## GEPHE SUMMARY

Gephebase Gene
enamelin (ENAM) (https://www.gephebase.org/search-criteria?/and+Gene Gephebase=^enamelin (ENAM)^#gephebase-summary-title)

GepheID
GP00001945

Entry Status
Published

Main curator
Courtier

## PHENOTYPIC CHANGE

Trait Category
Physiology (https://www.gephebase.org/search-criteria?/and+Trait Category=^Physiology^#gephebase-summary-title)

Trait
Tooth composition (no enamel production) (https://www.gephebase.org/search-criteria?/and+Trait=^Tooth composition (no enamel production)^#gephebase-summary-title)

Trait State in Taxon A
presence of enamel

Trait State in Taxon B
absence of enamel

Ancestral State
Taxon A

Taxonomic Status
Intergeneric or Higher (https://www.gephebase.org/search-criteria?/and+Taxonomic Status=^Intergeneric or Higher^#gephebase-summary-title)

### Taxon A

Latin Name
Canis lupus familiaris (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Canis lupus familiaris^#gephebase-summary-title)

Common Name
dog

Synonyms
Canis canis; Canis domesticus; Canis familiaris; dog; dogs; Canis familiaris Linnaeus, 1758; Canis lupus familiaris Linnaeus, 1758

Rank
subspecies

Lineage
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

Parent
Canis lupus (gray wolf) - (Rank: species) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 9612 )

NCBI Taxonomy ID
9615 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 9615 )

is Taxon A an Infraspecies?
No

### Taxon B #1

Latin Name
Bradypus tridactylus (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Bradypus tridactylus^#gephebase-summary-title)

Common Name
Pale-throated sloth

Synonyms
Pale-throated sloth; pale-throated three-toed sloth; Bradypus tridactylus Linnaeus, 1758

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; Pilosa; Folivora; Bradypodidae; Bradypus

Parent
Bradypus (three-toed sloths) - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 9353 )

NCBI Taxonomy ID
9354 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 9354 )

is Taxon B an Infraspecies?
No

### Taxon B #2

Latin Name
Tamandua tetradactyla (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Tamandua tetradactyla^#gephebase-summary-title)

Common Name
southern tamandua

Synonyms
southern tamandua

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; Pilosa; Vermilingua; Myrmecophagidae; Tamandua

Parent
Tamandua () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 9350 )

NCBI Taxonomy ID
48850 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id= 48850 )

is Taxon B an Infraspecies?

No

### Taxon B #3

Latin Name

Dasypus novemcinctus (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=^Dasypus novemcinctus^#gephebase-summary-title)

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; Dasypus

Parent

Dasypus () - (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 Infraspecies?

No

### Taxon B #4

Latin Name

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

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 Infraspecies?

No

## GENOTYPIC CHANGE

Generic Gene Name

ENAM

Synonyms

ADAI; AI1C; AIH2

String

9606.ENSP00000379383 (http://string-db.org/newstring_cgi/show_network_section.pl?identifier=9606.ENSP00000379383 )

Sequence Similarities

-

GO - Molecular Function

GO:0030345 : structural constituent of tooth enamel (https://www.ebi.ac.uk/QuickGO/term/GO:0030345)

GO - Biological Process

GO:0044267 : cellular protein metabolic process (https://www.ebi.ac.uk/QuickGO/term/GO:0044267)

UniProtKB Homo sapiens

Q9NRM1 (http://www.uniprot.org/uniprot/Q9NRM1)

GenebankID or UniProtKB

()

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)

## 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.