

GEPHE SUMMARY

<p>enamelin (ENAM) (https://www.gephebase.org/search-criteria?/and+Gene Gephebase=[^]enamelin (ENAM)[^]#gephebase-summary-title)</p> <p>Published</p>	<p>Gephebase Gene</p> <p>Entry Status</p>	<p>GP00001945</p> <p>Courtier</p>	<p>GepheID</p> <p>Main curator</p>
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PHENOTYPIC CHANGE

<p>Physiology (https://www.gephebase.org/search-criteria?/and+Trait Category=[^]Physiology[^]#gephebase-summary-title)</p> <p>Tooth composition (no enamel production) (<a href="https://www.gephebase.org/search-criteria?/and+Trait=<sup>^</sup>Tooth composition (no enamel production)<sup>^</sup>#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Trait=[^]Tooth composition (no enamel production)[^]#gephebase-summary-title)</p> <p>presence of enamel</p> <p>absence of enamel</p> <p>Taxon A</p> <p>Intergeneric or Higher (https://www.gephebase.org/search-criteria?/and+Taxonomic Status=[^]Intergeneric or Higher[^]#gephebase-summary-title)</p>	<p>Trait Category</p> <p>Trait</p> <p>Trait State in Taxon A</p> <p>Trait State in Taxon B</p> <p>Ancestral State</p> <p>Taxonomic Status</p>
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Taxon A		Taxon B #1	
<p>Canis lupus familiaris (<a href="https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=<sup>^</sup>Canis lupus familiaris<sup>^</sup>#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=[^]Canis lupus familiaris[^]#gephebase-summary-title)</p> <p>dog</p> <p>Canis canis; Canis domesticus; Canis familiaris; dog; dogs; Canis familiaris Linnaeus, 1758; Canis lupus familiaris Linnaeus, 1758</p> <p>subspecies</p> <p>cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Sarcopterygii; Dipnotetrapodomorpha; Tetrapoda; Amniota; Mammalia; Theria; Eutheria; Boreoeutheria; Laurasiatheria; Carnivora; Caniformia; Canidae; Canis; Canis lupus</p> <p>Canis lupus (gray wolf) - (Rank: species) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9612)</p> <p>9615 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9615)</p> <p>No</p>	<p>Latin Name</p> <p>Common Name</p> <p>Synonyms</p> <p>Rank</p> <p>Lineage</p> <p>Parent</p> <p>NCBI Taxonomy ID</p> <p>is Taxon A an Infrappecies?</p>	<p>Bradypus tridactylus (<a href="https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=<sup>^</sup>Bradypus tridactylus<sup>^</sup>#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=[^]Bradypus tridactylus[^]#gephebase-summary-title)</p> <p>Pale-throated sloth</p> <p>Pale-throated sloth; pale-throated three-toed sloth; Bradypus tridactylus Linnaeus, 1758</p> <p>species</p> <p>cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Sarcopterygii; Dipnotetrapodomorpha; Tetrapoda; Amniota; Mammalia; Theria; Eutheria; Xenarthra; Pilosa; Folivora; Bradypodidae; Bradypus</p> <p>Bradypus (three-toed sloths) - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9353)</p> <p>9354 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9354)</p> <p>No</p>	<p>Latin Name</p> <p>Common Name</p> <p>Synonyms</p> <p>Rank</p> <p>Lineage</p> <p>Parent</p> <p>NCBI Taxonomy ID</p> <p>is Taxon B an Infrappecies?</p>

Taxon B #2		
<p>Tamandua tetradactyla (<a href="https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=<sup>^</sup>Tamandua tetradactyla<sup>^</sup>#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=[^]Tamandua tetradactyla[^]#gephebase-summary-title)</p> <p>southern tamandua</p> <p>southern tamandua</p> <p>species</p> <p>cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Sarcopterygii; Dipnotetrapodomorpha; Tetrapoda; Amniota; Mammalia; Theria; Eutheria; Xenarthra; Pilosa; Vermilingua; Myrmecophagidae; Tamandua</p> <p>Tamandua () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9350)</p> <p>48850 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=48850)</p>	<p>Latin Name</p> <p>Common Name</p> <p>Synonyms</p> <p>Rank</p> <p>Lineage</p> <p>Parent</p> <p>NCBI Taxonomy ID</p>	<p>is Taxon B an Infrappecies?</p>

<p>Tamandua tetradactyla (<a href="https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=<sup>^</sup>Tamandua tetradactyla<sup>^</sup>#gephebase-summary-title">https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=[^]Tamandua tetradactyla[^]#gephebase-summary-title)</p> <p>southern tamandua</p> <p>southern tamandua</p> <p>species</p> <p>cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Sarcopterygii; Dipnotetrapodomorpha; Tetrapoda; Amniota; Mammalia; Theria; Eutheria; Xenarthra; Pilosa; Vermilingua; Myrmecophagidae; Tamandua</p> <p>Tamandua () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9350)</p> <p>48850 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=48850)</p>	<p>Latin Name</p> <p>Common Name</p> <p>Synonyms</p> <p>Rank</p> <p>Lineage</p> <p>Parent</p> <p>NCBI Taxonomy ID</p>	<p>is Taxon B an Infrappecies?</p>

is Taxon B an Intraspecies?

No

Taxon B #3

Latin Name

Dasyopus novemcinctus
([https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms="Dasyopus novemcinctus`#gephebase-summary-title](https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=))

Common Name

nine-banded armadillo

Synonyms

nine-banded armadillo

Rank

species

Lineage

cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Sarcopterygii; Dipnotetrapodomorpha; Tetrapoda; Amniota; Mammalia; Theria; Eutheria; Xenarthra; Cingulata; Dasypodidae; Dasyopus

Parent

Dasyopus () - (Rank: genus)
(<https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9360>)

NCBI Taxonomy ID

9361
(<https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=9361>)

is Taxon B an Intraspecies?

No

Taxon B #4

Latin Name

Euphractus sexcinctus
([https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms="Euphractus sexcinctus`#gephebase-summary-title](https://www.gephebase.org/search-criteria?/and+Taxon+and+Synonyms=))

Common Name

-

Synonyms

-

Rank

species

Lineage

cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Deuterostomia; Chordata; Craniata; Vertebrata; Gnathostomata; Teleostomi; Euteleostomi; Sarcopterygii; Dipnotetrapodomorpha; Tetrapoda; Amniota; Mammalia; Theria; Eutheria; Xenarthra; Cingulata; Chlamyphoridae; Euphractus

Parent

Euphractus () - (Rank: genus)
(<https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=143299>)

NCBI Taxonomy ID

143300
(<https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=143300>)

is Taxon B an Intraspecies?

No

GENOTYPIC CHANGE

ENAM	Generic Gene Name	Q9NRM1 (http://www.uniprot.org/uniprot/Q9NRM1)	UniProtKB Homo sapiens
ADA1; AI1C; AIH2	Synonyms	()	GenebankID or UniProtKB
9606.ENSP00000379383 (http://string-db.org/newstring.cgi/show_network_section.pl?identifier=9606.ENSP00000379383)	String		
-	Sequence Similarities		
GO:0030345 : structural constituent of tooth enamel (https://www.ebi.ac.uk/QuickGO/term/GO:0030345)	GO - Molecular Function		
GO:0044267 : cellular protein metabolic process (https://www.ebi.ac.uk/QuickGO/term/GO:0044267)	GO - Biological Process		

GO:0043687 : post-translational protein modification
(<https://www.ebi.ac.uk/QuickGO/term/GO:0043687>)
GO:0031214 : biomineral tissue development
(<https://www.ebi.ac.uk/QuickGO/term/GO:0031214>)
GO:0036305 : ameloblast differentiation
(<https://www.ebi.ac.uk/QuickGO/term/GO:0036305>)
GO:0097186 : amelogenesis (<https://www.ebi.ac.uk/QuickGO/term/GO:0097186>)
GO:0070175 : positive regulation of enamel mineralization
(<https://www.ebi.ac.uk/QuickGO/term/GO:0070175>)
GO:0022604 : regulation of cell morphogenesis
(<https://www.ebi.ac.uk/QuickGO/term/GO:0022604>)

GO - Cellular Component

GO:0031012 : extracellular matrix (<https://www.ebi.ac.uk/QuickGO/term/GO:0031012>)
GO:0005788 : endoplasmic reticulum lumen
(<https://www.ebi.ac.uk/QuickGO/term/GO:0005788>)

Presumptive Null

Yes (<https://www.gephebase.org/search-criteria?/and+Presumptive Null=^Yes^#gephebase-summary-title>)

Molecular Type

Coding (<https://www.gephebase.org/search-criteria?/and+Molecular Type=^Coding^#gephebase-summary-title>)

Aberration Type

Unknown (<https://www.gephebase.org/search-criteria?/and+Aberration Type=^Unknown^#gephebase-summary-title>)

Molecular Details of the Mutation

multiple frameshift insertions and deletions

Experimental Evidence

Candidate Gene (<https://www.gephebase.org/search-criteria?/and+Experimental Evidence=^Candidate Gene^#gephebase-summary-title>)

Main Reference

Molecular decay of the tooth gene Enamelin (ENAM) mirrors the loss of enamel in the fossil record of placental mammals. (2009) (<https://pubmed.ncbi.nlm.nih.gov/19730686>)

Authors

Meredith RW; Gatesy J; Murphy WJ; Ryder OA; Springer MS

Abstract

Vestigial structures occur at both the anatomical and molecular levels, but studies documenting the co-occurrence of morphological degeneration in the fossil record and molecular decay in the genome are rare. Here, we use morphology, the fossil record, and phylogenetics to predict the occurrence of "molecular fossils" of the enamelin (ENAM) gene in four different orders of placental mammals (Tubulidentata, Pholidota, Cetacea, Xenarthra) with toothless and/or enamelless taxa. Our results support the "molecular fossil" hypothesis and demonstrate the occurrence of frameshift mutations and/or stop codons in all toothless and enamelless taxa. We then use a novel method based on selection intensity estimates for codons (omega) to calculate the timing of iterated enamel loss in the fossil record of aardvarks and pangolins, and further show that the molecular evolutionary history of ENAM predicts the occurrence of enamel in basal representatives of Xenarthra (sloths, anteaters, armadillos) even though frameshift mutations are ubiquitous in ENAM sequences of living xenarthrans. The molecular decay of ENAM parallels the morphological degeneration of enamel in the fossil record of placental mammals and provides manifest evidence for the predictive power of Darwin's theory.

Additional References

RELATED GEPHE

Related Genes

No matches found.

Related Haplotypes

1 ([https://www.gephebase.org/search-criteria?/or+Gene Gephebase=^enamelin \(ENAM\)^/and+Taxon ID=^9615^/or+Gene Gephebase=^enamelin \(ENAM\)^/and+Taxon ID=^9354^/or+Gene Gephebase=^enamelin \(ENAM\)^/and+Taxon ID=^48850^/or+Gene Gephebase=^enamelin \(ENAM\)^/and+Taxon ID=^9361^/or+Gene Gephebase=^enamelin \(ENAM\)^/and+Taxon ID=^143300^#gephebase-summary-title](https://www.gephebase.org/search-criteria?/or+Gene Gephebase=^enamelin (ENAM)^/and+Taxon ID=^9615^/or+Gene Gephebase=^enamelin (ENAM)^/and+Taxon ID=^9354^/or+Gene Gephebase=^enamelin (ENAM)^/and+Taxon ID=^48850^/or+Gene Gephebase=^enamelin (ENAM)^/and+Taxon ID=^9361^/or+Gene Gephebase=^enamelin (ENAM)^/and+Taxon ID=^143300^#gephebase-summary-title))

EXTERNAL LINKS

COMMENTS

@ParrallelEvolution in baleen whales. No unique homoplasy-free frameshifts in AMELX; AMBN; MMP20 or ENAM in the common ancestry of either Xenarthra or Dasypodidae. This is consistent with the hypothesis that enamel was lost independently in Pilosa and also in more than one dasypodid lineage.