

PSEUDOGENE PPT SCRIPT

1. Title: [One-Gene-One-Enzyme, Pseudogenes & Common Ancestry](#)

The following animation is intended to show:

1. The one-gene-one-enzyme hypothesis
2. How a mutation in one gene (probably in some early pre-primate) prevented the production of Vitamin C, explaining why all primates today require Vitamin C in their diets (not so with other mammals).
3. The GULO pseudogene evidence for the common ancestry of primates.

SYNOPSIS

This short PowerPoint show can be used to introduce the Pseudogene lesson on the ENSI site. Part C of the **Pseudogene Suite** provides an opportunity for students to count the differences between the GULO Pseudogenes of four primates and the working GULO gene (necessary for producing vitamin C) found in other mammals. Parts A and B of the Pseudogene Suite provide background experiences that lead to Part C. At the very least, part of this show can be used to conveniently demonstrate the one-gene-one-enzyme concept.

2. What is a Pseudogene?

A pseudogene is a DNA sequence that is nearly identical to that of a functional gene, but contains one or more mutations, making it non-functional. Much of the intron material in the genomes of organisms is composed of recognizable pseudogenes.

3. Pseudogenes and Vitamin C

DNA segment

Gene 1 produces Enzyme 1 which catalyzes substance A into substance B

Gene 2 produces Enzyme 2 which catalyzes substance B into substance C

Gene 3 produces Enzyme 3 which catalyzes substance C into substance D

Gene 3 (in most mammals) is the “GULO” gene, because it produces the “GULO” enzyme, required to change substance C into Vitamin C. “GULO” is short for “L-gulonolactone oxidase”

This “Not so in primates” [monkeys, apes, and humans], where the GULO gene has mutated, and the GULO enzyme is not produced, so Vitamin C is not produced

So Primates must now feed on fruit rich in vitamin C, required for good health.

[Actually, early or pre-primates were probably feeding extensively on such fruit prior to the mutation, so when it happened, the lack of metabolic vitamin C had no effect on survival, and the mutated GULO gene (pseudogene) was retained in the primate genome, along with obligatory dependence on vitamin C in their diets, accumulating additional minor changes over time.]

Portion of Working GULO gene in a rat

Matching GULO Pseudogene segments in four primates

Green-labeled letters (nucleotides) are **identical** in all 5 species

Yellow-labeled letters **differ** from the working rat GULO gene

Note Deletion: The red band shows where cytosine (C) had been deleted in early primate or pre-primate, causing a frame shift, so all “downstream” nucleotides moved one step to the left, effectively garbling the remainder of the gene, resulting in the non-functional GULO pseudogenes found today in all primates.

4. Analysis

- Any one of thousands of possible mutations (especially a deletion) in the several genes for a biochemical pathway could explain why a particular species fails to make a particular enzyme.
- What does this suggest about the fact that Vitamin C production is blocked in several similar species by the exact same mutation in the GULO gene?

Answer: Very unlikely that identical change occurred by chance, strongly suggesting common ancestry.

5. Vitamin C, GULO Pseudogenes & Primate Evolution: Cladogram showing sequence of branching, based on the decreasing number of additional mutations found in the species moving upwards and to the left.

6. NOTE SIMPLIFICATION (Disclaimer)

Three adjacent DNA segments (genes) were shown as necessary for Vitamin C to be formed.

In reality, there can be more genes (or fewer), and they may not be adjacent, or even in the same chromosome.

7. Pseudogenes: Vitamin C & Common Ancestry

Part C of a 3-part suite on Pseudogenes and Evolution

By Mary Ball and Steve Carr

At Carson-Newman college

Posted on the ENSI website

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