= Proto @-@ Indo @-@ European root =

The roots of the reconstructed Proto @-@ Indo @-@ European language (PIE) are basic parts of words that carry a lexical meaning , so @-@ called morphemes . PIE roots usually have verbal meaning like " eat " or " run " . Roots never occur alone in the language . Complete inflected words like verbs , nouns or adjectives are formed by adding further morphemes to a root .

= = Word formation = =

Typically , a root plus a suffix forms a stem , and adding an ending forms a word .
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For example , * b?éreti ' he carries ' can be split into the root * b?er- ' to carry ' , the suffix * -e- ' imperfective aspect ' and the ending * -ti ' present tense , third person singular ' .
The suffix is sometimes missing , which has been interpreted as a zero suffix . Words with zero suffix are termed root verbs and root nouns . Beyond this basic structure , there is the nasal infix , a present tense marker , and reduplication , a sort of prefix with a number of grammatical and derivational functions .

= = = Finite verbs = = =

Verbal suffixes , including the zero suffix , convey grammatical information about tense and aspect , two grammatical categories that are not clearly distinguished . Present and aorist are universally recognised , while some of the other aspects remain controversial . Two of the four moods , the subjunctive and the optative , are also formed with suffixes , which sometimes results in forms with two consecutive suffixes : * b?ér @-@ e @-@ e @-@ ti > * b?ér?ti ' he would carry ' , with the first * e being the present tense marker , and the second the subjunctive marker . Reduplication can mark the present and the perfect .
Verbal endings convey information about grammatical person , number and voice . The imperative mood has its own set of endings .

= = = Nouns and adjectives = = =

Nouns usually derive from roots or verb stems by suffixation or by other means (see the morphology of the Proto @-@ Indo @-@ European noun for some examples) . This can hold even for roots that are often translated as nouns : * ped- , for example , can mean ' to tread ' or ' foot ' , depending on the ablaut grade and ending . Some nouns like * ag?n @-@ o- ' lamb ' or * h ? ster- ' star ' , however , do not derive from verbal roots . In any case , the meaning of a noun is given by its stem , whether this is composed of a root plus a suffix or not . This leaves the ending , which conveys case and number .
Adjectives are also derived by suffixation of (usually verbal) roots . An example is * ?n ? h ? -tó @-@ s ' begotten , produced ' from the root * ?enh ? - ' to beget , to produce ' . The endings are the same as with nouns .

= = = Infinitives and participles = = =

Infinitives are verbal nouns and , just like other nouns , are formed with suffixes . It is not clear whether any of the infinitive suffixes reconstructed from the daughter languages (* -d?ye- , * -tu- , * -ti- , among others) was actually used to express an infinitive in PIE .
Participles are verbal adjectives formed with the suffixes * -ent- (active imperfective and aorist participle) , * -wos- (perfect participle) and * -mh ? no- or * -m (e) no- (mediopassive participle) , among others .

= = Shape of a root = =

In its base form , a PIE root consists of a single vowel , preceded and followed by consonants . Except for a very few cases , the root is fully characterized by its consonants , while the vowel may alternate in accordance with inflection or word derivation . Thus , the root * b?er- can also appear as * b?or- , with a long vowel as * b??r- or * b??r- , or even unsyllabic as * b?r- , in different grammatical contexts . This process is called ablaut .

In linguistic works , * e is used to stand in for the various ablaut grades that the vowel may appear in . Some reconstructions also include roots with * a as the vowel , but the existence of * a as a distinct vowel is disputed ; see Indo @-@ European ablaut : a @-@ grade . The vowel is flanked on both sides by one or more consonants ; the preceding consonants are the onset , the following ones are the coda .

The onset and coda must contain at least one consonant ; a root may not begin or end with the ablaut vowel . Consequently , the simplest roots have an onset and coda consisting of one consonant each . Such simple roots are common ; examples are : * deh ? - ' to give ' , * b?er- ' to carry ' , * d?eh ? - ' to put ' , * d?ew- ' to run ' , * h ? ed- ' to eat ' , * h ? e?- ' sharp ' , * ped- ' to tread ' , * sed- ' to sit ' , * wes- ' to clothe ' . Roots can also have a more complex onset and coda , consisting of a consonant cluster (multiple consonants) . These include : * d?wes- ' to breathe ' , * h ? rewd?- ' red ' , * h ? erh ? - ' to plough ' , * h ? re?- ' straight ' , * ley?- ' to bind ' , * prews- ' to freeze ' , * srew- ' to flow ' and * swep- ' to sleep ' , * wleyk?- ' to moisten ' . The maximum number of consonants seems to be five , as in * streng?- ' to twine ' .

Early PIE scholars reconstructed a number of roots beginning or ending with a vowel . The latter type always had a long vowel (* d??- ' to put ' , * b?w?- ' to grow ' , * d?- ' to give ') , while this restriction did not hold for vowel @-@ initial roots (* ed- ' to eat ' , * a?- ' to drive ' , * od- ' to smell ') . Laryngeal theory can explain this behaviour by reconstructing a laryngeal following the vowel (* d?eh ? - , * b?weh ? - , * deh ? - , resulting in a long vowel) or preceding it (* h ? ed- , * h ? e?- , * h ? ed- , resulting in a short vowel) . These reconstructions obey the mentioned rules .

= = = Sonority hierarchy = = =

When the onset or coda of a root contains a consonant cluster , the consonants in this cluster must be ordered according to their sonority . The vowel constitutes a sonority peak , and the sonority must progressively rise in the onset and progressively fall in the coda .

PIE roots distinguish three main classes of consonants , arranged from high to low sonority :

Non @-@ labial sonorants * l , * r , * y , * n , denoted collectively as R.

Labial sonorants * w * m , denoted collectively as M.

Obstruents , denoted collectively as * C. These include three subgroups :

Plosives (voiceless * p * t * ? * k * k? , voiced * b * d * ? * g * g? and aspirated * b? * d? * ?? * g? * g??) , denoted collectively as * P.

The sibilant * s .

The laryngeals * h ? * h ? * h ? , denoted collectively as H.

The following rules apply :

A consonant closer to the main vowel must have a higher sonority than the consonant further away . Thus , consonants in the onset must follow the order CMR , and the reverse RMC in the coda , giving CMReRMC as the full root shape . Roots with a different order of sonority , like * * mter- or * * resl- , are not allowed .

Only one member of each sonority class may appear in the onset or coda . Thus , roots like * * wmek- , * * lekt- or * * peyl- are not allowed .

Strangely , laryngeals can also occur in the coda before a sonorant , as in * peh ? w- ' small ' .

= = = Obstruent clusters = = =

The obstruent slot of an onset or coda may consist of multiple obstruents itself . Here , too , only one member of each subgroup of obstruents may appear in the cluster ; a cluster may not contain

multiple laryngeals , sibilants or plosives .
The rules for the ordering within a cluster of obstruents are somewhat different , and do not fit into the general sonority hierarchy :
* s may appear only before a plosive , not after it . Thus , * spe?- ' to observe ' , * steh ? - ' to stand ' and * strew- ' to spread ' are valid roots . * * tser- and * * ?eps- are not . Plosives are automatically devoiced when preceded by * s in the onset .
A laryngeal may appear before or after any obstruent other than another laryngeal . Examples are * keh ? p- ' to grab ' , * peth ? - ' to fly ' .
In several roots , an unusual phenomenon called s @-@ mobile occurs , where some descendants include a prepended * s while other forms lack it . There does not appear to be any particular pattern ; sometimes forms with * s and without it even occur side by side in the same language .

= = = Further restrictions = = =

PIE abided by the general cross @-@ linguistic constraint against the co @-@ occurrence of two similar consonants in a word root . In particular , no examples are known of roots containing two plain voiced plosives (* * ged-) or two glides (* * ler-) . A few examples of roots with two fricatives , two nasals , or two glides (* h ? eh ? - , * nem- etc .) can be reconstructed , but they were rare as well . An exception , however , were the voiceless and voiced aspirated plosives , which relatively commonly co @-@ occurred (e.g. * peth ? - ' to fly ' , * d?eg??- ' to burn ') . In particular , roots with two voiced aspirates were more than twice as common than could be expected to occur by chance .
An additional constraint prohibited roots containing both a voiced aspirated and a voiceless plosive (* * teb?-) , unless the latter occurs in a word @-@ initial cluster after an * s (e.g. * steb?- ' to stiffen ') . Taken together with the abundance of * D?eD? @-@ type roots , it has been proposed that this distribution results from a limited process of voice assimilation in pre @-@ PIE , where a voiceless stop was assimilated to a voiced aspirate , if another one followed or preceded within a root .

= = = Exceptions = = =

Some roots cannot be reconstructed with an ablauting * e , an example being * b?uH- ' to grow , to become ' . Such roots can be seen as generalized zero grades of forms like * * b?weH- , and thus follow the phonotactical rules .
Some roots like * pster- ' to sneeze ' or * pteh ? k- ' to duck ' do not appear to follow these rules . This might be due to incomplete understanding of PIE phonotactics or to wrong reconstructions . * pster- , for example , might not have existed in PIE at all , if the Indo @-@ European words usually traced back to it are onomatopoeias .
Thorn clusters are sequences of a dental (* t * d * d?) plus a velar plosive (* k * g * g? etc .) . Their role in PIE phonotactics is unknown . Roots like * d?g??ei- ' to perish ' apparently violate the phonotactical rules , but are quite common .

= = Lexical meaning = =

The meaning of a reconstructed root is conventionally that of a verb ; the terms root and verbal root are almost synonymous in PIE grammar . This is because , apart from a limited number of so @-@ called root nouns , PIE roots overwhelmingly participate in verbal inflection through well @-@ established morphological and phonological mechanisms . Their meanings are not always directly reconstructible , due to semantic shifts that led to discrepancies in the meanings of reflexes in the attested daughter languages . Many nouns and adjectives are derived from verbal roots via suffixes and ablaut .
Nevertheless , some roots did exist that did not have a primary verbal derivation . Apart from the aforementioned root nouns , the most important of these were the so @-@ called Caland roots , which had adjectival meaning . Such roots generally formed proterokinetic adjectives with the suffix *

-u- , thematic adjectives in * -ró- and compounding stems in * -i- . They included at least * h ? rewd?- ' red ' , * h ? er?- ' white ' , * d?ewb- ' deep ' and * g?reh ? - ' heavy ' .

Verbal roots were inherently imperfective (durative , present) or perfective (punctual , aoristic) . To form a verb from the root 's own aspect , verb endings were attached directly to the root , either with or without a thematic vowel . The " other " aspect , if it was needed , would then be a so @-@ called " characterised " stem , as detailed in Proto @-@ Indo @-@ European verb . The characterised stems are often different in different descendants , which suggests that they did not yet exist in PIE proper .

= = Creation of new roots = =

Roots were occasionally created anew within PIE or its early descendants . A variety of methods have been observed .

= = = Root extensions = = =

Root extensions are additions of one or two sounds , often plosives , to the end of a root . These extensions do not seem to change the meaning of a root , and often lead to variant root forms across different descendants . The source and function of these extensions is not known .

For * (s) tew- ' to push , hit , thrust ' , we can reconstruct :

* (s) tewk- > Ancient Greek ????? (túkos) ' hammer'
* (s) tewg- > English stoke (Germanic k goes back to PIE * g .)
* (s) tewd- > Vedic tudáti ' beats'

= = = Sonorant metathesis = = =

When the root contains a sonorant , the zero grade is ambiguous as to whether the sonorant should be placed before the ablaut vowel or after it . Speakers occasionally analysed such roots the " wrong " way , and this has led to some roots being created from existing ones by swapping the position of the sonorant .

An example of such a pair of roots , both meaning ' to increase , to enlarge ' :

* h ? weg- > Gothic wahsjan , Ancient Greek aéks? .
* h ? ewg- > Gothic aukan , Latin auge? , Lithuanian áugti .

Another example concerns the root ' sky ' :

* dyew- > Ancient Greek Zeus , Latin di?s , Sanskrit dyú .
* deyw- > Latin d?vus , Old Prussian deiwis , Sanskrit devá .