

4 Phonetics and Phonology

KEY CONCEPTS

Articulatory phonetics, phonetic symbols

Consonants, approximants, vowels

Syllables, feet

Phonology, phonemes, allophones, phonological rules

INTRODUCTION

In this chapter we sketch the pronunciation system of English. We begin with **phonetics**, a system for describing and recording the sounds of language objectively. Phonetics provides a valuable way of opening our ears to facets of language that we tend to understand by reference to their written rather than their actual spoken forms. **Phonology** concerns itself with the ways in which languages make use of sounds to distinguish words from each other.

Teachers should be knowledgeable about the phonetics and phonology of English because (1) the sound system is primary and the basis for the spelling system; (2) they may have to teach English pronunciation to students who are not native speakers of English; (3) they may have to teach poetry, which requires that they teach about rhyme, alliteration, assonance, and other poetic devices that manipulate sound; (4) it is important to understand accents and language variation and to react appropriately to them and to teach appropriate language attitudes about them to students (see our chapters on Language and Society and Usage in Book II); (5) we are so literate that we tend to “hear” the sounds of our language through its spelling system, and phonetics/phonology provides a corrective to that; and (6) phonetics and phonology provide systematic and well-founded understandings of the sound patterns of English.

ARTICULATORY PHONETICS

We have three goals in this section. First, we introduce you to the ways in which the sounds of English are produced. Second, we develop a system for classifying speech sounds on the basis of how they are produced. Simultaneously we introduce an alphabet approximating that developed by the International Phonetics Association (IPA), which will allow us to refer to sounds quite precisely. When we want to indicate that letters are to be interpreted as phonetic symbols, we enclose them in square brackets, [], and when we want to indicate that letters are to be interpreted as letters from an ordinary spelling system, we enclose them in angled brackets, < >.

The phonetic alphabet uses many of the letters of the English alphabet, but their pronunciations are very restricted and are not always the ones you might expect. In this system, there are no “silent” letters—every phonetic symbol represents an actual sound. Every letter always has the same pronunciation regardless of its context, no letter has more than one pronunciation, and no sounds are represented by more than one letter. To make fine distinctions, phoneticians add special symbols, called **diacritics**, to the basic letters. For some English sounds and for languages other than English, symbols not from the English alphabet have been devised. (You might visit the IPA web site for a full listing of the symbols.)

In the sections to follow, we describe the sounds represented by these symbols and how these sounds are made. As we go through these sections, pay attention to the ways in which individual sounds are ordinarily spelled in English, as well as to the phonetic spellings.

To produce speech, air must flow from the **lungs** through the **vocal tract**, which includes the **vocal folds** (popularly called the vocal cords, though they are more like thick elastic bands than strings), the nose or **nasal cavity**, and the mouth or **oral cavity** (See Figure 1). The vocal folds vibrate for some sounds but not for others. Air flows through the nose for certain sounds but not others. But the main creator of speech sounds is the mouth. We will describe the roles that each of these elements plays in the following paragraphs.

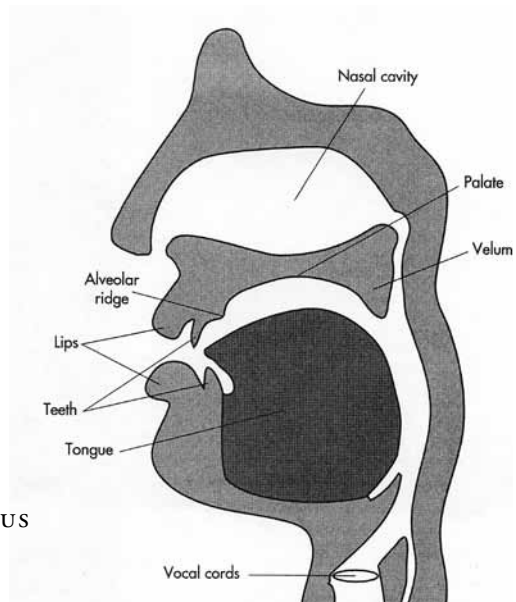


FIGURE 1: VOCAL APPARATUS

CONSONANTS

Consonants include the sounds we represent as <p, b, t, d, m, n, f, v, s, z, l, r, h> in the ordinary alphabet. All **consonants** are produced by entirely or almost entirely stopping the airstream coming from the lungs. When we almost entirely stop the airstream we force it through such a narrow opening that the airflow at that point is turbulent and noisy.

We classify consonants according to the following characteristics: (a) whether or not the vocal folds are vibrating (**voicing**); (b) whether the sound is made with a fully stopped or merely constricted airstream (its **manner of articulation**); (c) where in the mouth the stoppage or constriction is made (its **place of articulation**); (d) whether or not air is flowing through the nasal cavity (**nasality**); and (e) whether or not the lips are pursed (**lip-rounding**).

Voicing

As a warm-up exercise, make the sound ffff, and keep it going for a count of five. Now make the sound vvvv, and keep it going for a count of five. Now alternate these two: ffffvvvvffffvvvv. You probably noticed that vvvv had a “buzz” that ffff did not have. That “buzz” is caused by the vibrating of your vocal folds—which you can check by putting your fingers on your throat or by covering your ears as you alternate ffff and vvvv. Now try the same exercises with the first sounds of the following words: *thigh, thy; sip, zip*. You should be able to feel the vocal folds vibrate as you make the second sound of each pair.

Sounds produced with vibrating vocal folds (see Figure 1) are said to be **voiced**; those produced without vocal cord vibration are **voiceless**. Table 1 lists the voiced and voiceless consonants of English. The letters in [] are the phonetic symbols for the sounds.

VOICED	VOICELESS
b y [b]	p ie [p]
m y [m]	
w et [w]	
v ie [v]	f ie [f]
th y [ð]	th igh [θ]
d ie [d]	t ie [t]
n igh [n]	
z ip [z]	s ip [s]
l ie [l]	
r ye [r]	

beige [ʒ]	bash [ʃ]
jive [dʒ]	chive [tʃ]
yet [j]	
guide [g]	kite [k]
gong [ŋ]	
	hive [h]

TABLE 1: VOICED AND VOICELESS CONSONANTS

Exercise

1. Collect a set of words in which each of the voiced and voiceless sounds listed in the two columns above occurs as the first sound of a word, in the middle of a word (specifically between two vowels), and at the end of a word, as in: [b] *bird*, *rubbing*, *rub*; [p] *pan*, *tapping*, *tap*. How are each of these sounds ordinarily spelled? (Note: English single and double consonants, as in *rub* and *rubbing*, *tap* and *tapping*, represent the same sound. The doubled consonants tell us how the vowel before them is to be pronounced; cf. *tapping*, *taping*.)

2. Identify the sound represented by each of the following phonetic symbols and for each sound collect five words in which it occurs: [p, b, f, v, θ, ð, ʃ, ʒ, tʃ, dʒ, s, z]. How is each of these sounds ordinarily spelled?

Nasality

Make the sound represented by <m> in the word *Pam* and continue it for some seconds. As you continue it, pinch your nose and observe what happens to the sound. It should stop immediately. This shows that air was flowing through your nose as you produced this sound. Now try the same little experiment with the <n> of *pan* and the <ng> of *pang*. You should find that the air flows through the nose in these two cases also. Sounds in which air flows through the nose are called **nasal** sounds. The air is allowed into the nose by lowering the **velum**, the soft palate at the back of the mouth (see Figure 1). English has three main nasal sounds:

[m]	Pam	clammy	mat
[n]	pan	clannish	Nat
[ŋ]	pang	clingy	----

Exercise

Using the data just above, say where [ŋ] **cannot** occur in a word. How are each of these nasal sounds ordinarily spelled?

Manner of articulation

By **manner of articulation** we mean the kind of closure or constriction used in making the sound. We classify English consonants according to three manners of articulation: **stops** (full stoppage of the airstream somewhere in the *oral* cavity between the vocal folds and the lips, as in [p], [b], [m]); **fricatives** (constriction of the airstream in the oral cavity producing turbulence and noise, as in [f], [v]); **affricates** (full stoppage of the airstream followed immediately by constriction, as in [tʃ], [dʒ]). Table 2 summarizes the different manners of articulation.

Stops

[p]	pad	[b]	bad	[m]	mat
[t]	tad	[d]	dad	[n]	Nat
[k]	cad	[g]	gad	[ŋ]	tang

Fricatives

[f]	fie	[v]	vie
[θ]	thigh	[ð]	thy
[s]	Sue	[z]	zoo
[ʃ]	shoe	[ʒ]	jus (au jus)
[h]	how		

Affricates

[tʃ]	chin
[dʒ]	gin

TABLE 2: MANNERS OF ARTICULATION

Exercise

For each of the sounds listed in Table 2, collect five words in which the sound occurs as the last sound of the word and another five in which the sound occurs in the middle of the word (specifically, between two

vowels), as [ŋ] is in *ring*, *ringing*. How is each sound ordinarily spelled?

Place of articulation

By **place of articulation** we mean the area in the mouth at which the consonantal closure or constriction occurs. English uses only seven places of articulation (see Figure 1) which we describe and illustrate below.

Bilabial sounds are made by bringing both lips together to stop the air-stream:

[p]	pie	cupping	cup
[b]	by	clubbing	cub
[m]	my	coming	come

Labiodental sounds are made by bringing the top teeth into contact with the bottom lip and forcing air between the two to create the fricatives:

[f]	feel	raffle	tough
[v]	veal	ravel	dove

Interdental sounds are made by placing the tip of the tongue between the top and bottom teeth and forcing air through. Again, these are both fricatives:

[θ]	thigh	ether	mouth	bath (noun)
[ð]	thy	either	mouth	bathe (verb)

Alveolar sounds are made by bringing the tongue and the alveolar ridge (the bony ridge just behind the top teeth) together to create either a stop or fricative:

[t]	tub	boating	boat	[s]	sip	fussy	grace
[d]	dub	boding	bode	[z]	zip	fuzzy	graze
[n]	knit	boning	bone	[r]	rip	terror	tear

(Alveo-)palatal sounds are made by bringing the blade of the tongue to, or close to, the alveo-palatal area of the roof of the mouth to create fricatives and affricates:

[ʃ]	sure	vicious	rush
[ʒ]	genre	vision	rouge
[tʃ]	chin	catcher	etch
[dʒ]	gin	edger	edge

Velar sounds are created by stopping the airstream by bringing the back of the tongue into contact with the velum:

[k]	could	backer	tuck
[g]	good	bagger	tug
[ŋ]	-----	banger	tongue

Glottal sounds are created by either narrowing the vocal folds sufficiently to create a fricative or closing them to create a stop:

[h]	hat	cahoots	[ʔ] butter (some varieties of English)
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Exercise

For each of the sounds listed under Place of Articulation, find five words in which the sound occurs. How are each of these sounds ordinarily spelled?

Approximants

Approximants are sounds made by narrowing the oral cavity but not enough to cause turbulence in the airstream; the airstream is said to be smooth. The beginning sounds of *hye* and *rye* are approximants. The narrowest point in the airstream is wider in approximants than in fricatives, but is not as wide as it is in vowels. Approximants are more **sonorant** (**resonant**, i.e., naturally loud) than consonants, but less so than vowels. They are like consonants in that they typically occur before or after the vowels of syllables (see below). English has three kinds of approximants.

Lateral approximants are made by touching the tongue to the alveolar ridge while allowing the air to pass along one or both sides, as in [l]—in *lack*, *call*, and *callow*.

Central approximants are made by raising the sides of the tongue so that the air flows along the center of the tongue, as in [r]—in *rock*, *roll*, and *Rory*. [r] is regarded as an alveolar sound.

Glides (**semivowels**) come in two kinds: palatal and labio-velar. **Palatal**

glides are made by raising the tongue toward the hard palate, close to where the vowel in *eat* is made. The first sound of *yet*, *yolk*, and *y'all* is a palatal glide, represented phonetically as [j]. **Labio-velar** glides are made by rounding the lips and simultaneously raising the back of the tongue toward the velum, close to where the vowel sound of *ooze* is made. Labio-velar glides thus have two places of articulation—they are both labial and velar. The first sound of *wet*, *wall*, and *wink* is a labio-velar glide, represented phonetically as [w].

Lateral	[l]	let	
Central	[r]	Rhett	
Glides	Labio-velar	[w]	wet
	Palatal	[j]	yet

Articulatory descriptions

An **articulatory description** of any consonant or approximant must specify (at least) its place and manner of articulation, whether it is voiced or voiceless, and whether it is nasal or oral. For example, [m] is made at the lips by stopping the airstream, is voiced, and is nasal. These features are represented as:

	[m]	[w]	[l]
Voicing	voiced	voiced	voiced
Place	bilabial	labio-velar	alveolar
Manner	stop	glide	lateral approximant
Nasality	nasal	oral	oral
Example word	mime	wow	low

We can gather all of the consonants that we have described into a single chart:

		labio-	inter-		(alveo-)		
	bilabial	dental	dental	alveolar	palatal	velar	glottal
stop	p b			t d		k g	(ʔ)
nasal stop	m			n		ŋ	
fricative		f v	θ ð	s z	ʃ ʒ		h
affricate					tʃ dʒ		
approximants							
glides	(w)				j	(w)	
lateral				l			
central				r			

TABLE 3: ENGLISH CONSONANTS AND APPROXIMANTS

Exercise

You should now be able to provide an articulator description for each of the following sounds. Consult Tables 1-3.

	[t]	[k]	[b]	[d]	[g]
Voicing					
Place					
Manner					
Nasality					
Example word					
	[n]	[ŋ]	[f]	[v]	[θ]
Voicing					
Place					
Manner					
Nasality					
Example word					
	[ð]	[s]	[z]	[ʃ]	[ʒ]
Voicing					
Place					
Manner					
Nasality					
Example word					
	[tʃ]	[dʒ]	[l]	[r]	[h]
Voicing					
Place					
Manner					
Nasality					
Example word					
	[w]	[j]			
Voicing					
Place					
Manner					
Nasality					
Example word					

VOWELS

Vowels include the sounds we ordinarily represent as the letters <a, e, i, o, u>, as well as a number of other sounds for which the ordinary alphabet has no unique symbols.

Vowels are distinguished from consonants in several ways. As we have seen, consonants are produced by constricting the airstream to various degrees as it flows through the oral tract. **Vowels** are produced with a smooth, unobstructed airflow through the oral tract.

Differences in vowel quality are produced by different shapes of the oral cavity. Characteristic vowel qualities are determined by (a) the height of the tongue in the mouth; (b) the part of the tongue raised (front, middle, or back); (c) the configuration of the lips; and (d) the tension of the muscles of the oral tract. An articulatory description of a vowel must include all of these features.

Tongue height

Pronounce the words *eat* and *at*. Now pronounce just the vowels of these two words. Notice that as you go from the vowel of *eat* to the vowel of *at*, your mouth opens. If this is not obvious to you just by playing with these two vowels, look in a mirror as you produce them. Alternate the words, and then just the two vowels.

Once you've become accustomed to the different degrees of openness of these two vowels, pronounce *ate* between *eat* and *at*. The degree of openness of its vowel falls between those of *eat* and *at*, so there is a continuous increase in mouth openness as you go from one vowel to another. These degrees distinguish **high**, **mid**, and **low** vowels. We will use the following symbols for this sequence of vowels:

(1)	eat	[i]	High
	ate	[e]	Mid
	at	[æ]	Low

Exercise

For each of the three vowels above, find five words in which the vowel occurs. Be clear about which symbol most accurately applies to each vowel. How is each of these vowels ordinarily spelled?

Front and back vowels

Now compare the vowel of *beat* with that of *boot*. Alternate the words, and then just the vowels. It will be more difficult this time to monitor the activities of your tongue as you shift from one of these to the other, but try anyway.

You produce the [i] of *beat* with the front (blade) of your tongue raised toward your palate. If you draw in your breath as you make this vowel, you will feel the cold air against your palate. As you shift from [i] to [u], the vowel of *boot*, you will find yourself raising the back of your tongue. (You will also find yourself pursing (**rounding**) your lips, but disregard this for the moment.) Because of the relative positions at which these vowels are made in the mouth, phoneticians call [i] and the other vowels in (1) **front vowels**, and [u] a **back vowel**.

The back vowels, like the front ones, descend from high, through mid, to low, in a continuous sequence. You can observe this by pronouncing the words *coot*, *coat*, and *cot*, and then just their vowels. As you produce this series of vowels you'll find your mouth opening (monitor your lower jaw) as you go from *coot* to *coat* to *cot*. We use the following symbols for these back vowels:

(2)	coot	[u]	High
	coat	[o]	Mid
	cot	[ɑ]	Low

Exercise

For each of the three vowels just above, find five words in which the vowel occurs. Be clear about which symbol most accurately applies to each vowel. How is each of these vowels ordinarily spelled?

We combine these two series of vowels in Table 4:

	FRONT	BACK
HIGH	i	u
MID	e	o
LOW	æ	ɑ

TABLE 4: FRONT AND BACK VOWELS

Exercise

For each of the vowels in Table 4, find five more words in which the vowel occurs. Be clear about which symbol most accurately applies to each vowel. How is each of these vowels ordinarily spelled?

Lip rounding

As you compared [i] and [u] you probably noticed that your lips changed shape as you shifted from the front vowel to the back one. Your lips were **rounded** as you produced [u]. They were **unrounded** (**spread** or **neutral**) as you produced [i]. As you moved through the series of back vowels you may also have noticed that lip rounding decreased as you moved from high to low. In fact the lips are unrounded during the pronunciation of [ɑ]. In English, the only rounded vowels are back, though many languages, such as French and German, have rounded front vowels.

Exercise

Find five pairs of words to illustrate lip rounding. The first member of each pair of words must include a rounded vowel; the second member should be as similar as possible to the first, but must include a corresponding vowel that is not rounded. Assign a phonetic symbol to each vowel, e.g., *heat* [i], *hoot* [u]. As always, note how each vowel is ordinarily spelled.

Intermediate vowels

First, pronounce the words *meat*, *mitt*, *mate*, *met*, and *mat*. Then pronounce just their vowels:

meat	me	[i]
mitt		[ɪ]
mate	may	[e]
met		[ɛ]
mat		[æ]

The vowels we've just added, [ɪ] and [ɛ], are intermediate in height between [i] and [e], and [e] and [æ], respectively.

Exercise

For each of the vowels we've just discussed, find 5 more words in which they occur. Note how they are ordinarily spelled.

Now pronounce the series of words *suit, soot, sowed, sought, sot*. Then pronounce just their vowels:

suit	ooed	flew	[u]
soot	could		[ʊ]
sowed	code	flow	[o]
sought	fraught	caw	[ɔ]
sot	cot	spa	[ɑ]

We've added two more intermediate vowels to the back series, [ʊ] and [ɔ].

Exercise

For each of the vowels we've just discussed, find 5 more words in which they occur. Note how they are ordinarily spelled.

Now say the following words, paying attention to their vowels, and especially to the movement of your tongue as you go from one vowel to the next: *ate, up, oat*. The vowel in *ate* is [e] and that in *oat* is [o]. The vowel in *up* is represented by [ʌ], called “wedge” or “caret.”

We hope that you noticed your tongue pull back as you went from [e] to [ʌ], and back farther as you went from [ʌ] to [o]. [e] is a mid, front vowel, and [o] is a mid back vowel. As [ʌ] is between these two and at about the same height, it is a mid central vowel.

We've now added five intermediate vowels: [ɪ] as in *mitt, hid, rip*; [ɛ] as in *wept, bed, flex*; [ʊ] as in *hood, could*; [ɔ] as in *caw*; and [ʌ] as in *mutt*. Of these, [ɪ] and [ɛ] are front and unrounded, while [ʊ] and [ɔ] are back and rounded, and [ʌ] is central and unrounded. These new vowels differ from the ones we introduced earlier in several ways:

1. In length: [i], [e], [u], [o], [ɔ], and [ɑ] are longer than [ɪ], [ɛ], [æ], [ʊ], and [ʌ], when they occur in the same contexts.
2. In position in the mouth: [i] and [e] are higher and farther front than [ɪ] and [ɛ], respectively; [u] and [o] are higher and farther back than [ʊ] and [ɔ], respectively.

3. All vowels can occur in syllables (see below) that end in at least one consonant (**closed** syllables); [i], [e], [u], [o], [ɔ], and [ɑ] can occur as the final sound in a syllable (**open** syllables).
4. Muscle tension: [i], [e], [u], [o], [ɔ], and [ɑ] are produced with greater muscle tension in the articulators than [ɪ], [ɛ], [æ], [ʊ], and [ʌ] are. The former are **tense** vowels; the latter are **lax**. The greater tension in [i], [e], [u], [o], [ɔ], and [ɑ] may explain why they are longer and more peripheral, i.e., closer to the boundary of the mouth, than the other vowels.

Even though there are several differences separating these two sets of vowels, we will refer to them as **tense** and **lax** vowels. Table 5 lists all of them:

	TENSE		LAX
beat, bee	[i]	hit	[ɪ]
boot, boo	[u]	hood	[ʊ]
bait, bay	[e]	head	[ɛ]
boat, beau	[o]	hat	[æ]
bought, paw	[ɔ]	hut	[ʌ]
pot, spa	[ɑ]		

TABLE 5: TENSE AND LAX VOWELS

You may have noticed that all of the example words we have used to exemplify the vowels we have distinguished consist of a single syllable. This is because vowels in multi-syllabic words can differ from those in monosyllables, and we wanted to compare vowels in similar contexts. We have now distinguished the following vowels:

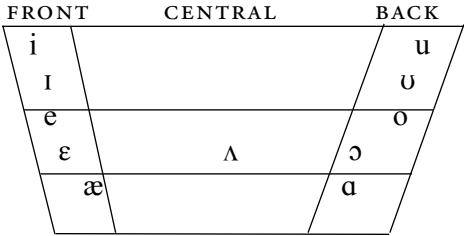


TABLE 6: ENGLISH VOWELS IN MONOSYLLABIC WORDS

Not all American English speakers distinguish [ɔ] and [ɑ] in all contexts.

In some dialects of American English (California, Midwest), the vowels [ɔ] and [ɑ] in pairs of words such as *sought* and *sot*, *caught* and *cot*, and *wrought* and *rot* are pronounced identically, though the vowel used is neither [ɔ] nor [ɑ], but one intermediate between them.

Vowels in multi-syllabic words

Pronounce the words *above*, *soda*, *sofa*, *comma*, *arena*, *patina*, *photograph*, paying particular attention to the vowel represented by the bold letters. Then pronounce this vowel in isolation. This vowel is called **schwa** and written [ə]. Schwa is made at approximately the same place as [ʌ], that is, farther forward than the back vowels and farther back than the front ones. Hence, it is central. In addition, [ə] is mid, lax, and unrounded. It is heard primarily in unstressed syllables, as in the words above. It is the vowel we produce if we vocalize as we prepare to speak—*uh*. The tongue is said to be in its neutral position as we pronounce this vowel.

Exercise

Find five words to illustrate the vowel [ə]. Can you estimate how common this vowel is in English? What letters of the alphabet ordinarily indicate this sound?

We can present the vowels as we presented the consonants, on a chart indicating their articulatory properties.

	FRONT	CENTRAL	BACK
	Unrounded		Rounded
Upper high	i		u
Lower high	ɪ		ʊ
Upper mid	e	ə	o
Lower mid	ɛ	ʌ	ɔ
Low		æ	ɑ

TABLE 7: ENGLISH VOWELS

Exercise

1. Find five words to illustrate each of the vowels we distinguish in Table 7. Be clear about which symbol most accurately applies to each vowel.

2. Provide an articulatory description for each of the following vowels; that is, indicate its height, position (front or back), tension, and lip configuration.

	[ɪ]	[e]	[u]	[ʊ]	[ɛ]	[ʌ]
Height						
Position						
Tension						
Rounding						
Example word						
	[ɑ]	[æ]	[o]	[i]	[ə]	[ɔ]
Height						
Position						
Tension						
Rounding						
Example word						

Diphthongs

We have approached vowels as if they were articulated by a specific configuration of the tongue, lips, and oral cavity, which is held constant throughout their pronunciation. Vowels made like this are called **monophthongs**; others, called **diphthongs**, involve a change in the configuration of the mouth.

The vowel sounds in the words *boy*, *by*, and *how* involve a change in the shape of the mouth as the vowel is being produced. The vowel of *boy* begins with approximately the mid back vowel [ɔ] and finishes with approximately the high front lax vowel [ɪ] (or the palatal glide [j]). The vowel of *by* begins with approximately the low back vowel [ɑ] (a low back vowel slightly more forward than [ɑ], but not as forward as [æ]) and also finishes with approximately [ɪ] (or [j]). The vowel of *how* begins with approximately [ɑ] and finishes with approximately the high lax rounded vowel [ʊ] (or the labio-velar glide [w]). We represent these diphthongs as [ɔɪ], [aɪ], and [aʊ], respectively (though many linguists use [ɔj], [aj], and [aw]).

Exercise

1. For each of the three diphthongs symbolized below provide four more example words. In two of these words the diphthong should appear in a closed syllable (i.e., before a consonant, e.g., *Boyd*) and in the other two words it should appear in an open syllable (i.e., not followed by a consonant, e.g., *boy*).

[ɔɪ]	_____	_____	_____	_____
[aɪ]	_____	_____	_____	_____
[aʊ]	_____	_____	_____	_____

2. Are the English diphthongs tense or lax? (Hint: they can occur in open syllables.)

A second set of English diphthongs is not as clearly distinguished as the first, primarily because we tend to perceive them as simple vowels. However, in a precise (**narrow**) phonetic transcription they must be represented as diphthongs. The tense front vowel [e] is diphthongized. If you listen carefully you will notice that the vowel of *bate* is actually pronounced [eɪ]. The tense back vowel [o] is also diphthongized: if you listen carefully you will notice that the vowel of *boat* is actually pronounced [oʊ]. So, the front tense vowel is diphthongized by the addition of a front vowel and the back tense vowel is diphthongized by the addition of a back vowel. We can express this pattern as a rule: *Mid and high tense vowels are diphthongized by the addition of a high lax vowel that matches the original vowel in frontness or backness.*

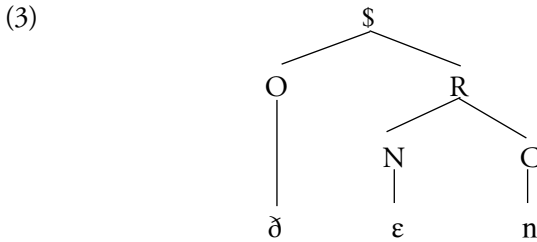
Diphthongization of these vowels is a feature of English rather than a universal feature of natural language. Other languages, notably Spanish and German, do not diphthongize their corresponding vowels. The tendency to diphthongize these vowels is one characteristic of the “foreign accent” that betrays English speakers when they begin to learn these languages.

SYLLABLES AND FEET

It's a lot easier to count syllables than to give them a satisfactory definition. If the entire class were to count the syllables in this paragraph, there would be considerable agreement about the number, but probably not about where each syllable begins and ends. The fact that syllabic writing systems developed before alphabetic systems (see our Spelling chapter in Book II) suggests that syllables are very salient linguistic units. That children seem to be able to associate symbols with syllables before they can associate symbols

with phonetic segments also points to the importance of the syllable.

Every **syllable** (symbolized as \$) consists of at least a **nucleus** (symbolized as N), which is typically a vowel. The nucleus may be preceded by an **onset** (symbolized as O), consisting of one or more consonants, and followed by a **coda** (symbolized as C), again consisting of one or more consonants. The nucleus and the coda together make up a unit called the **rhyme** (R). The diagram (3) illustrates the constituent of the single-syllable word *then*.



Because vowels are high in sonority, a syllable nucleus is usually a vowel. However, a consonant with high sonority, such as [l,r,m,n,ŋ] may also be a nucleus. The sonority level of a syllable thus rises from the onset (if there is one) up to a peak in the nucleus and falls off again in the coda. In this respect, the onset and coda are (almost) mirror images of each other.

Parts of syllables may be repeated for poetic effects. Of these repetitions, rhyme is the most important: it involves repeating the rhyme of syllables, usually at the ends of lines, as the rhyming words in the following stanza show:

- (4) Piping down the valleys wild,
 Piping songs of pleasant glee,
 On a cloud I saw a child,
 And he laughing said to me:
 (William Blake, Introduction to *Songs of Innocence*)

The syllable onsets, [w] of *wild*, [tʃ] of *child*, [gl] of *glee*, and [m] of *me* are not part of Blake's rhymes.

Repeating onsets, or first sounds in onsets, as in *then* and *there*, creates **alliteration**. Repeating nuclei, as in *Mikey likes it*, or *the incredible edible egg* creates **assonance**.

In speech, syllables are combined into rhythmic units called feet, which are also of considerable importance in scanning lines of poetry. Each **foot** consists of at least one stressed syllable (its energy peak) and one or two

unstressed syllables. Feet are differentiated from each other by the number of stressed syllables they contain and by the position of the stressed (S) syllable(s) relative to other syllables in the foot. In (5), S represents a stressed syllable and U an unstressed one; the stressed syllable of each example word is bolded.

(5) Iambic:	[U S]	today
Trochaic:	[S U]	trochee
Anapestic:	[U U S]	intervene
Dactylic:	[S U U]	personal
Spondaic:	[S S]	good news

In English, stressed syllables tend to be approximately equally far apart in time; as a result unstressed syllables may be articulated slower or faster, depending on the type of foot. (See Beers (2003: 339) Appendix I: the 175 most common syllables (as ordinarily spelled) in the 5,000 most frequently occurring English words.)

Exercise

1. In the stanza given in (4) above, identify each stressed syllable, determine the feet, and identify the kind of meter (iambic, trochaic, etc.) used.
 2. How does your dictionary identify syllables and the stressed syllable(s) in words? Why does your dictionary indicate syllabication of words? (You'll probably have to read the relevant section of your dictionary's front matter for this.) Would your dictionary and our system always give the same syllabic analysis of words?
 3. Compare the phonetic alphabet we introduced here with the system used in your dictionary to indicate pronunciation. Which is simpler to learn? Which is simpler to use? For whom? What other pros and cons can you think of for each?
-
-

PHONOLOGY

While phonetics is the study of the ways in which speech sounds are produced, **phonology** is the study of (1) how the speech sounds of a language are used in that language to distinguish meaningful units (such as words)

from each other, and (2) how sounds are patterned in a language. Consequently, the study of phonology requires us to take meaning into consideration, while phonetics does not. In this section we explore phonology and the basic unit of phonological analysis, the **phoneme**.

PHONEMES

You might reasonably have assumed that whenever speakers distinguish between a pair of sounds, they will use that difference to distinguish between words. For example, we know that English speakers distinguish between [s] and [z], and we use this difference to signal the difference between the words *sip* and *zip*. We will say that [s] and [z] **contrast** with each other in English. In fact, all of the sounds we have described so far contrast with each other in English and so are used by English speakers to distinguish words from each other. You can test this out by taking any pair of sounds (as we took [s] and [z]) and creating a pair of words (like *sip* and *zip*) which are identical, except that where one has one sound, the other has the other sound, just as where *sip* has [s], *zip* has [z]. Pairs of words like this are called **minimal pairs**, and are used to demonstrate that pairs of sounds are used in a language to distinguish words from each other. Sound units that distinguish words from each other are called **phonemes**. We enclose phonemes in / / (e.g., /s/, /z/) to distinguish them from sounds ([s], [z]) and ordinary letters (<s>, <z>).

Exercise

Phonemes are most easily identified through minimal pairs. Thus *Pete* [pit] and *beat* [bit] differ only in that where [pit] has [p], [bit] has [b]. These two words make a minimal pair that shows that [p] and [b] represent separate phonemes in English, which we symbolize as /p/, /b/. For each pair of sounds below, identify a minimal pair that shows that they represent different phonemes.

[k]–[g]	[θ]–[ð]	[ɑ]–[æ]	[l]–[r]
[n]–[ŋ]	[w]–[j]	[aɪ]–[aʊ]	[f]–[dʒ]
[f]–[s]	[i]–[ɪ]	[aɪ]–[oɪ]	[tʃ]–[dʒ]
[s]–[ʃ]	[ɛ]–[æ]	[tʃ]–[s]	[k]–[ŋ]

ALLOPHONES

Now listen to the vowels in the words *cat* and *cad*. Are they identical or different? We hope you said “different.” Can you now say how they differ? We

hope you said that one was longer than the other. Now listen to the consonants after the vowels. Are these the same or different? Again, we hope you said different, and that you know that [t] is voiceless and [d] is voiced. Now, which vowel, the longer or the shorter, precedes [d] and which precedes [t]? We hope you said that the longer vowel precedes the voiced consonant.

Are the two vowels similar in any way? Again, we hope you said that they seem to be longer and shorter versions of the same vowel, [æ]. Let's use [ɪ] to indicate extra length. So, the vowel before voiceless [t] is just [æ], but the one before voiced [d] is [æɪ].

Now let's listen to some more word pairs like *cat* and *cad*:

root	rood
moat	mode
leaf	leave
gape	Gabe

Listen to the vowels in each pair. You should hear that the vowel in the second word in each pair is a little longer than the vowel in the first.

Now determine the similarities and differences between the consonants after the vowels in each word pair. You should find that the consonant in the first word is the voiceless version of the consonant in the second word.

Turning our attention again to the vowels in each word pair: how are they related? We hope you said that they were very similar vowels, specifically, short and long versions of the same vowel.

You should now be able to determine a very general rule of English. When are vowels lengthened and when are they not lengthened?

Your answer should be something along the lines of: *English vowels are lengthened when they occur before a voiced consonant; otherwise they are not lengthened.*

So far we've seen [æ] and [æɪ], [u] and [u:], [o] and [o:], [i] and [i:], and [e] and [e:]; in each case the longer vowel occurs before a voiced consonant. We've also noted that the vowels are otherwise virtually identical—they differ only in length. So it makes good sense to regard these pairs of vowel sounds as slightly different pronunciations of the same vowel, and that whether the vowel is lengthened or not depends on whether the consonant that follows it is voiced or not.

Importantly, the long and short pairs of vowels do not contrast with each other: English contains no pairs of words that are identical except that where one contains a short version of a vowel, the other contains the longer version of the same vowel. Consequently, the long and short versions of

vowels do not represent separate phonemes.

Let's now turn our attention to some consonants. For example, English speakers pronounce the [t] in *toll* differently from that in *stole*. The [t] of *toll* is breathier than the [t] of *stole*. The former is said to be **aspirated**, and the latter **unaspirated**. We represent the aspirated [t] as [t^h], with the **diacritic** [h] indicating aspiration. We represent the unaspirated [t] as [t] with no diacritic. The important point here is that English speakers do not signal any difference in meaning with the difference between [t^h] and [t]. They treat the two sounds as variant ways of pronouncing the “the same sound.” Substituting one of these sounds for the other would not affect the meaning of a word, but it would create an odd and perhaps non-native pronunciation of the word. No pair of English words is distinguished solely by the difference between [t] and [t^h]. You can satisfy yourself that this is so by trying to find a minimal pair of English words differentiated solely by the fact that where one has an aspirated consonant the other has an unaspirated version of that same consonant. (Don't spend too long trying!)

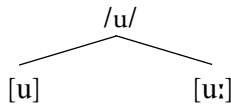
Let's now look at a different pair of English sounds. If we replace the [t] in [rat] (*rot*) with [d], then we get the sequence of sounds [rad] (*rod*), which, of course, is quite distinct in meaning from *rot*. Clearly, English speakers treat the difference between [d] and [t] differently from the way they treat the difference between [t^h] and [t] and between longer and shorter versions of vowels. In the case of [t] and [d], the difference can signal a difference in meaning; in the other cases it cannot. Differences in sound that signal differences in meaning are said to be **phonemic**, **distinctive**, or **contrastive**. Differences in sound that do not signal meaning differences are **non-distinctive** or **non-contrastive**. One objective of phonology is to identify which sound differences are contrastive and which are not. As we have seen, the contrastive sound units are called phonemes.

Phonemes and allophones

A good way to think about a phoneme is as a group of phonetically similar sounds that are treated as members of the same sound category. Because the members of a sound category are treated as “the same sound” in a language, they cannot be used for communicating differences in meaning. English speakers treat [t^h] and [t] as belonging to the same sound category, so they cannot be used to distinguish one word from another. Different phonemes are different categories of sounds and the differences among these categories can signal differences in meaning. English speakers treat [t] and [d] as belonging to different sound categories—/t/ and /d/, respectively—and so

these can be used to differentiate one word from another.

Sound categories are abstractions. We can only perceive them when one of their members is pronounced. The sounds that make up the category are called the **allophones** of that phoneme. Thus [t] and [t^h] are allophones of the English phoneme /t/. Notice that the individual sound symbols are the same as those we used for phonetics, but to distinguish phonology from phonetics, we enclose phonemes in **slanted brackets** / / and use square brackets [] for phonetic notation. Perhaps the following diagram will help. It represents the phoneme /u/ and two of its allophones:



That is, the phoneme /u/ is pronounced in (at least) two ways, [u] and [u:], depending upon its context. Table 8 lists the phonemes of English.

Consonants: /p, t, k, b, d, g, m, n, ŋ/
 /f, θ, s, ʃ, h, v, ð, z, ʒ/
 /tʃ, dʒ/
 /r, l, w, j/
 Vowels: /i, I, e, ε, æ, a, ɔ, o, u, u, (ə)/
 Diphthongs: /ɔɪ, aʊ, aɪ/

TABLE 8: ENGLISH PHONEMES

As you have no doubt noticed, there are nearly 40 phonemes of English (the number varies somewhat from dialect to dialect), while there are only 26 letters in the English alphabet. This is one of the reasons why the alphabet appears to fit the language so poorly. (For more on English spelling see our chapter on Spelling in Book II.)

Exercise

1. What phoneme is represented by the bolded letter(s) in the following words? Make sure to enclose the symbols you choose in the phoneme slashes //.

ton, bump, dip, comb, chin, zoom, shave, mango, thing, lame, read, sleep, red, mat, good, caught, kite, bid, coy.

2. Transcribe the following words in a phonemic (**broad**) transcription. That is, just represent the phonemes that each word is composed of and ignore the allophonic detail.

thin, then, cheese, rouge, June, shin, fling, heave, yak, cow.

Allophones and their contexts

We have already noted that if we substitute the aspirated allophone of /t/ for its unaspirated relative, then we create an odd pronunciation of a word. [t^hɪl] is the typical American English pronunciation of *till*, but [tɪl] is not. What, if any, patterns can we observe in where allophones of a phoneme can and cannot occur?

Some allophones of a phoneme are in **complementary distribution**, that is, they occupy different positions (**contexts** or **environments**) in words—where one can occur the other cannot. As we have seen, English has a very general pattern of lengthening vowels before voiced consonants. That is, the allophone of a vowel phoneme before a voiced consonant will be appreciably longer (up to three times longer) than the allophone of the same vowel phoneme before a voiceless consonant. For example, listen to the pronunciation of /ɛ/ in *bet* and *bed*. You should have little difficulty in hearing the difference in vowel length. We can represent the pattern of occurrence (**distribution**) of these two allophones of the phoneme /ɛ/ as the following **phonological rule**: *When the phoneme /ɛ/ occurs before a voiceless consonant it is pronounced as its allophone [ɛ]; when it occurs before a voiced consonant it is pronounced as its allophone [ɛː].* (Remember: [ː] is a diacritic indicating a lengthened sound.)

In fact, the rule is much more general than this. Because it applies to all vowels, we can write it as: *In English a vowel is longer before a voiced consonant than it is before a voiceless one.* One of our objectives in studying a language is to be able to describe these sound patterns, i.e., to be able to specify in the most general terms possible the phonetic environments in which each allophone occurs.

Let's look at another very systematic set of English vowel allophones. The vowels of *cap* and *can* differ phonetically: that of *cap* is a plain [æ]; that of *can* is **nasalized**, represented by [æ̃]. (If you have trouble hearing the difference, try starting to say each word normally and then omit the final consonant.) The phoneme /æ/ thus has the allophones, [æ] and [æ̃]. In fact, all English vowels have both nasalized and non-nasalized allophones. We can represent this as the rule: *Whenever an English vowel occurs before a nasal consonant, it becomes nasalized; otherwise it is non-nasalized.*

In fact, the situation is a bit more intricate than this. Because nasals are voiced, we should expect a vowel before them to be lengthened relative to the same vowel before a voiceless sound. And, indeed, this is what we find. Listen to the vowels in *cat*, *cad*, and *can*. You should notice that the first vowel is unlengthened, [æ]; the second one is lengthened, [æ:]; and the third one is both lengthened (in fact, probably even more than the second one) and nasalized, [æ̃:].

Exercise

1. What sounds are presented by the bolded letter(s) in the following words? Provide an allophonic (**narrow**) transcription.

mad, back, spill, cat, tang

2. Try your hand at distinguishing allophones of phonemes. Using the discussion above as a guide, see if you can describe the phonetic differences between the allophones of the designated phoneme in the example words.

- a. /k/: kin, skin
- b. /ɛ/: bet, Ben
- c. /e/: rate, raid
- d. /æ/: bat, bad
- e. /l/: lead, pull
- f. /k/: cool, keel

PHONOLOGICAL RULES

As we saw above, a **phonological rule** is a general statement about the distribution of a phoneme's allophones, e.g., those of /t/. There are several types of phonological rules to represent the several patterns of distribution of sounds in a language.

The rule for the [t^h] allophone of /t/ can be seen as adding extra breathiness after the release of a voiceless stop. This rule adds the aspiration feature to the consonant. Such rules are referred to as **feature addition rules**.

Exercise

Listen carefully to the sounds represented by the bolded letters in each of the following pairs of words: *steal*, *teal*; *spin*, *pin*; *skate*, *Kate*. What phonetic difference can you hear between the [t] of *steal* and the

[t] of *teal*? Write the two sounds in narrow (allophonic) phonetic transcription. Where does each of these two sounds occur in the example words? Answer the same questions for the [p] of *spin* and *pin* and the [k] of *skate* and *Kate*. What general pattern applies to all three pairs of sounds? Express this general pattern as a phonological rule.

Feature changing rules change the value of a component feature of a sound, for instance, from non-nasal to nasal or from short to long. The nasal pronunciation of the vowel of *can* is due, as we've seen, to the influence of the nasal consonant /n/ that comes immediately after it. In this case, the rule changes an oral (non-nasal) sound to a nasal one.

Segment deletion rules remove sound segments. For instance, in informal speech, a segment deletion rule removes the second of a pair of consonants at the end of one word when the next word begins with a consonant. Thus words such as *frost* and *ask* are pronounced as [fras] and [æs] when they occur before consonants (e.g., *Ask Katie*). This effect is especially likely when the last consonant of the first word is phonetically similar to the first consonant of the next word, as in *used to* [jus tə], instead of [just tə], (which leads to the incorrect spelling *use to*). French adjectives which end in consonants routinely lose those consonants if the following word begins with a consonant: 'small friend' *petit ami* [pətit ami] vs. 'small book' *petit livre* [pəti livr].

Phonological rules may also reverse the order of segments in words. In some dialects of English the verb *ask* is pronounced as [æks], reversing [s] and [k]. Several hundred years ago, the word *bird*, now pronounced as [bɜrd] was pronounced [brɪd]. The vowel and the [r] switched places. Rules that reverse a sequence of segments are called **metathesis rules**.

Some rules, such as the vowel nasalization rule, make a segment and its neighbor more alike. Such rules are called **assimilation rules**.

Exercise

1. (a) Identify the rapid, natural pronunciation of the sound represented by the letter <n> in the words *input*, *intake*, and *inquest*. (b) Identify the sound immediately after the sound represented by <n> in each word. (c) In what ways are the sound represented by <n> and the sound immediately following it in each word similar? (d) Express the similarity between the members of the pairs of sounds in all three words in one general rule. (e) What kind of phonological rule is this?

2. Examine the rapid, natural pronunciation of <n> in the phrases below. Write each entire phrase phonemically. Then try to state a rule that accounts for the different pronunciations. What type of rule did you discover?

- a. In Bill's house
- b. In Ted's house
- c. In Greg's house

3. Describe the phonetic difference between the allophones of /k/ (written as <c> and <k> in ordinary spelling) in the two columns of words:

coop	keep
could	kid
coat	Kate
cot	cat

Express the difference and the distribution of the allophones as a phonological rule. What kind of rule did you come up with?

Assimilation can be so thoroughgoing that two sounds can merge into one. For example, [t,d,s,z] are palatalized—i.e., pronounced [tʃ, dʒ, ʃ, ʒ] respectively—when they occur at the ends of words and the next word begins with the palatal glide [j]. For example, *Did you?* is typically pronounced as [dɪdʒə] or even [dʒə]; the [dʒ] results from the coalescence of [dj].

The study of phonology shows that languages make use of unpredictable units (phonemes) to differentiate words from each other. It also shows that languages employ very general patterns of sounds. By representing the general, predictable patterns as phonological rules, we leave only that information which is unpredictable and idiosyncratic to be listed in the set of phonemes. This way we minimize the number of basic phonemic units we need to posit; we also minimize the number of times any given piece of information is mentioned, thus simplifying the overall grammar or description of the language. For example, English has two series of vowels, those with and those without nasalization. The nasalized vowels occur only before nasal consonants; the non-nasalized ones occur everywhere else. If we merely listed all these vowels as belonging to the language, then we would have postulated far more basic units than we—or native speakers—really need. And we would have missed the generalization that the two series of vowels are really quite alike, one series being merely a predictable positional

variant of the other. We capture this generalization by eliminating the series of nasalized vowels from our inventory of basic units and replacing it with the nasalization rule.

Exercise

1. Arabic speakers learning English often produce [b] where English requires [p], e.g., saying “bark” instead of “park.” Describe the phonetic difference between [b] and [p].

2. We noted that English has approximately 40 phonemes but only 26 letters of the ordinary alphabet to represent them. Illustrate with appropriate examples at least three ways in which the English spelling system uses those 26 letters to represent its almost 40 phonemes.

REFERENCES AND RESOURCES

- Ashby, Patricia. 1995. *Speech Sounds*. London, UK: Routledge.
- Attridge, Derek. 1995. *Poetic Rhythm: an Introduction*. Cambridge, UK: Cambridge University Press.
- Beers, Kylene. 2003. *When Kids Can't Read: What Teachers Can Do*. Portsmouth, NH: Heinemann.
- Celce-Murcia, Marianne, D.M. Brinton, and J.M. Goodwin. 1996. *Teaching Pronunciation: A Reference for Teachers of English to Speakers of Other Languages*. Cambridge, UK: Cambridge University Press.
- Crane, B.L., E. Yeager, and R.L. Whitman. 1993. Phonetics. In L.M. Cleary and M.D. Linn (eds.). *Linguistics for Teachers*. pp. 397-410. New York: McGraw Hill.
- Hogg, R. and C.B. McCully. 1987. *Metrical Phonology: A Coursebook*. Cambridge, UK: Cambridge University Press.
- Kreidler, Charles W. 1997. *Describing Spoken English*. London, UK: Routledge.
- Ladefoged, Peter. 2001. *A Course in Phonetics*. (4th ed.) Ft. Worth, TX: Harcourt, Brace, Jovanovich.
- _____. 2005. *Vowels and Consonants*. (2nd ed.) Oxford, UK: Blackwell.
- Lass, Roger. 1984. *Phonology: An Introduction to Basic Concepts*. Cambridge, UK: Cambridge University Press.
- McMahon, April. 2001. *An Introduction to English Phonology*. Oxford, UK: Oxford University Press.
- Pennington, Martha C. 1996. *Phonology in English Language Teaching*.

London, UK: Longman.

Yavaş, Mehmet. 2006. *Applied English Phonology*. Oxford, UK: Blackwell.

GLOSSARY

AFFRICATE: sound produced with full stoppage of the airstream followed immediately by constriction.

ALLOPHONE: non-distinctive phonetic variant of a phoneme.

ALVEO-PALATAL: sound produced at the hard palate just behind the alveolar ridge.

ALVEOLAR: sound produced at the alveolar ridge, the bony ridge behind the teeth.

APPROXIMANTS: sounds produced when the articulators approach each other but not so closely as to cause turbulence in the airstream; they include laterals (the tongue touches the top of the mouth but the air is allowed to pass along one or both sides, as in [l]); central (the sides of the tongue are raised so that air flows along the center of the mouth, as in [r]); as well as the labiovelar [w] and palatal [j].

ASPIRATED: consonant sound released with a puff of air.

ASSIMILATION RULE: phonological rule that makes a sound similar to a nearby sound. e.g., palatalization.

BACK VOWEL: vowel produced with the back of the tongue raised toward the soft palate.

BILABIAL: sound produced with constriction or closure of the lips.

BROAD TRANSCRIPTION: the attempt to record pronunciation without regard to non-contrastive details. See **NARROW TRANSCRIPTION**.

CENTRAL: vowel—e.g., [ə]—produced with the tongue raised at the center of the mouth rather than at the front or back.

CODA: last part of a syllable; follows the nucleus.

COMPLEMENTARY DISTRIBUTION: when the allophones of a phoneme occupy different positions in words.

CONSONANT: sound produced with complete or partial obstruction of the air flow through the mouth. See **VOWEL**.

CONTRASTIVE (also **DISTINCTIVE**): sounds used in a language to signal differences of meaning.

DIACRITIC: phonetic symbols used to represent fine differences in pronunciation, e.g., the [h] that indicates aspiration.

DIPHTHONG: vowel unit that begins with one oral configuration and ends with another. See **MONOPHTHONG**.

DISTINCTIVE: See **CONTRASTIVE**.

DISTRIBUTION: specific circumstances (**ENVIRONMENTS**) in which a sound oc-

curs, e.g., at the beginning, middle, or end of a word.

ENVIRONMENT: See **DISTRIBUTION**.

FEATURE CHANGING RULE: rule that changes the value of a component feature of a sound, e.g., from stop to fricative, from non-nasal to nasal, or from lax to tense.

FOOT: a rhythmic unit consisting of at least one stressed syllable and 1-2 other syllables, typically unstressed.

FRICATIVE: sound produced with constriction of the airstream, producing friction.

FRONT VOWEL: vowel produced with the front of the tongue raised toward the hard palate.

GLIDES: sounds, e.g., [j] and [w], that are intermediate in openness and sonority between consonants and vowels. Also called **SEMIVOWELS**.

GLOTTAL: sound produced by constricting or stopping the airstream at the vocal folds.

HIGH VOWEL: vowel pronounced with the mouth in the least degree of openness. See **MID VOWEL** and **LOW VOWEL**.

INTERDENTAL: sound produced with the tongue protruding between the teeth.

LABIODENTAL: sound produced with constriction between the bottom lip and top teeth.

LABIOVELAR: sound produced by raising the back of the tongue to or toward the velum and rounding the lips, e.g., [w].

LATERAL: sound produced with the tongue touching the top of the mouth with air allowed to pass along one or both sides, as in [l].

LAX: sound produced with musculature of the mouth relatively relaxed. See **TENSE**.

LOW VOWEL: vowel pronounced with the mouth in the greatest degree of openness. See **HIGH VOWEL** and **MID VOWEL**.

MANNER OF ARTICULATION: the kind of closure or constriction used in making a consonant sound.

METATHESIS RULE: phonological rule that reverses the order of segments in words.

MID VOWEL: vowel pronounced with the mouth in an intermediate degree of openness. See **HIGH VOWEL** and **LOW VOWEL**.

MINIMAL PAIR: two words of different meaning that are phonetically the same except for one sound, e.g., **pit** and **bit** (used to demonstrate that [p] and [b] contrast with each other).

MONOPHTHONG: vowel unit consisting of a single segment held constant during its pronunciation. See **DIPHTHONG**.

NARROW TRANSCRIPTION: attempt to record non-contrastive details of pronunciation. See **BROAD TRANSCRIPTION**.

NASAL, NASALIZED: sounds articulated with air flowing through the nasal cavity.

NON-CONTRASTIVE (also NON-DISTINCTIVE): sounds not used in a language to signal different meanings.

NUCLEUS: central part of a syllable, i.e., the segment with the highest sonority.

ONSET: initial part of a syllable; precedes the nucleus.

PHONEME: contrastive or distinctive sound category; distinguishes words from each other.

PHONETICS (ARTICULATORY): the study of how speech sounds are produced.

PHONOLOGICAL RULE: a general statement about the distribution of a phoneme's allophones and about other phonological processes.

PHONOLOGY: the study of the ways in which a given language shapes sounds into distinctive categories of perception and of its rules of pronunciation.

PLACE OF ARTICULATION: the area in the mouth at which the consonantal closure or constriction occurs.

RHYME: the nucleus and coda of a syllable.

ROUNDED: vowel sound produced with the lips pursed. See **UNROUNDED**.

SCHWA: a mid central unrounded vowel, represented as [ə].

SEGMENT DELETION RULE: phonological rule that eliminates a sound from pronunciation in a word or phrase.

SEMIVOWEL: see **GLIDE**.

SONORANT: sounds produced with a smooth airflow, allowing for a high degree of resonance.

STOP: sound produced with full stoppage of the airstream anywhere in the *oral* cavity from the vocal folds to the lips.

TENSE: sound produced with musculature of the mouth relatively tight. See **LAX**.

UNROUNDED: vowel produced without lip rounding. See **ROUNDED**.

VELAR: sound produced with constriction at the soft palate.

VOICED: sound produced with the vocal folds vibrating.

VOICELESS: sound produced with the vocal folds not vibrating.

VOWEL: sound produced with smooth, unobstruction air stream through the mouth. See **CONSONANT**.