G11 Hugo De Vries, Mutations, and Mutagenesis

CIE Biology Jones p387-389 (little bit)



Not Required –Interest Only

Mutagenesis (Chemical basis)

https://www.slideshare.net/sreerajsree/spontaneous-and-induced-mutations

Not required – Interest only

Chimera Mutations

Images - https://www.ranker.com/list/chimera-animals/mariel-loveland?utm_expid=16418821-388.8yjUEguUSkGHvlaagyulMg.0&utm_referrer=https%3A%2F%2Fwww.google.kz%2F

Information --https://en.wikipedia.org/wiki/Chimera_(genetics)

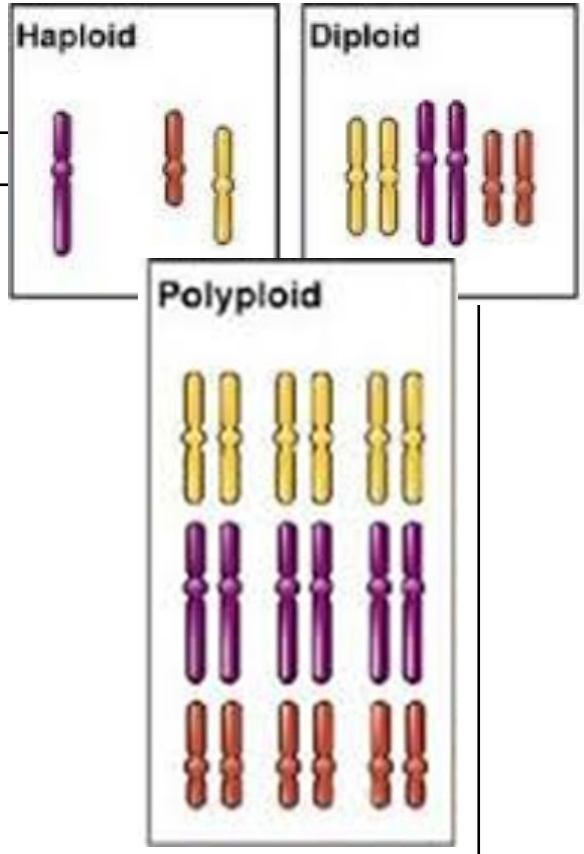
11.2.4.12 to explain the mechanism of chromosome, gene mutation.

11.2.3.13 to study the theory of mutation of Hugo De Vries and mutagenesis and its causes.

Success Criteria

1. Identify and explain the causes, types and mechanisms of genetic mutations.
2. Discuss the features of Hugo De Vries theory of mutations.
3. Compare points in favor and against Hugo De Vries theory.
4. Differentiate between spontaneous and induced mutations.
5. Define Mutagenesis

Terminology **with Definitions**



Aberrant – different that usual

Self-pollinated – pollen and egg from same plant

Saltation (salutatory) – single step, large mutation

Jerky – abrupt starts and stops

Discontinuous – intermittent

Punctuated – discontinuous

Conceivable – imaginable

Progressive evolution – when an organism increased in complexity and develops more advanced characteristics over time.

Retrogressive evolution – an organism becomes less complex over time.

Induced – persuaded / influenced

Polyploid – 3 or more of the same chromosomes

Polyploidy

Examples of Polyploid Plants	
Name	**Number**
Common wheat	**6N** = 42
Tobacco	**4N** = 48
Potato	**4N** = 48
Banana	**3N** = 27
Boysenberry	**7N** = 49
Strawberry	**8N** = 56

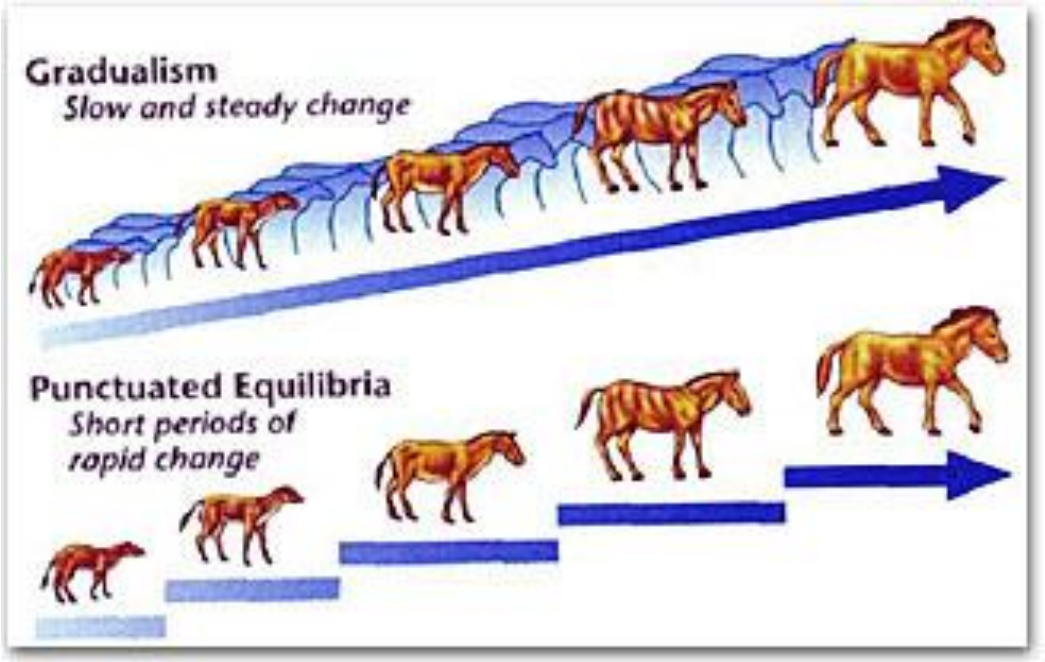
Many **ferns** are polyploid with chromosome number up to 400N

Hugo De Vries Theory of Evolution by Mutation

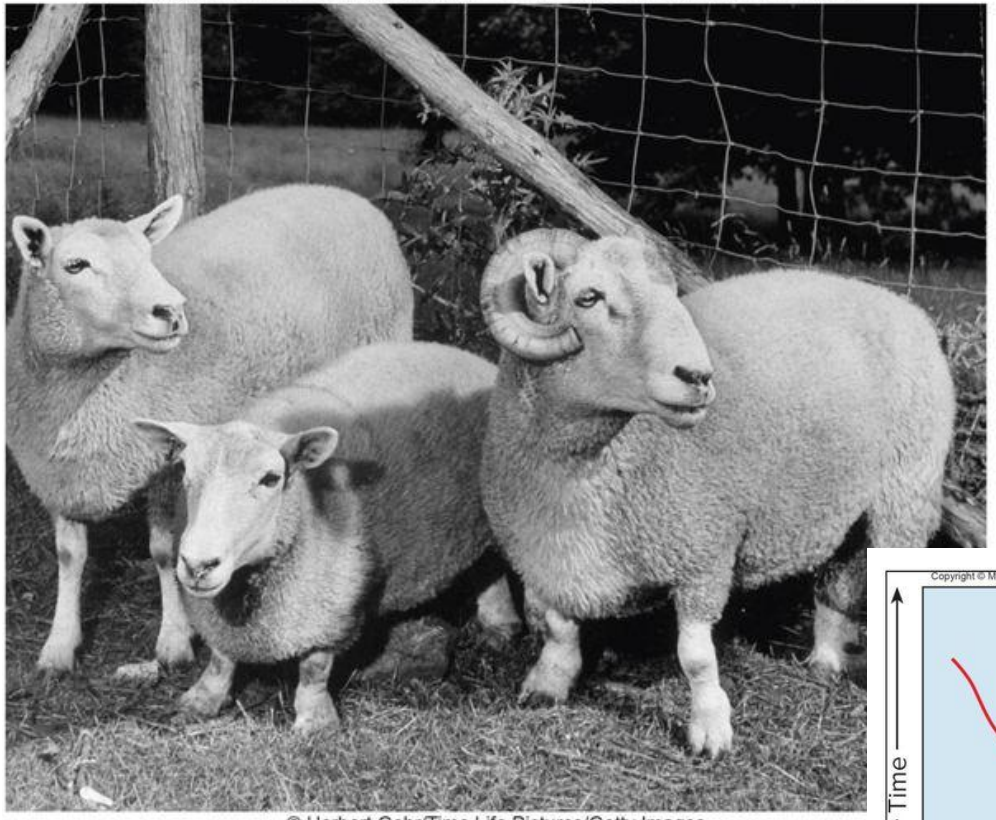
Fig. 7.39. Appearance of short-legged Ancon sheep mutant.

New characteristics suddenly appear (mutation), but they may be selected against due to not being as 'fit to survive..

de Vries theory	Darwin's theory
Evolution resulted from mutation.	Evolution resulted from variations.
Evolution was sudden.	Evolution was gradual.
Mutations are random and directionless.	Variations are small and directional.



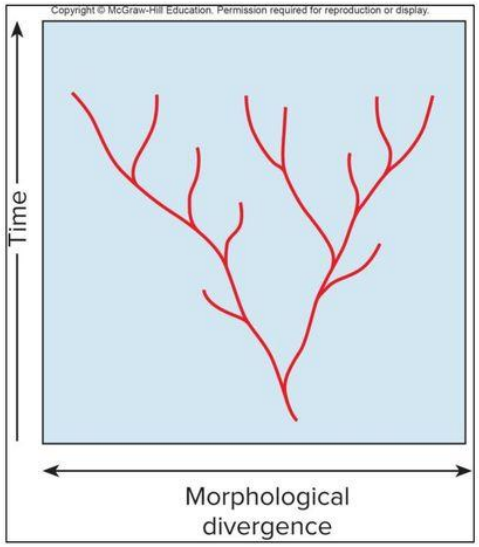
Punctuated equilibrium is similar to De Vries **Discontinuous Evolution** by Mutation Theory



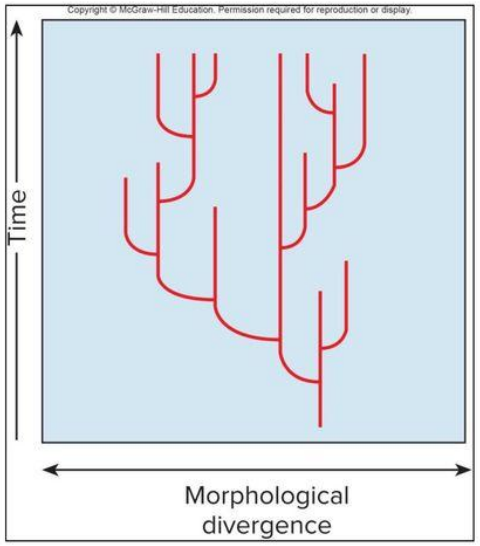
© Herbert Gehr/Time Life Pictures/Getty Images

Ancon breed of sheep arose from a *mutation* that caused dwarfing of legs

New species originate as a result of discontinuous variation that appears suddenly and may be passed to offspring.



Continuous
Slow and gradual
Change over time



Discontinuous
fast and jerky
change over time

Who was Hugo De Vries?

-1935

as a Dutch botanist and

of the first geneticist.

Evening primrose
Oenothera lamarckiana

He is known mainly for suggesting the concept of

1. Genes
2. Rediscovering the laws of heredity in the 1890s while unaware of Gregor Mendel's work
3. Introducing the term "mutation"
4. Developing a mutation theory of evolution.

https://en.wikipedia.org/wiki/Hugo_de_Vries

Sudden, fast changes - Discontinous

Evening primrose - *Oenothera lamarckiana*

Hugo De Vries did most of his research without knowing about Mendel's work, but he came to the same conclusions. He first published his work without mentioning Mendel, but later updated his work to include him as a source.

De Vries – studied Evening Primrose, a plant that would have significant phenotypical differences such as leaf shape and plant sizes. Some offspring with a 'mutation' would pass this on to their progeny (offspring), which De Vries decided was a new species.

He called this discontinuous variation – Defined as species that evolve from other species through, sudden large changes of character traits.

It is now known that the unusual variations, 'mutations' observed from his plant *Oenothera lamarckiana,* were due to aberrant chromosomal segregations and NOT to mutation of specific genes.

Hugo De Vries – Highlights – from another article

- From Darwin's Book the "Theory of Pangenesis", he suggested that inheritance of specific traits in an organism comes in particles. He called the particles '**pangenes**' which 20 years later was shortened to '**genes**'

- He also agreed with Darwin that organisms change over time, but postulated that they did **large changes** over time were discontinuous and called them, **saltationism**. *Remember* ***saltatory conduction of action potential?***

- He took a wild primrose from a field and grew plants that had many new variations. He called the changes **mutations**. Later it would be found that the variety was due plants being **polypoloidy**, not muations.

- He **inspired Thomas Morgan** to study mutations in fruit flies.

- He was the first to suggest the occurrence of recombination between homologous chromosomes. "**Crossovers**"

Compare Theories

de Vries theory	Darwin's theory
Evolution resulted from mutation.	Evolution resulted from variations.
Evolution was sudden.	Evolution was gradual.
Mutations are random and directionless.	Variations are small and directional.

Mutations

Chromosomal (X) Mutation

Errors of DNA Chromosome

Deletion

Part of a X is left off

Insertion / Duplication

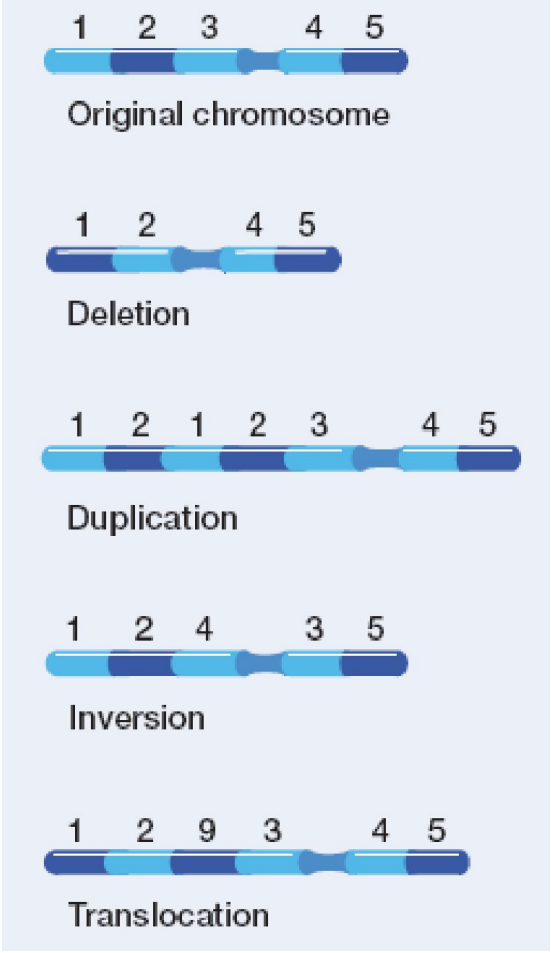
Part of a X breaks off and is reinserted on a sister chromosome

Inversions

Part of a X breaks off, flips, and then reinserts backwards

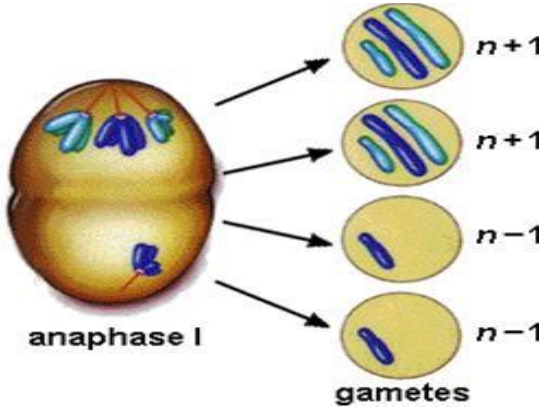
Translocations

Part of a X breaks off and is added to a different chromosome.



Nondisjunction: failure of homologous chromosomes of gametes to separate correctly anaphase I of Meiosis

Monosomy	X
Disomy	XX (normal)
Trisomomy	XXX
Polyploid	XXXXX



GENE Mutation

Errors of DNA-base pairing

Point mutation: SUBSTITUTION

exchange of one nitrogen base for another. May or may not change one amino acid –

Frameshift mutation – INSERTION OR DELETIONS

addition or deletion of one nitrogen base. Changes the entire reading frame of the protein.

SUBSTITUTION

The dog bit the cat
The dog bit the car
AAA TTT CCC GGG
AAA TTA CCC GGG

INSERTIONS: DELETIONS

The dog bit the cat
The dog itt hec at
AAA TTT CCC GGG
AAA TTC CCG GG

Some Definitions

Mutagenesis – the changing of a nucleotide sequence of a gene or chromosome

Spontaneous – naturally occurs from errors in replication or replication repair.

Induced – exposure to radiation or mutagens (things that cause mutations – carcinogens…)

Two types of Mutagenesis

1. **Spontaneous Gene Mutagenesis**

   (a) Point / Frame-shift (GCAT)

   (i) substitution, deletion, insertion

   (b) Chromosomal Mutations

   (ii) insertion, deletion, translocation, duplication

   (c) Unrepaired DNA replication errors – p53 defected

2. **Induced Mutagenesis**

   (a) Environmental DNA damage – radiation, free radicals…