

Speech Science

WiSe 2023

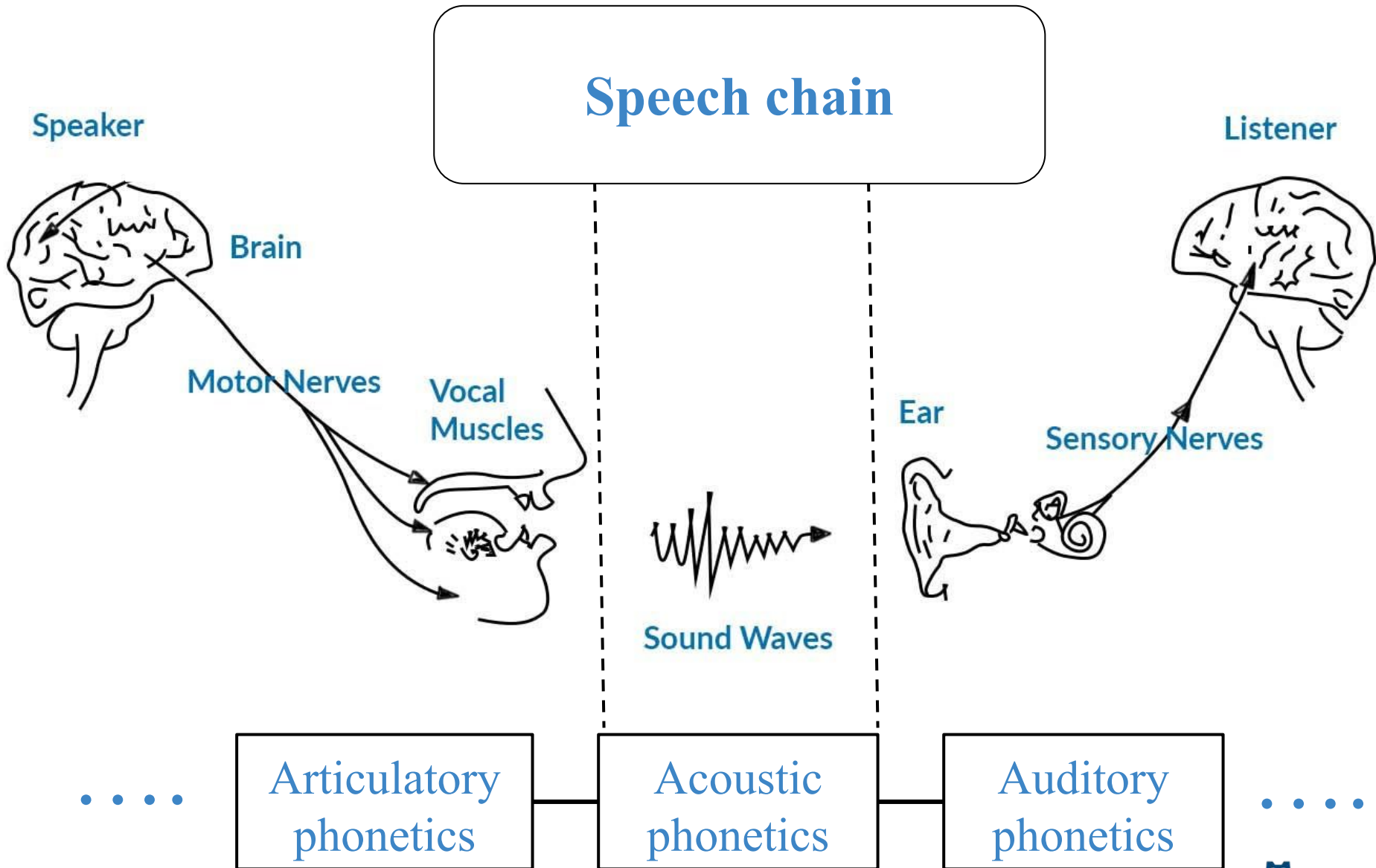
Exercise 1: Classification of speech sounds

Nov 6, 2023

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Language Science and Technology
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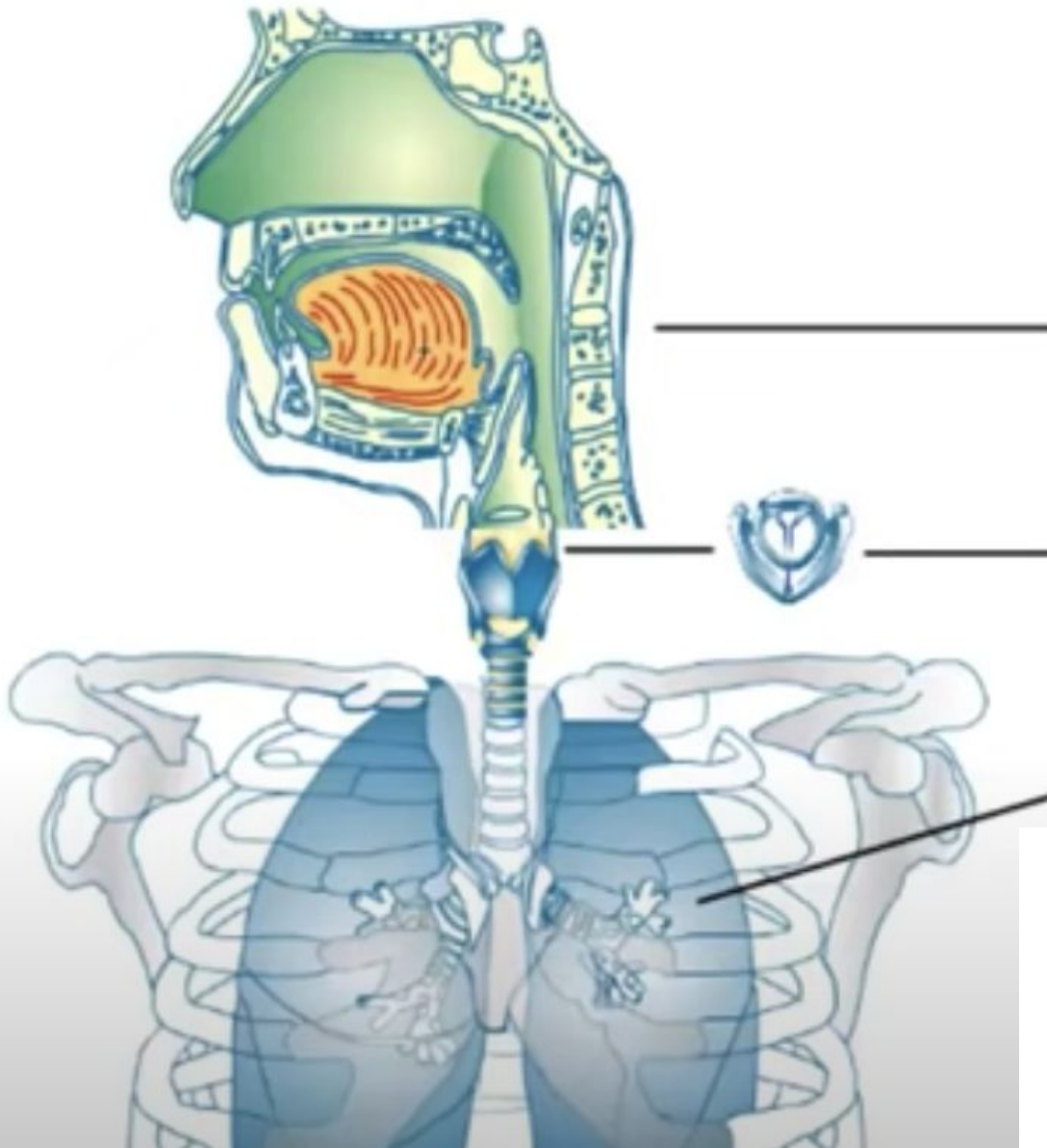
Exercise 1: How complex is articulation?



Full video: <https://www.youtube.com/watch?v=Wh4aEc4yPh0>

Another video: <https://www.youtube.com/watch?v=JF8rlKuSoFM>

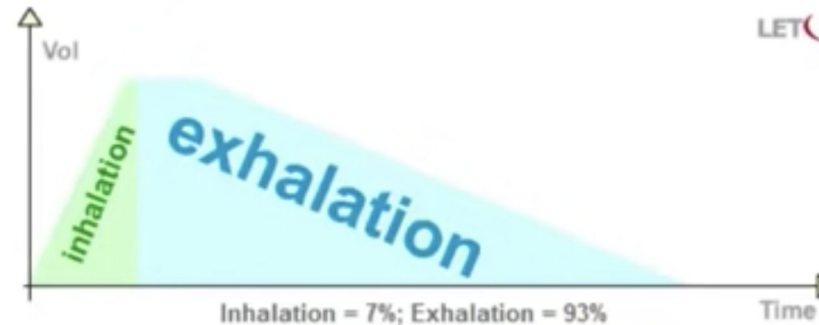
Speech production organs



- **Articulation**

- **Phonation**

- **Respiration**



Exercise 2: Speech production organs

Match the organ with its function:

Diaphragm, Teeth, Lungs, Nasal Cavity, Hard palate, Velum, Larynx,
Jaw, Tongue, Vocal folds

Articulation

Phonation

Respiration

Exercise 2: Speech production organs - Answer

Match the organ with its function:

Articulation

Teeth, Nasal Cavity, Hard palate, Velum, Jaw, Tongue

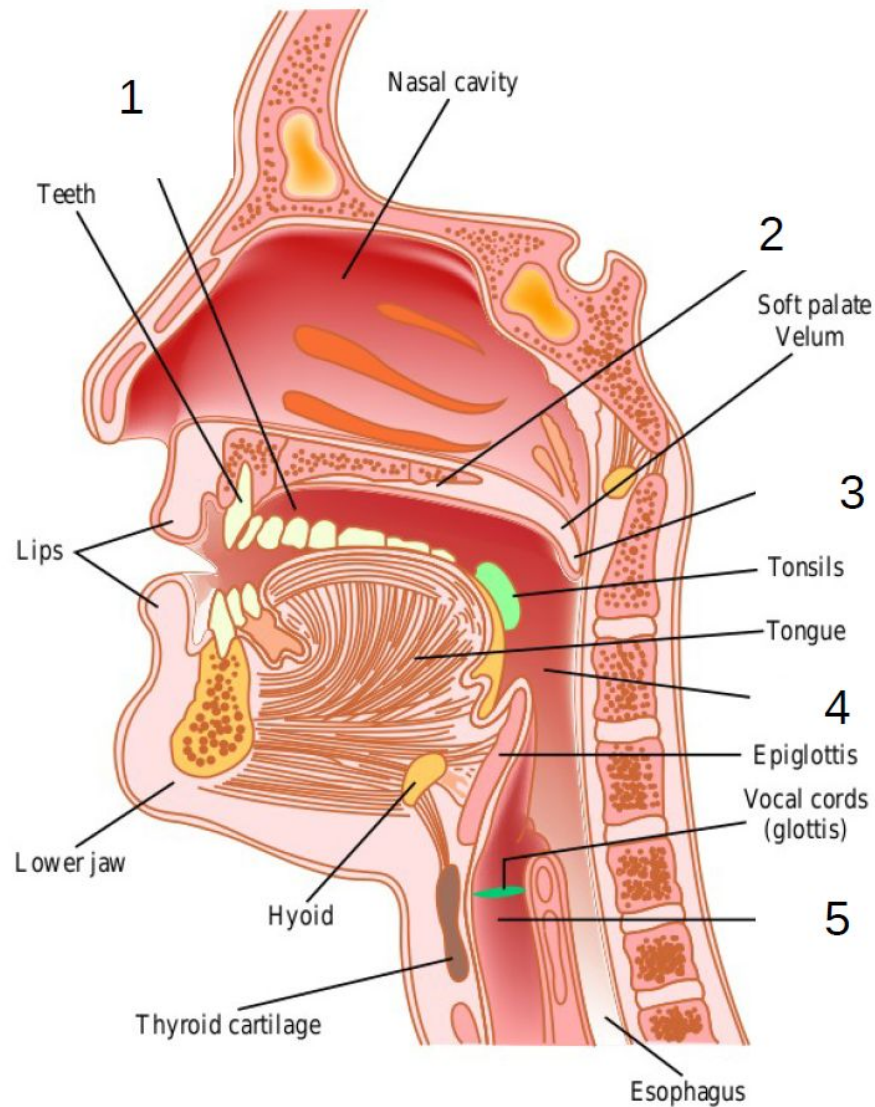
Phonation

Larynx

Respiration

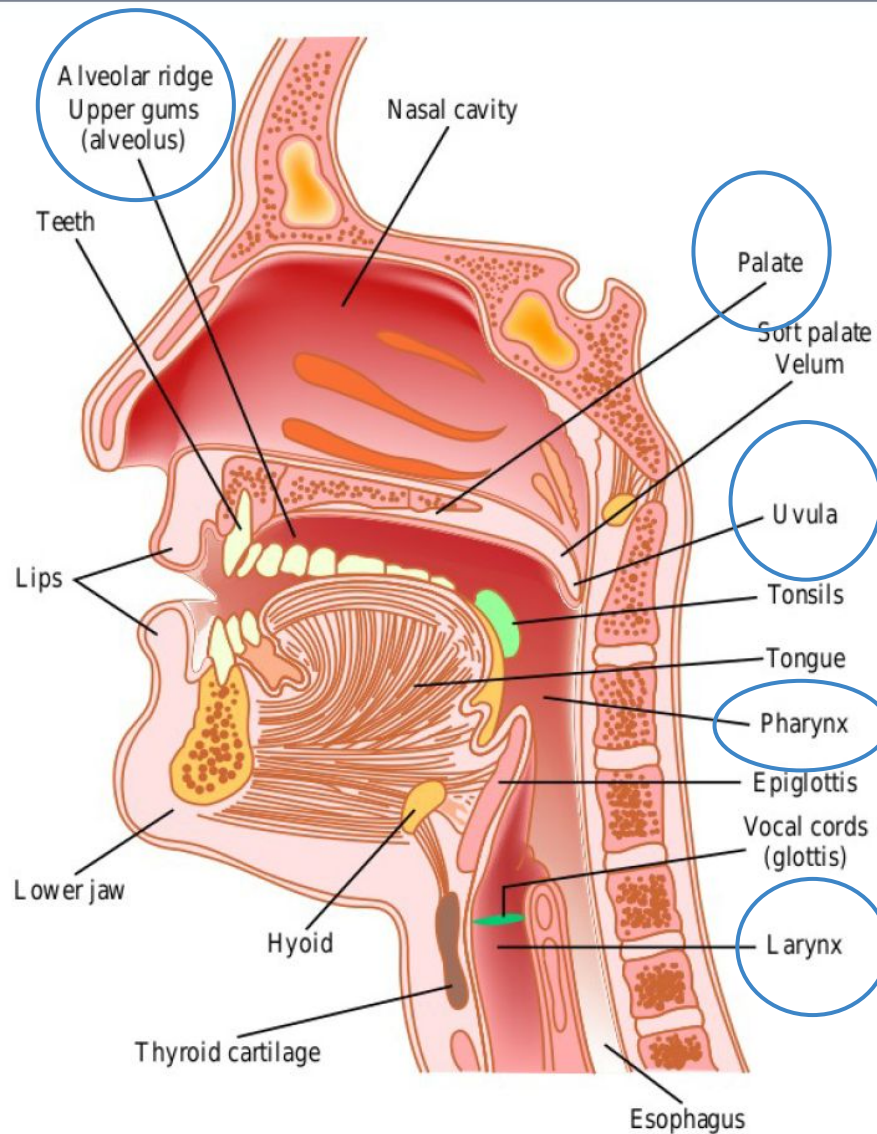
Diaphragm, Lungs, Nasal Cavity

Exercise 3: Vocal Tract



Vocal tract configuration with raised soft palate for articulating non-nasal sounds.

Exercise 3: Vocal Tract - Answer

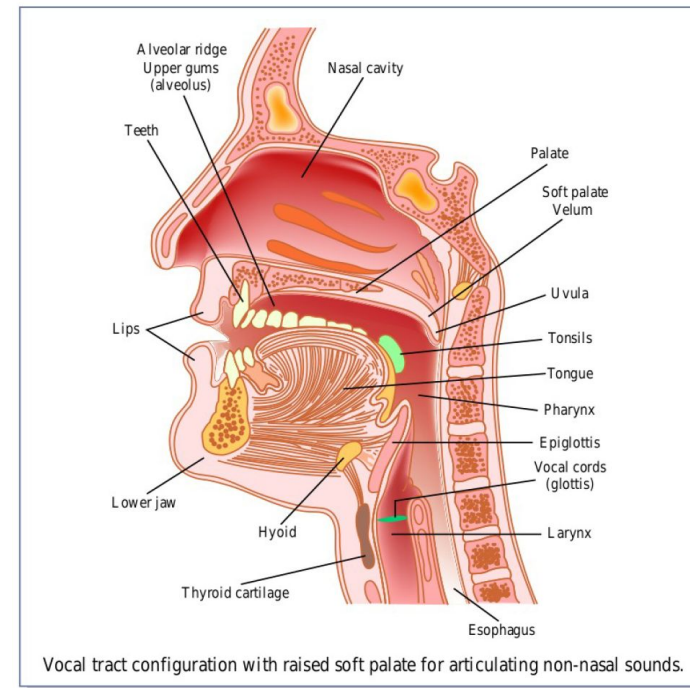


Vocal tract configuration with raised soft palate for articulating non-nasal sounds.

Active vs. passive articulators

There is a constriction between an active articulator and a passive articulator

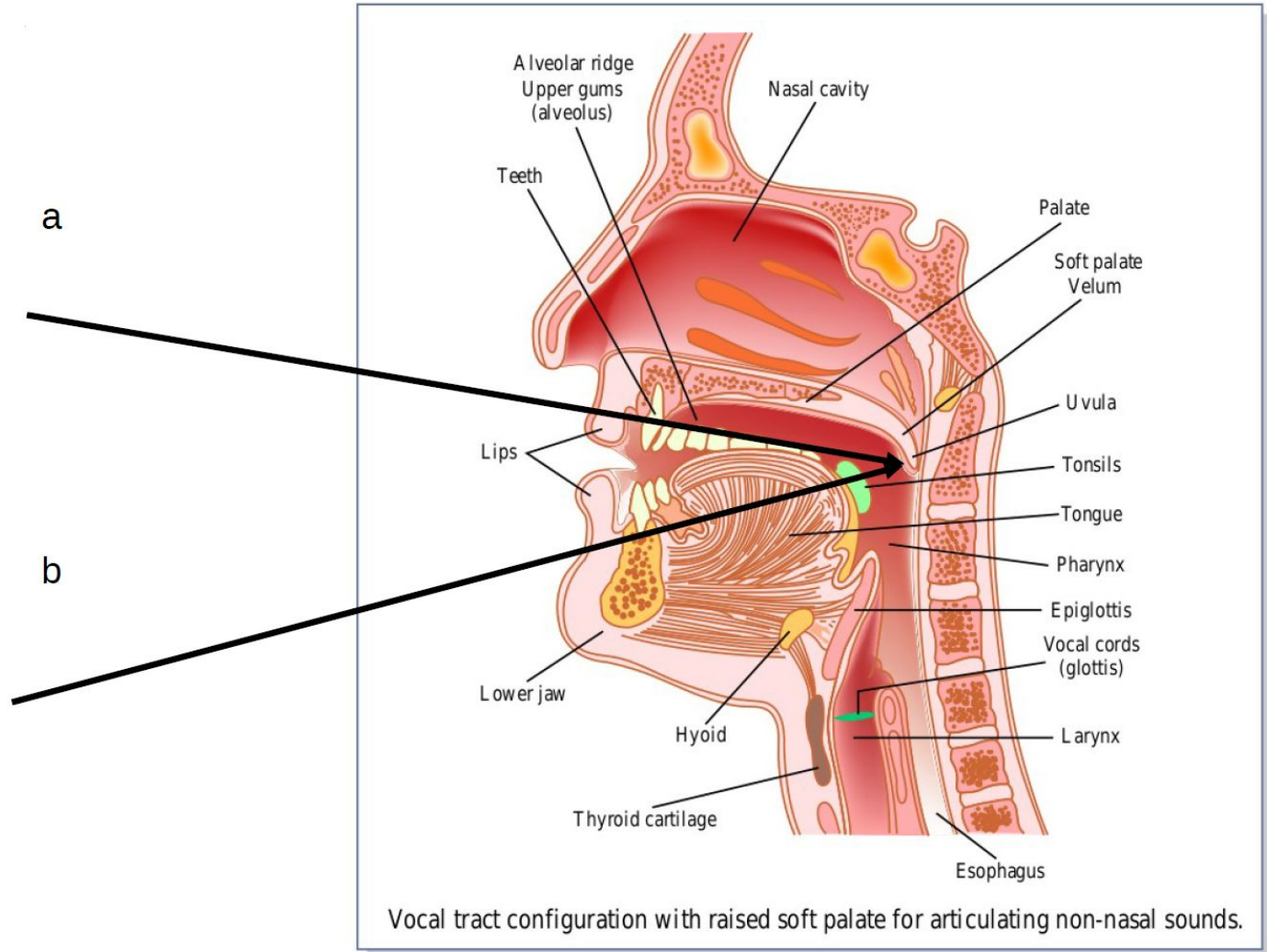
- The active articulators are the lower lip and the tongue
- The passive articulators are the upper lip, the upper teeth, the roof of the mouth, and the rear wall



Exercise 4: Vocal Tract



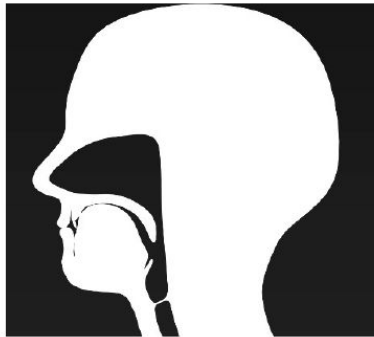
nasal / oral ?



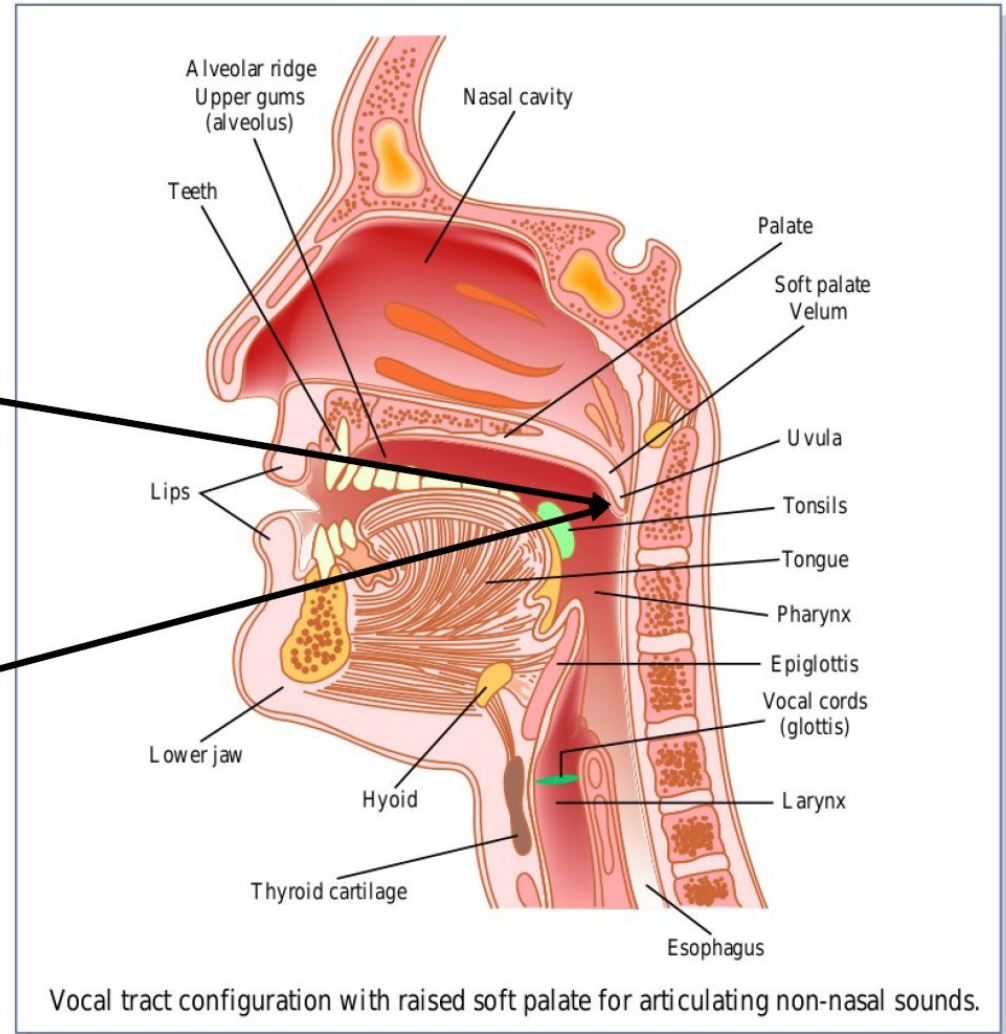
Exercise 4: Vocal Tract - Answer



a Oral



b Nasal





There are over 7000 spoken languages around the world

www.internationalphoneticassociation.org



- IPA =International Phonetic Association
- established 1886 in Paris
- Aim: universal classification system for all speech sounds
- Aim: universal phonetic alphabet, to describe all speech sounds of all languages
- most recent revision: alphabet: 2020

Classification of speech sounds

- **Consonants**

- Airstream → Pulmonic vs. non-pulmonic
- Voicing → Binary
- Place of articulation → Where
- Manner of articulation → How

- **Vowels**

- Tongue movement 
- Jaw opening 
- Lip rounding

IPA: Seeing speech



Janet Beck: Voiceless bilabial plosive

Context: ə_ə, a_a, i_i

<https://www.seeingspeech.ac.uk/ipa-charts/?chart=1>

Pulmonic vs. non-pulmonic consonants

airstream

PULMONIC

THE INTERNATIONAL PHONETIC ALPHABET (revised to 2020)

CONSONANTS (PULMONIC)											
	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k ɡ	q ɢ		ʔ
Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
Trill				ʀ					ʀ		
Tap or Flap		ⱱ		ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant		ʋ		ɹ		ɻ	j	ɰ			
Lateral approximant				l		ɭ	ʎ	ʟ			

Symbols to the right in a cell are voiced, to the left are voiceless. Shaded areas denote articulations judged impossible.

NON-PULMONIC

18% of languages [WALS]

CONSONANTS (NON-PULMONIC)		
Clicks	Voiced implosives	Ejectives
◌ ɸ Bilabial	ɓ Bilabial	◌ ʼ Examples:
◌ ǀ Dental	ɗ Dental/alveolar	◌ ɸ' Bilabial
◌ ǃ (Post)alveolar	ɟ Palatal	◌ t' Dental/alveolar
◌ ǁ Palatoalveolar	ɠ Velar	◌ k' Velar
◌ ǁ Alveolar lateral	ɠ Uvular	◌ s' Alveolar fricative

OTHER SYMBOLS

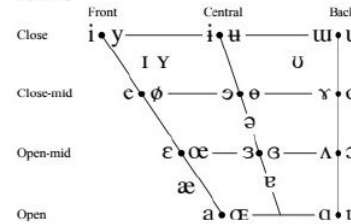
- ◌ ʌ Voiceless labial-velar fricative
- ◌ ɕ ʑ Alveolo-palatal fricatives
- ◌ ɰ Voiced labial-velar approximant
- ◌ ɭ Voiced alveolar lateral flap
- ◌ ɥ Voiced labial-palatal approximant
- ◌ ɥɥ Simultaneous ɥ and x
- ◌ ɦ Voiceless epiglottal fricative
- ◌ ʄ Affricates and double articulations can be represented by two symbols joined by a tie bar if necessary.
- ◌ ɕ Voiced epiglottal fricative
- ◌ ɶ Epiglottal plosive

DIACRITICS

◌ ̥ Voiceless	◌ ̤ Breathy voiced	◌ ̦ Dental
◌ ̦ Voiced	◌ ̧ Creaky voiced	◌ ̨ Apical
◌ ̨ Aspirated	◌ ̩ Linguolabial	◌ ̪ Laminar
◌ ̩ More rounded	◌ ̪ Labialized	◌ ̫ Nasalized
◌ ̪ Less rounded	◌ ̫ Palatalized	◌ ̬ Nasal release
◌ ̫ Advanced	◌ ̬ Velarized	◌ ̭ Lateral release
◌ ̬ Retracted	◌ ̭ Pharyngealized	◌ ̮ No audible release
◌ ̭ Centralized	◌ ̮ Velarized or pharyngealized	
◌ ̮ Mid-centralized	◌ ̯ Raised	
◌ ̯ Syllabic	◌ ̰ Lowered	
◌ ̰ Non-syllabic	◌ ̱ Advanced Tongue Root	
◌ ̱ Rhoticity	◌ ̲ Retracted Tongue Root	

Some diacritics may be placed above a symbol with a descender, e.g. ɲ̰

VOWELS



Where symbols appear in pairs, the one to the right represents a rounded vowel.

SUPRASEGMENTALS

- ◌ ˈ Primary stress
- ◌ ˌ Secondary stress
- ◌ ː Long
- ◌ ˑ Half-long
- ◌ ˑ Extra-short
- ◌ ˑ Minor (foot) group
- ◌ ˑ Major (intonation) group
- ◌ ˑ Syllable break
- ◌ ˑ Linking (absence of a break)

TONES AND WORD ACCENTS

- ◌ ˥ Extra high
- ◌ ˦ High
- ◌ ˧ Mid
- ◌ ˨ Low
- ◌ ˩ Extra low
- ◌ ˩ Downstep
- ◌ ˩ Upstep
- ◌ ˥ or ˦ Rising
- ◌ ˧ or ˨ Falling
- ◌ ˩ High rising
- ◌ ˩ Low rising
- ◌ ˩ Rising-filling
- ◌ ˩ Global rise
- ◌ ˩ Global fall

Classification of speech sounds - Consonants

- **Voicing**

Voiced

Voiceless

THE INTERNATIONAL PHONETIC ALPHABET (revised to 2020)

CONSONANTS (PULMONIC)

© 2020 IPA

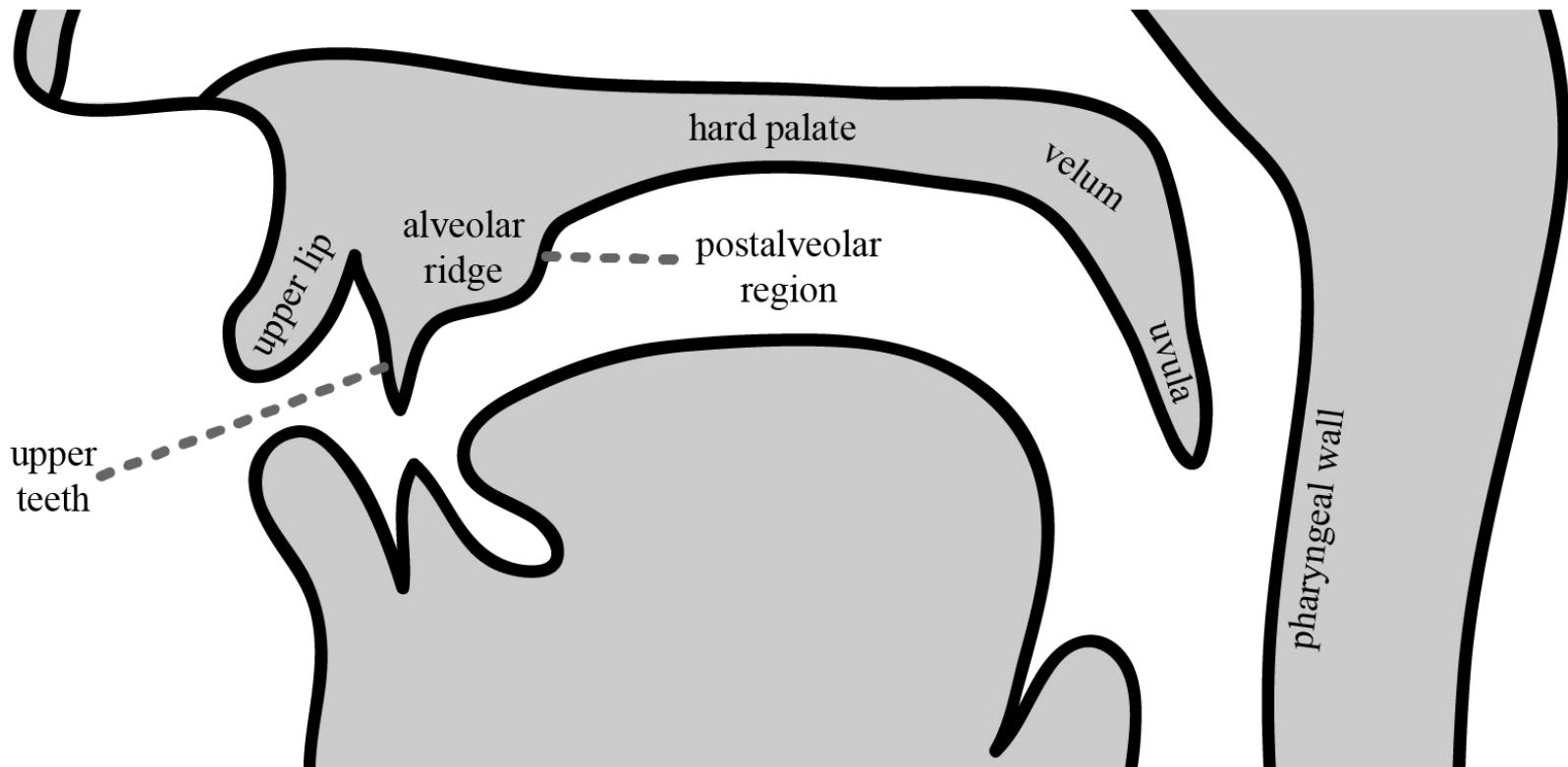
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Trill	ʙ			ɾ					ʀ		
Tap or Flap		ⱱ		ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant		ʋ		ɹ		ɻ	j	ɰ			
Lateral approximant				l		ɭ	ʎ	ʟ			

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Classification of speech sounds - Consonants

- **Place of articulation**

Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
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Classification of speech sounds - Consonants

- **Manner of articulation**

THE INTERNATIONAL PHONETIC ALPHABET (revised to 2020)

CONSONANTS (PULMONIC)

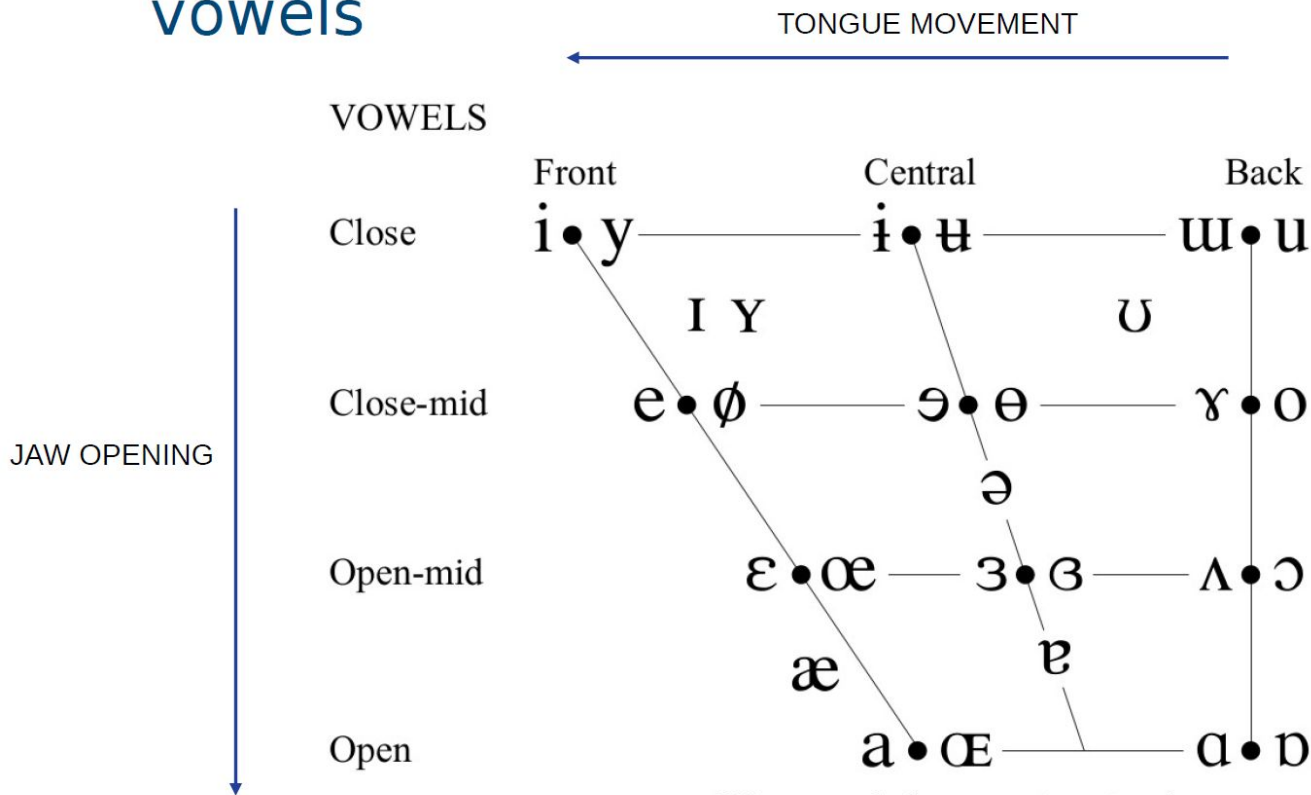
© 2020 IPA

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
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Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
Trill	ʙ			ɾ					ʀ		
Tap or Flap		ⱱ		ɽ		ɽ					
Fricative	ɸ β	4 v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant		ʋ		ɹ		ɻ	j	ɰ			
Lateral approximant				l		ɭ	ʎ	ʟ			

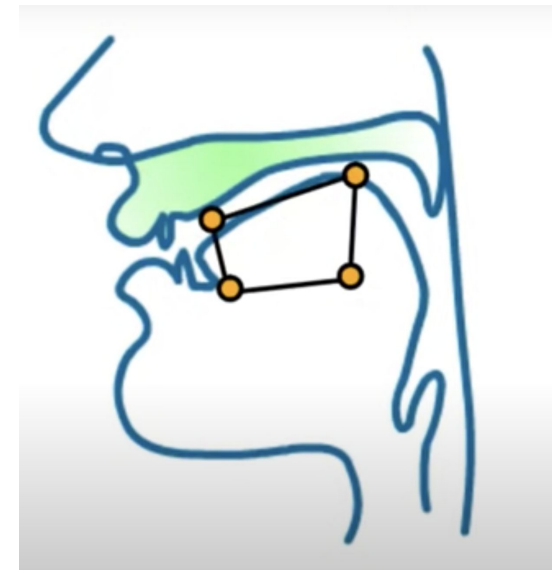
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IPA: Vowels

vowels

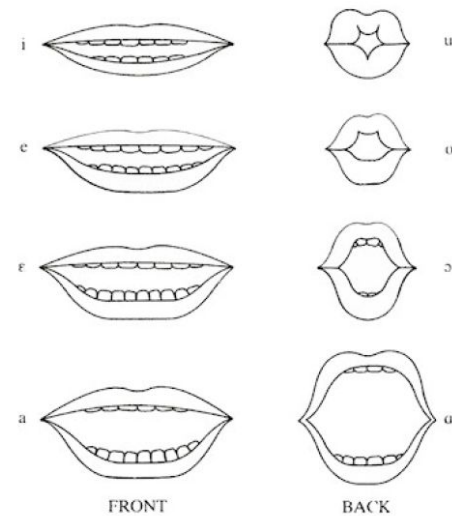
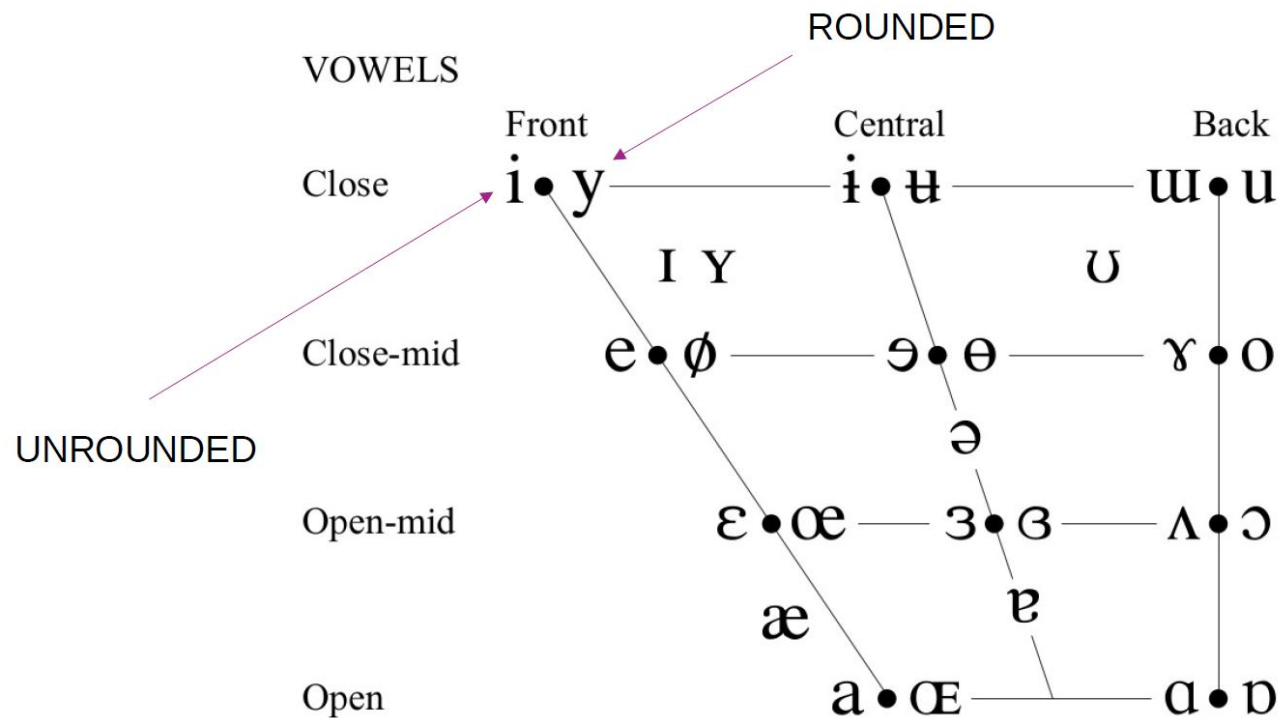


Where symbols appear in pairs, the one to the right represents a rounded vowel.



IPA: Vowels

vowels



Where symbols appear in pairs, the one to the right represents a rounded vowel.

Assignment 1

Find the IPA symbol and an example word for the sounds described below. The answers are on the following slide.

01) bilabial nasal

02) voiceless labiodental fricative

03) glottal plosive

04) velar nasal

05) voiced alveolar fricative

06) voiceless velar plosive

07) voiceless palatal fricative

08) palatal approximant

09) voiced postalveolar fricative

10) voiced bilabial plosive

11) voiced uvular fricative

12) voiceless postalveolar fricative