

# **A Sketchbook Atlas of the Vocal Tract**

THIRD EDITION

Cheri Montgomery

Presentation slides: [link available with purchase](#)

S.T.M. Publishers  
Nashville, TN

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Cover from Quain's Elements of Anatomy Col. III published in 1896,  
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## Preface

*A Sketchbook Atlas of the Vocal Tract* is designed to help students gain articulatory awareness. It was written for singers but has a broad range of practical applications. The visual-based approach makes it ideal for ESL studies or speech therapy. Readers discover accurate pronunciation by learning how breath and tone flow through the unique vowel and consonant formations of the English, Italian, German, and French languages. Sketch pages engage students in the learning process. The third edition contains improved images and additional units that cover the muscles of the tongue, lips, and palate.

The first unit contains an in-depth study of articulatory phonetics. Units covering muscles of the tongue, lips, and palate are introduced early. This facilitates understanding of the many vowel and consonant formations. The middle units are organized according to articulatory points of contact. The progression begins with bilabial consonants and front vowel formations and ends with glottal consonants and back vowel formations. Vowels and consonants unique to English, Italian, German, and French are covered in the final units. Sketch pages, multiple views of the vocal tract, and audio links are provided throughout the text. Access to full color images and instructions for building models of the tongue and palate are included in the presentation slides. A link to the slides is located on page i.

This text contains a novel method of charting vowels. Organization of the the new chart is based on the muscular structure of the tongue. The chart was introduced in two articles: *Diction (Still) Belongs in the Music Department* and *Defining the Schwa for the English, German, French, and Russian Languages* published in the *Journal of Singing* (National Association of Teachers of Singing).

The International Phonetic Alphabet (IPA) is applied throughout the text. It is the standardized system for dictionary transcription and in use by educational programs throughout the world. For those new to the IPA, the symbols are easy to learn and closely align with spellings of the European languages. A free listening lab, IPA charts, and recommended resources are available at [www.stmpublishers.com](http://www.stmpublishers.com).

The transcriptions in this text are based on rules established by standard textbook authorities: Madeleine Marshall for English, Evelina Colorni for Italian, William Odom for German, and Thomas Grubb for French. Students are encouraged to sing the sample words. Singing slows down the articulatory process and releases the jaw providing more space to discover formation.

*Preface Continued*

The contents of this book represent years of experience gained from teaching voice and the English, Italian, German, and French lyric diction courses at the Blair School of Music at Vanderbilt University. Research as author of *The Singer's Daily Practice Journal*, the *Lyric Diction Workbook Series*, articles published in the *Journal of Singing*, and co-authorship of *Exploring English Lyrics* published by Rowman & Littlefield and *Exploring Art Song Lyrics* published by Oxford University Press served to further develop the concepts outlined in this text.

The voice is a phonetic instrument. Vowels and consonants are the basic elements of languages that serve as tools for vocal discovery. It is my hope that this workbook will help students explore the lovely sounds that are uniquely designed for the human voice.

Cheri Montgomery

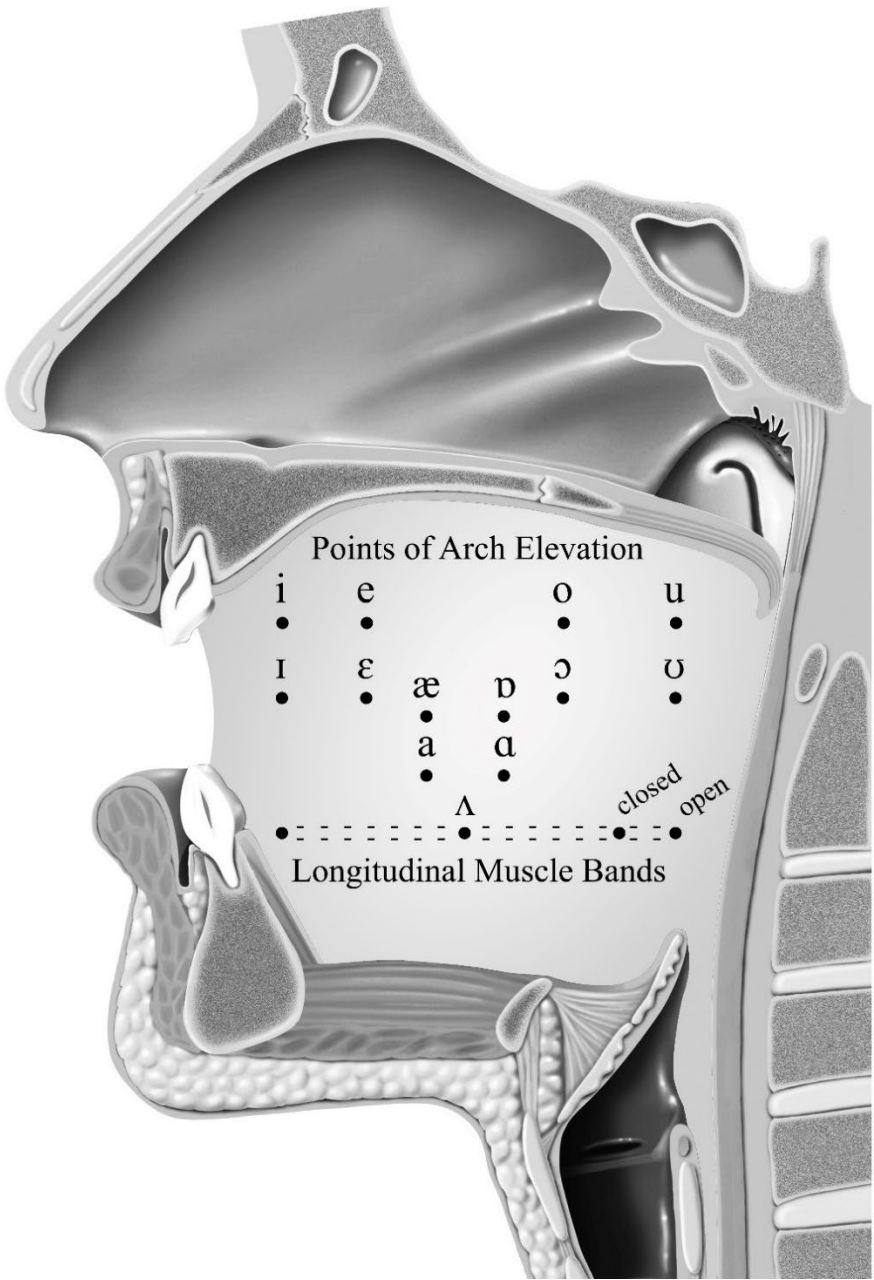
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INFERIOR LONGITUDINAL MUSCLE CHART



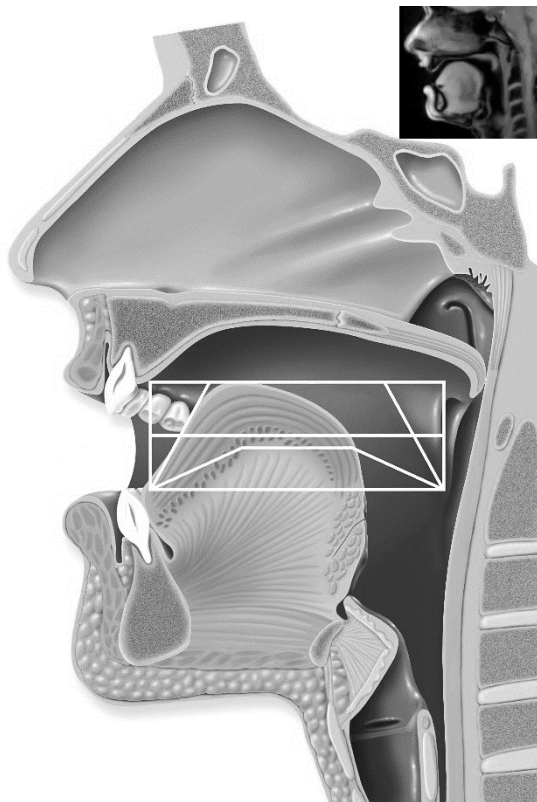
# UNIT 8:

## Moderately steep closed front [e] and open [ɛ]

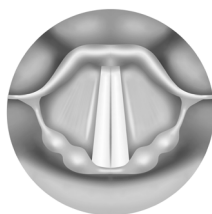
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# MODERATELY STEEP CLOSED FRONT [e]



Audio



**Description.** English does not have a pure [e] vowel. An approximation of the sound is found in words of foreign origin and in the unstressed or secondary stressed syllable of a few words: *café, nativity, debut*.

**Enunciation.** Release and lower the jaw. Find the space of *ah* without spreading the lips. The tongue tip touches the lower front teeth, the front of the tongue arches forward, and the sides of the tongue contact the length of the upper molars to the bicuspid. Raise the soft palate and direct vocalized tone toward the upper front teeth. Maintain an unaltered formation throughout vocalization.

**Warnings.** Form [e] with the tongue arch (not by spreading the lips). Do not replace [e] with an open [ɛ] vowel. Closed [e] is closer to a closed [i] vowel.

**Italian exercise.** Contrast the following: *say/se* [se], *day/vede* ['vede], *twenty/venti* ['venti], *fresh/fresca* ['freska], *destiny/destino* [des'tino]

**German exercise.** Contrast the following English/German words: *state/stet* [ʃte:t], *way/weh* [ve:], *gate/geht* [ge:t], *sail/Seele* ['ze:lə]

**French [e] exercise.** Contrast the following English/French words: *pray/prés* [pre], *desire/désir* [dezir], *serenade/sérénade* [serenadə]

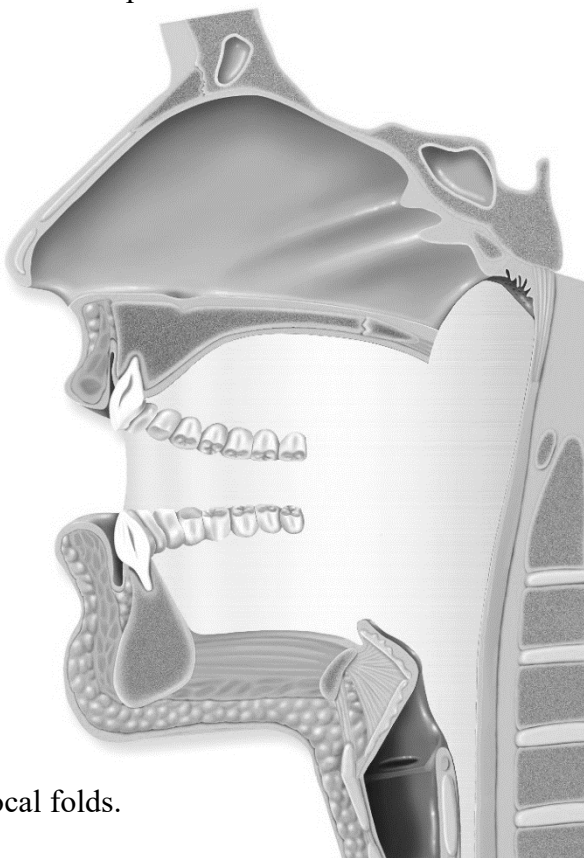
# VOWEL WORKSHEETS

## Sagittal View of Tongue Formation for [e]

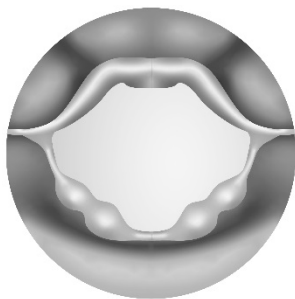
Sketch the tongue and palate formations of moderately steep closed front [e] and label the numbered points.

1. Nasal cavities
2. Pharynx
3. Tongue tip
4. Peak of tongue arch
5. Alveolar ridge
6. Hard palate
7. Soft palate
8. Uvula
9. Epiglottis
10. Vocal folds
11. Trachea
12. Esophagus

Full color image:



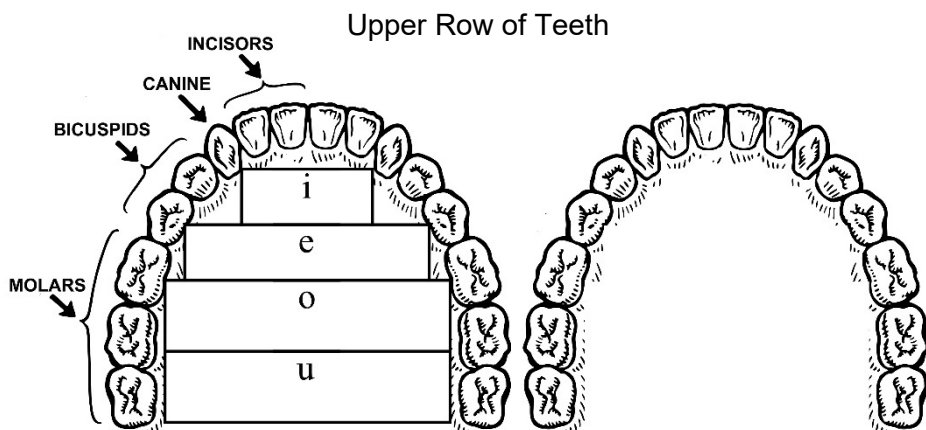
Sketch and label the vocal folds.



Draw a dotted line to indicate the airflow pathway through the vocal tract. Mark the narrowest point of airflow with an *x*. See page 208.

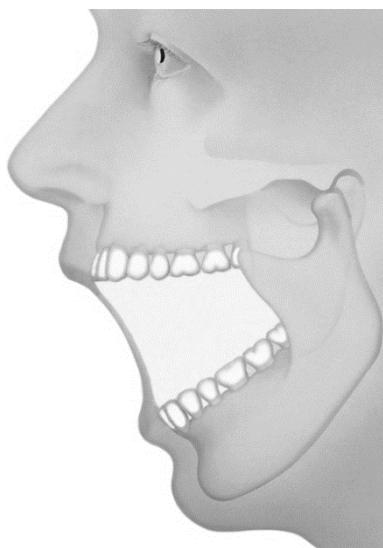
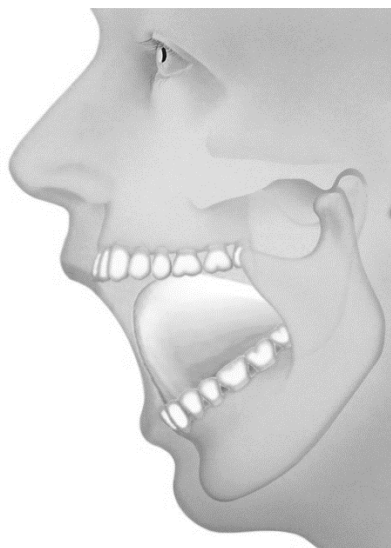
## Palatal View of Tongue Formation for [e]

Observe the points of tongue contact against the upper teeth for [e] from a palatal view. The edges of the tongue contact the upper teeth while the tip touches the lower front teeth. Indicate the contact points of the tongue against the teeth in the blank palate.



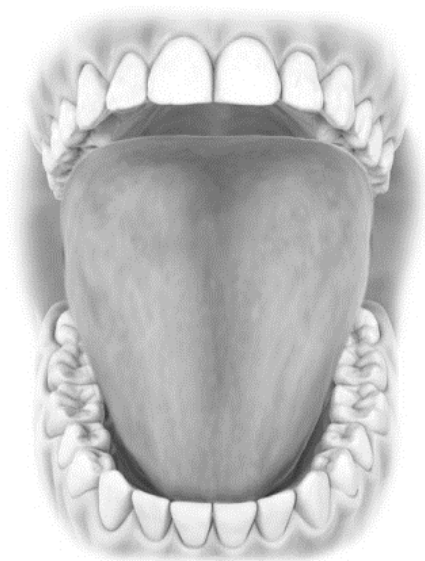
## External View of Tongue Formation for [e]

The edges of the tongue contact the upper molars to the bicuspid for [e]. Sketch the external tongue formation of [e] in the blank mouth.

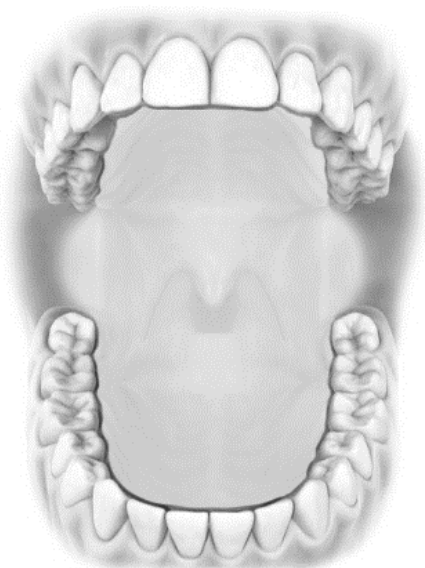


## Front View of Tongue Formation for [e]

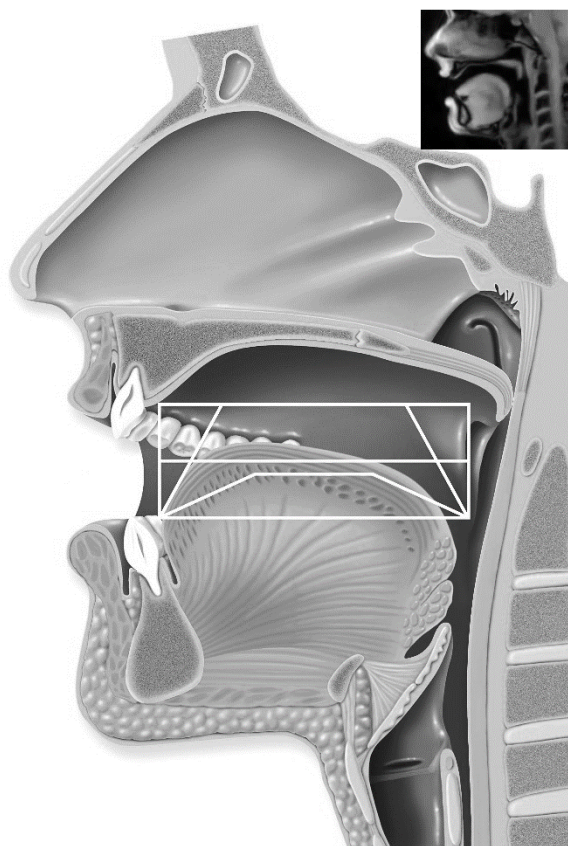
The front of the tongue has a moderately steep arch. The tongue's contact with the upper teeth combines with the arch to create a peak shape of the tongue.



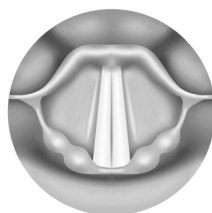
Sketch the front view tongue formation of [e] in the blank mouth.



# MODERATELY STEEP OPEN FRONT [ɛ]



Audio



**Enunciation.** Release and lower the jaw. Find the space of *ah* without spreading the lips. The tongue tip touches the lower front teeth, the front of the tongue arches forward, and the sides of the tongue contact the length of the upper molars to the bicusps. The angle of the tongue arch is identical to [e] but with a plateau in the middle of the tongue. Raise the soft palate and direct vocalized tone toward the upper front teeth. Maintain an unaltered formation of the vowel throughout vocalization.

**Warnings.** Form [ɛ] with the tongue arch (*not* by spreading the lips). Do not sing [ɛ] with a breathy tone. To clarify the vowel: enunciate [ɛ] with the sides of the tongue in the [i] position. It is easier to focus [ɛ] with a more narrowed furrow of the tongue.

**Examples:** *gem, echo, rest, hedges, pleasant, breathless*

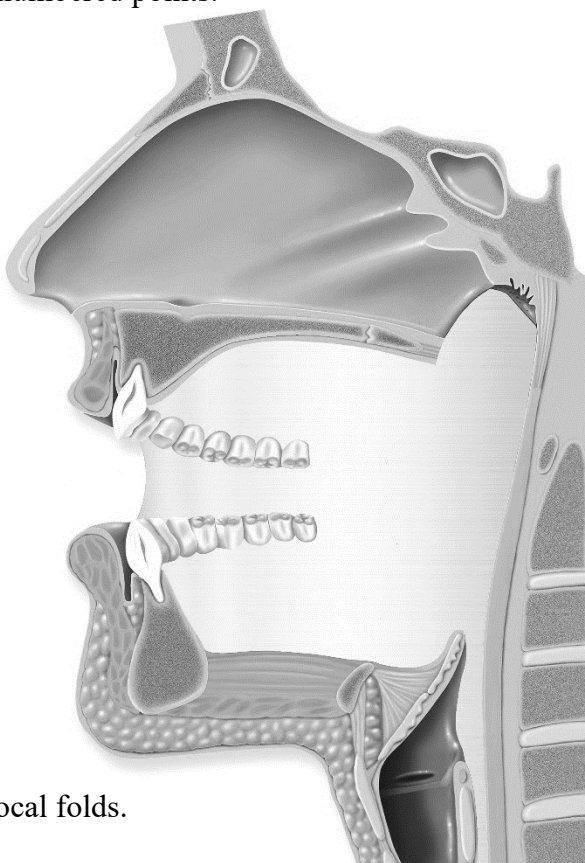
# VOWEL WORKSHEETS

## Sagittal View of Tongue Formation for [ɛ]

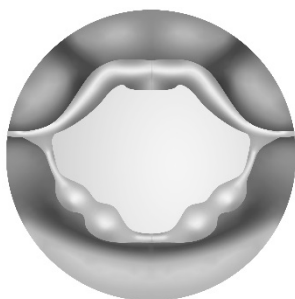
Sketch the tongue and palate formations of moderately steep open front [ɛ] and label the numbered points.

1. Nasal cavities
2. Pharynx
3. Tongue tip
4. Peak of tongue arch
5. Alveolar ridge
6. Hard palate
7. Soft palate
8. Uvula
9. Epiglottis
10. Vocal folds
11. Trachea
12. Esophagus

Full color image:



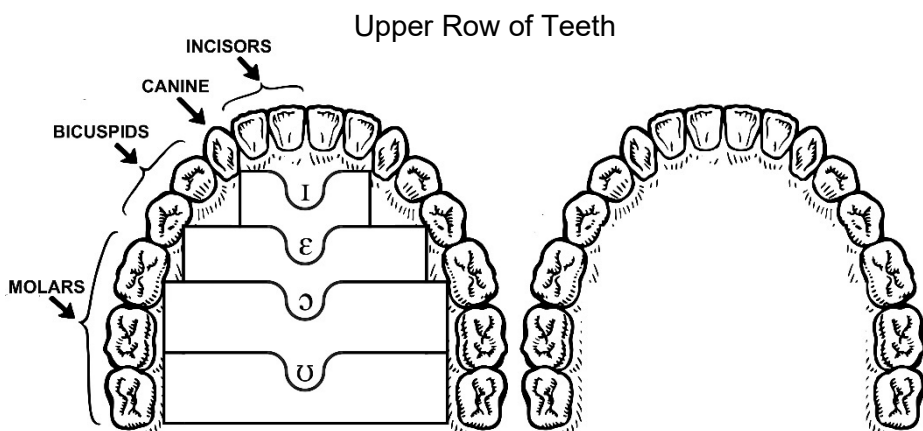
Sketch and label the vocal folds.



Draw a dotted line to indicate the airflow pathway through the vocal tract. Mark the narrowest point of airflow with an *x*. See page 208.

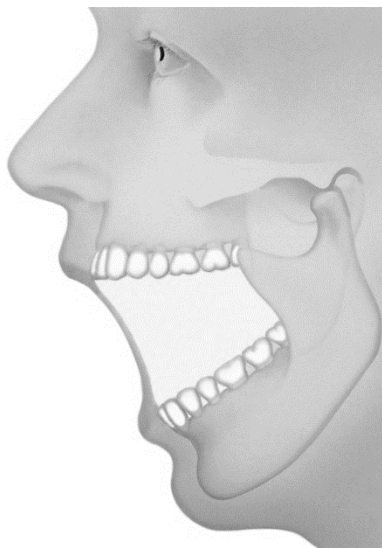
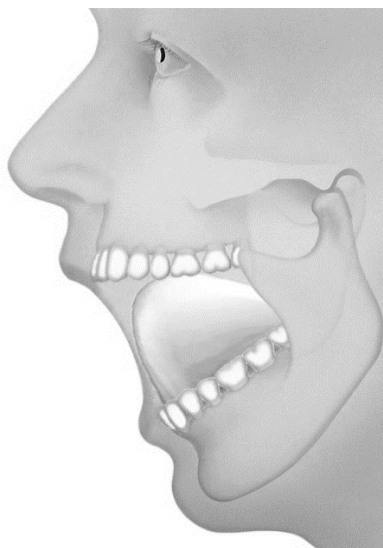
## Palatal View of Tongue Formation for [ɛ]

Observe the points of tongue contact against the upper teeth for [ɛ] from a palatal view. The edges of the tongue contact the upper teeth while the tip touches the lower front teeth. The curved indentation represents a furrow formed along the middle of the tongue. Indicate the contact points of the tongue against the teeth in the blank palate.



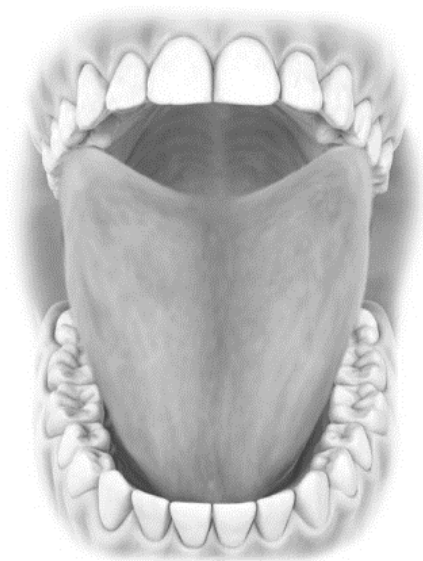
## External View of Tongue Formation for [ɛ]

The edges of the tongue contact the upper molars to the bicuspid for [ɛ]. Sketch the external tongue formation of [ɛ] in the blank mouth.

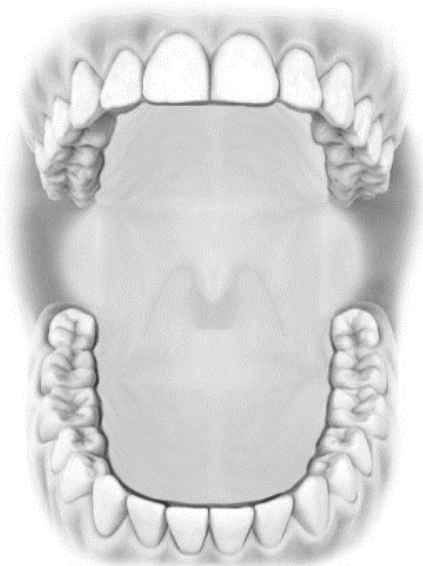


## Front View of Tongue Formation for [ɛ]

The front of the tongue has a moderately steep arch. The middle of the tongue is lowered to form a plateau. The plateau creates a furrowed shape of the tongue.



Sketch the front view tongue formation of [ɛ] in the blank mouth.





## Articulatory process for *web* [wɛb]

**Step 1:** Form the space of *Ah*: release the jaw, allow the tongue tip to touch the lower front teeth, and raise the soft palate (this closes the nose gate)

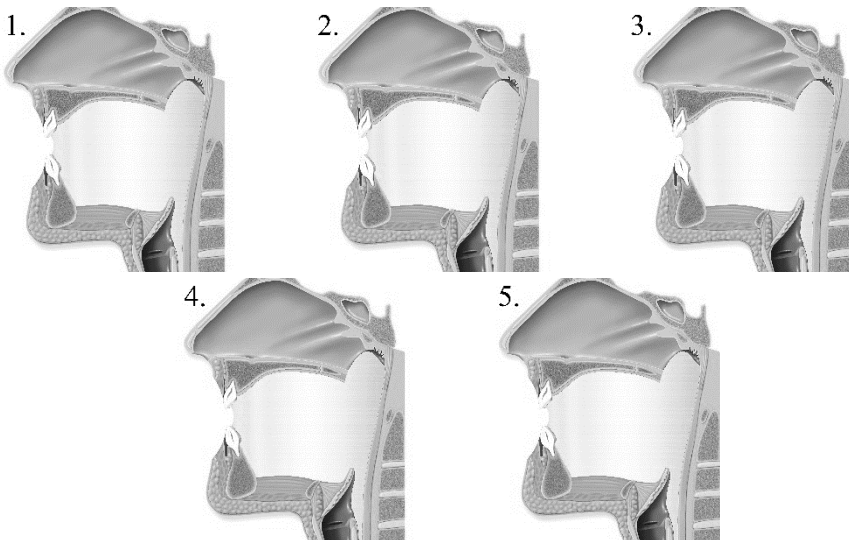
**Step 2:** Gently round the lips and sing an abbreviated [u] vowel

**Step 3:** Release lip rounding while arching the tongue forward to sing [ɛ]

**Step 4:** Allow the lips to lightly contact

**Step 5:** Pop the lips open while singing a shadow vowel

**Assignment:** Sketch the lip, tongue, and palate formations for each step



## Articulatory process for *may* [mɛ:I]

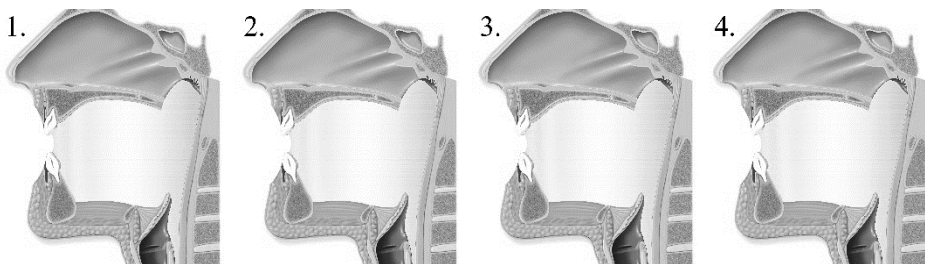
**Step 1:** Form the space of *Ah*: release the jaw, allow the tongue tip to touch the lower front teeth, and relax the soft palate (to open the nose gate)

**Step 2:** Allow lips to lightly contact while humming the [m] consonant

**Step 3:** Pop the lips open while raising the soft palate, arching the tongue forward, and singing the [ɛ] vowel (yawning raises the soft palate and closes the nose gate).

**Step 4:** Tilt the front of the tongue farther forward and sing a short [ɪ]

**Assignment:** Sketch the lip, tongue, and palate formations for each step



## END NOTES

<sup>1</sup> Ahmed, R.I.; Abu Talib, A.R.; Rafie, A.S. Mohd; Djojodihardio, H. Elsevier Masson SAS, *Aerodynamics and flight mechanics of MAV based on Coandă Effect. Aerospace science and technology*, 2017, Vol. 62.

<sup>2</sup> Benson, Mark. *The Venturi Effect explained*. Engineering Clicks. <https://bit.ly/3QT3lhZ>. Last accessed 9/16/2022.

## PHOTO CREDITS

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<sup>3</sup> Extrinsic muscles photo credit: OpenStax. License: <https://creativecommons.org/licenses/by/3.0/legalcode>. Changes were made to indicate the palatoglossus muscle.

<sup>4</sup> Intrinsic muscles photo credit: Remko van Deijk. *Functional Swallowing Units (FSUs) as organs-at-risk for radiotherapy. PART 1: Physiology and anatomy*. [https://www.thegreenjournal.com/article/S0167-8140\(18\)33552-7/fulltext](https://www.thegreenjournal.com/article/S0167-8140(18)33552-7/fulltext)

<sup>5</sup> Soft palate muscles photo credit: von Arx, T., Lozanoff, S. (2017). Hard and Soft Palate. In: *Clinical Oral Anatomy*. Springer, Cham. [https://doi.org/10.1007/978-3-319-41993-0\\_10](https://doi.org/10.1007/978-3-319-41993-0_10)

<sup>6</sup> Lip muscles photo credit: Uldis Zarins. *Anatomy of Facial Expression (Anatomy for Sculptors)*. Anatomy Next, Inc. 1/1/2017.

<sup>7</sup> Schieren device photo credit: National Federation of State High School Associations ([www.NFHS.org](http://www.NFHS.org)) with Dr. James Weaver, Director of Performing Arts and Sports. Screen shot from *Vocal Test Edited*. <https://bit.ly/3QYxHiZ>. Last accessed 9/19/2022.

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