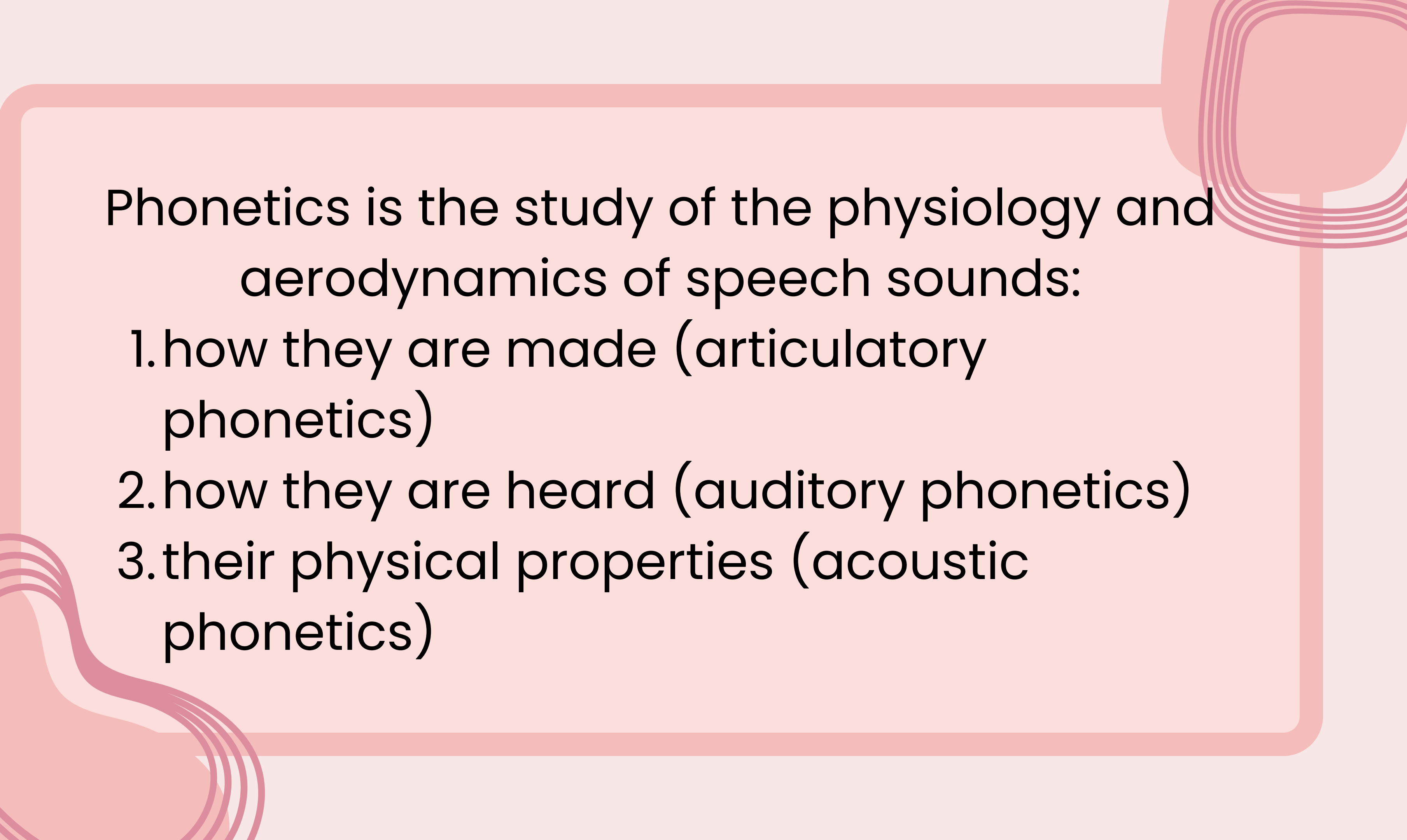
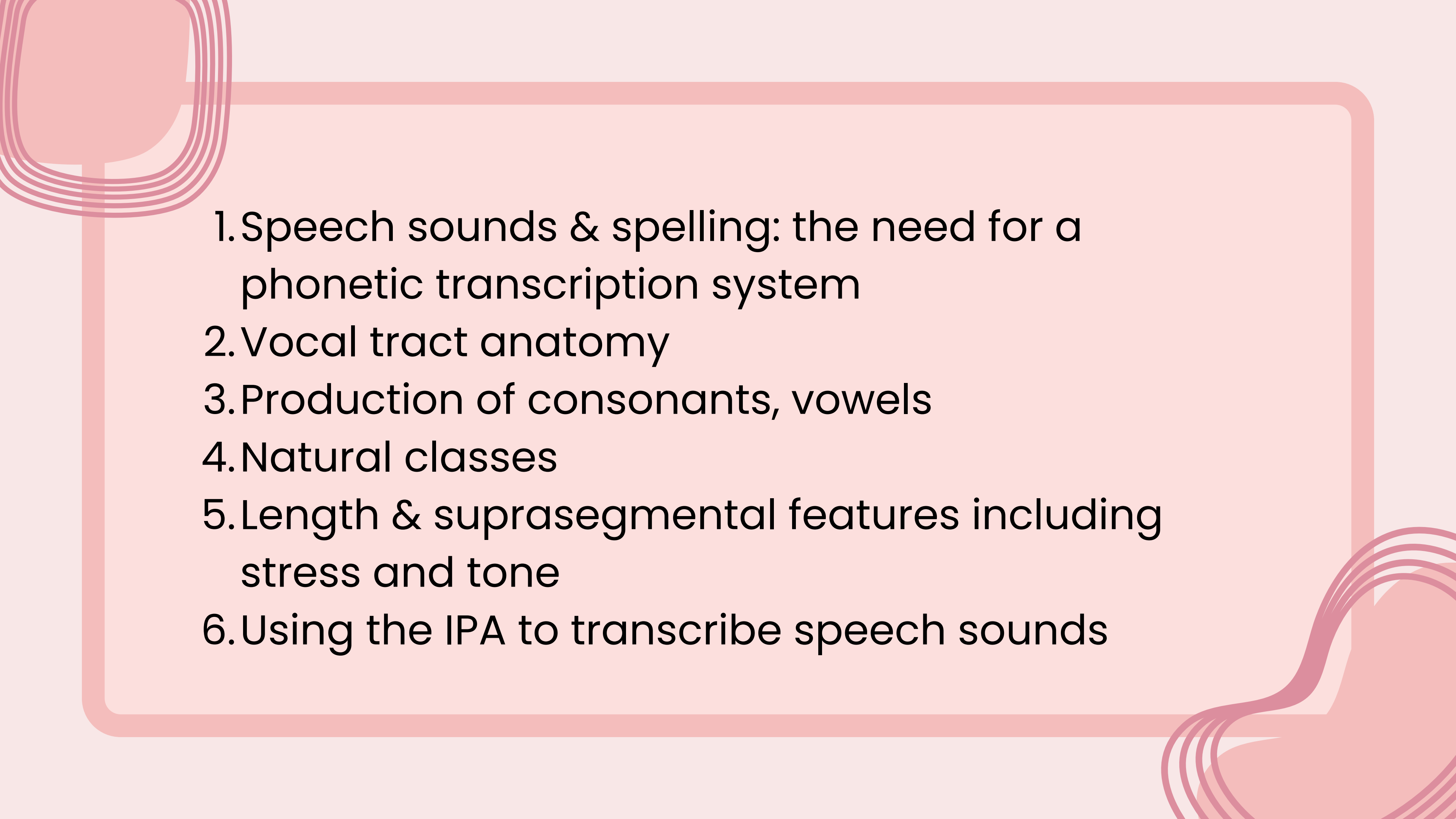


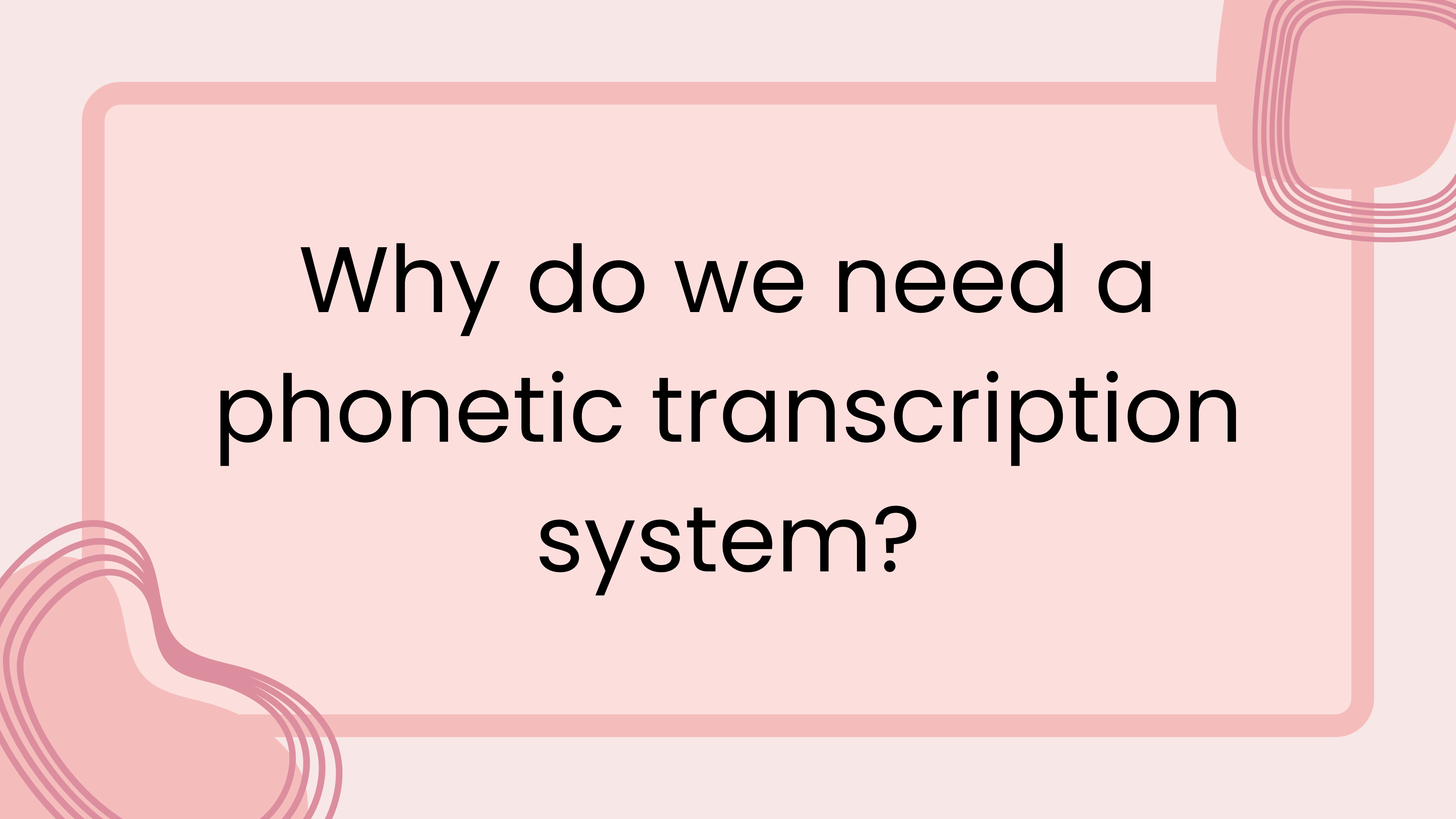
PHONETICS



Phonetics is the study of the physiology and aerodynamics of speech sounds:

1. how they are made (articulatory phonetics)
2. how they are heard (auditory phonetics)
3. their physical properties (acoustic phonetics)

- 
1. Speech sounds & spelling: the need for a phonetic transcription system
 2. Vocal tract anatomy
 3. Production of consonants, vowels
 4. Natural classes
 5. Length & suprasegmental features including stress and tone
 6. Using the IPA to transcribe speech sounds



Why do we need a
phonetic transcription
system?

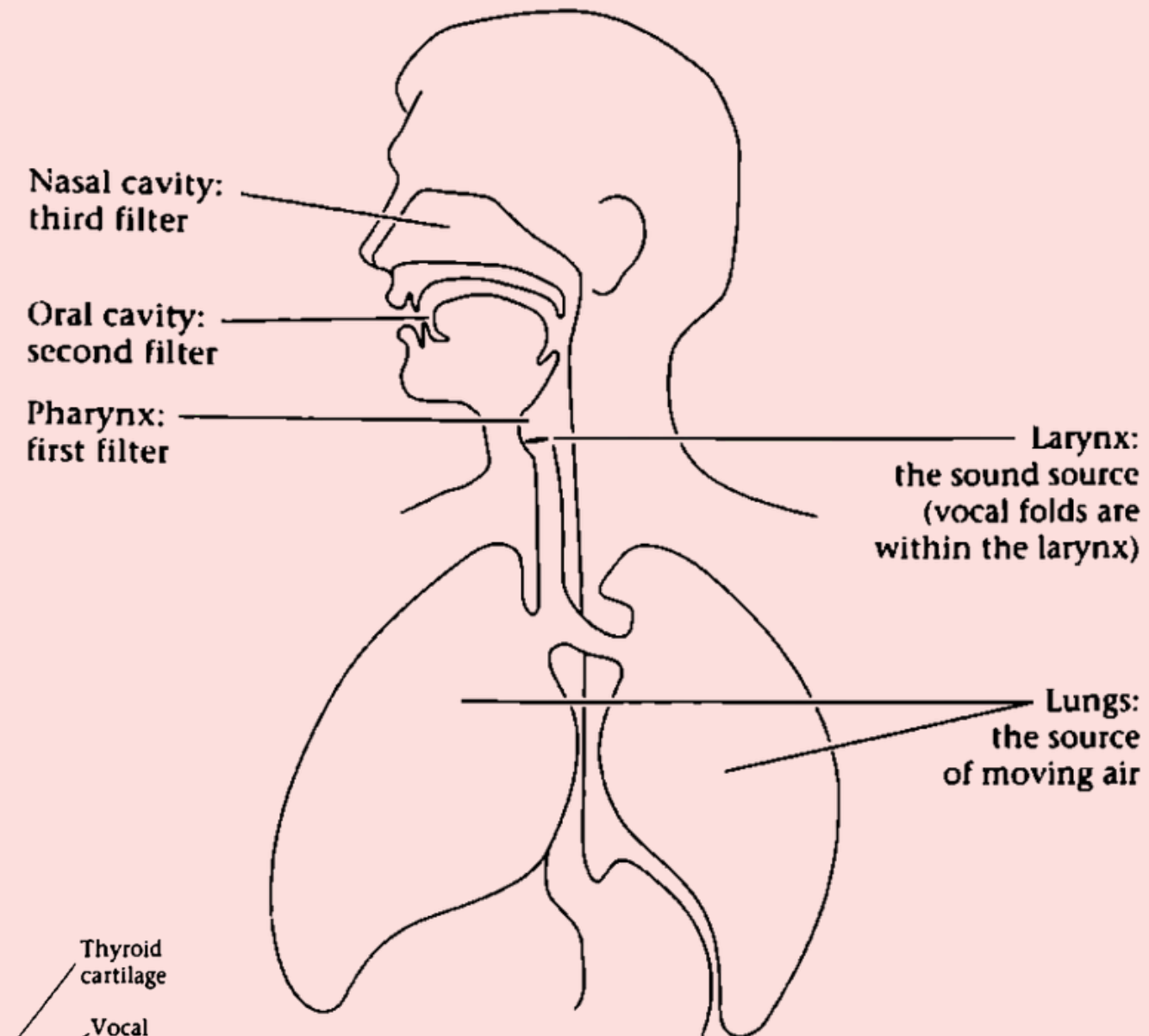
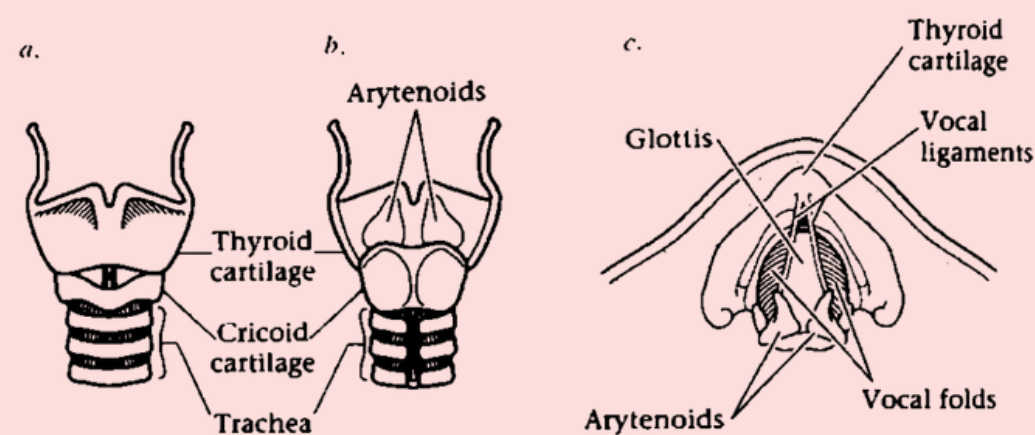
Writing Systems:

- 1 sound may be represented by 2 letters (digraphs): ,<th>, <sh>, <ch>
- 1 letter may represent 2 sounds: <x> = [ks]
- some sounds may be represented by different letters:
 - [s]: <s> in **sea**; <c> in **ice**; <ss> in **glass**
 - [a]: <o> in **cot**; <a> in **father**; <au> in **caught**
- while a single letter may represent many different sounds:
 - o <o> [ɪ] in *women*; [ɑ] in *odd*; [ə], [o] in *potato*; [o] in *stove*; [u] in *whose*
- letters may not indicate any sound at all: **know**, **lamb**, **through**, **love**
- Some spellings can be read in more than one way: *bow*, *lead*, *defense*, *pie*.

- Conventional writing systems of any language are hard to use for linguistic analysis, because they:
 - represent speech sounds in an unreliable, erratic, and poorly detailed manner
 - vary pretty drastically from one language to the next in design & accuracy
- We need a transcription system that is consistent

MAKING SOUNDS

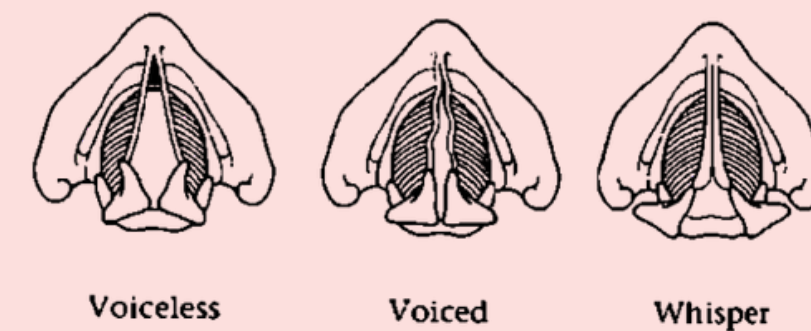
- Formulate sound order
- Translate into movements
- Lungs supply air
- Larynx produces sound
- Vocal tract shapes airflow
- Air flows out of mouth with particular frequencies and harmonics

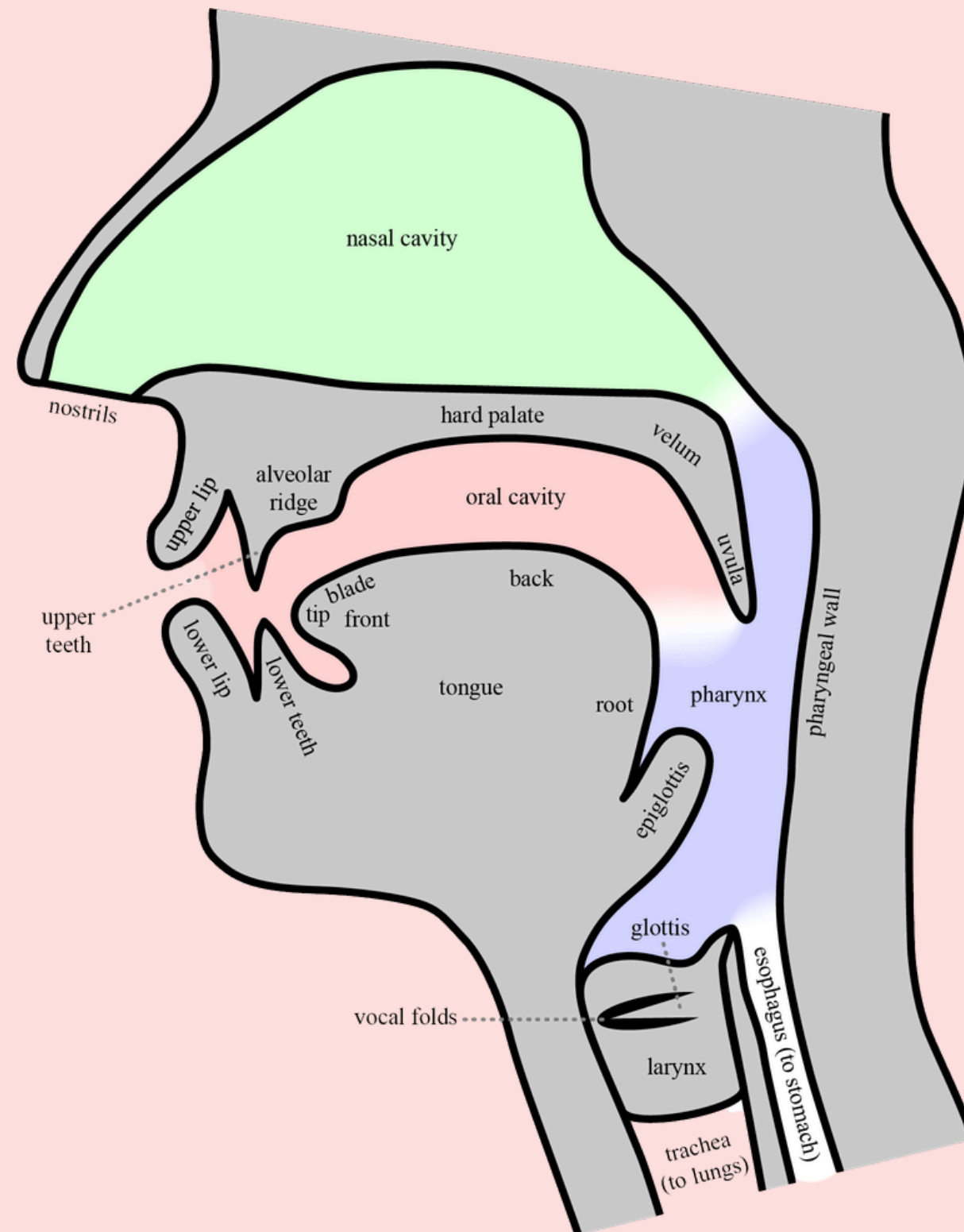


Larynx (voice box/Adam's apple)
Glottal States (voiced, voiceless, whisper, etc.)

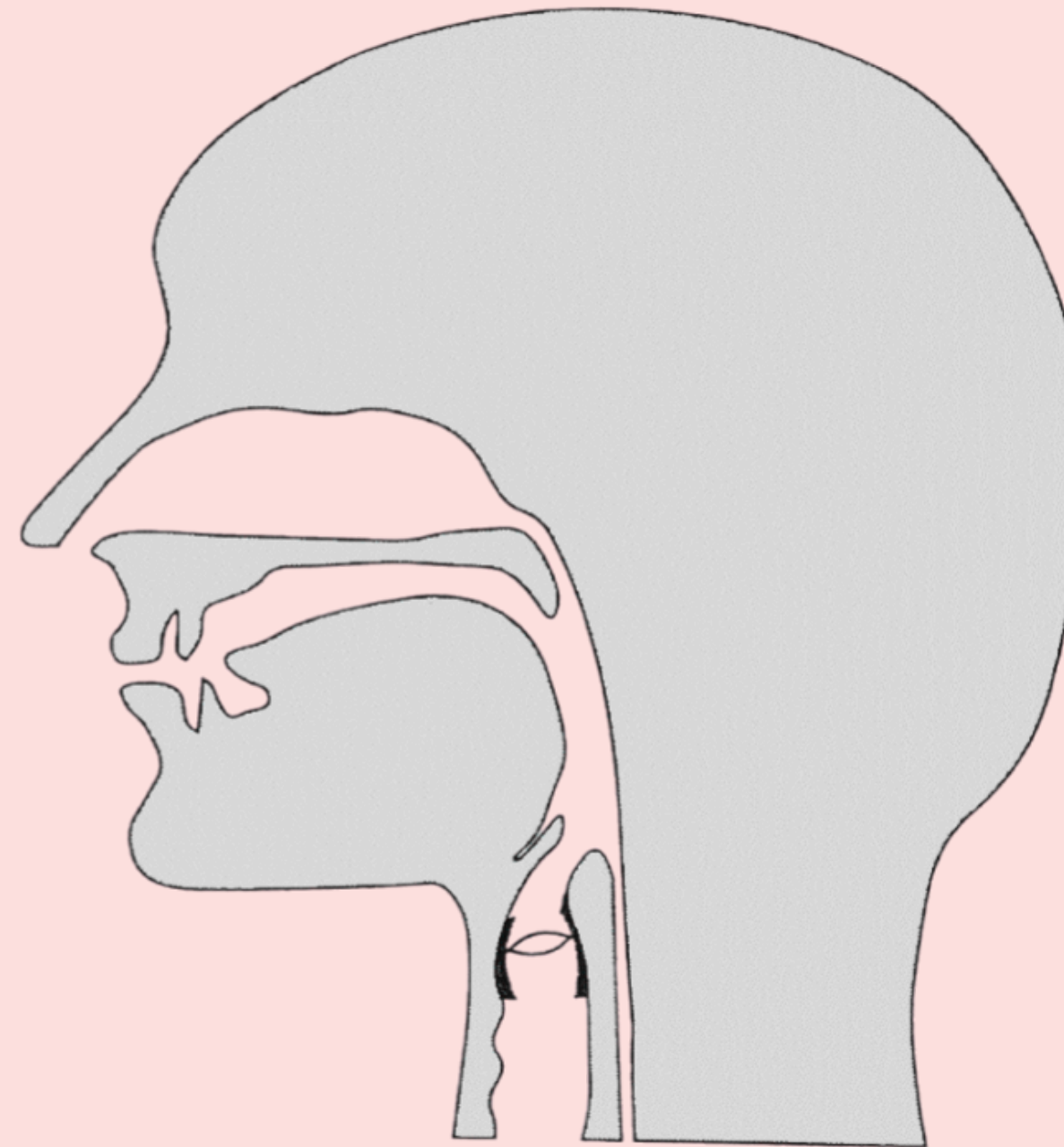
UNDERSTANDING SOUNDS

- Sounds enter ear canal
- Amplified in inner ear canal
- Neurons send information to brain
- Brain divides sound into segments
- Brain translates word form into meaning





lips
teeth
alveolar ridge
(hard) palate
velum (soft palate)
uvula
tongue (tip, blade, dorsum, root)
nasal cavity
oral cavity
pharynx
epiglottis
larynx
glottis
vocal folds
lungs



Phonetic Transcription

Describing a sound (phone)

Consonants are usually described with these characteristics:

- **Voicing**: is there vocal fold vibration associated with the sound?
- **Place of articulation**: where in the vocal tract is the sound produced?
- **Manner of articulation**: how does the vocal tract produce the sound?

They are also classified as **obstruent** or **sonorant**:

- Obstruents are produced when the flow of air through the vocal tract is tightly obstructed or blocked altogether, so that there is a downstream noise source
- Sonorant consonants are produced when airflow is relatively less obstructed, and there is no downstream noise source (Vowels are sonorants, too)

Voicing

Voicing is contributed by the vocal folds, two membranes in the larynx which may vibrate as air passes through the glottis (the space between them).

Examples:

[p t k s f ʃ ɱ] are all voiceless
consonants

[b d g z v ʒ r l w] are all voiced
consonants

[ffffffffffffvVVVVVVVV]

[sssssssssszzzzzzzzzz]

Place of Articulation

bilabial consonants: produced by bringing both lips together [p b]

pop [pʰap] beep [bip] mope [mop] whip [wɪp]

labiodental: the lower lip is brought against the upper teeth. [f v]

food [fud] rough [ʁʌf] void [vɔɪd] have [hæv]

interdental: the tongue tip (or apex) is brought between (or just behind) both sets of teeth [θ ð]

thin [θɪn] with [wɪθ] then [ðɛn] bathe [beð]

alveolar: the tongue apex is brought against or near the alveolar ridge, just behind the upper teeth. [t d s z n l ɹ]

sock [sɒk] base [beɪs] zoo [zu] ten [tʰɛn] net [nɛt] duck [dʌk] could [kʰʊd] reign [reɪn] cotton [kʰɑʔn] lock [lɒk] rock [ɹɒk] call [kʰɑɫ] bore [bɔɹ]

Place of Articulation

palatal: the tongue body (or blade) is brought against or near the hard palate [ʃ ʒ tʃ dʒ j]

hush [hʌʃ] rouge [ʁuʒ] chalk [tʃak] judge [dʒʌdʒ] bridge [brɪdʒ] yell [jɛl]

velar: the tongue back (or dorsum) is brought against the velum. [k g ŋ]

kick [kʰɪk] rack [ɹæk] gone [ɡən] beg [bɛɡ] bang [bæŋ] think [θɪŋk]

- [w] also has both a labial and a velar gesture, so it's **labiovelar**

glottal sounds [h ʔ]

for [h], air flows through the glottis without vibrating the vocal folds:

hot [hət] haughty [hæɪ]

for [ʔ], the vocal folds are closed and then opened, creating a small pop:

rotten [ɹɑʔən] kitten [kʰɪʔən]

Manner

Obstruents:

Stops/Plosives: Complete closure of the oral cavity (except [ʔ]) followed by an abrupt, noisy release:

[p t k b d g ʔ]

Fricatives: Narrow constriction but not complete closure, noisy turbulence during constriction:

[f v θ ð s z ʃ ʒ h]

Affricates: Complete closure like a stop, but slower, noisier release than stop

Resemble a stop followed by a fricative:

[ts tʃ dʒ]

Manner

Sonorants:

Nasals: Have complete oral closure, like stops, but have unobstructed airflow via the nasal cavity, require a lowered velum

[m n ŋ]

Liquids: Partial obstruction of the oral cavity, free flow of air around the obstruction permitted

[l ɹ]

Flaps: Very brief contact between articulators
e.g. the alveolar flap [ɾ]

Rhotics: Many rhotic “r-like” consonants.

→ American English has retroflex [ɻ]: a true phonetic sonorant.

Glides: minimal obstruction of the oral cavity.

Vowel-like, but more transient: [j w]

→ Some English dialects also have voiceless [ɱ]

THE INTERNATIONAL PHONETIC ALPHABET (revised to 2020)

CONSONANTS (PULMONIC)

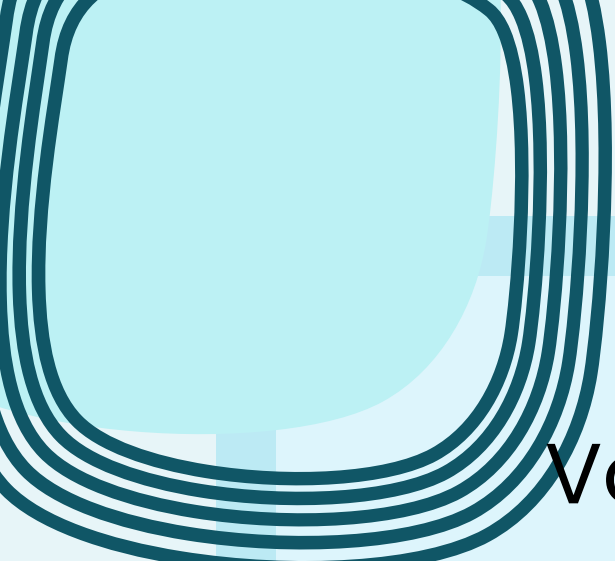
© 2020 IPA

	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	ʙ		r						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.

<https://www.ipachart.com/> <https://ipa.typeit.org/>

VOWELS



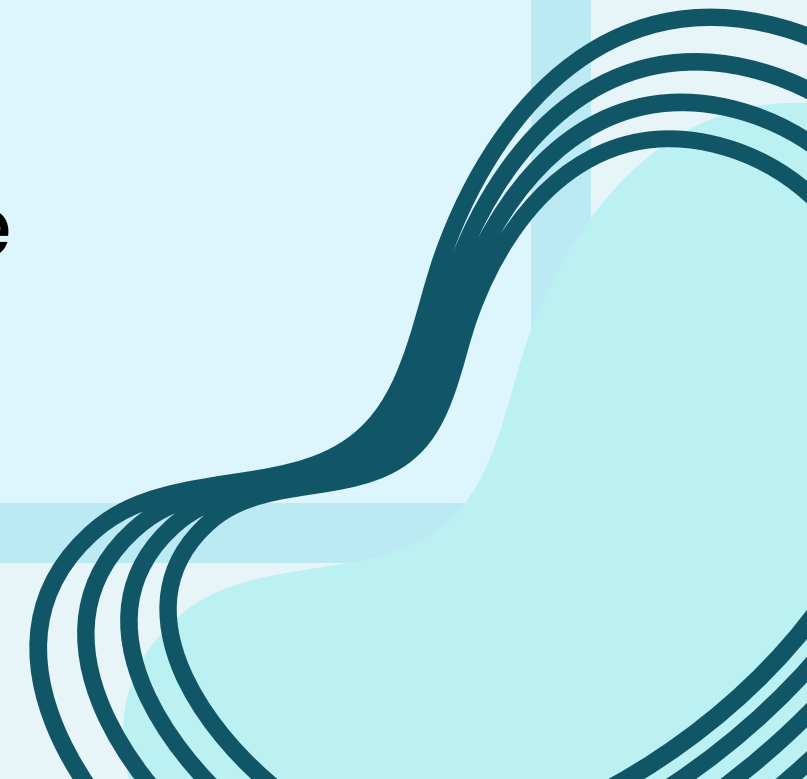
Vowels are highly sonorant speech sounds, formed with a very open vocal tract.

- Vowels default to voiced like other sonorants
- They are generally syllabic: they can form a syllable without the presence of any other speech sounds.

They are usually described according to

- jaw height (high – mid –low)
- tongue position (front, back)
- lip rounding

Vowels may occur singly (monophthongs), or they may be combined with a glide to form diphthongs.



Articulatory features:

1. height: Is the tongue higher or lower in the mouth?

a. High vowels in English: [i ɪ u ʊ]:

‘heat’ [hit] ‘hit’ [hɪt] ‘hoot’ [hut] ‘hood’ [hʊd]

b. Mid: [e ɛ ə ʌ o ɔ]

‘bait’ [beɪt] or [beɪt] ‘bet’ [bɛt] ‘above’ [əˈbʌv] ‘bone’ [boʊn]

‘caught’ [kʰɔt] (for eastern speakers mostly)

c. Low: [æ a ɑ]

‘cat’ [kʰæt] ‘cot’ [kʰat] ‘Pa’ [pʰɑ]

Articulatory features:

2. backness: Is the tongue relatively advanced or retracted?

a. Back vowels in English: [u ʊ o ɔ ɑ a]

‘boot’ [bu:t] ‘good’ [gʊd] ‘goat’ [gɔ:t] ‘Pa’ [pʰɑ] ‘pie’ [pʰa]

b. Front: [i ɪ e ε æ]

‘neat’ [ni:t] ‘nit’ [nɪt] ‘Nate’ [net] ‘net’ [nɛt] ‘gnat’ [næt]

c. Central: [ə ʌ]

‘annul’ [əˈnʌl] ‘but’ [bʌt] ‘along’ [əˈlɒŋ]

Articulatory features:

3. roundness: Are the lips protruded and pursed?

a. Round vowels: [u ʊ o ɔ]

b. All other vowels are unrounded.

4. tense/lax: What is the degree of muscular tension in the tongue?

a. Tense vowels: [i e u o]

b. Lax vowels: [ɪ ɛ æ ʌ ɑ ɔ ʊ ə ʌ]

IPA	Description	Example
[i]	high front unrounded, tense	<i>beet</i>
[ɪ]	high front unrounded, lax	<i>bit</i>
[eɪ]	front diphthong	<i>bait</i>
[ɛ]	mid front unrounded	<i>bet</i>
[æ]	low front unrounded	<i>bat</i>
[ə]	mid central vowel; schwa	first vowel in about
[ʌ]	mid central unrounded	<i>but</i>
[u]	high back rounded, tense	<i>boot</i>
[ʊ]	high back rounded, lax	<i>book</i>
[oʊ]	back rounded diphthong	<i>boat</i>
[ɔ]	mid back rounded	<i>bought</i>
[ɑ]	low back unrounded	<i>father</i>

A monophthong has one relatively steady vowel quality: bed [bɛd].

A diphthong involves movement from one vowel position toward another:

- [aɪ] in bite
- [aʊ] in house
- [ɔɪ] in boy
- [eɪ] in day
- [oʊ] in go

Sometimes [j] instead of
[ɪ] or [w] instead of [ʊ]

In American English, tense vowels are
pronounced as diphthongs:

front

key [ij]

hey [ej]

back + round

boo [uw]

no [ow]

Natural Classes

A natural class is the set of all sounds that share some feature or set of features.

Sometimes, a functional natural class is the set of sounds that do NOT have some feature.

Think of them as $[-\text{feature}]$ instead of $[+\text{feature}]$ (whatever the feature happens to be).

Natural classes are very important, especially because sound rules usually apply to whole classes of sounds, not to random single sounds (important to remember when we move into phonology).

Examples:

1. In English, the voiceless oral stops /p t k/ are aspirated when they appear first in a stressed syllable:

$$/p\ t\ k/ \rightarrow [p^h\ t^h\ k^h] / \text{'}\sigma_$$

2. In AmE, the alveolar stops /t d/ are flapped between vowels after a stressed syllable:

$$/t\ d/ \rightarrow [ɾ] / \text{'}\mathbf{V_V}$$

3. In English, vowels are nasalized preceding a nasal consonant [m n ŋ]:

$$V \rightarrow \tilde{V} / _N$$

Length + Suprasegmentals

In some languages, consonant and/or vowels can be lengthened distinctively, by extending the length of time the articulation is held, indicated by the diacritic [:]

Examples:

Latin: [populus] ‘people’ but [po:pulus] ‘poplar’

Sc Gaelic: [pa^hta] ‘stick’ but [pa:^hta] ‘boat’

Suprasegmental Features

Not all of the significant components of speech affect individual segments; some occur “above” the segment level. That is, they’re not part of single speech sounds, but instead seem to apply at the syllable or word level.

These suprasegmental features include

- stress
- pitch
- tone

Stress

Stress can take varying forms, but usually involves increased length and volume of certain syllables, or a rising pitch. In most languages, each content word has one and only one main stress.

Stress is predictable (rule-driven) in some languages:

- a. Stress in Spanish nouns usually falls on the penultimate syllable if vowel-final, or the final syllable if consonant-final:

pepíta [pe'pita] 'seed', sonído [so'niðo] 'sound', but
corazón [kora'zon] 'heart', estrés [es'tres] 'stress'

- b. in Scottish Gaelic and Finnish, stress is usually on the first syllable:

Gaelic: tapadh ['t̪a^hpə] 'success', balach ['paɫəx] 'lad', uisge ['uʃkə] 'water'

Finnish: kirja ['kirja] 'book', istua ['istua] 'to sit', hypätä ['hypætæ] 'to jump'

Stress

In other languages, stress is assigned lexically; there's no rule. (Or, if there are patterns, they can be pretty complex and opaque to most speakers, as in English.)

English: reject [rə'dʒɛkt] (the verb) vs. reject ['rɪdʒɛkt] (the noun)

Russian: glaz ['glas] 'eye' (nom.sg)

glaza [gla'za] 'eyes' (nom.pl) but

glaza ['glaza] 'of an eye' (gen.sg)

IPA uses a high bar marks primary stress, a low bar secondary. The bar goes in front of the affected syllable:

happenstance: ['hæpɪˌstænts], laboratory ['læbɪəˌtɔɪ]

home sick vs. homesick: ['hɒm'sɪk], ['hɒmˌsɪk]

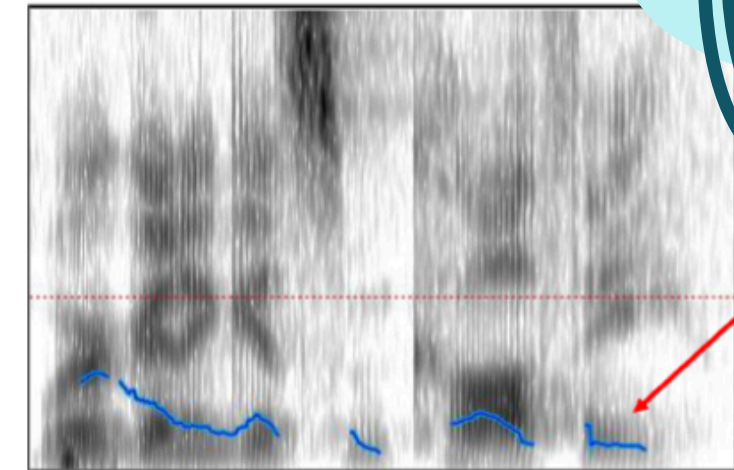
Pitch & Tone:

Both pitch and tone refer to the fundamental frequency of the utterance: the rate at which the vocal folds are vibrating. This frequency can be adjusted by speakers to serve different linguistic functions.

Prosodic pitch: frequency adjustment at the sentence or utterance level

- may be used as a conversational cue
- e.g. to tell questions from statements in English

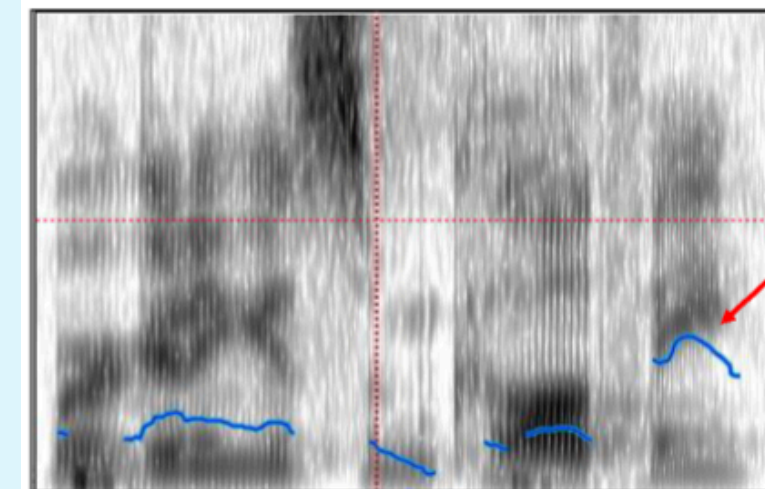
Tone: Or frequency can be modified at the word level: speakers use it to distinguish one word from another, as in the Chinese languages and their neighbors



We're gonna get some coffee.

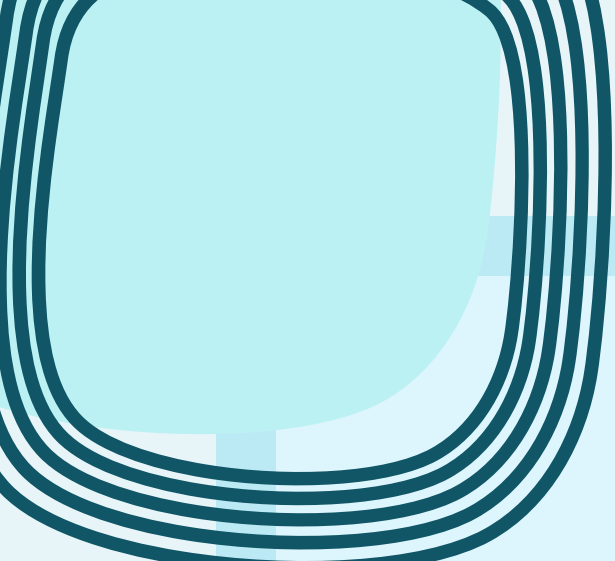
(statement, falling pitch)

spectrograms



We're gonna get some coffee?

(question, rising pitch)



Are the first and last sounds voiced or voiceless?

a. though

b. laugh

c. nudge

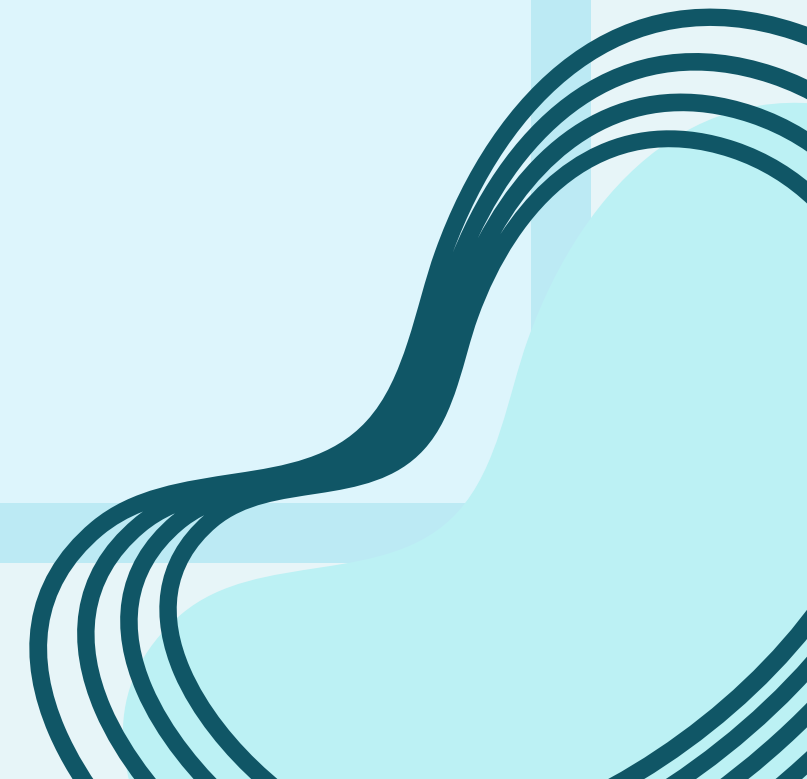
d. depot

e. blot

f. stitch

g. passed

h. crate



Same or Different

Place of Articulation

- a. [t] : [p]
- b. [k] : [ŋ]
- c. [p] : [b]
- d. [z] : [s]
- e. [dʒ] : [ʃ]
- f. [h] : [k]

Manner of Articulation

- a. [k] : [p]
- b. [w] : [j]
- c. [ð] : [tʃ]
- d. [l] : [ɹ]
- e. [dʒ] : [tʃ]
- f. [m] : [h]

Natural Classes

a. [s z tʃ dʒ ʃ ʒ]:

b. [i ɪ e ε æ]:

c. [tʃ ʒ ʃ dʒ j]:

d. [h ʔ]:

e. [t d l ɹ n s z]:

f. [p b m f v]:

g. [u o i e]:

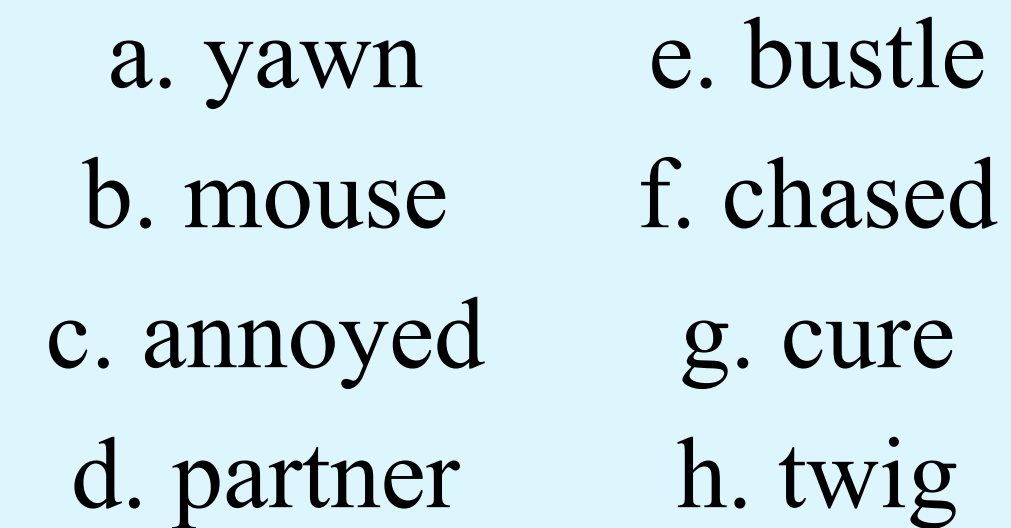
h. [p b t d k g ʔ]:

i. [l ɹ m n ŋ j w]:

j. [u ʊ o ɔ]:

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



For nasalization [̃], as in yawn [jɔ̃n], the vowel becomes nasalized because the next sound is [n], which is a nasal consonant. Your soft palate starts lowering a little early to prepare for the [n], so some air goes through your nose while you're still saying the vowel. This is called anticipatory coarticulation.

For a syllabic consonant [ɹ], as in bustle [bʌsɹ̩], the [ɹ] acts like the vowel of the second syllable. Instead of clearly saying something like [bʌsəl], speakers often weaken or leave out the schwa [ə], and the [ɹ] takes over as the syllable's center.

For aspiration [ʰ], as in cure [kʰjʊɹ], there is a short puff of air after the [k]. In English, voiceless stops [p t k] are usually aspirated when they occur at the beginning of a stressed syllable. Your vocal folds don't start vibrating immediately after the stop is released, creating that puff of air.

Conlang

1. Consonant sounds: list the consonants in IPA, such as /p t k m n s l r/
2. Vowel sounds: list the vowels in IPA, such as /i e a o u/
3. How the sounds are made: briefly describe unusual sounds if needed
4. Voicing: note pairs like /p/ vs. /b/ or /t/ vs. /d/
5. Make basic consonants and vowel charts
 - Include place and manner of articulation
 - Include vowel height/backness/rounding