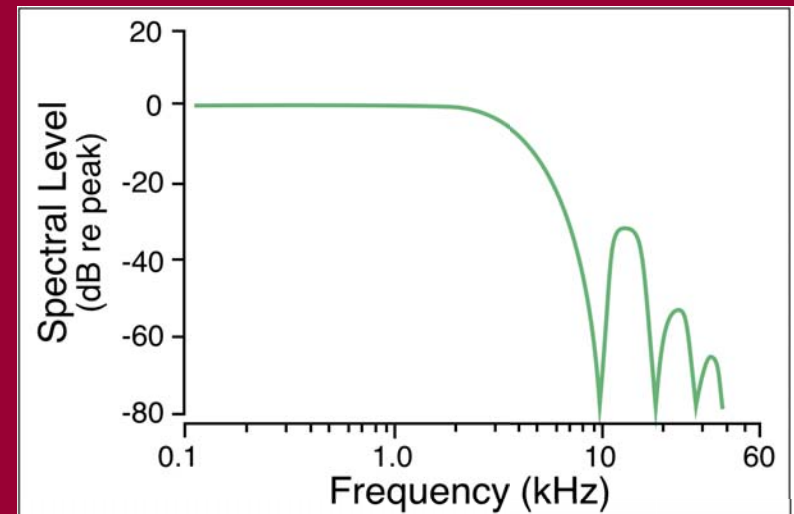
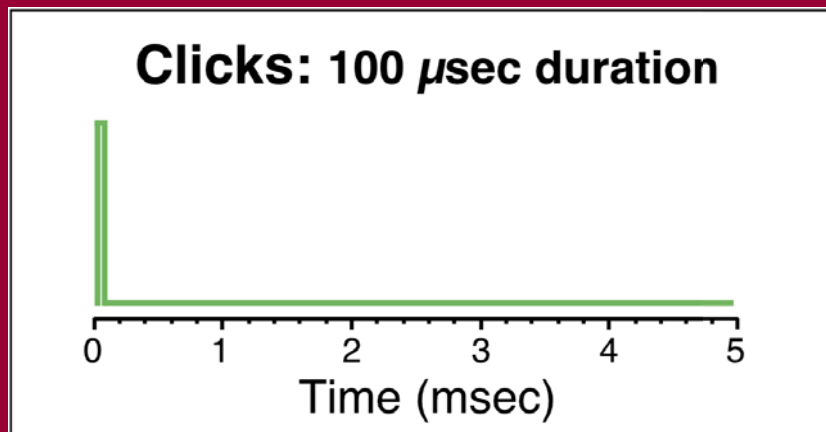
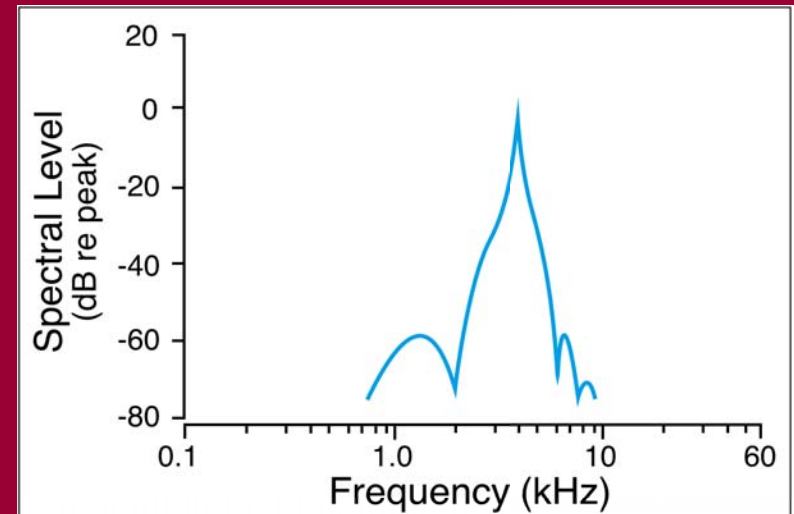
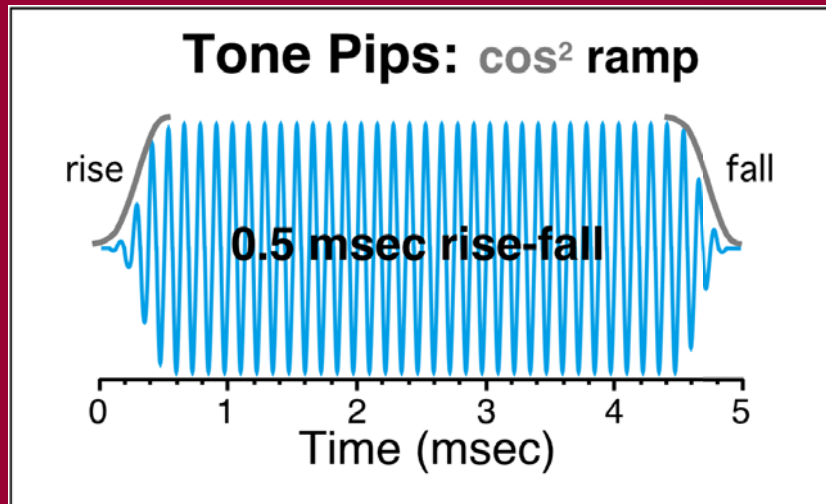


# ABRs: Which cells dominate the peaks ?



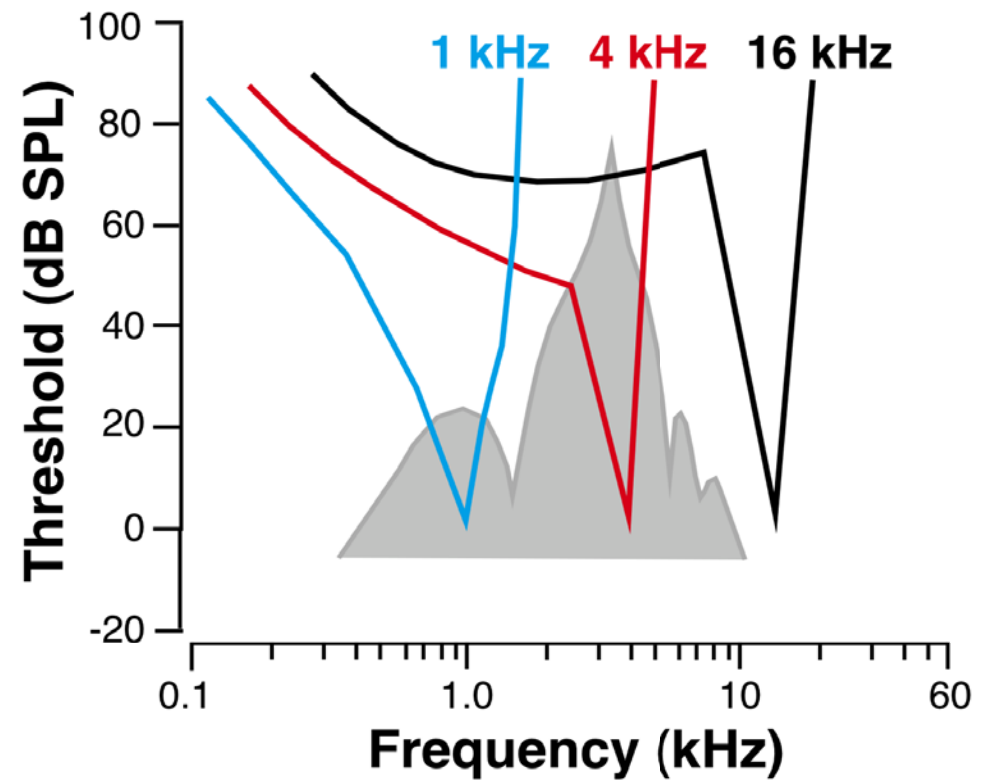
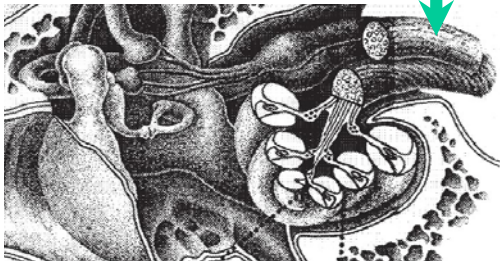


# ABRs: Tone pips vs. Clicks

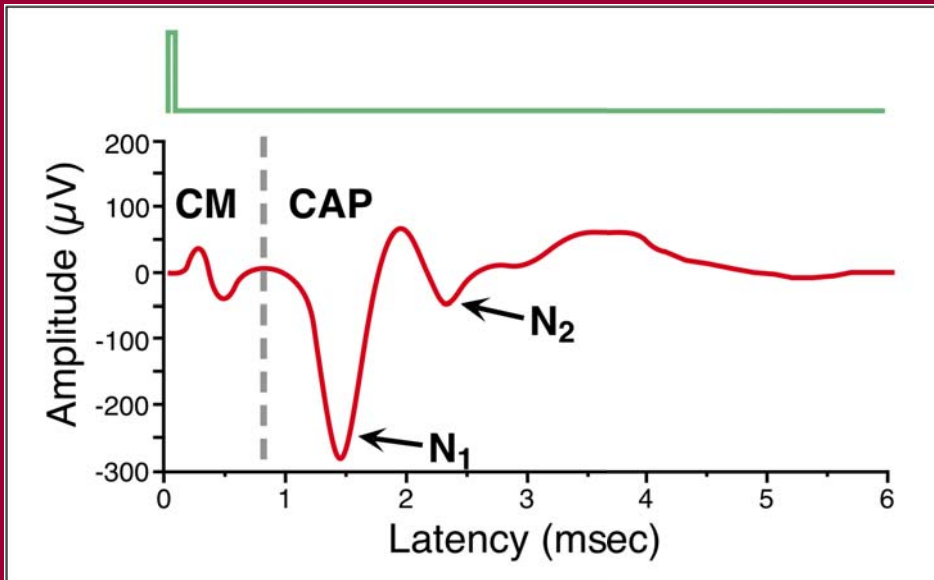
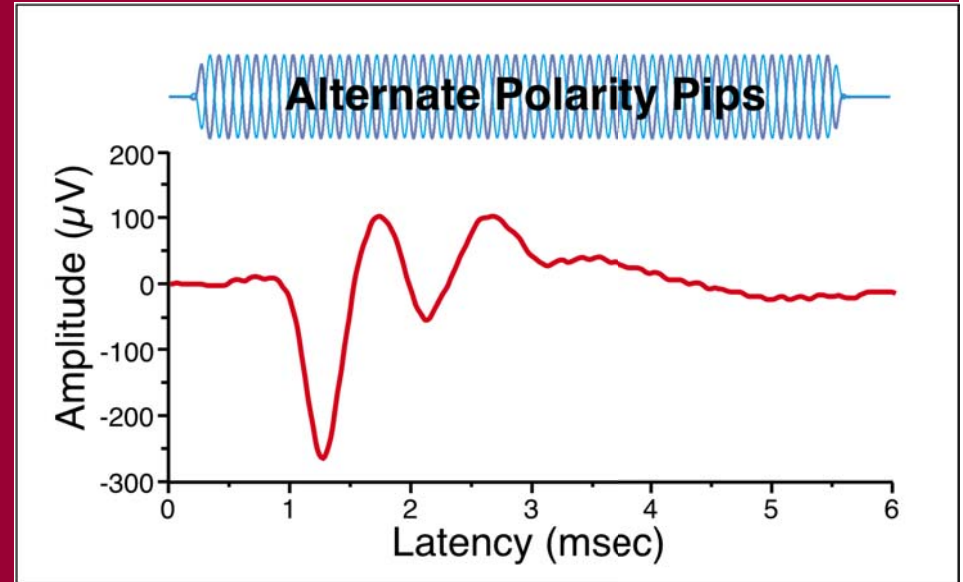
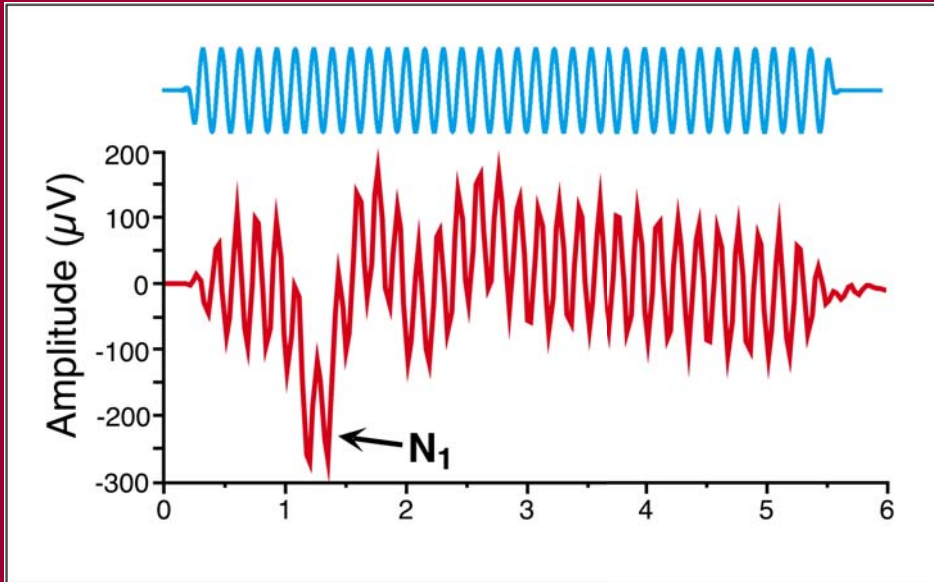


# ABRs: Frequency selectivity of tone pips

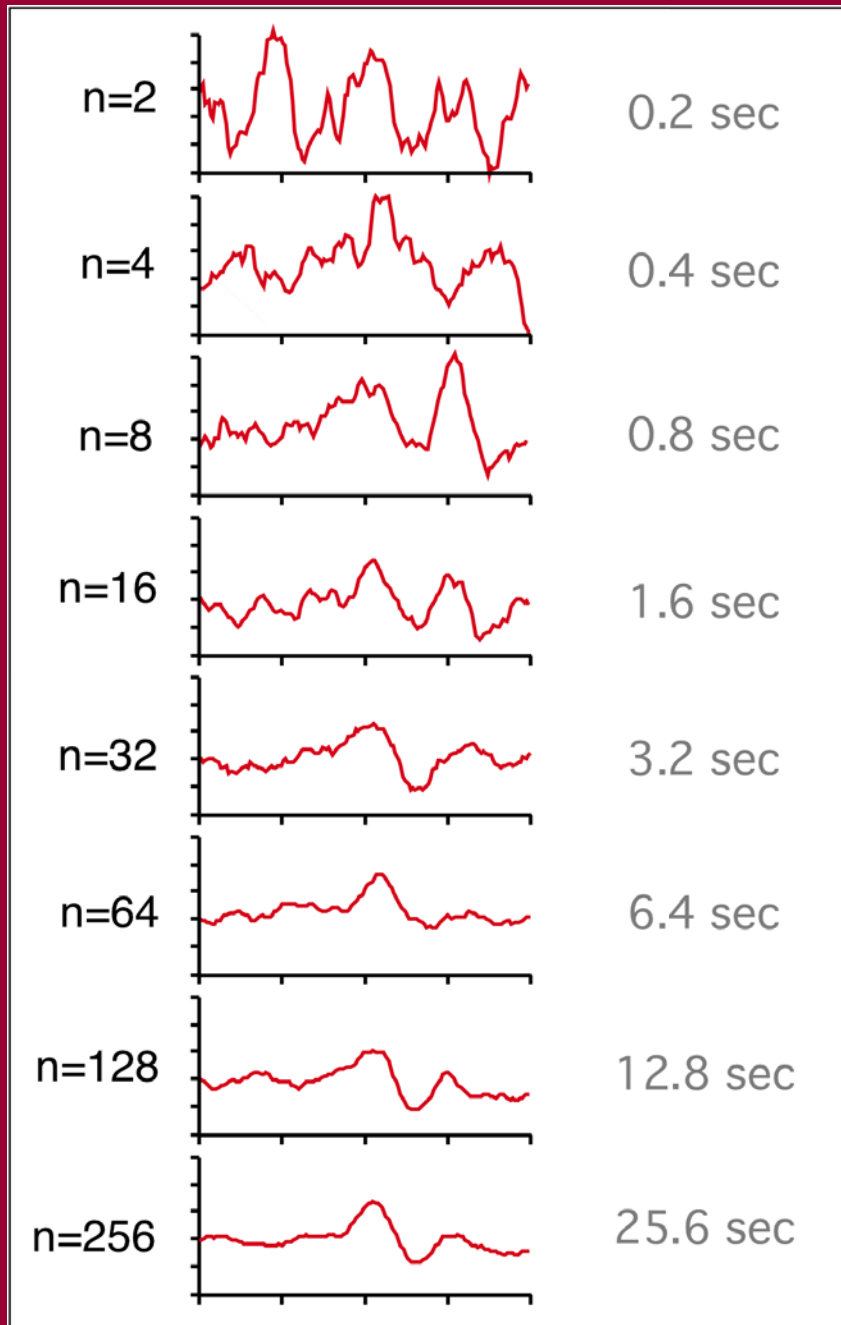
Single-Fiber Recordings



# ABRs: Tone pips vs. Clicks



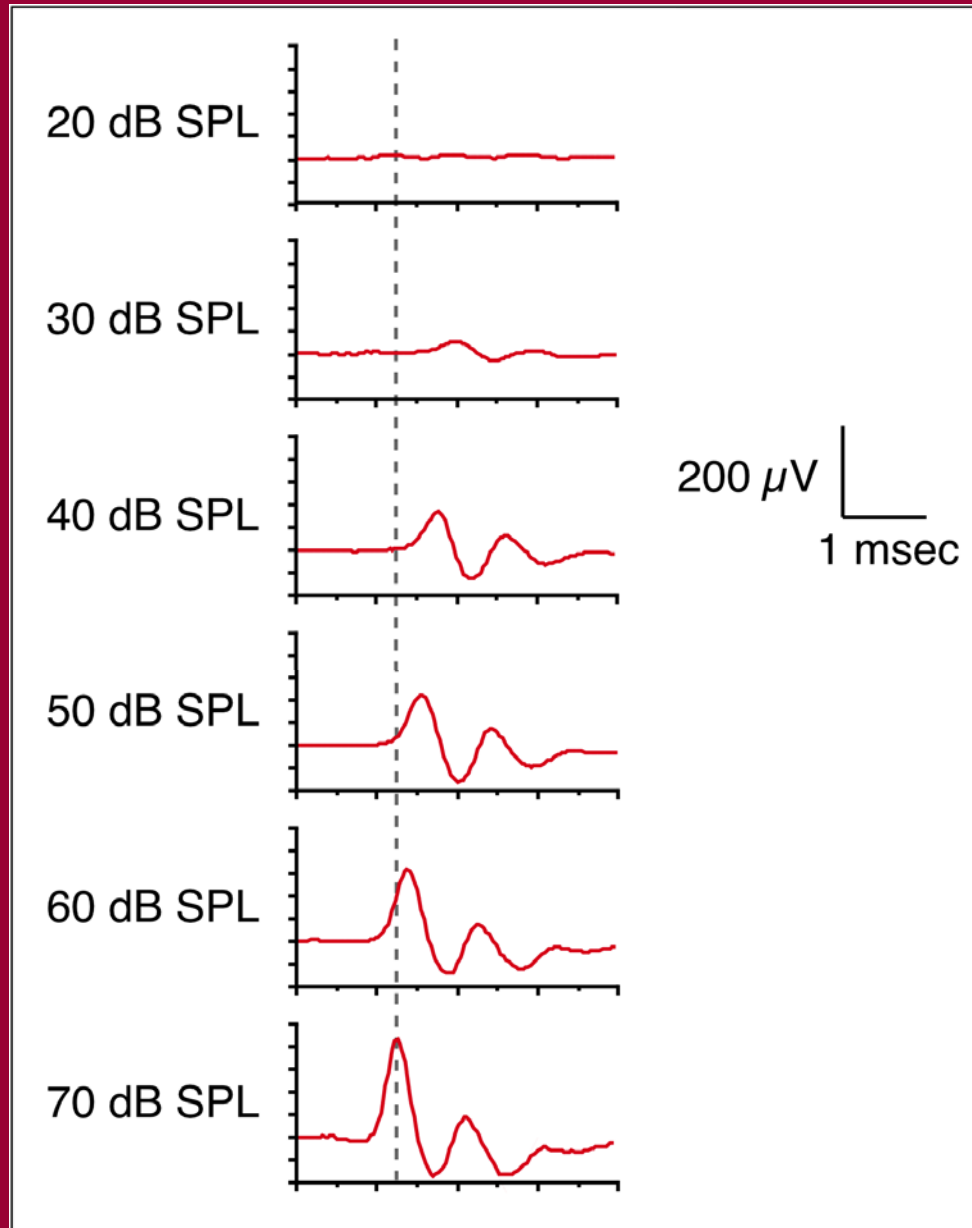
## ABRs: Signal Averaging



Noise decreases in proportion to  $\sqrt{n}$ , where  $n = \#$  averages

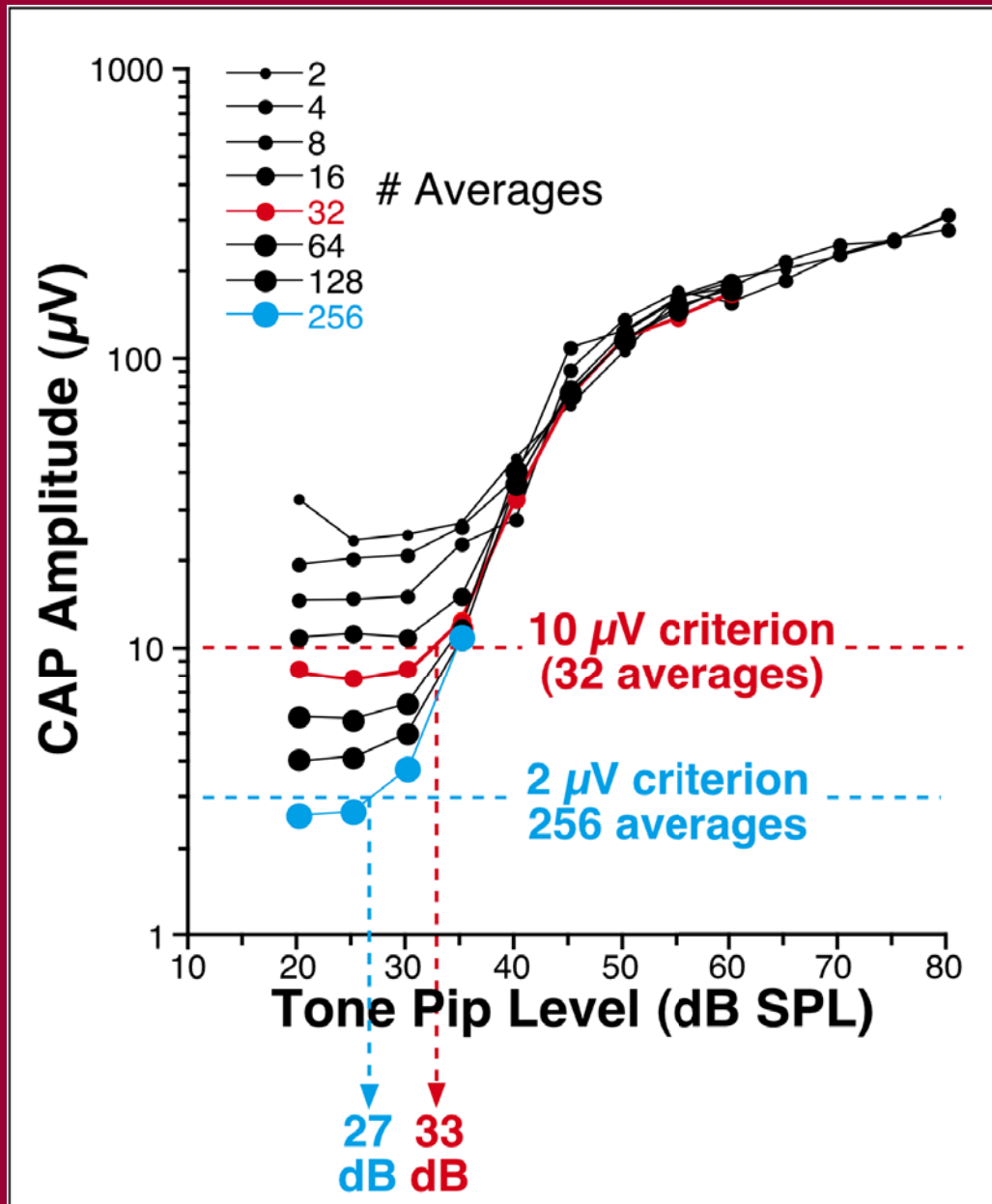
Near threshold, 1024 averages are typically acquired for ABR.

# ABRs: What is Threshold?



Response amplitude  
grows with increasing  
stimulus SPL

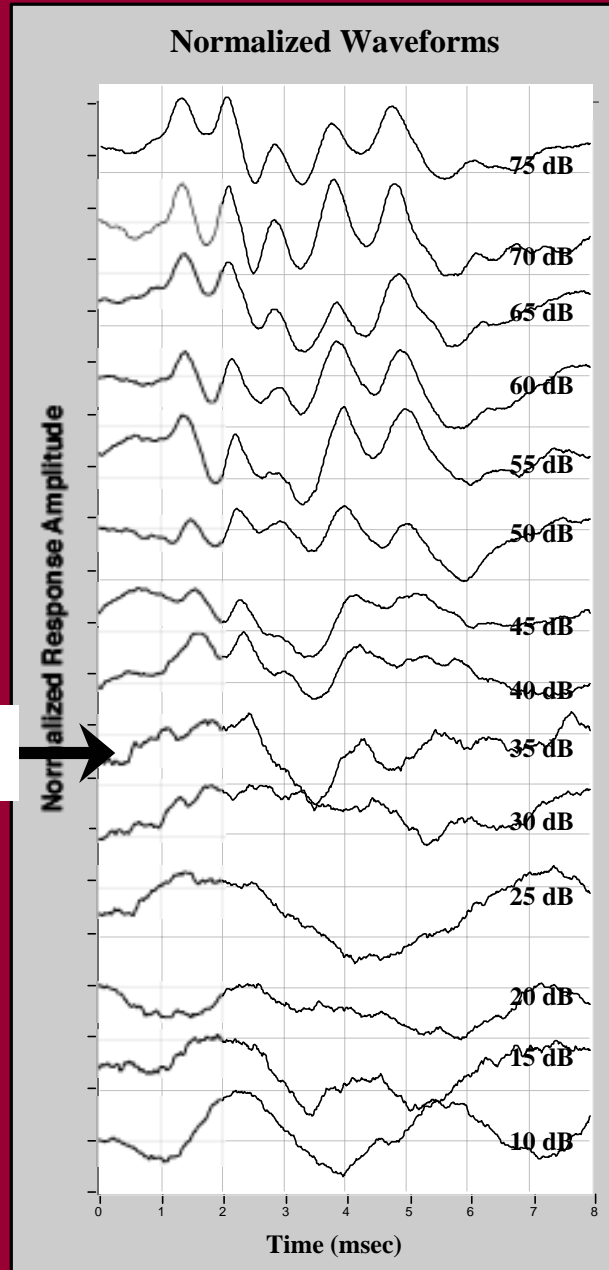
# ABRs: What is Threshold?



Strategy 1:  
Iso-response criteria

Noise floor, and therefore “threshold” is affected by amount of averaging

# ABRs: What is Threshold?

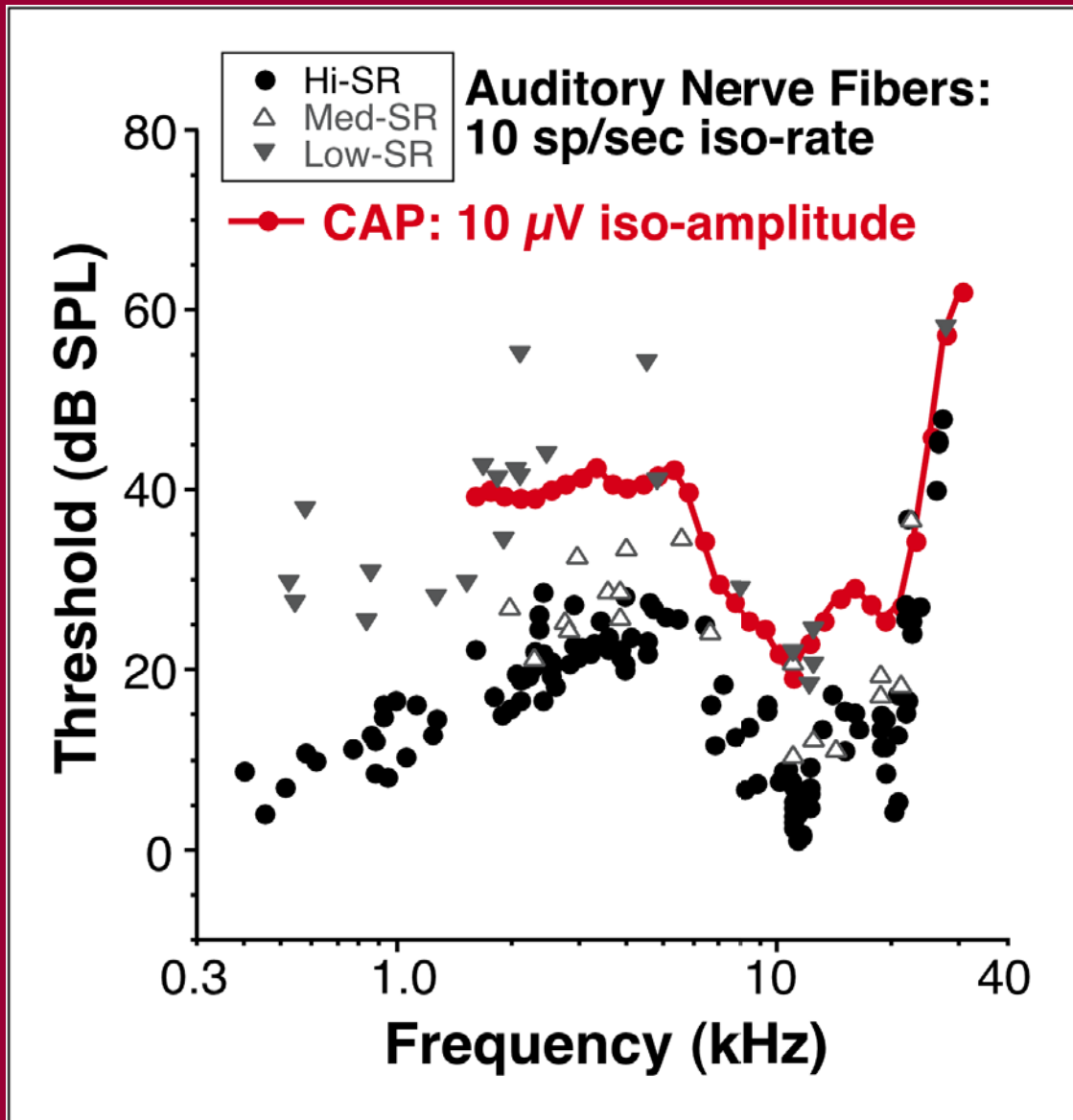


**Threshold**

Strategy 2:  
Follow the waves

Noise floor, and  
therefore “threshold”  
is affected by amount  
of averaging

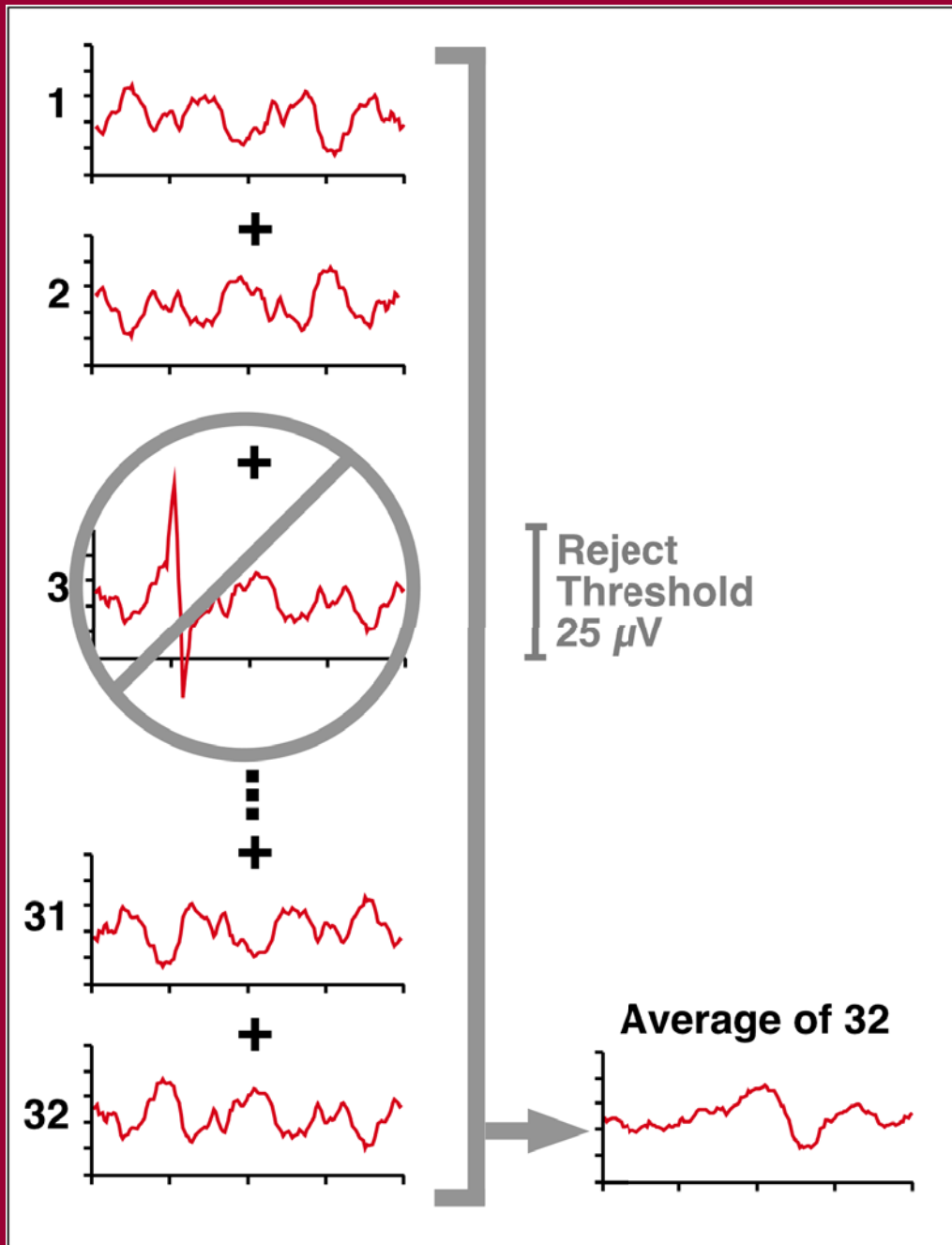
# ABRs: What is Threshold?



Even with extensive averaging, ABR/CAP “Threshold” is  $>$  single fiber “Threshold”

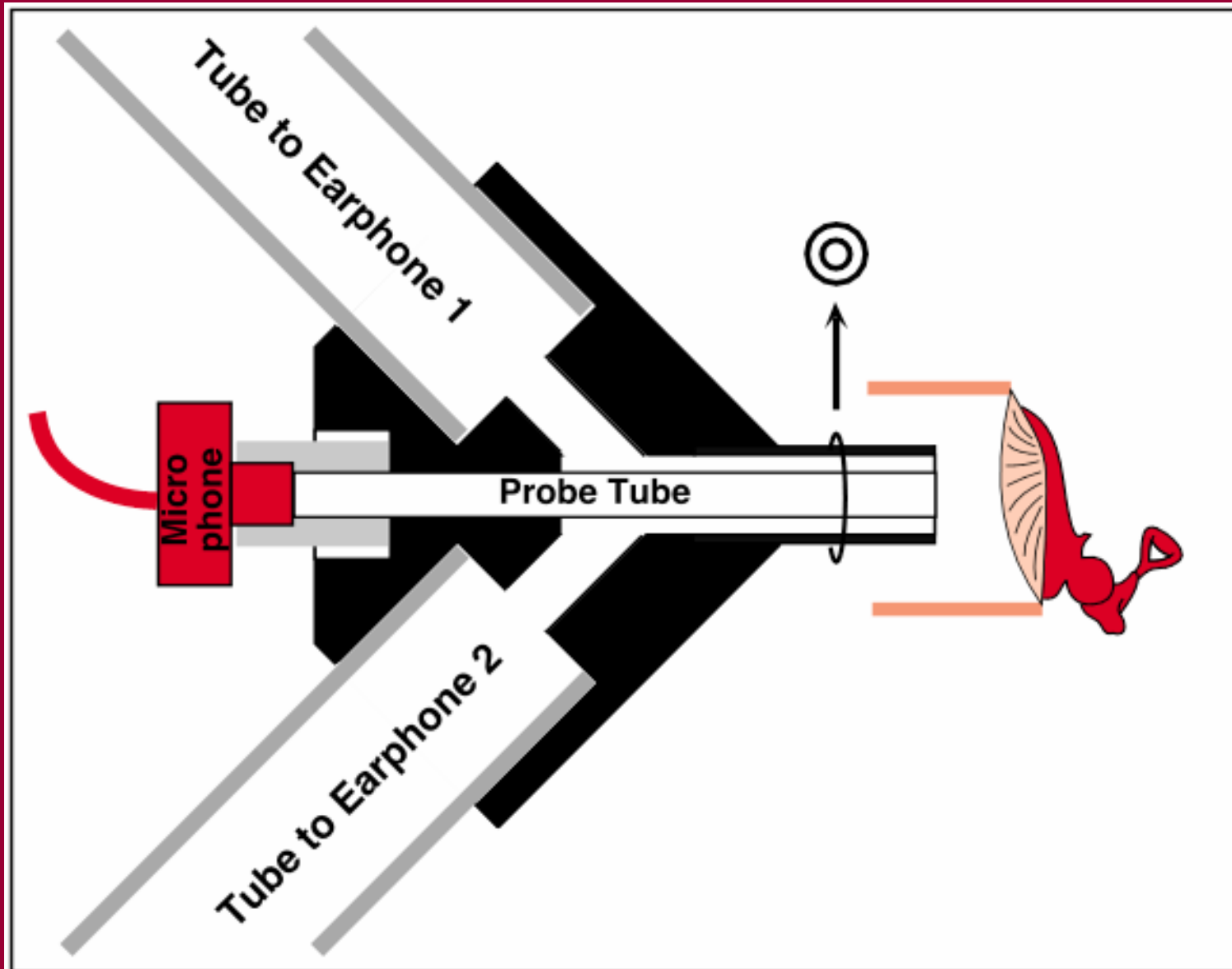


# ABRs: Signal Averaging

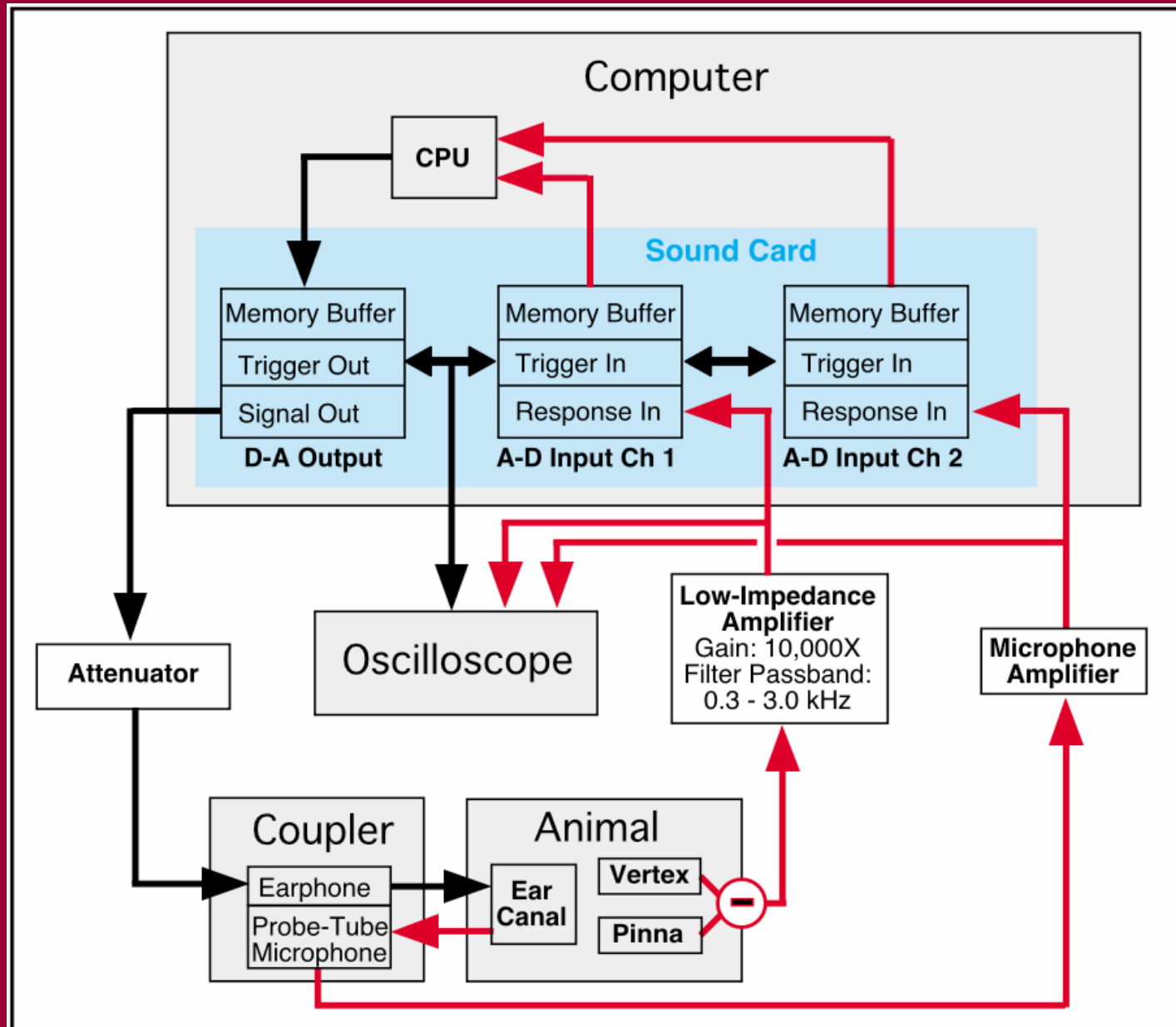


“Artifact Reject” in the software allows removal of large potentials due to EKG

# ABRs: How they are measured in the lab



# ABRs: How they are measured in the lab

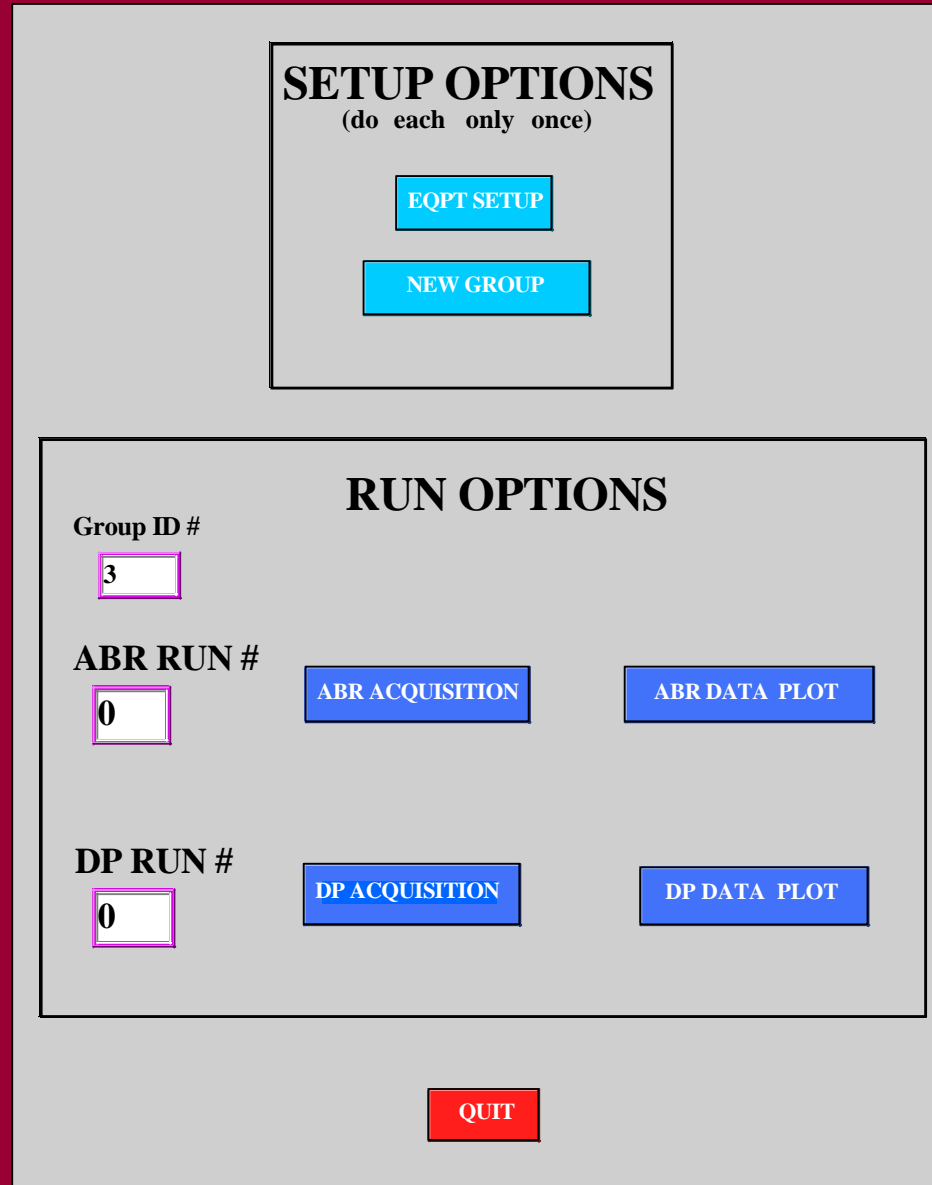


# **ABRs and DPOAEs: The Laboratory**

# Ear Canal Surgery



# LabVIEW Software Controller: Main Menu



The interface is divided into two main sections: 'SETUP OPTIONS' and 'RUN OPTIONS'. The 'SETUP OPTIONS' section contains two buttons: 'EQPT SETUP' and 'NEW GROUP'. The 'RUN OPTIONS' section contains three input fields and four buttons. The 'Group ID #' field has the value '3'. The 'ABR RUN #' field has the value '0', with buttons for 'ABR ACQUISITION' and 'ABR DATA PLOT'. The 'DP RUN #' field has the value '0', with buttons for 'DP ACQUISITION' and 'DP DATA PLOT'. A 'QUIT' button is located at the bottom center.

**SETUP OPTIONS**  
(do each only once)

EQPT SETUP

NEW GROUP

**RUN OPTIONS**

Group ID #  
3

ABR RUN #  
0

ABR ACQUISITION

ABR DATA PLOT

DP RUN #  
0

DP ACQUISITION

DP DATA PLOT

QUIT

# Software Controller: DPOAE Control & Indicators

## 1. Set Stimuli

f2 Frequency  
4.0

Start dB | Stop dB | dB Step  
15 | 80 | 5

#Waves per Spectrum  
25

## 2. Start

START

## 3. Watch Data Acquisition

→

ABORT

## 4. Add Notes (Optional)

Type stuff here if you want

## 5. Save

SAVE DATA

## 6. Note FilePath

→

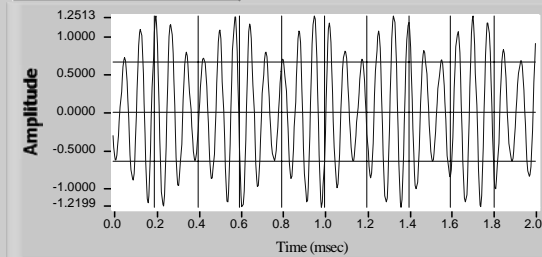
## 7. Return to Main Menu

RETURN

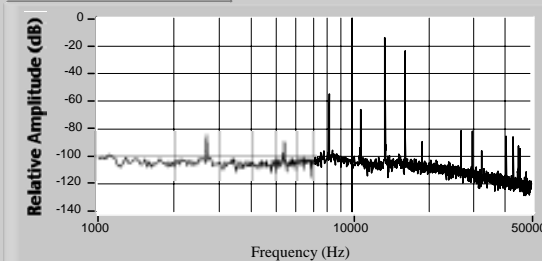
f1 | 2f1-f2  
103.25 | 105.46 | MAX SPL

f1 | f2

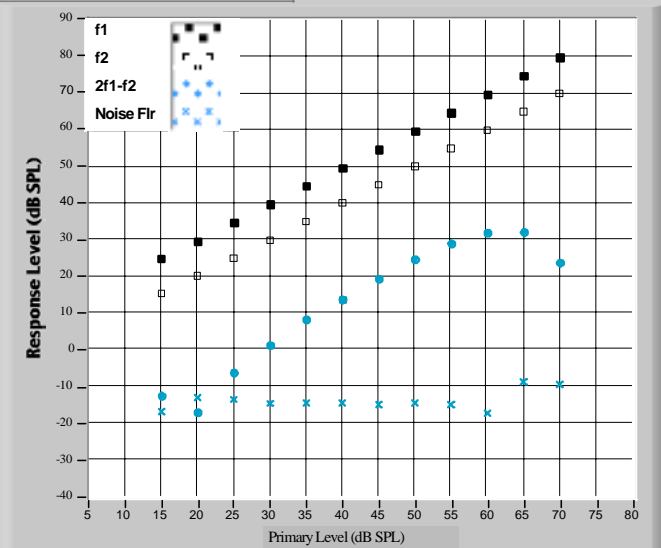
### Response Waveform



### Response Spectrum



### DPOAE Amplitude vs Level



ID # | Run #

2

1

C:\Data\HST721- DATA\HST721-2\DP-2-1

# Software Controller: Data Storage

:RUN-1 DP I-O 3:54 PM:Level Step (dB):5 Start dB: 20 Stop dB: 50  
# Buffers Averaged: 25Sampling Interval:4 Ear: Right

:NOTES-

:CHAMBER-4

:ANALYZED DATA

:Command dB	Measured f1(dB)	Measured f2(dB)	2f1-f2(dB)	2f1-f2Nse(dB)
20.00	30.01	19.97	-24.01	-25.33
25.00	35.05	24.98	-26.75	-23.71
30.00	40.04	30.01	-25.80	-25.42
35.00	45.04	35.01	-25.51	-24.86
40.00	50.04	40.04	-22.93	-25.06
45.00	55.11	45.05	-20.88	-24.54
50.00	60.10	50.05	-23.63	-24.94

:RAW WAVEFORMS

0.002390	0.003187	0.004161	0.006183	0.009836	0.016199	0.027711
0.002397	0.003308	0.004397	0.006392	0.010246	0.016801	0.028828
0.002385	0.003362	0.004509	0.006510	0.010535	0.017273	0.029696

etc.



# Software Controller: ABR Control & Indicators

## 1. Set Stimuli

Tone Pip Stimuli

FREQUENCY: 8.00

START (dB): 10    STOP (dB): 80    dB STEP: 5

# AVERAGES per LEVEL: 512

REP RATE (pips/sec): 35    REJECT THRESH (µV): 15

## 2. Start

START

## 3. Watch Data Acquisition →

ABORT

## 4. Add Notes (Optional)

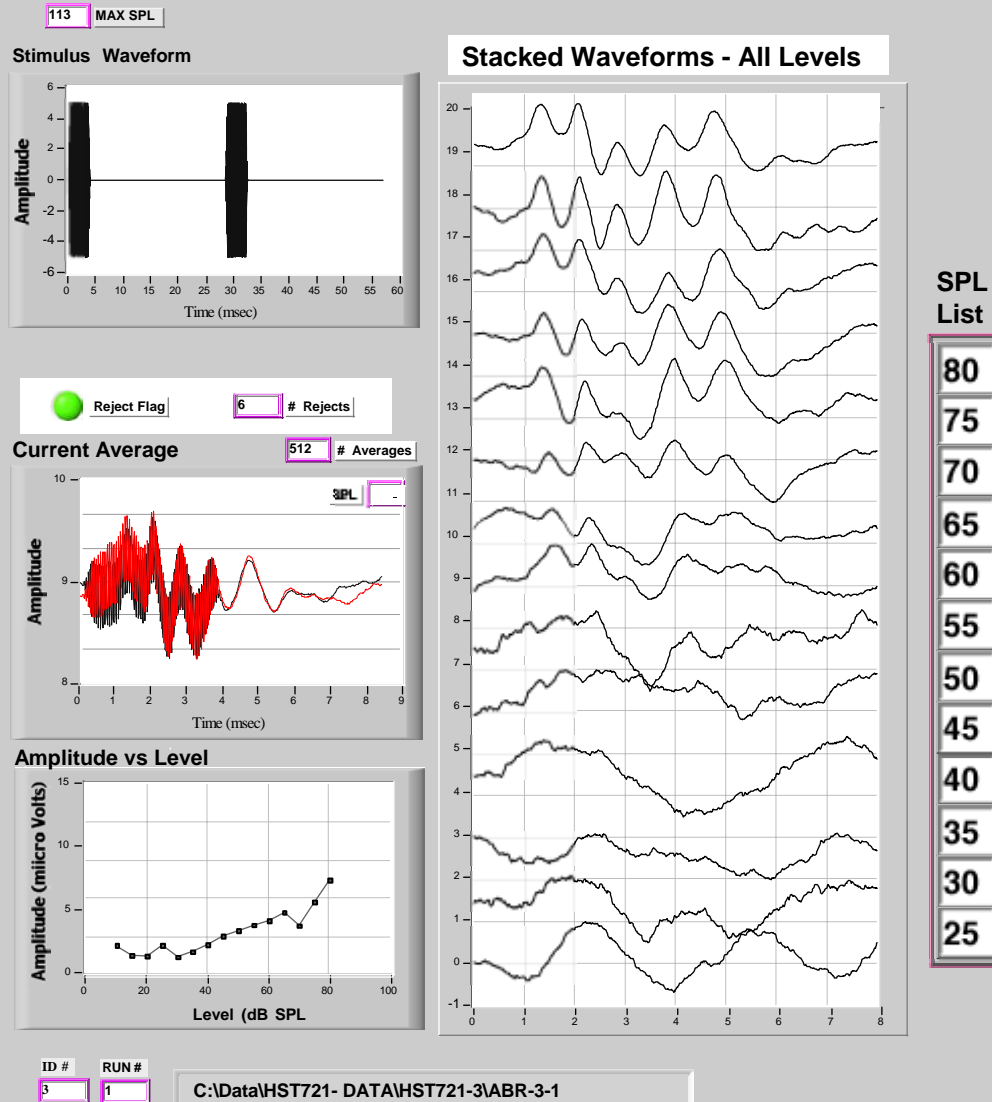
## 5. Save

SAVE DATA

## 6. Note FilePath:

## 7. Return to Main

RETURN



# Software Controller: Data Storage

```
:RUN-0 ABR I-O 10/24/2003 4:47 PM: EAR: R FREQ: 16.00 # AVES: 400 REP RATE (/sec): 80 SAMPLING
(μsec): 10
:NOTES-
:CHAMBER-4
:SPLs TESTED-20;30;40;50;60;70;80;
```

## :ANALYZED DATA

:SPL	"NEURAL" P-P	"CM" P-P
20.000	1.563	1.296
30.000	1.587	1.529
40.000	1.514	1.017
50.000	1.562	1.566
60.000	1.820	1.490
70.000	2.368	2.671
80.000	3.563	4.549

## :RAW WAVEFORMS

-0.084572	-0.060116	-0.104443	0.059216	0.167206	-0.009075	-0.132732
-0.046043	-0.051418	-0.105358	0.054485	0.158127	-0.014187	-0.088329
-0.042152	-0.030743	-0.097805	0.046932	0.125854	-0.006329	-0.072536