

Advanced Cell Biology. Lecture 23

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Outline

Questions and answers

Genes and genomes

Evolution of genome

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Genes and genomes

Evolution of genome

Previous final question: the answer

Are riboswitches capable to facilitate the epigenetic inheritance?

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Are riboswitches capable to facilitate the epigenetic inheritance?

- ▶ No. They are temporarily repressors/activators.

Genes and genomes

Evolution of genome

Mechanisms of genome changes

- ▶ Mutation within gene
- ▶ Mutation in regulatory region
- ▶ Duplication
- ▶ Exon shuffling
- ▶ Mobile elements and HGT

- └ Genes and genomes
- └ Evolution of genome

Types of evolutionary changes in genome

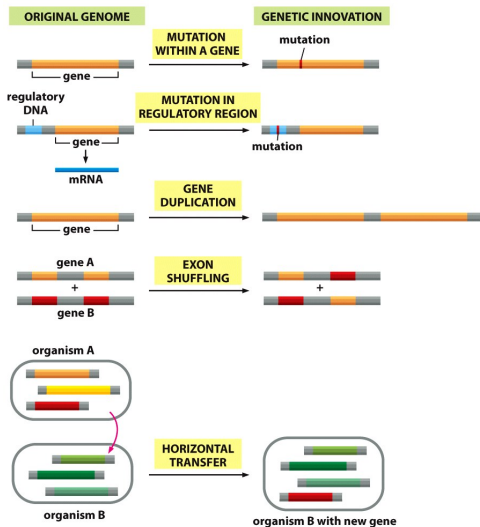


Figure 9-2 Essential Cell Biology 3/e (© Garland Science 2010)

Germ line and somatic cells

- ▶ Germ line: every mutation will change progeny
- ▶ Somatic line: mutations have no direct effect on progeny
- ▶ However, phenocopies show a way of transition between these two lines

Himalayan rabbit: example of phenocopies



Point mutations: neutral and lethal

- ▶ Neutral mutations either will not change protein, or change insignificant part of it
- ▶ Lethal mutations will not allow to leave progeny
- ▶ Typical mutation rate is 10^{-6}
- ▶ Simple mutations could be reversible

Regulatory mutations

- ▶ Simple point mutation could block expression of the gene
- ▶ Reverse mutation will unblock expression
- ▶ Lactose digestion in adults is an example of rapidly spreading mutation of this kind
- ▶ Regulatory mutations are simpler to reverse

Evolution through regulatory genes

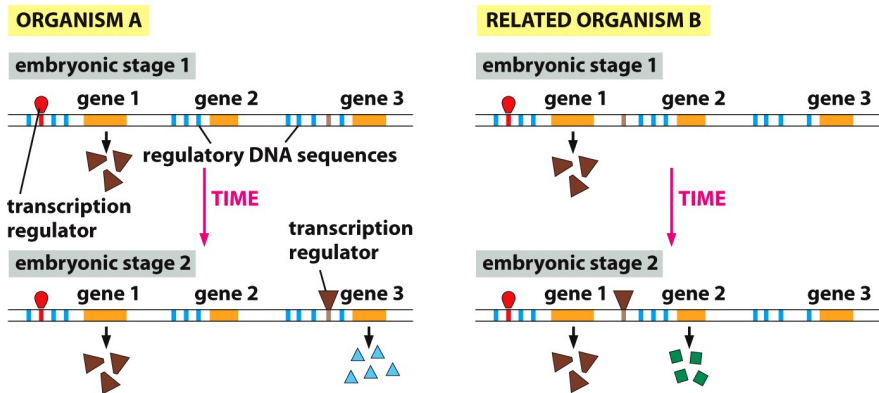


Figure 9-7a Essential Cell Biology 3/e (© Garland Science 2010)

Rise of gene families

- ▶ Gene duplication (e.g., in crossover) will ultimately result in accepting of neutral (at first) and non-neutral changes (later)
- ▶ This is a gene divergence
- ▶ Gene families (e.g., globin family) are mostly results of these divergencies

Gene duplication in crossover

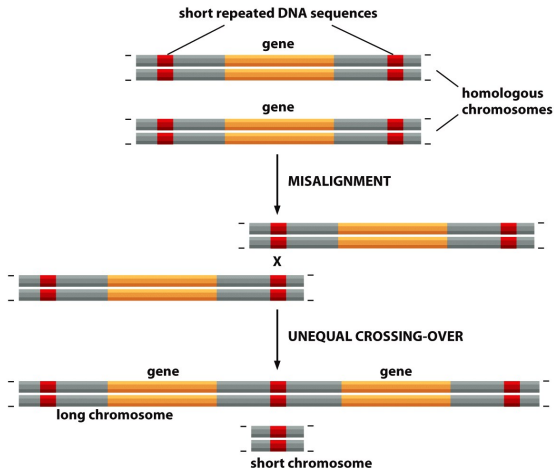


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Globine family

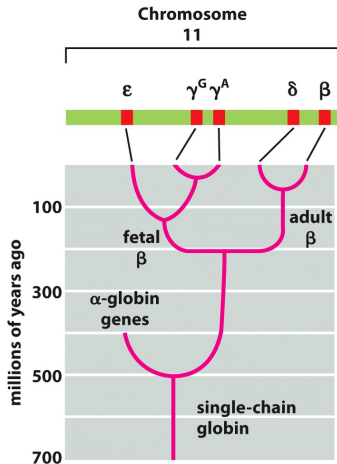
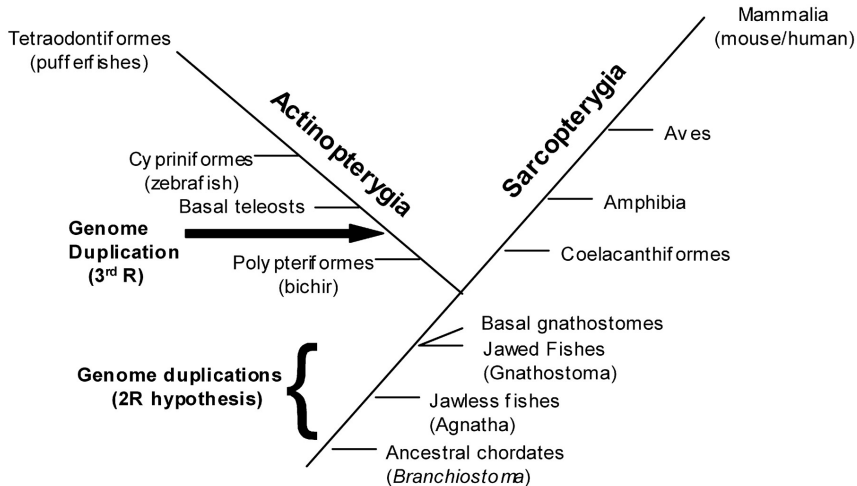


Figure 9-11 Essential Cell Biology 3/e (© Garland Science 2010)

Whole genome duplications

- ▶ Whole genome duplication will immediately provide a “space” for new genes and even gene families
- ▶ Several major duplications mark evolution of vertebrates and angiosperms
- ▶ Duplications also occur in smaller lineages like *Xenopus* frogs or grasses

Chordate genome duplications



Final question (2 points)

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Why reversal mutation rates are different between point mutations and regulatory mutations?

Summary

- ▶ Genome evolutionary processes include point mutations, duplications + divergencies, recombinations of gene parts and HGTs

For Further Reading



A. Shipunov.

Advanced Cell Biology [Electronic resource].

2011—onwards.

Mode of access: [http:](http://)

[//ashipunov.info/shipunov/school/biol_250](http://ashipunov.info/shipunov/school/biol_250)



B. Alberts et al.

Essential Cell Biology. 3rd edition.

Garland Science, 2009.

Chapter 9.