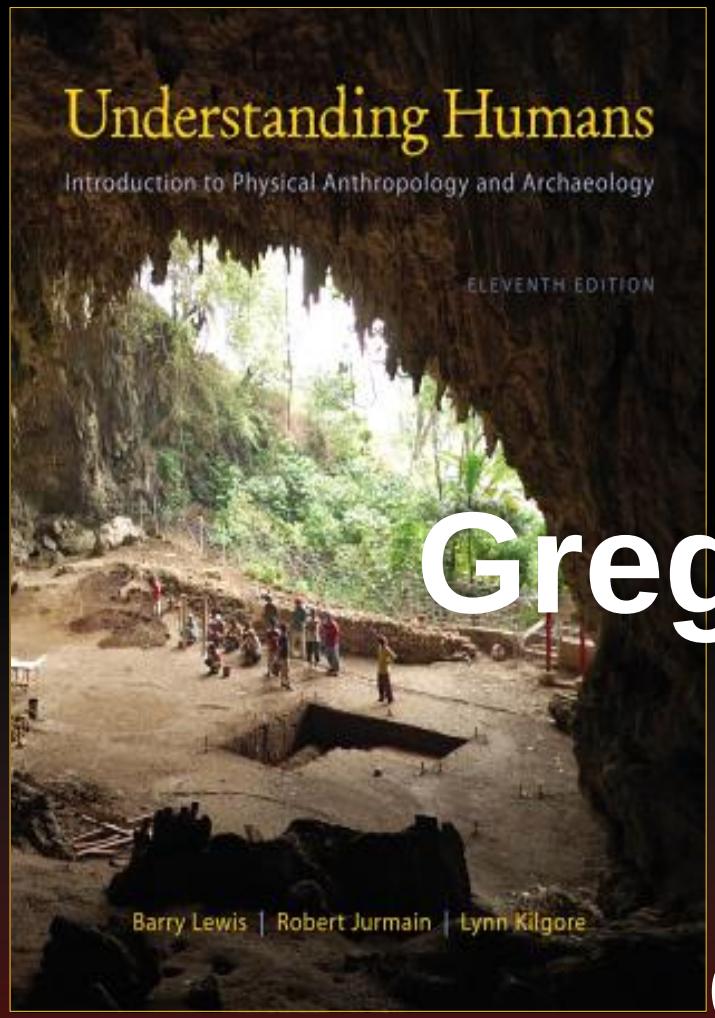

Gregor Johann Mendel

(1822 - 1884)

Tim Roufs
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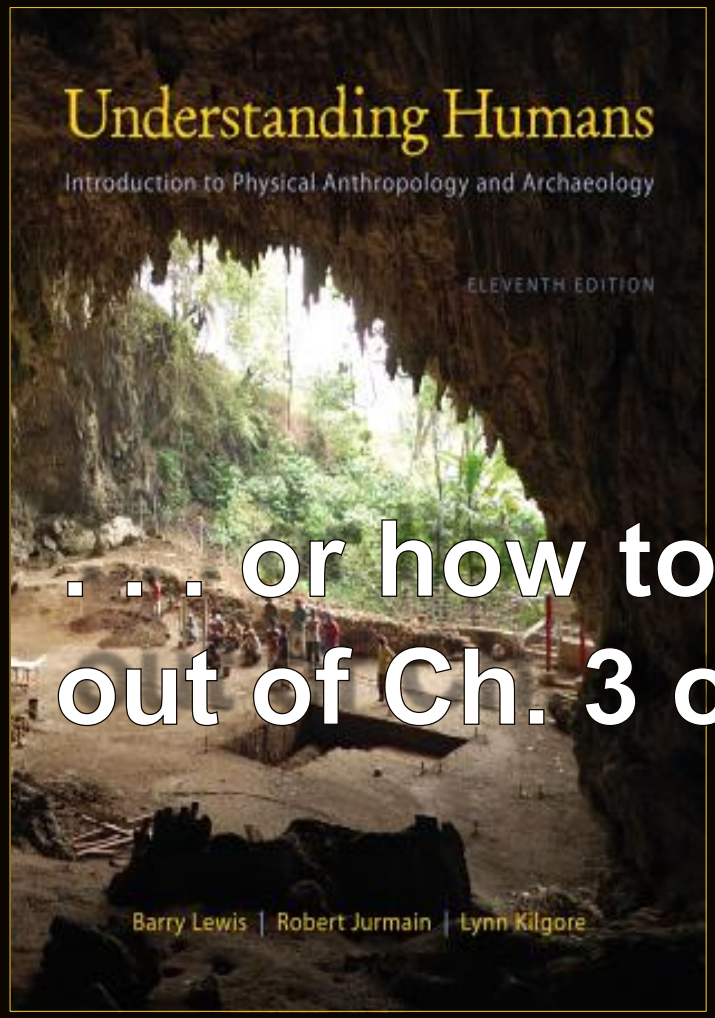

. . . or how to make sense out of Ch. 3 of the text . . .

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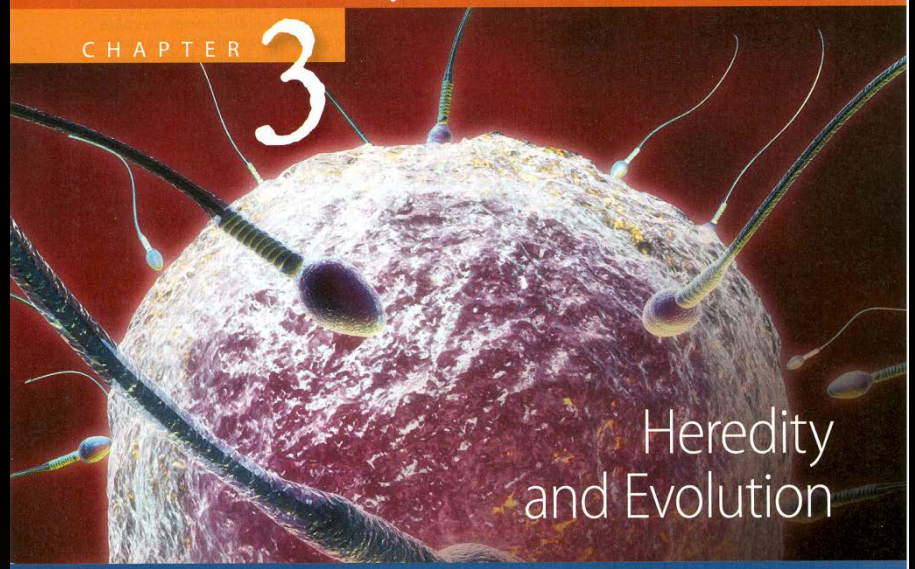
http://www.d.umn.edu/cla/faculty/troufs/anth1602/

Heredity and Evolution

CHAPTER 3



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LEARNING OBJECTIVES

After you have mastered the material in this chapter, you will be able to:

- Explain why cells are basic to life and describe the two different types of cells found in animals.
- Compare and contrast the two types of cell division.
- Describe the basic structure of DNA and explain how it relates to DNA replication.
- Describe the basic concepts of heredity that are found in all sexually reproducing organisms, including humans.

Important People / Works

Raychel Ciemma and Precision Graphics

Figure 3-12
Portrait of Gregor Mendel.

selection (and evolution) couldn't occur. Although there are other sources of variation (mutation being the only source of *new* variation), sexual reproduction and meiosis are of major evolutionary importance because they enhance the role of natural selection in populations.

The Genetic Principles Discovered by Mendel

It wasn't until Gregor Mendel (1822–1884) addressed the question of heredity that this crucial biological process began to be scientifically resolved (**Fig. 3-12**). Mendel was a monk living in an abbey in what is now the Czech Republic. At the time he began his research, he had already studied botany, physics, and

Gregor Johann Mendel

(1822 - 1884)

Understanding Physical Anthropology and Archaeology, 11th ed., p. 48

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Gregor Mendel

Understanding Humans, 10th ed., p. 50

some basic terms . . .

“inherited characteristics”

genetically determined traits

e.g., eye color

11th Ed. p. 56

“acquired characteristics”

learned traits

e.g., the ability to write

blending inheritance

an earlier theory stating that offspring receive a combination of all characteristics of each parent through the mixture of their “bloods”

blending inheritance

an outmoded theory superseded by Mendelian genetics

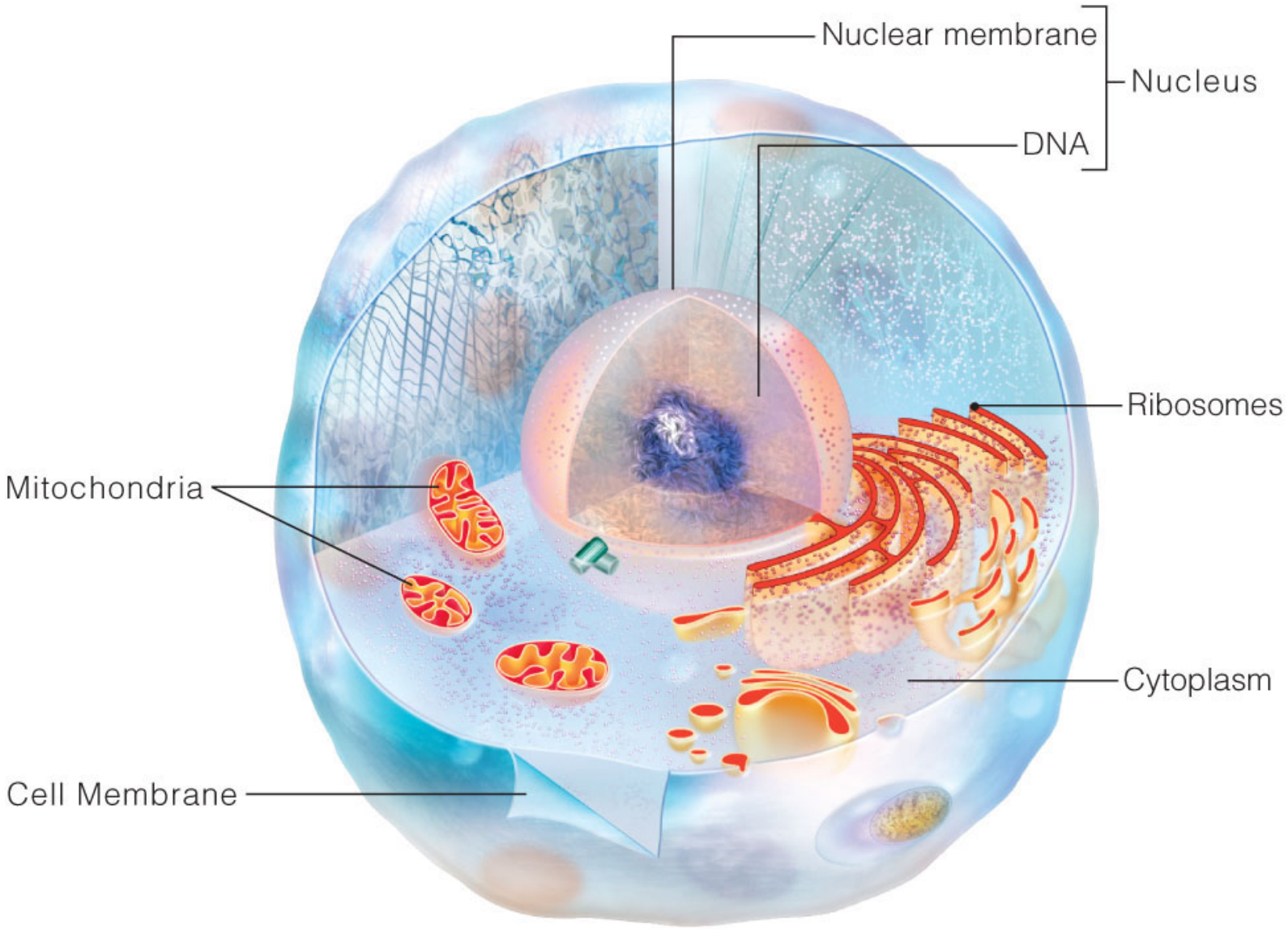
particulate inheritance

physical traits are inherited as "particles"

- **Mendel did not know what the particles were**
- **today they're recognized as particles like chromosomes and DNA**

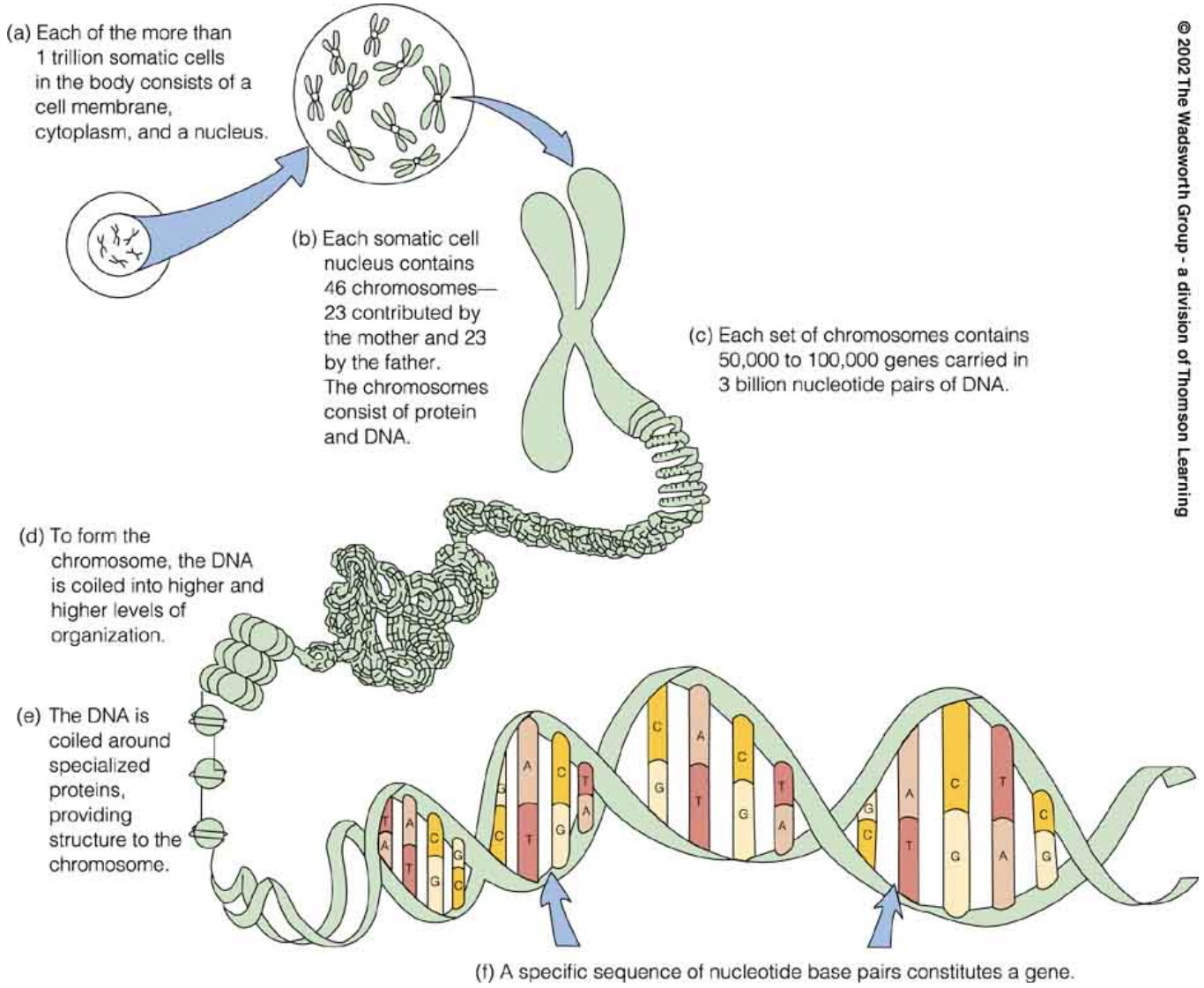
chromosomes

discrete structures composed of DNA and protein found only in the nuclei of cells



The cell's three dimensional nature

Understanding Humans, 11th ed., p. 39



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A model of a human chromosome

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phenotype

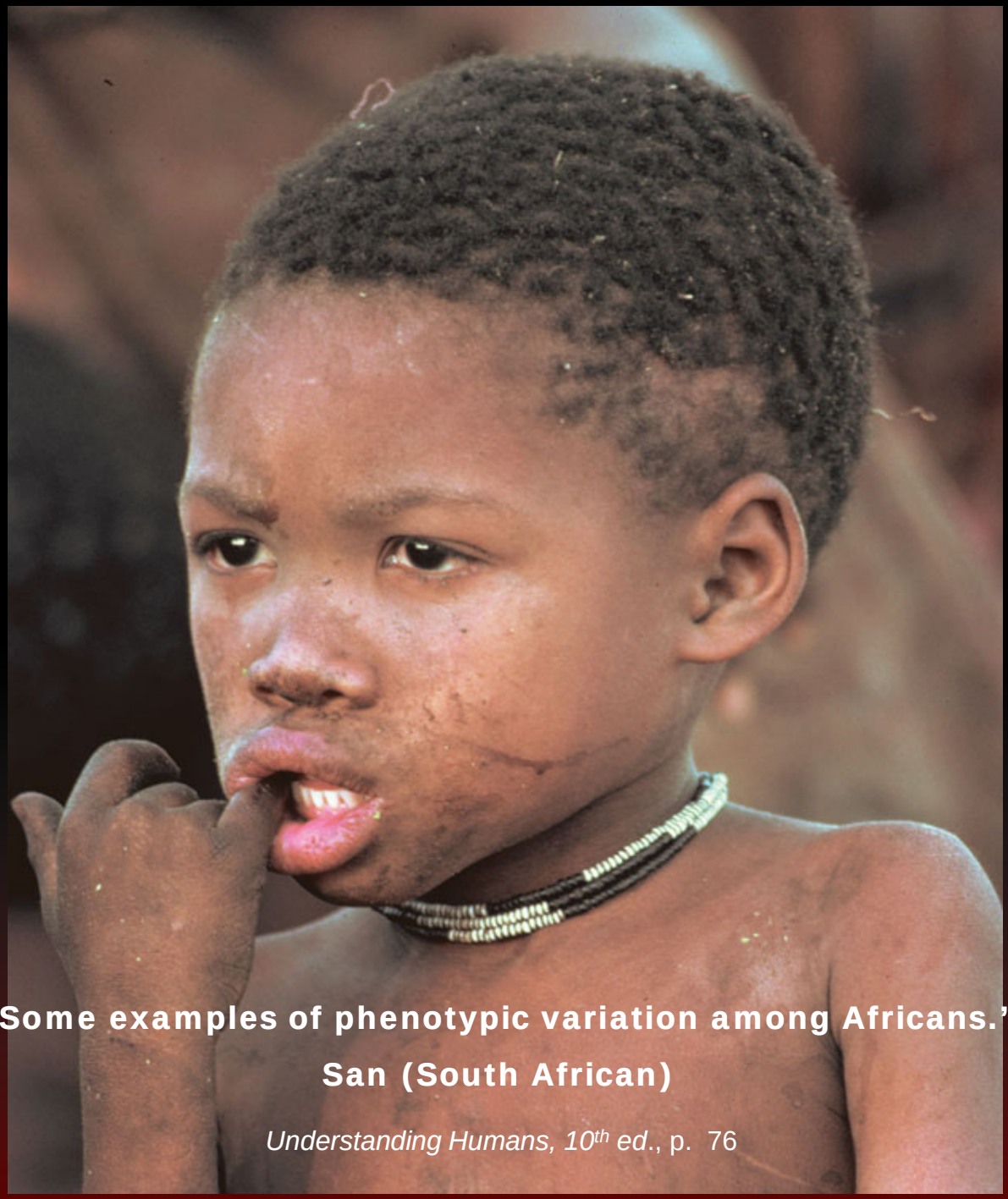
genotype

phenotype

genotype

phenotype

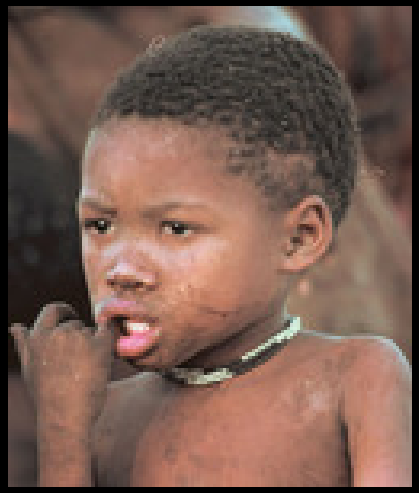
- **the observable physical characteristics of an organism**
- **the things you can see**
- **the detectable expressions of genotypes**

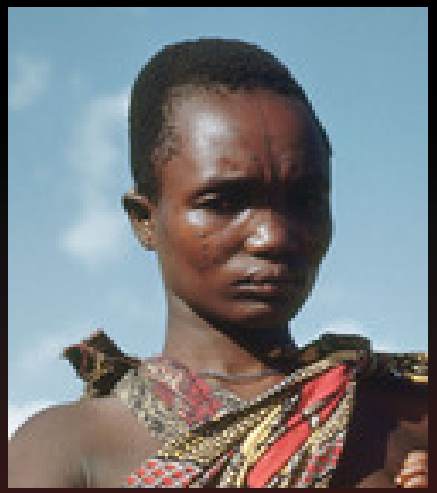


“Some examples of phenotypic variation among Africans.”

San (South African)

Understanding Humans, 10th ed., p. 76




“Some examples of phenotypic variation among Africans.”

San (South African)

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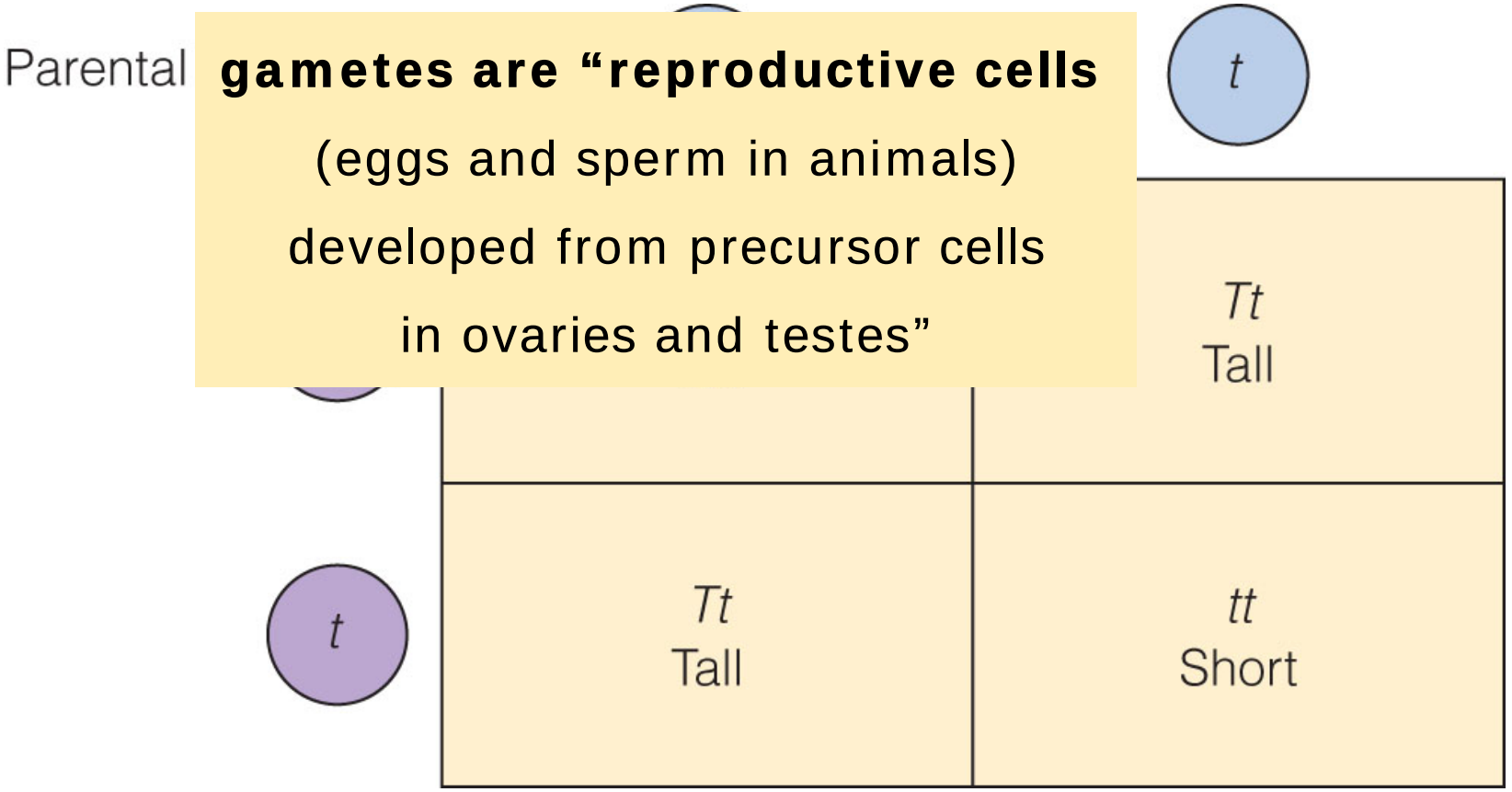
phenotype

genotype

genotype

- **includes genetic items you *can not* see**



gametes are "reproductive cells

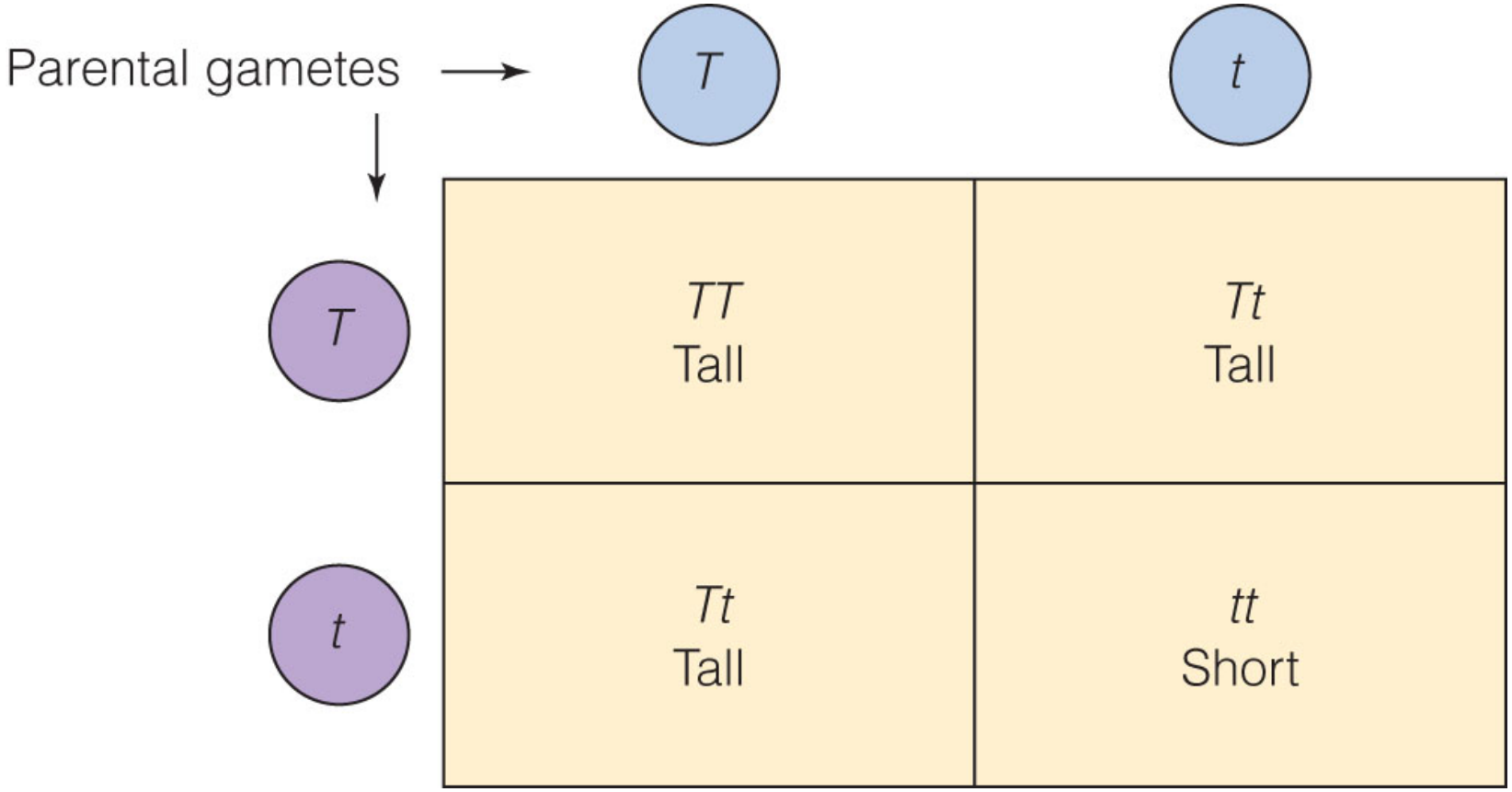
(eggs and sperm in animals)

developed from precursor cells

in ovaries and testes"

Punnett square representing possible genotypes and phenotypes

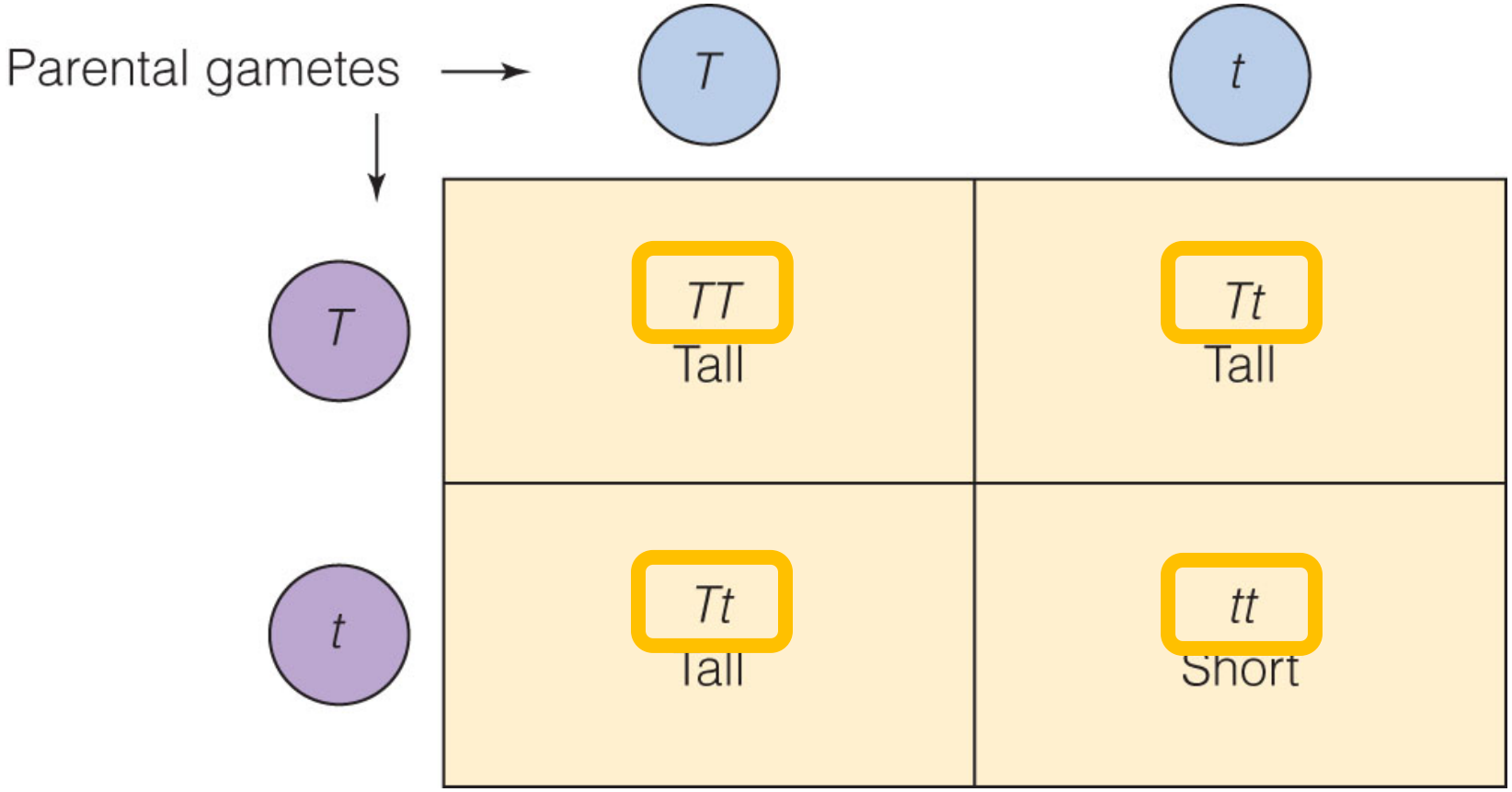
Understanding Humans, 11th ed., p. 51



Punnett square representing

possible **genotypes** and phenotypes

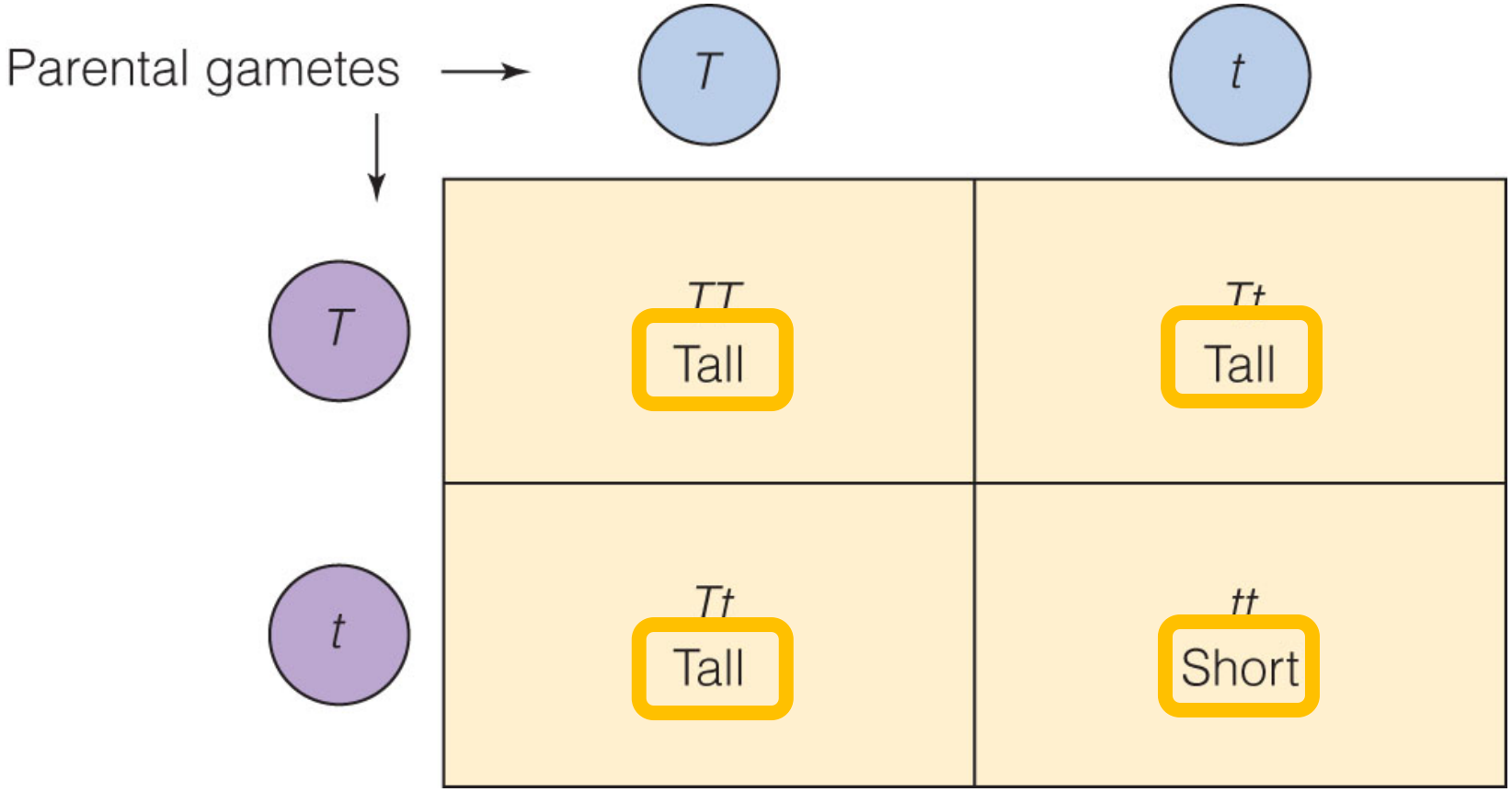
Understanding Humans, 11th ed., p. 51



Punnett square representing

possible **genotypes** and phenotypes

Understanding Humans, 11th ed., p. 51



Punnett square representing possible genotypes and **phenotypes**

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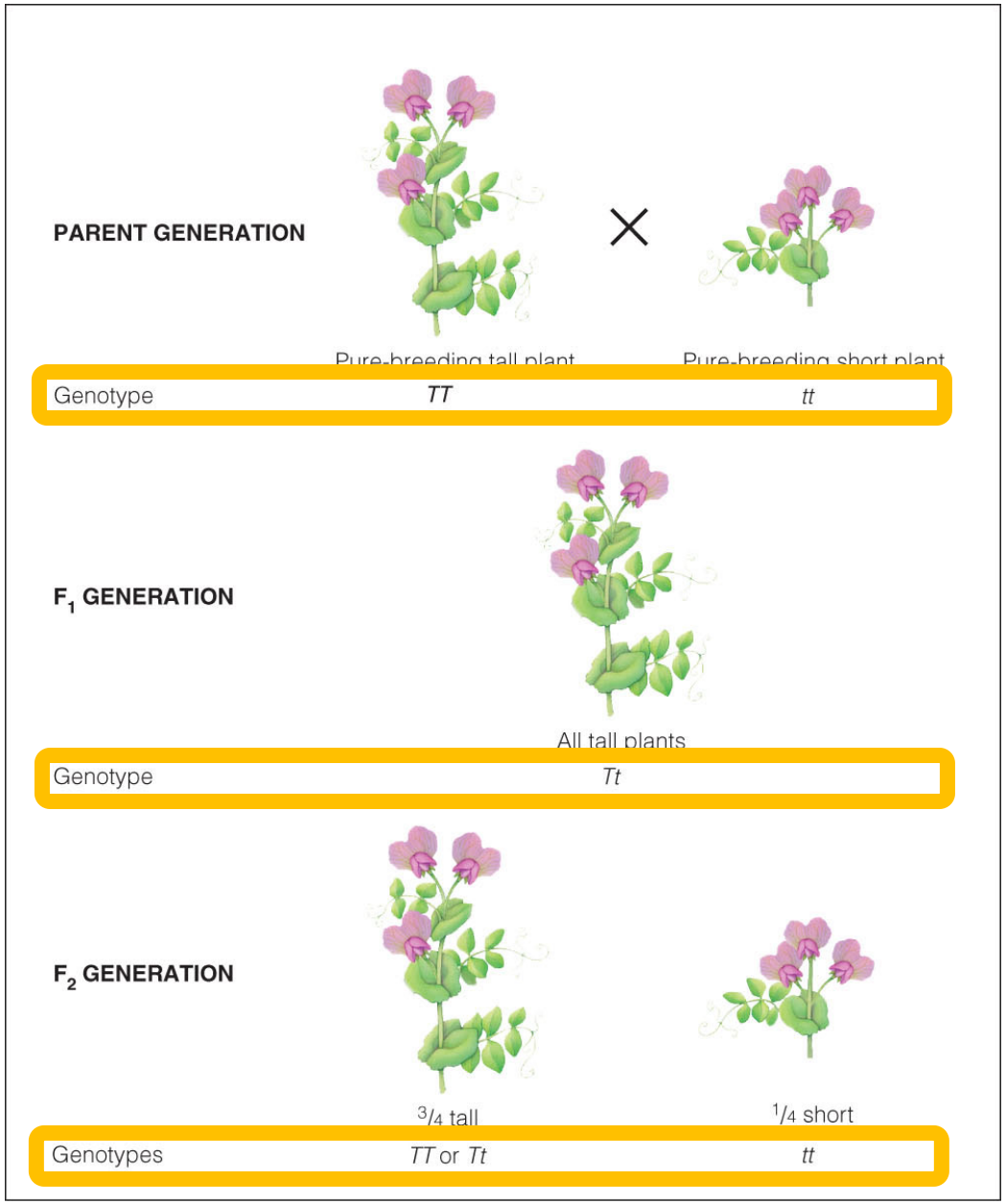

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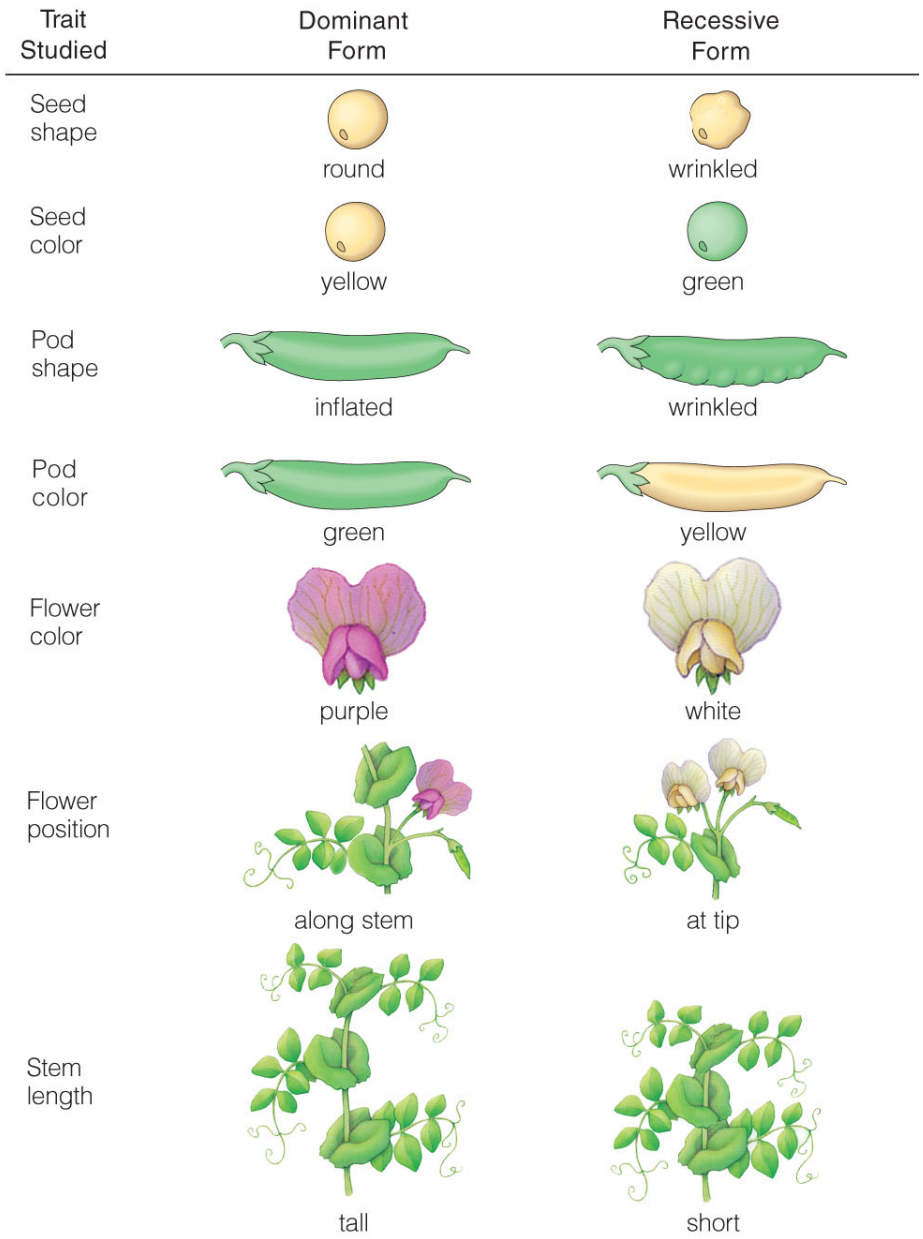
Gregor Mendel



The traits Mendel studied in peas

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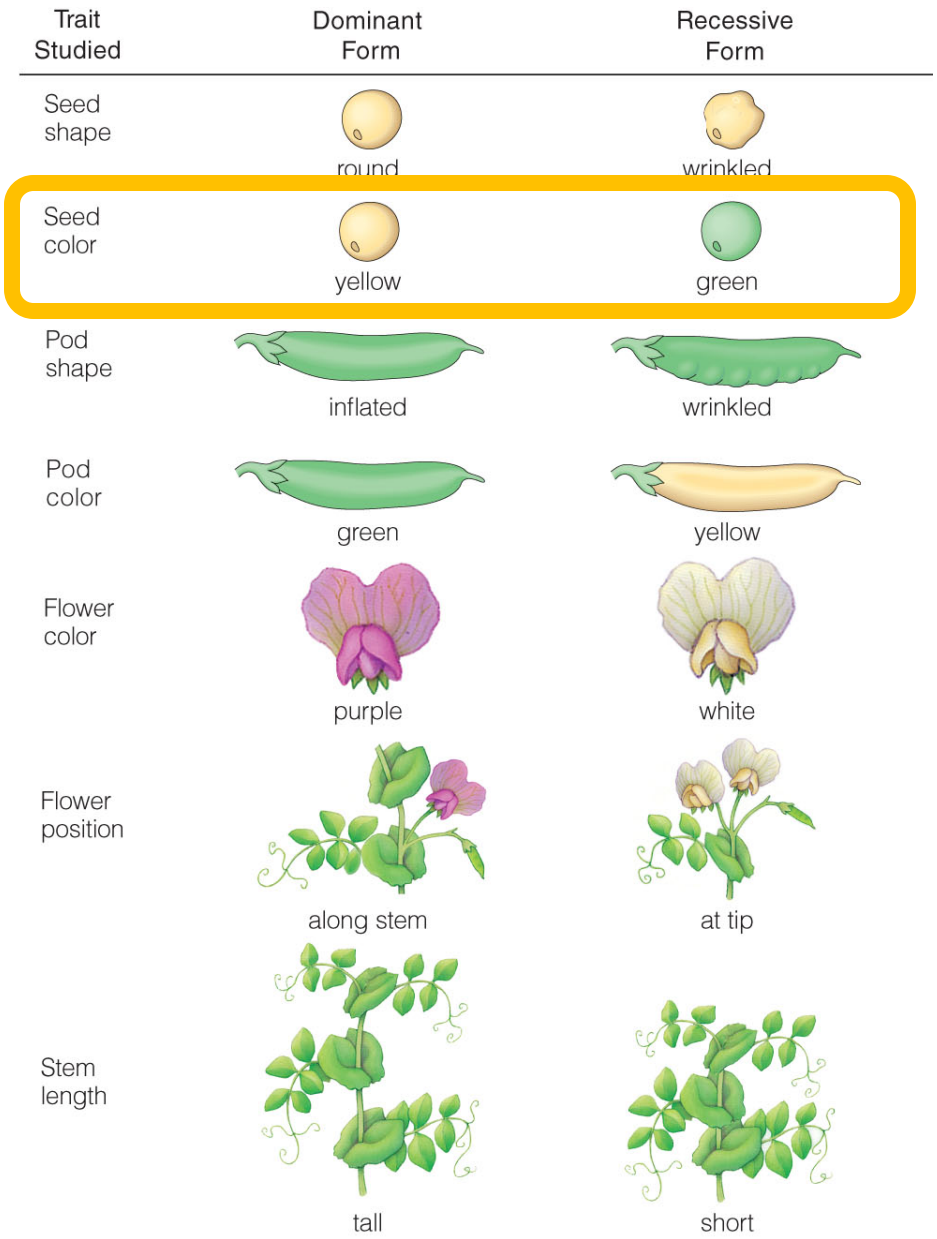

The traits Mendel studied in peas

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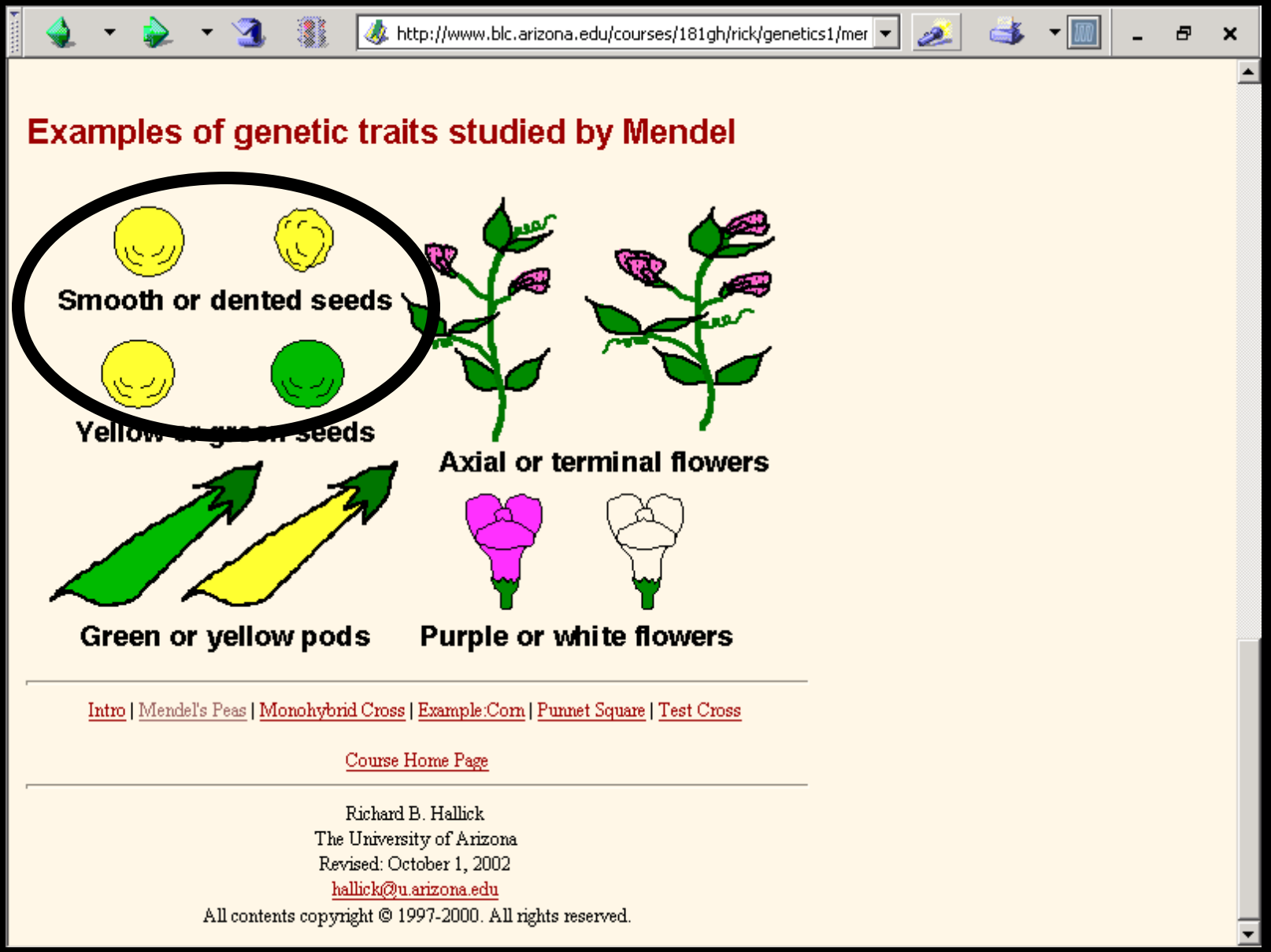
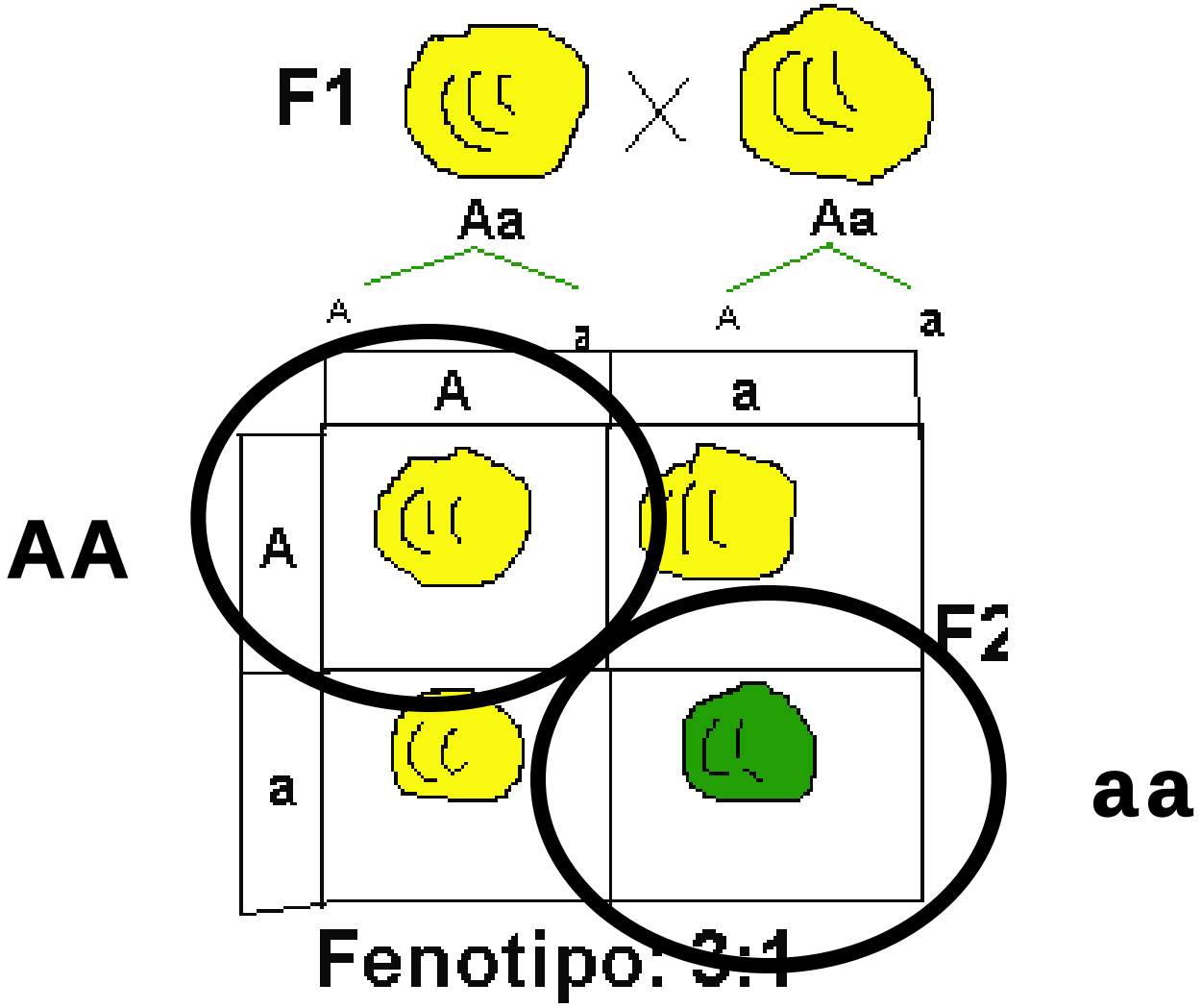


www.blc.arizona.edu/courses/181gh/rick/genetics1/mendel.html



Punnett square representing possible genotypes and phenotypes and their proportions in the F_2 generation.

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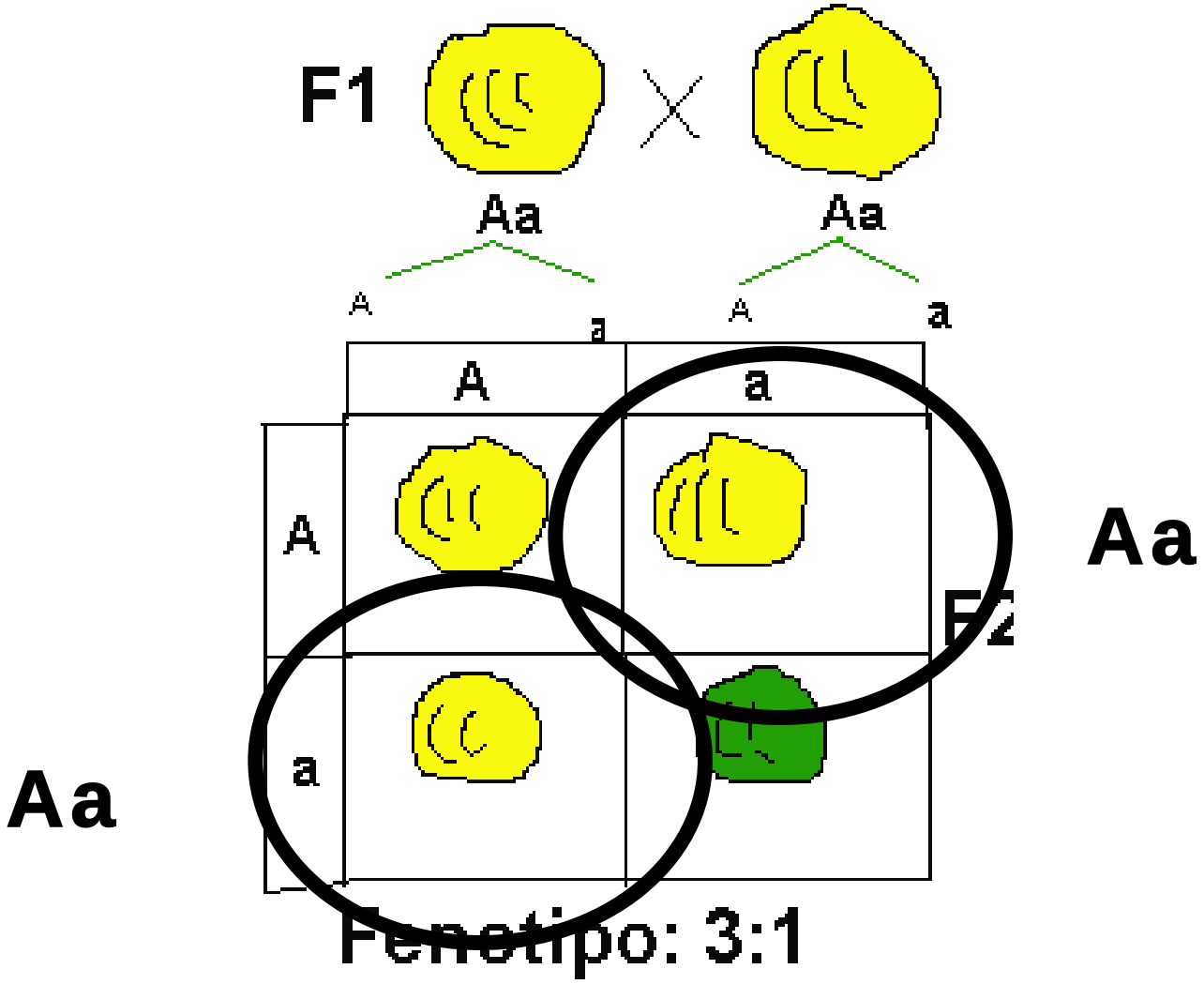
Conceptos básicos : Mendel: Experiment 1



Punnett square representing possible genotypes and phenotypes and their proportions in the F_2 generation.

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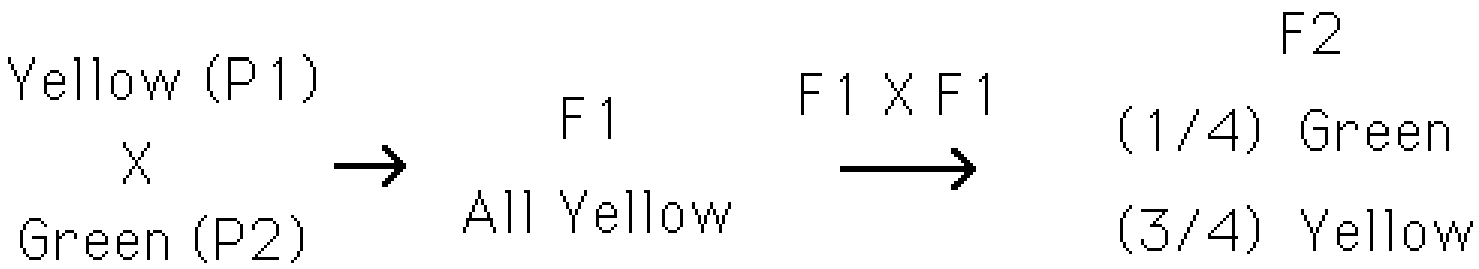
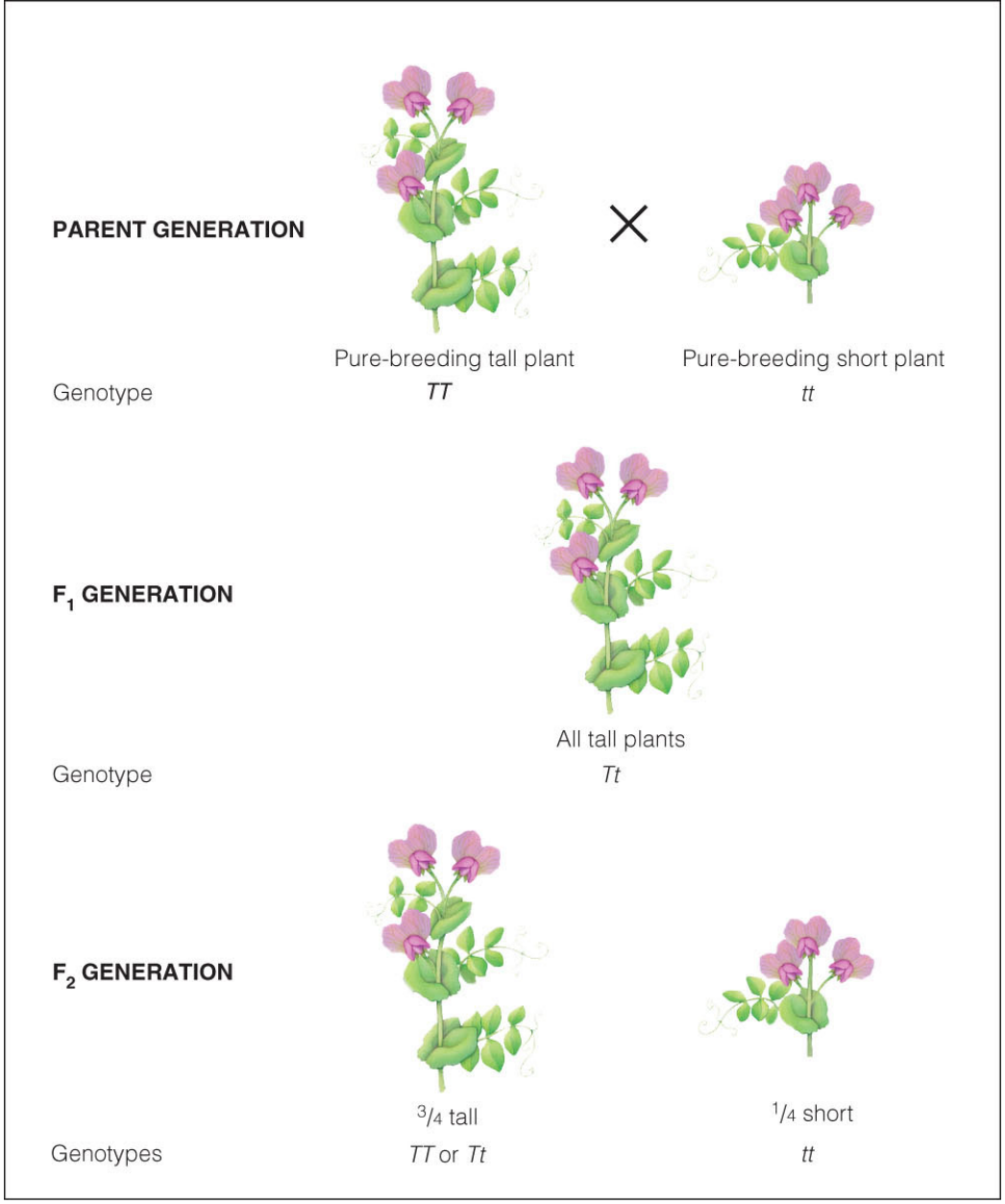
Conceptos básicos : Mendel: Experiment 1



3:1 ratio of Yellow : Green in F2

http://nitro.biosci.arizona.edu/courses/EEB195-2007/Lecture02/Lecture02.html



Results of crosses when only one trait at a time is considered

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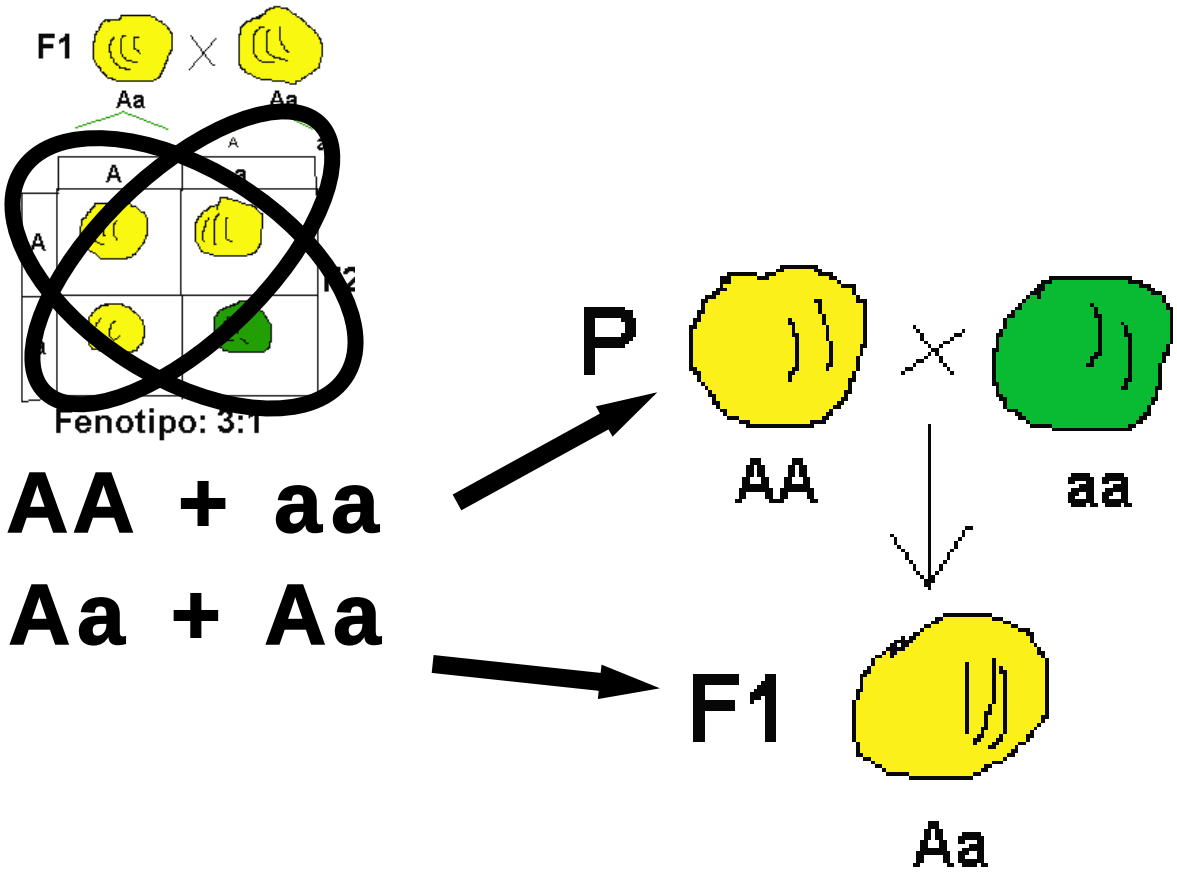


Genotypes and phenotypes in the F_1 generation.

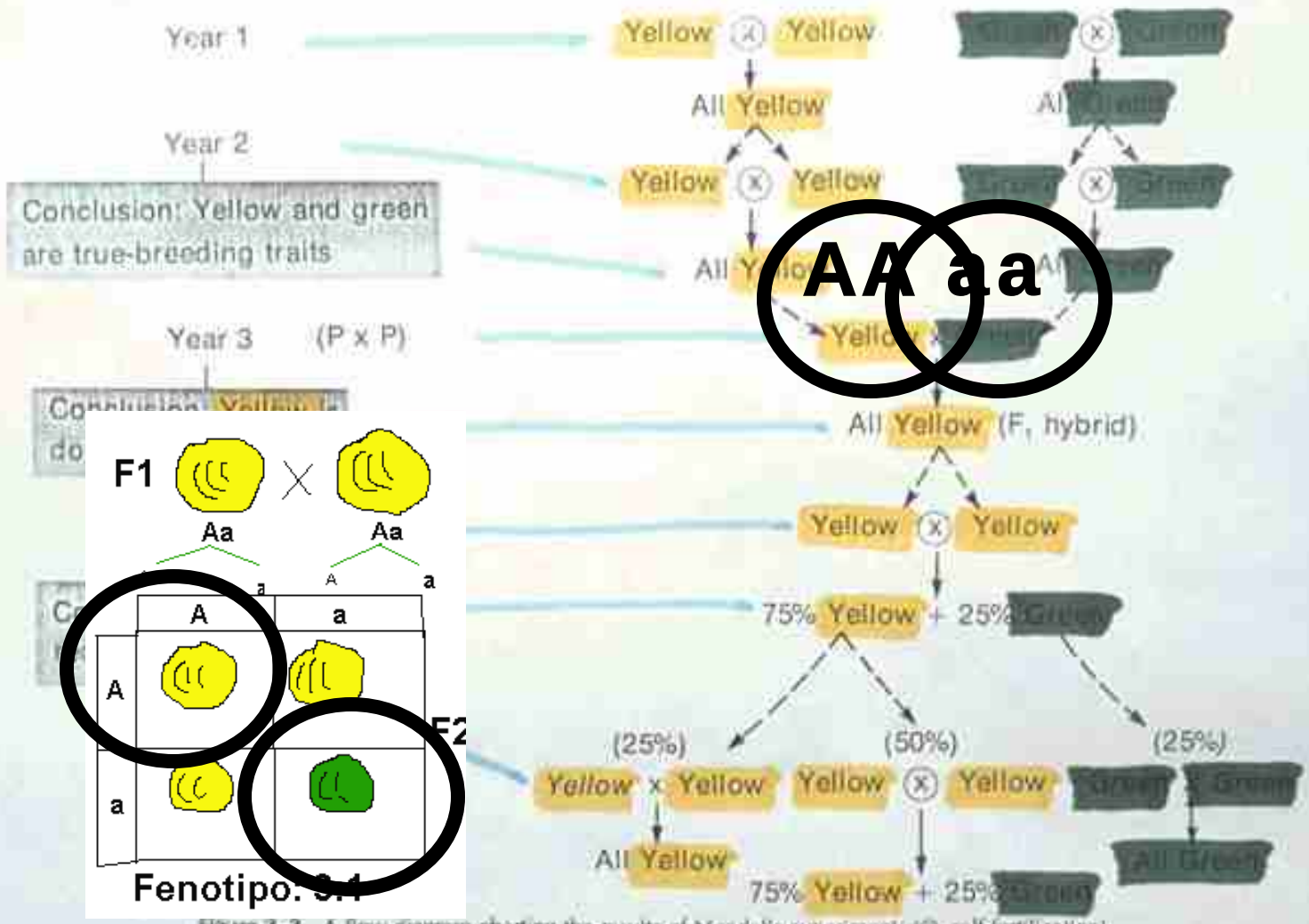
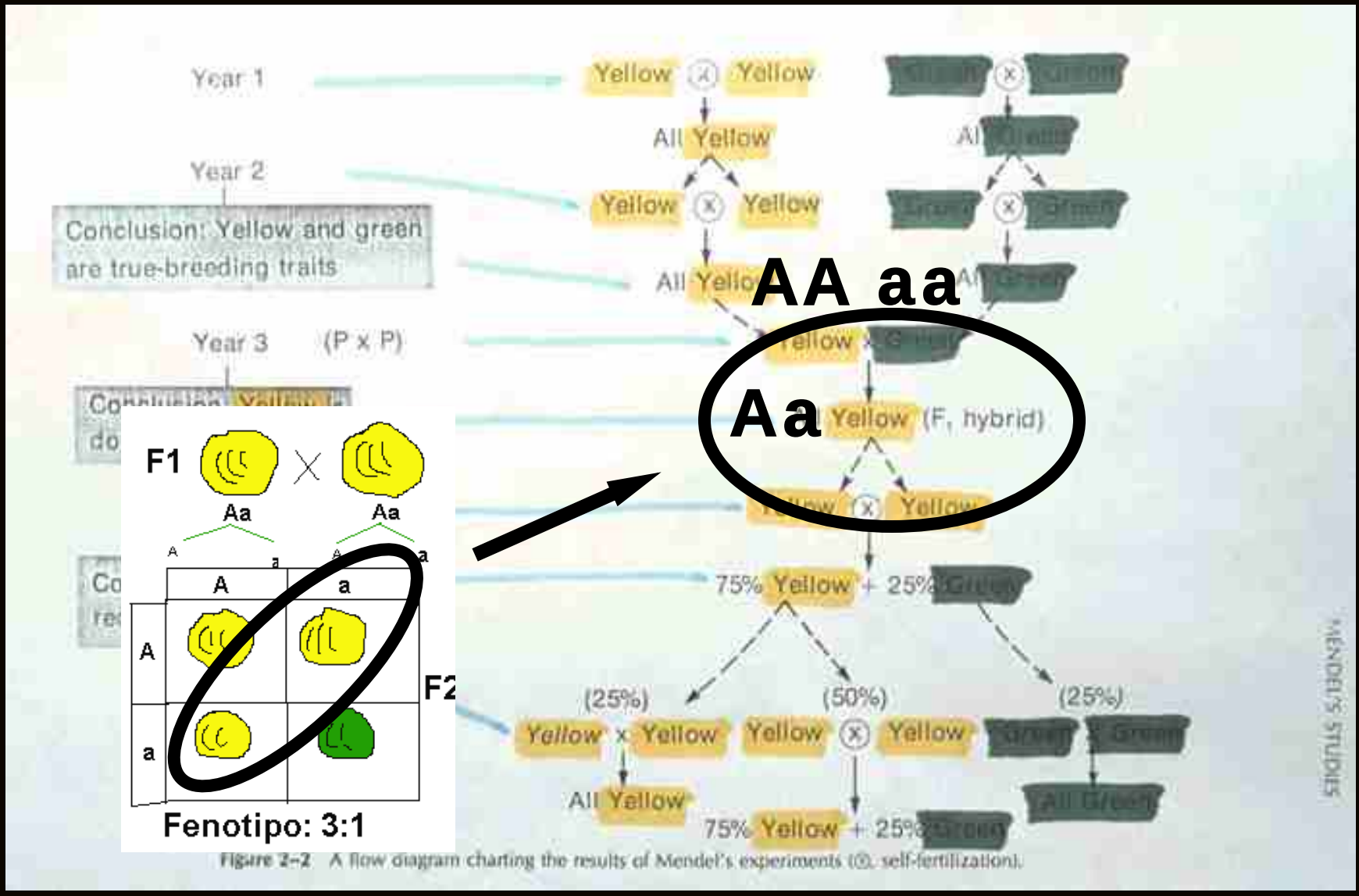


Figure 2–2 A flow diagram charting the results of Mendel's experiments (⊗, self-fertilization).



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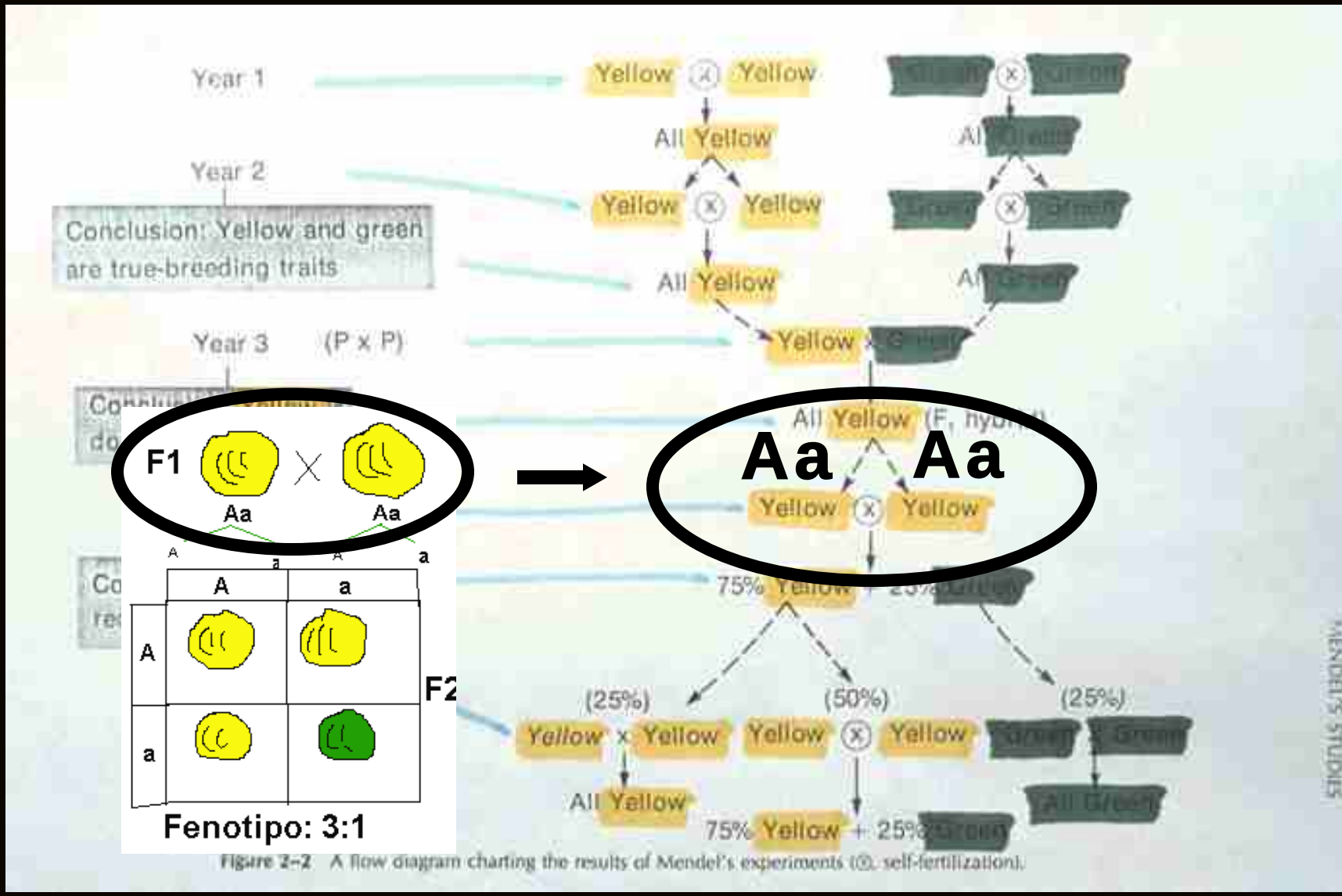

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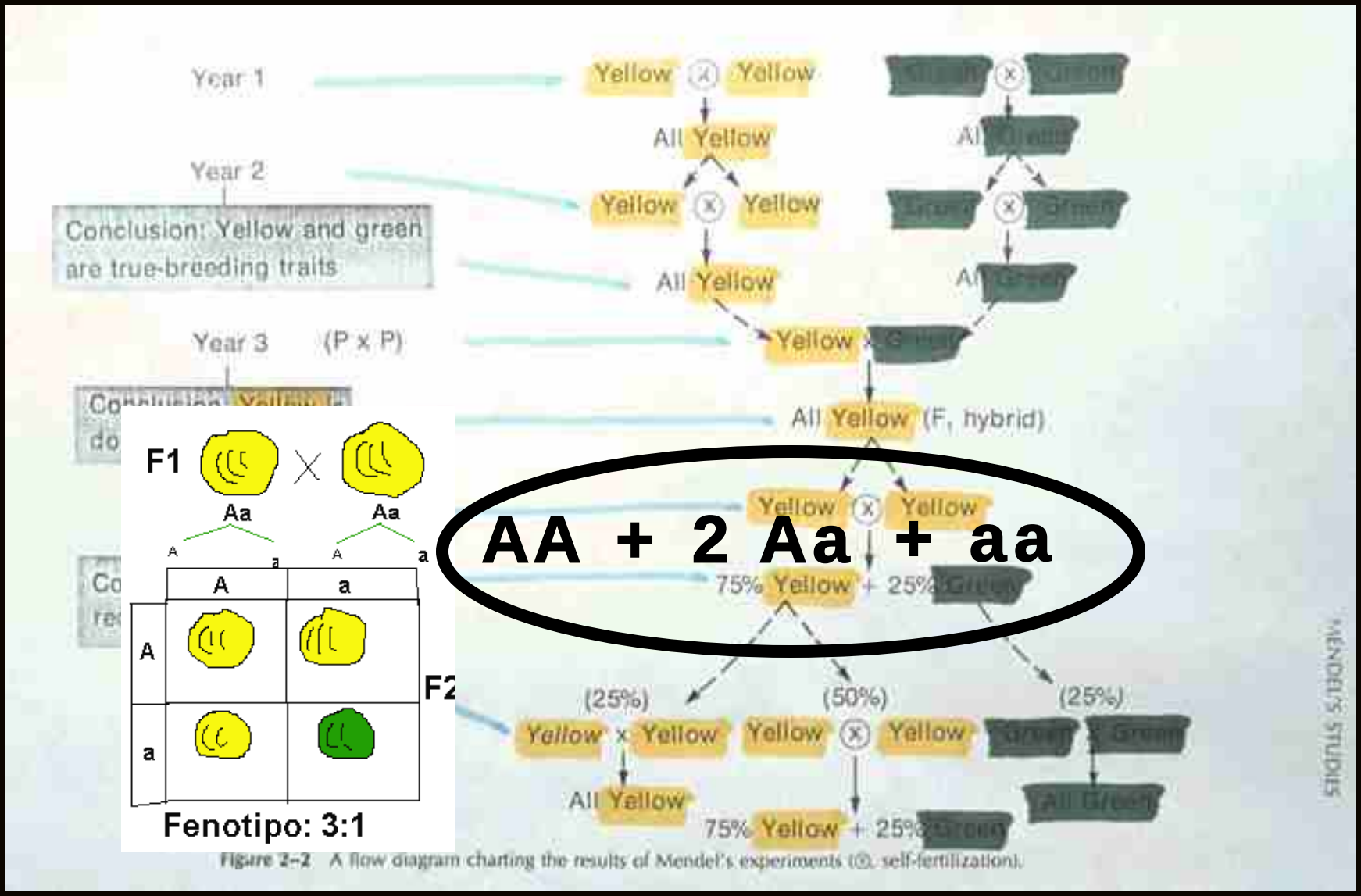

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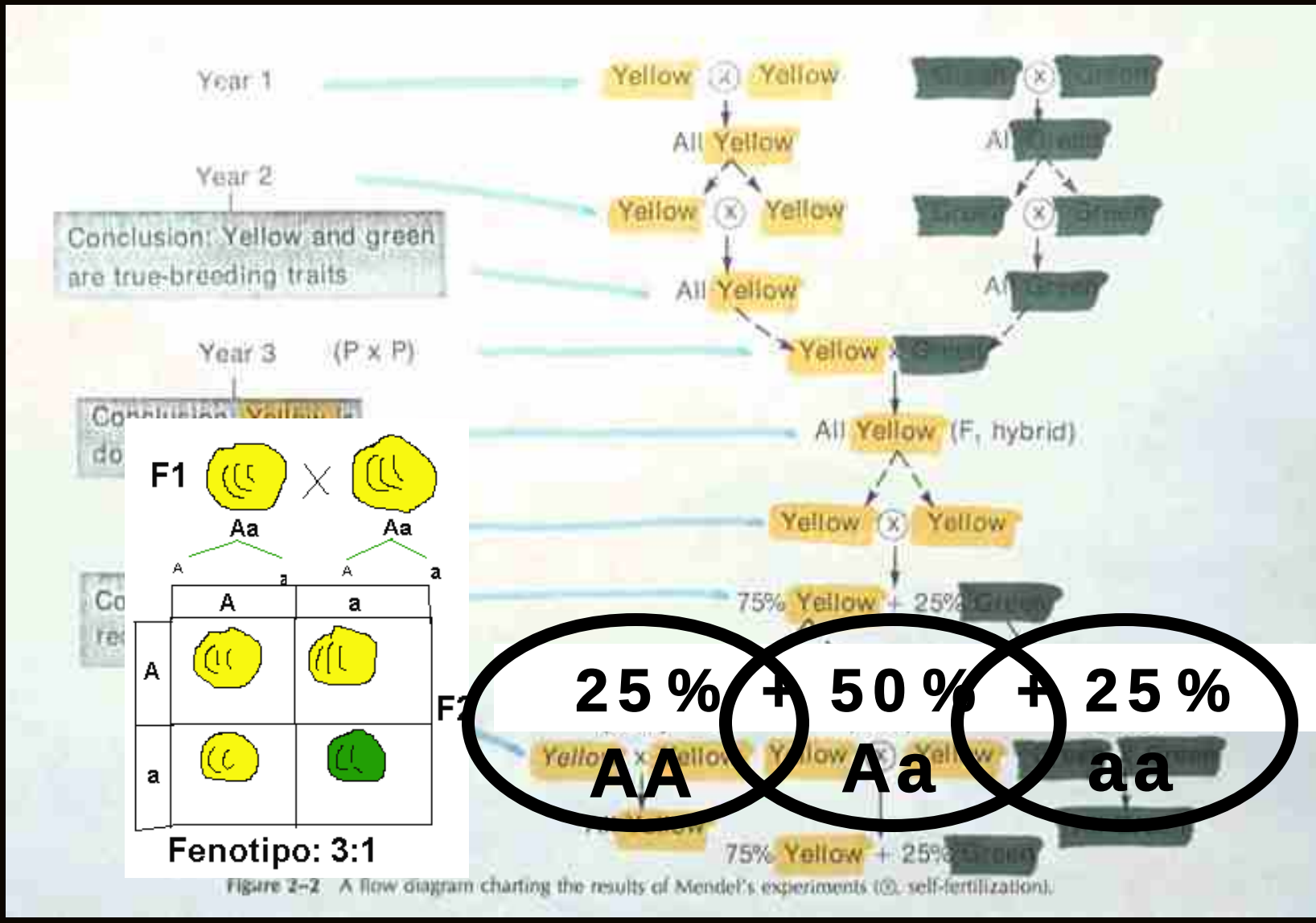

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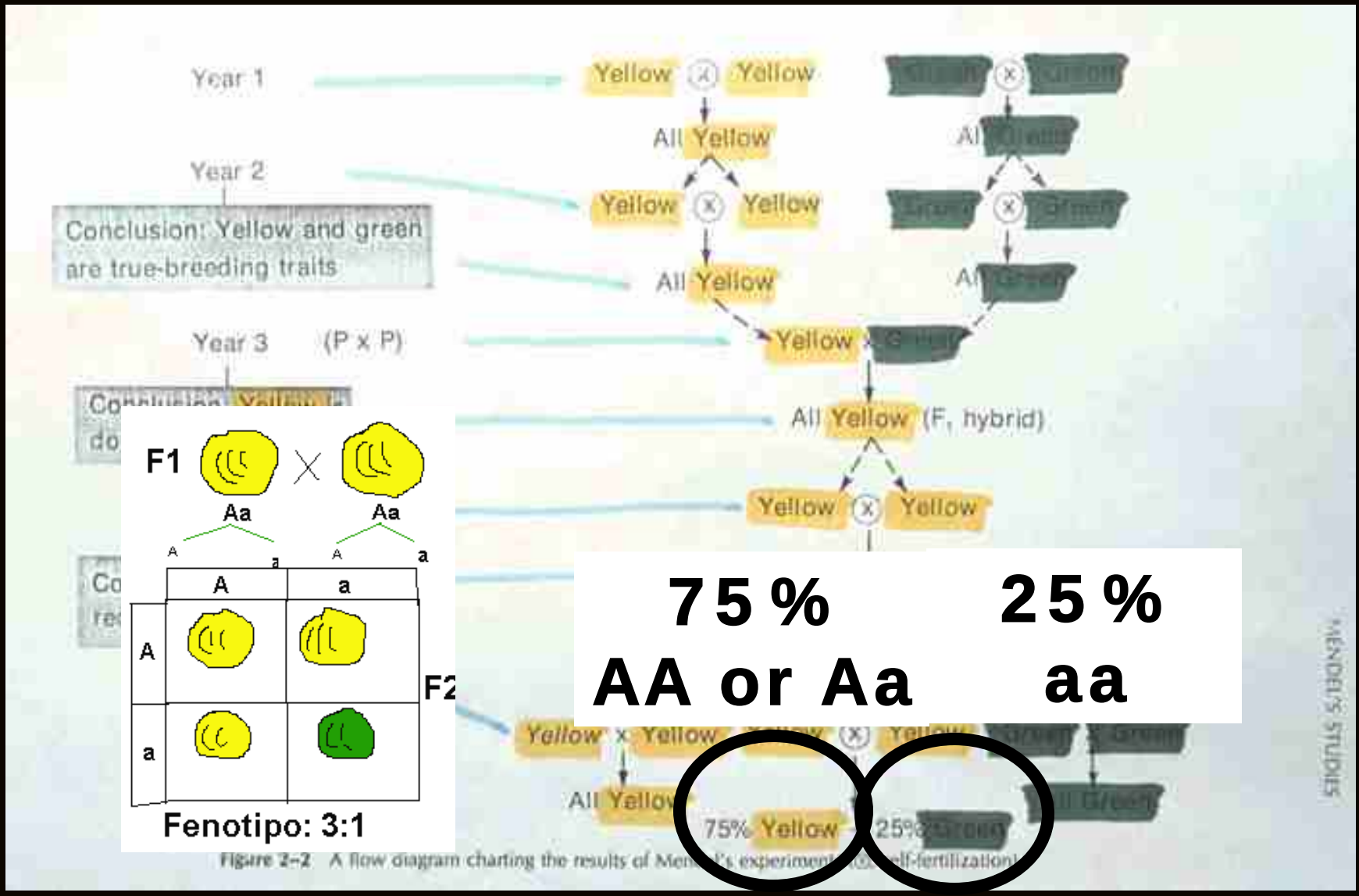
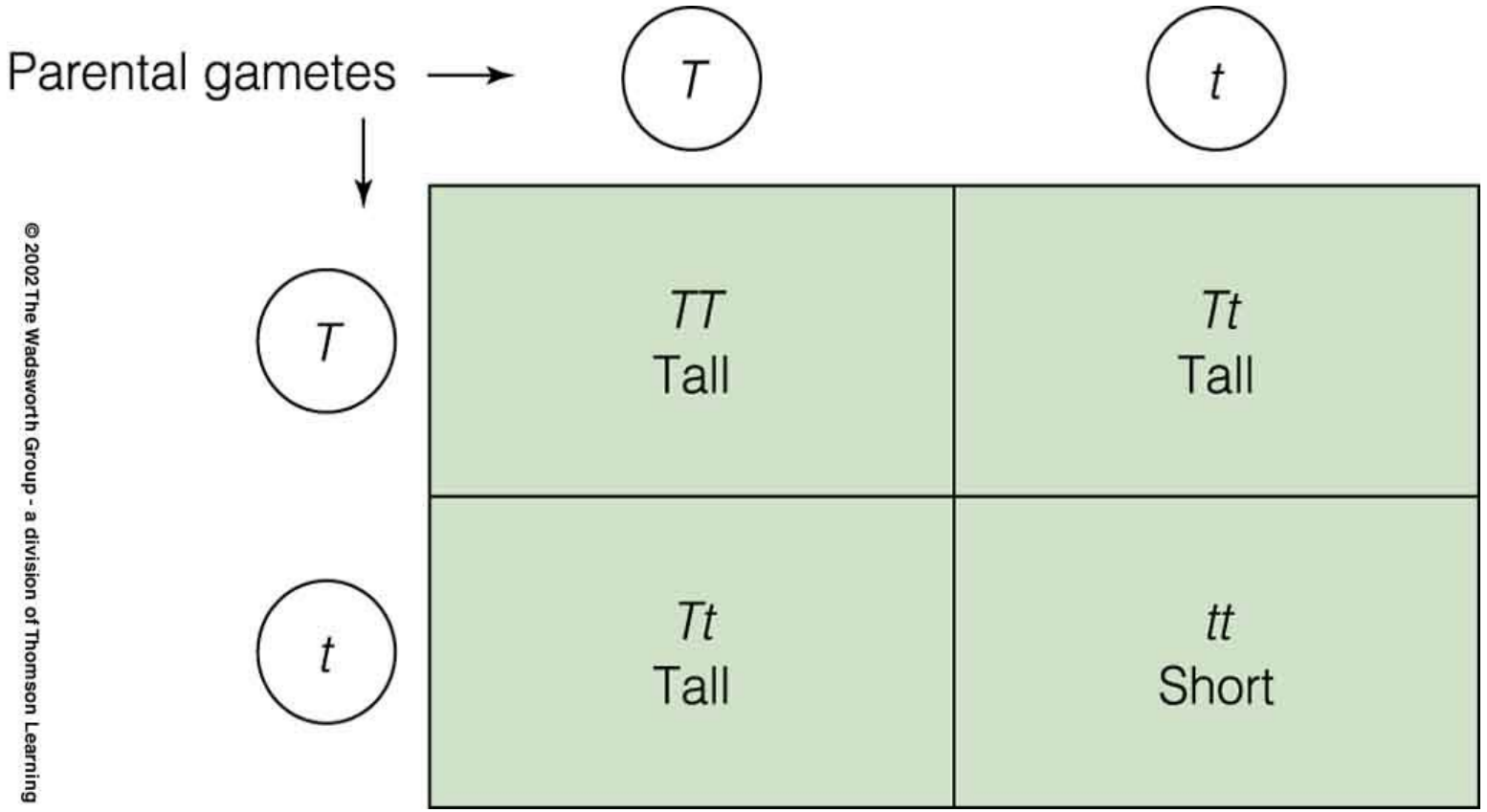


Figure 2-2 A flow diagram charting the results of Mendel's experiment (self-fertilization)



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Punnett square representing possible genotypes and phenotypes and their proportions in the F_2 generation.

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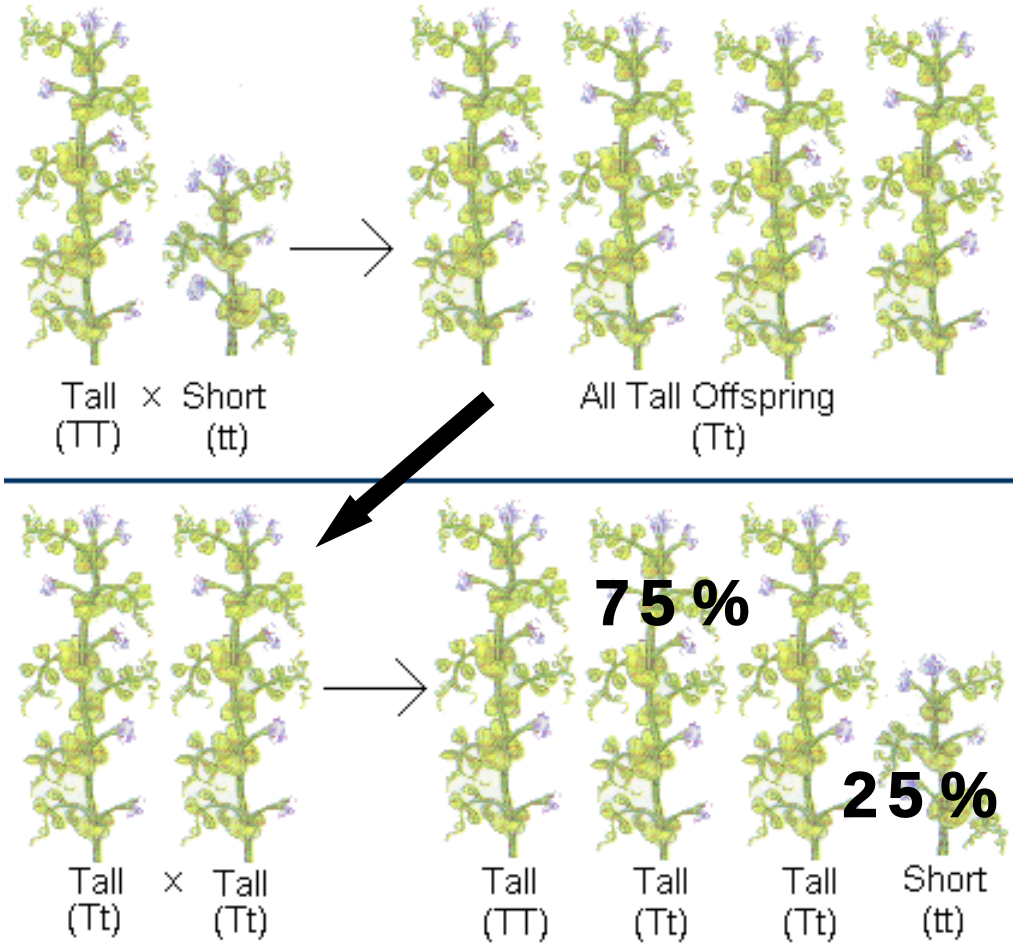


Punnett square representing possible genotypes and phenotypes and their proportions in the F_2 generation.

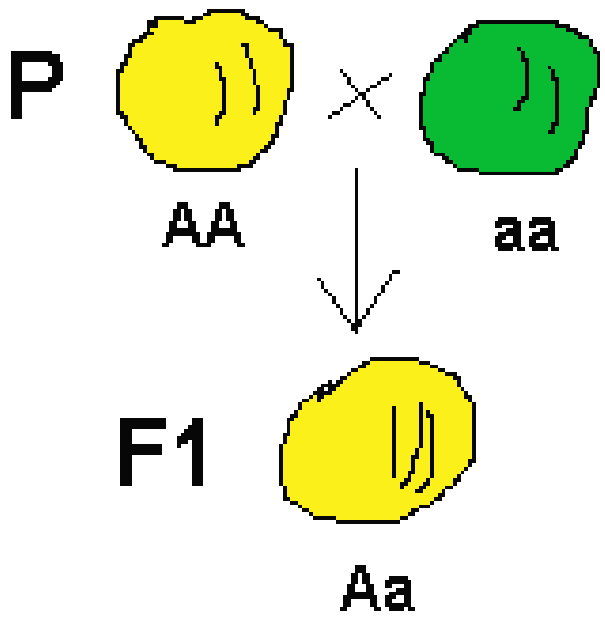
[Think-Quest: Introduction to Genetics]

dominant

describing a genetic trait governed by an allele

(one of a group of genes)

that can be expressed in the presence of another, different allele



Genotypes and phenotypes in the F_1 generation.

recessive

describing a genetic trait that is not expressed in heterozygotes

Aa

Tt

recessive

for a recessive allele to be expressed, there must be two copies of the allele, *i.e.*, the individual must be homozygous

aa

tt

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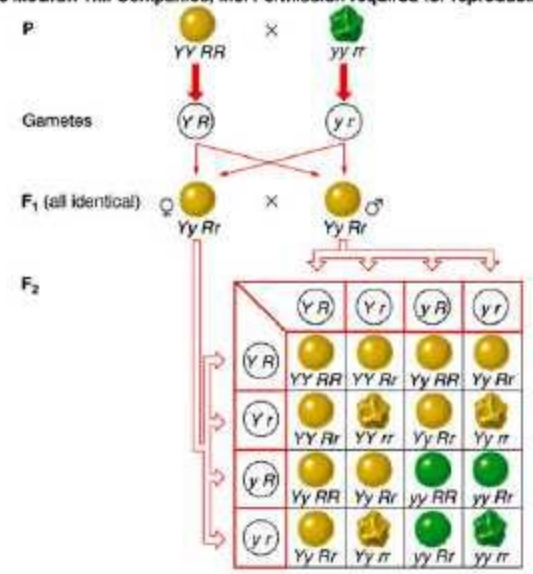

Type	Genotype	Phenotype	Number	Phenotypic ratio
Parental	Y– R–	yellow round	315	9/16
Recombinant	yy R–	green round	108	3/16
Recombinant	Y– rr	yellow wrinkled	101	3/16
Parental	yy rr	green wrinkled	32	1/16

Ratio of yellow (dominant) to green (recessive) = 12:4 or 3:1
Ratio of round (dominant) to wrinkled (recessive) = 12:4 or 3:1

Crosses with Two traits

http://nitro.biosci.arizona.edu/courses/EEB195-2007/Lecture02/Lecture02.html

sex-linked trait

traits carried by genes located on the X or Y sex chromosomes

genetically normal females: XX

genetically normal males: XY

sex-linked trait

- **most X-linked characteristics are recessive in females**
- **which means that unless they are present on both X chromosomes of a female, the trait is carried but not expressed**

sex-linked trait

- **males, with only one X chromosome, more commonly exhibit such traits phenotypically**
  - **e.g. hemophilia**
  - **e.g. red-green color blindness**

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Page last updated at 18:26 GMT, Thursday, 8 October 2009 19:26 UK

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Royal blood disorder identified

The mutation was transmitted from Russian Empress Alexandra to her son Crown Prince Alexei

DNA analysis has revealed the identity of the "cursed blood" disorder that afflicted the British Royal Family in the 19th and early 20th centuries.

http://news.bbc.co.uk/2/hi/science/nature/8297467.stm

Scientists say the disease inherited by Queen Victoria's descendants was probably a severe form of the blood clotting disorder haemophilia B.

The scientists examined DNA samples extracted from the skeletal remains of Russia's Romanov family.

The research is published in the journal Science.

Their analysis included the remains of Queen Victoria's great grandson Crown Prince Alexei.

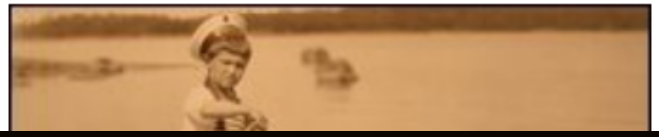
Scientists already knew that males of the Royal Family at that time suffered from a type of haemophilia.

But their latest analysis of the remains of Victoria's Russian descendants helped identify the exact form.

Modern analytical techniques allowed the scientists to amplify the very degraded DNA.

They discovered a mutation in a gene on the X chromosome that codes for the production of Factor IX, a substance that causes blood to clot.

This genetic mutation is the cause of haemophilia B.



http://news.bbc.co.uk/2/hi/science/nature/8297467.stm

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Case Closed: Famous Royals Suffered From Hemophilia

By Michael Price
*Science*NOW Daily News
8 October 2009

Queen Victoria's male descendants were cursed with poor health. The 19th century British monarch's son Leopold, Duke of Albany, died from blood loss after he slipped and fell. Her grandson Friedrich bled out at age 2; her grandsons Leopold and Maurice, at ages 32 and 23, respectively. The affliction, commonly known as the "Royal disease," spread as Victoria's heirs married into royal families across Europe, decimating the thrones of Britain, Germany, Russia, and Spain. Based on the symptoms, modern researchers concluded that the royals suffered from hemophilia--a genetic disease that prevents blood from clotting--but there was never any concrete evidence. Now, new DNA analysis on the bones of the last Russian royal family, the Romanovs, indicates the Royal disease was indeed hemophilia, a rare subtype known as hemophilia B.

Hemophilia prevents proteins known as fibrins from forming a scab over a cut or forming clots to stop internal

Enlarge Image

Royal affliction. Prince Alexei bled frequently and for prolonged periods.

CREDIT: STATE ARCHIVES OF THE RUSSIAN FEDERATION

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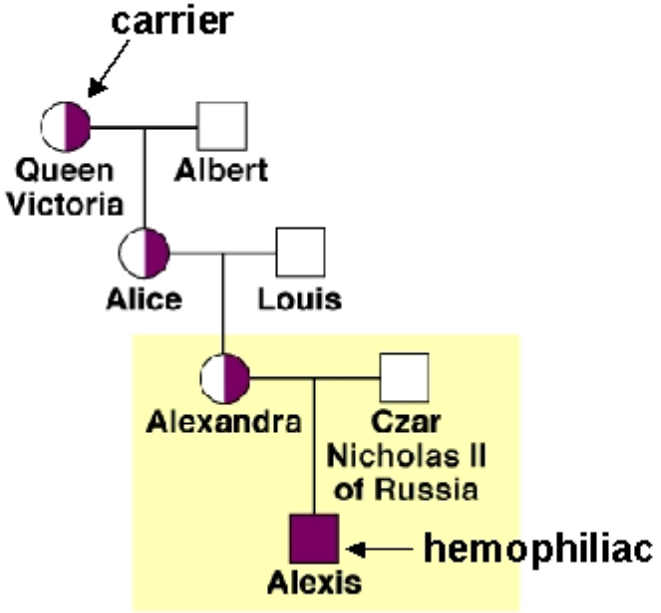
http://sciencenow.sciencemag.org/cgi/content/full/2009/1008/2

In a sex-linked trait (like hemophilia), women are carriers, and men have the phenotype more often.

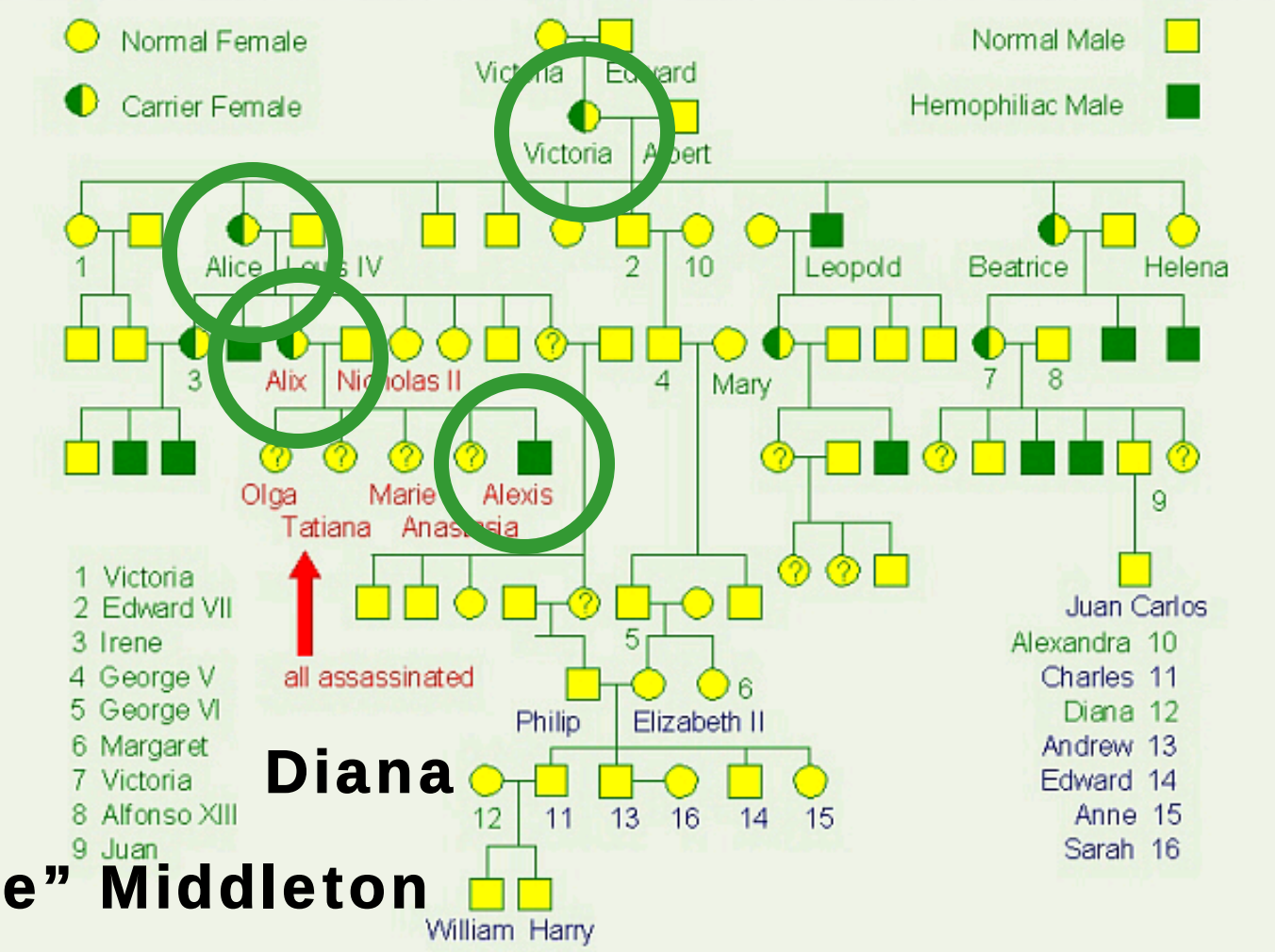
©Addison Wesley Longman, Inc.



Sex-linked recessive: hemophilia A

The pedigree chart of **Queen Victoria** of England illustrates inheritance of hemophilia A. Queen Victoria herself was a carrier due to a chance mutation. Her children married other royalty and passed the trait throughout the royal families of Europe.

The pedigree below has been generously provided by Janet Stein Carter, biology instructor at Clermont College, University of Cincinnati, who retains copyright.



brie.medlabscience.med.ualberta.ca/de/genetics/70gen-hemophil.html

sex-linked trait

aka **“Holandric Inheritance”**

- **Y-linked traits, which are directly involved with determining maleness, are manifested only by males**
- **known examples are rare but probably include the long hairs on the ear rims of some adult males in India, Ceylon, Israel and aboriginal Australia**

Important People / Works

Hugo de Vries

(1848 - 1935)

in 1900 rediscovered Mendel's work on plant hybrids

Hugo de Vries

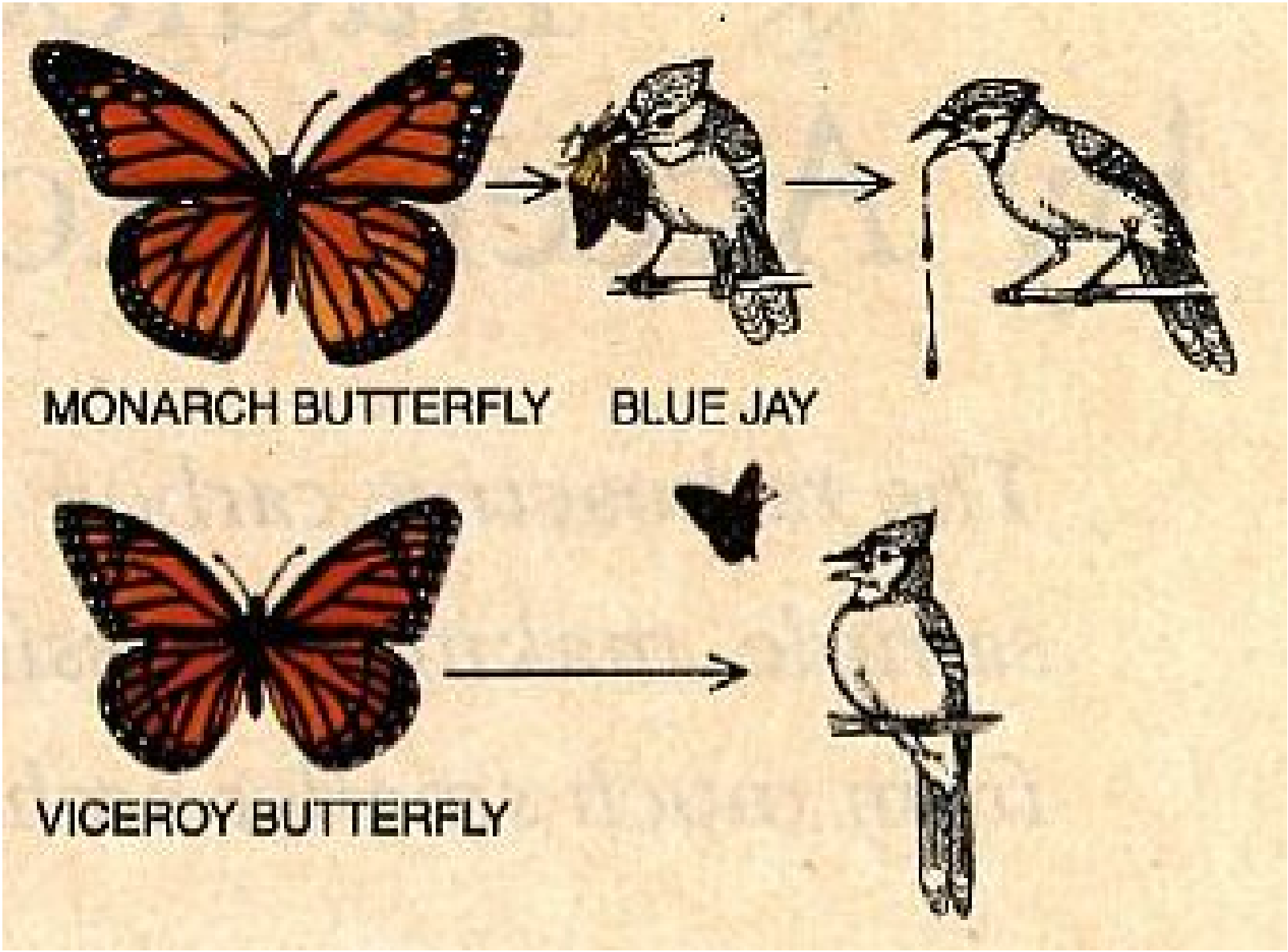
1848-1935

The monarch tastes bad to birds because as a caterpillar it ate milkweed leaves.

Viceroy caterpillars do not eat milkweed so the butterfly probably would taste good, but birds leave it alone because it looks like a monarch.

Mimicry

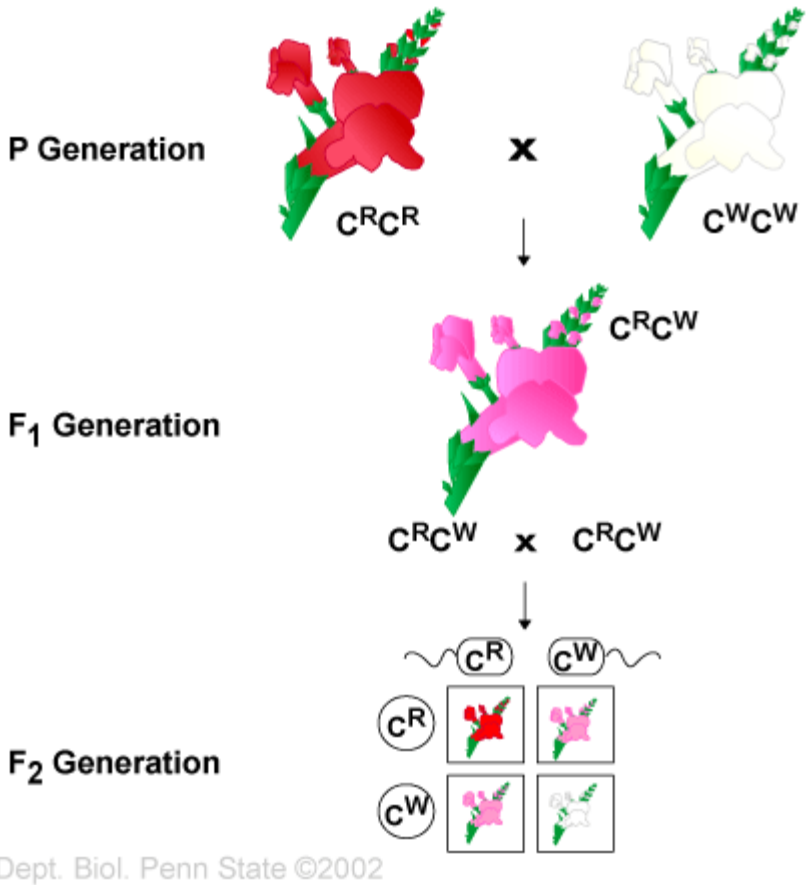
[Minnesota Department of Natural Resources]



Mimicry

Predaatio: saaliin ja saalistajan kilpajuoksu

so where did those pink flowers Come from?



-- Penn State Biology Department

Incomplete dominance in snapdragon color

http://courses.bio.psu.edu/fall2005/biol110/tutorials/tutorial5.htm

“In Mendel's experiments, offspring always looked like one of their two parents due to the complete dominance of one allele over the other.”

“This is not always the case because some genes display

incomplete dominance

and individuals with heterozygous alleles exhibit a phenotype intermediate between those with homozygous alleles.”

-- Penn State Biology Department

http://courses.bio.psu.edu/fall2005/biol110/tutorials/tutorial5.htm

“In Mendel's experiments, offspring always looked like one of their two parents due to the complete dominance of one allele over the other.”

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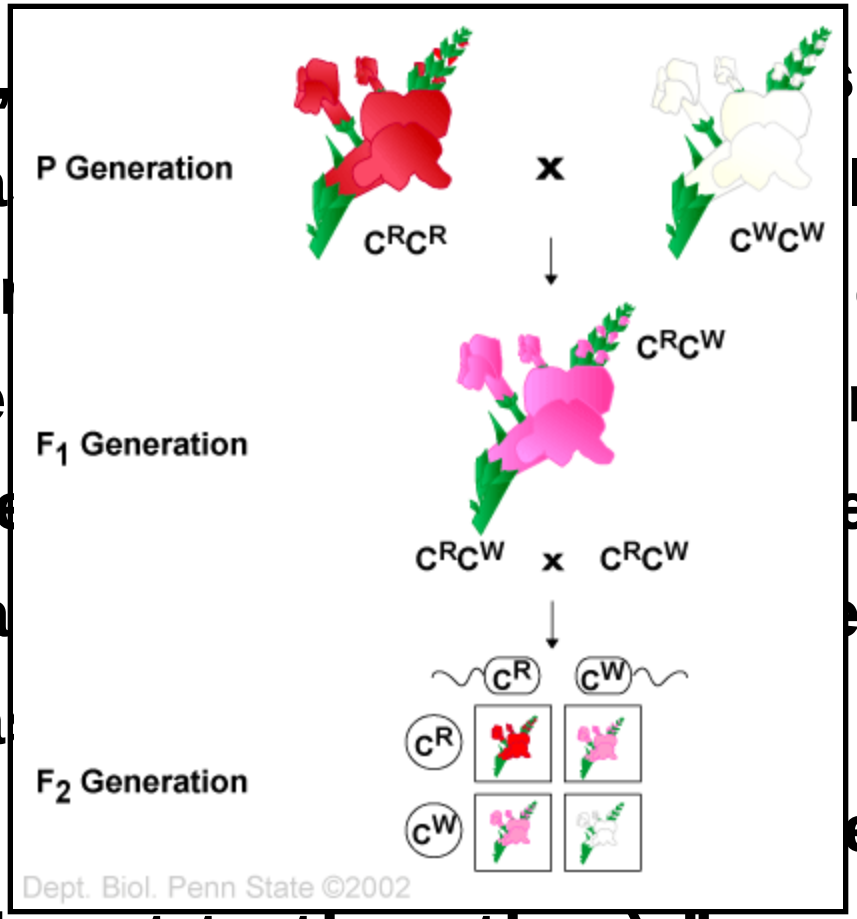
incomplete dominance

and individuals with heterozygous alleles exhibit a phenotype intermediate between those with homozygous alleles.”

-- Penn State Biology Department

http://courses.bio.psu.edu/fall2005/biol110/tutorials/tutorial5.htm

“Since neither allele dominates over the other, se and lowerca letter is inappr e, the characte ndicated by a lette encoding the tra ed) are listed a (recall, they are e neither is dominant to the other).”



-- Penn State Biology Department

http://courses.bio.psu.edu/fall2005/biol110/tutorials/tutorial5.htm

Misconceptions of Darwin's Work

Some thought Darwin's work was anti-religious

Wrong

Misconceptions of Darwin's Work

Some thought Darwin took the position that humans descended from an ape

Wrong

“In the distant future . . . light will be thrown on the origin of man and his history.” – *Origin of Species*, 1859

Important People / Works

Thomas H. Huxley

(1825 - 1895)

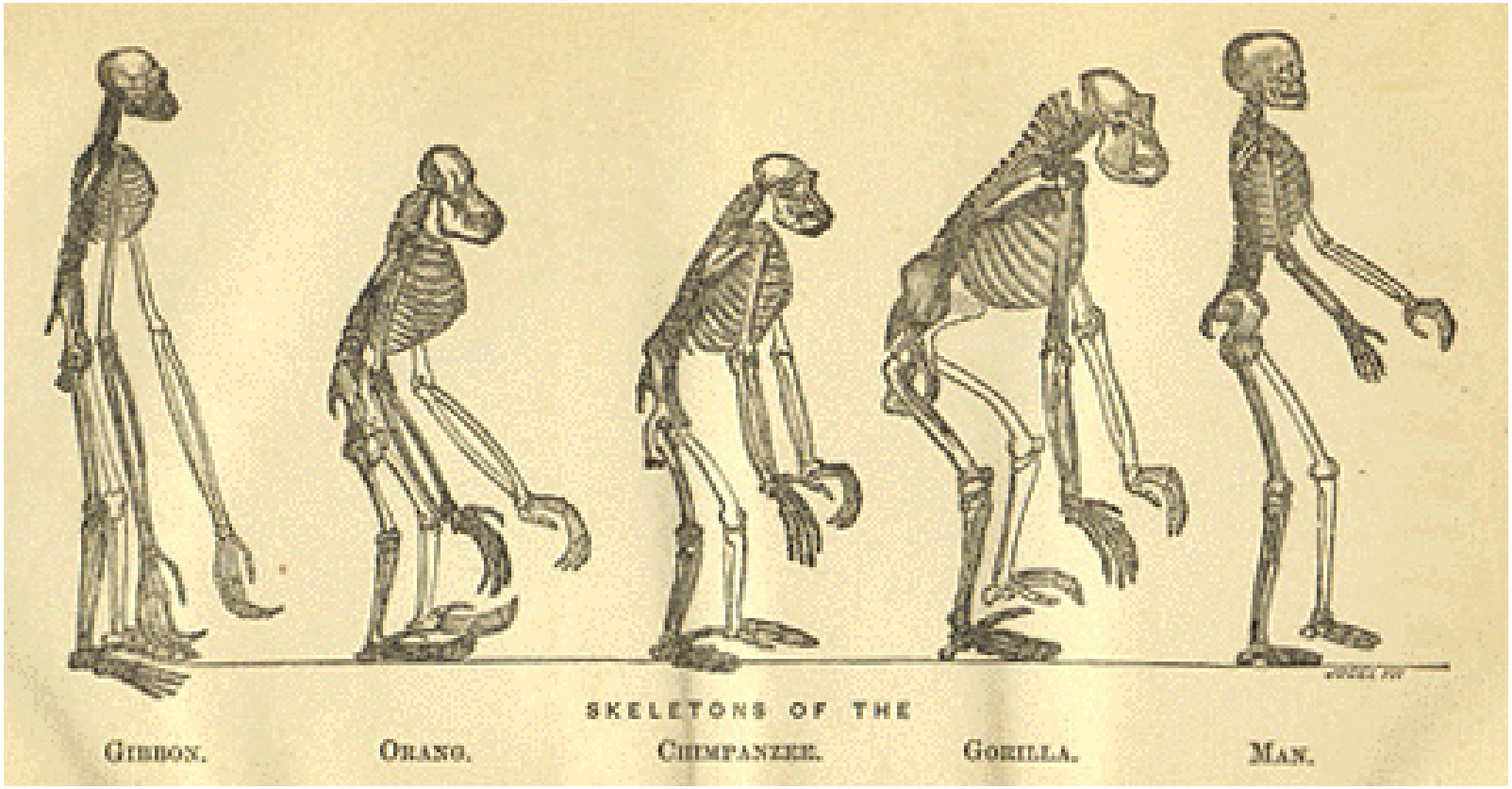
[*Evidence as to*]

Man's Place in Nature

1863

Thomas Henry Huxley

1825 - 1895



Frontispiece from T. H. Huxley's *Evidence as to Man's Place in Nature*
(London: Williams and Norgate, 1863)

Important People / Works

Charles Darwin

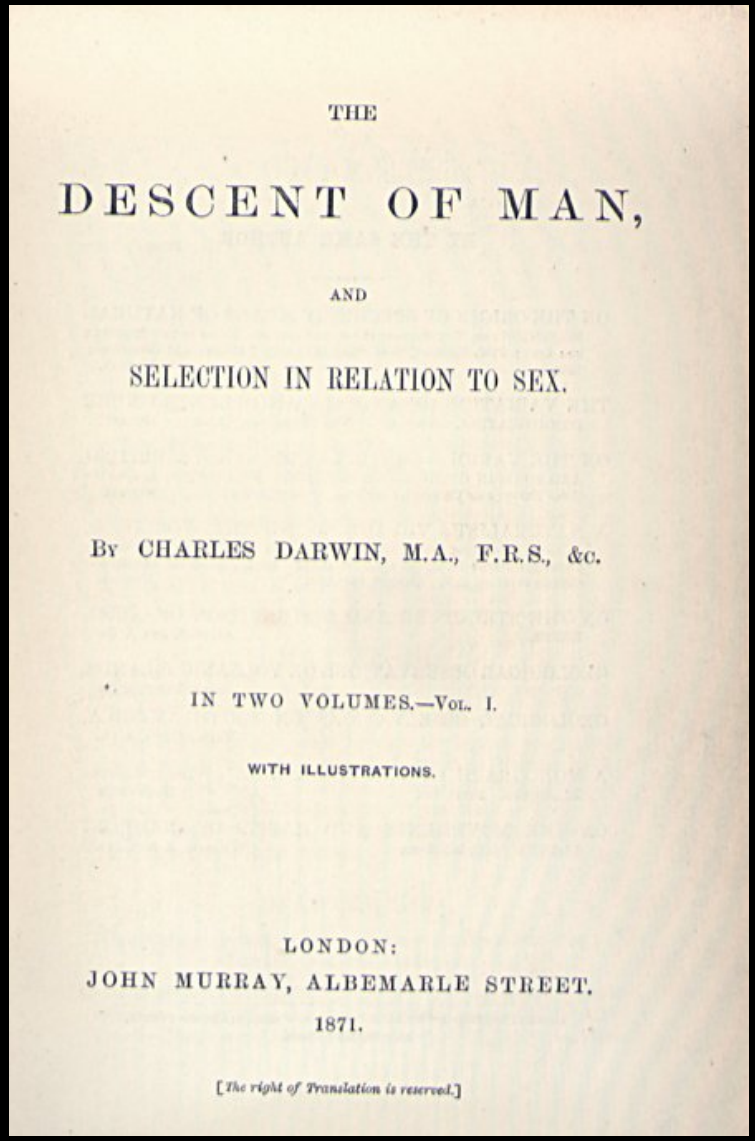
(1809 - 1882)

- ***Origin of Species***

  1859

- ***Descent of Man***

  1871



THE

DESCENT OF MAN,

AND

SELECTION IN RELATION TO SEX.

By CHARLES DARWIN, M.A., F.R.S., &c.

IN TWO VOLUMES.—Vol. I.

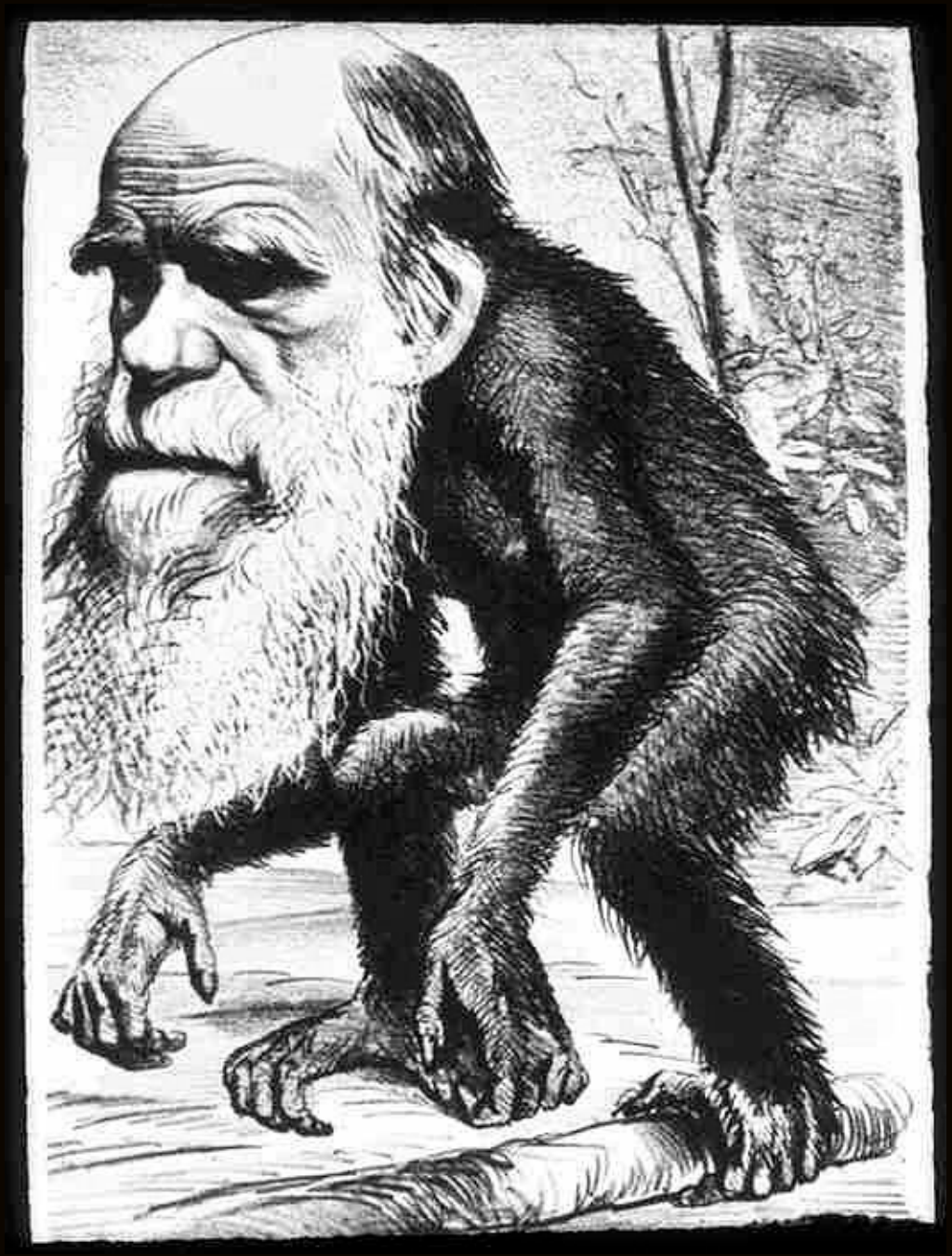
WITH ILLUSTRATIONS.

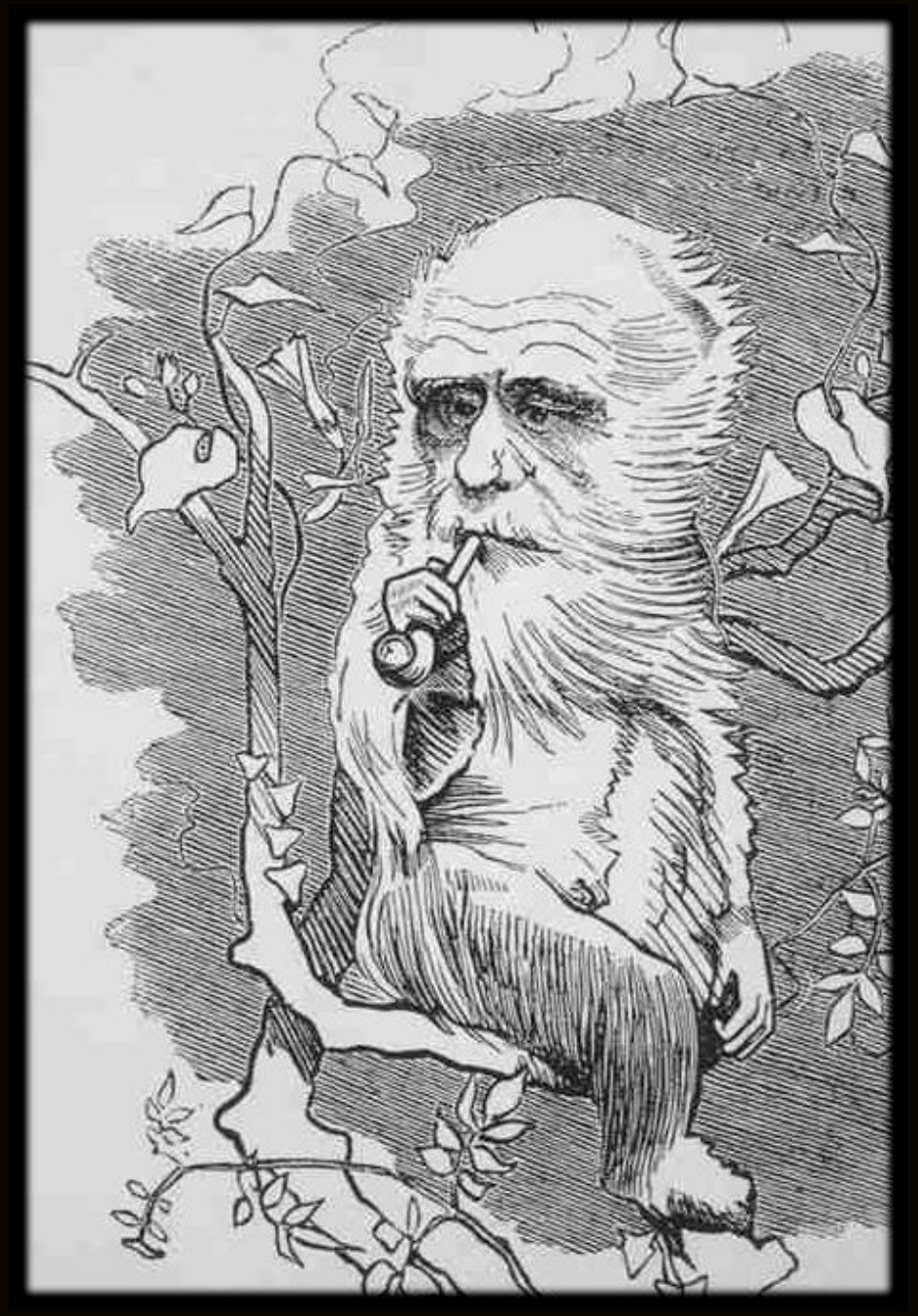
LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1871.

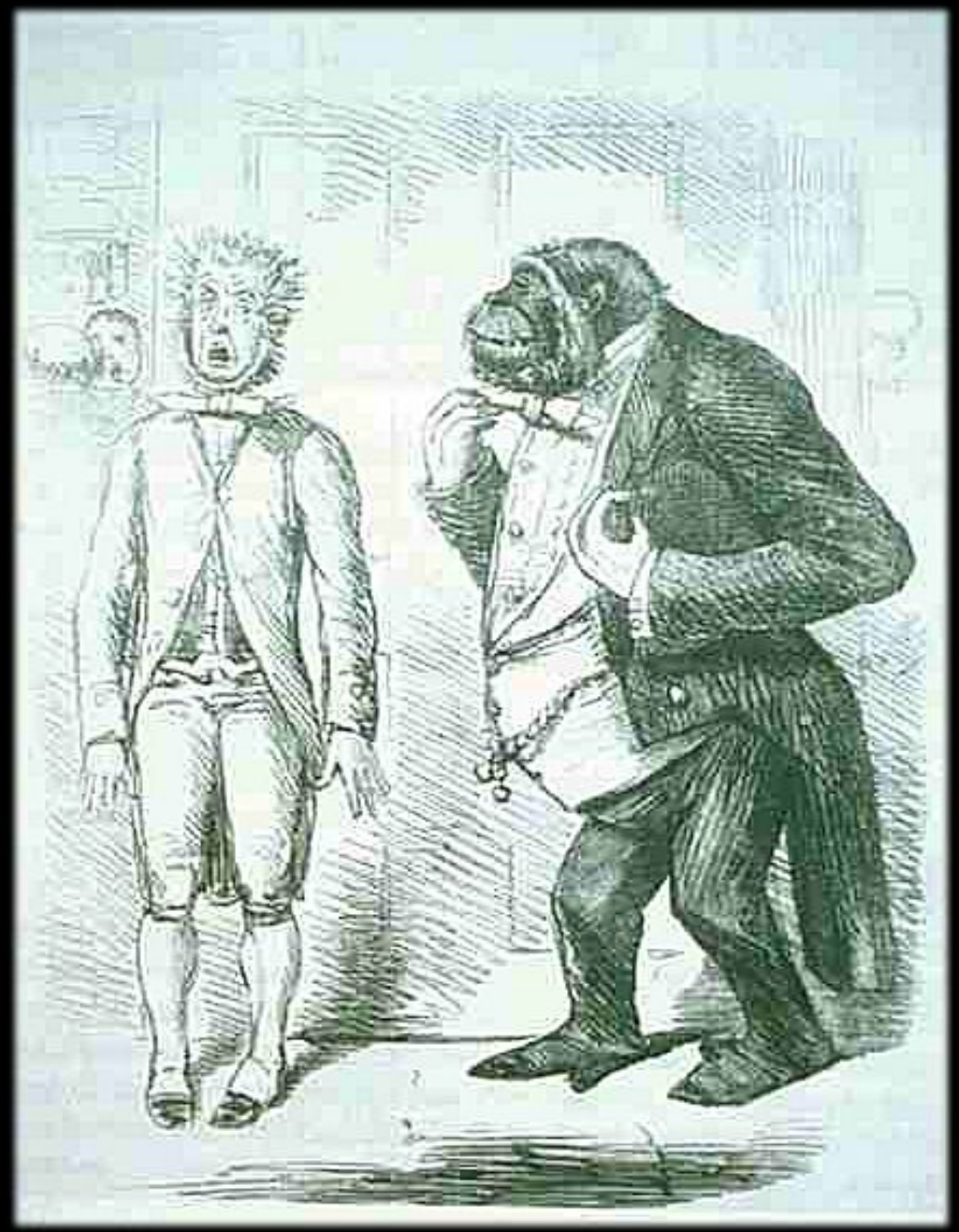
[*The right of Translation is reserved.*]

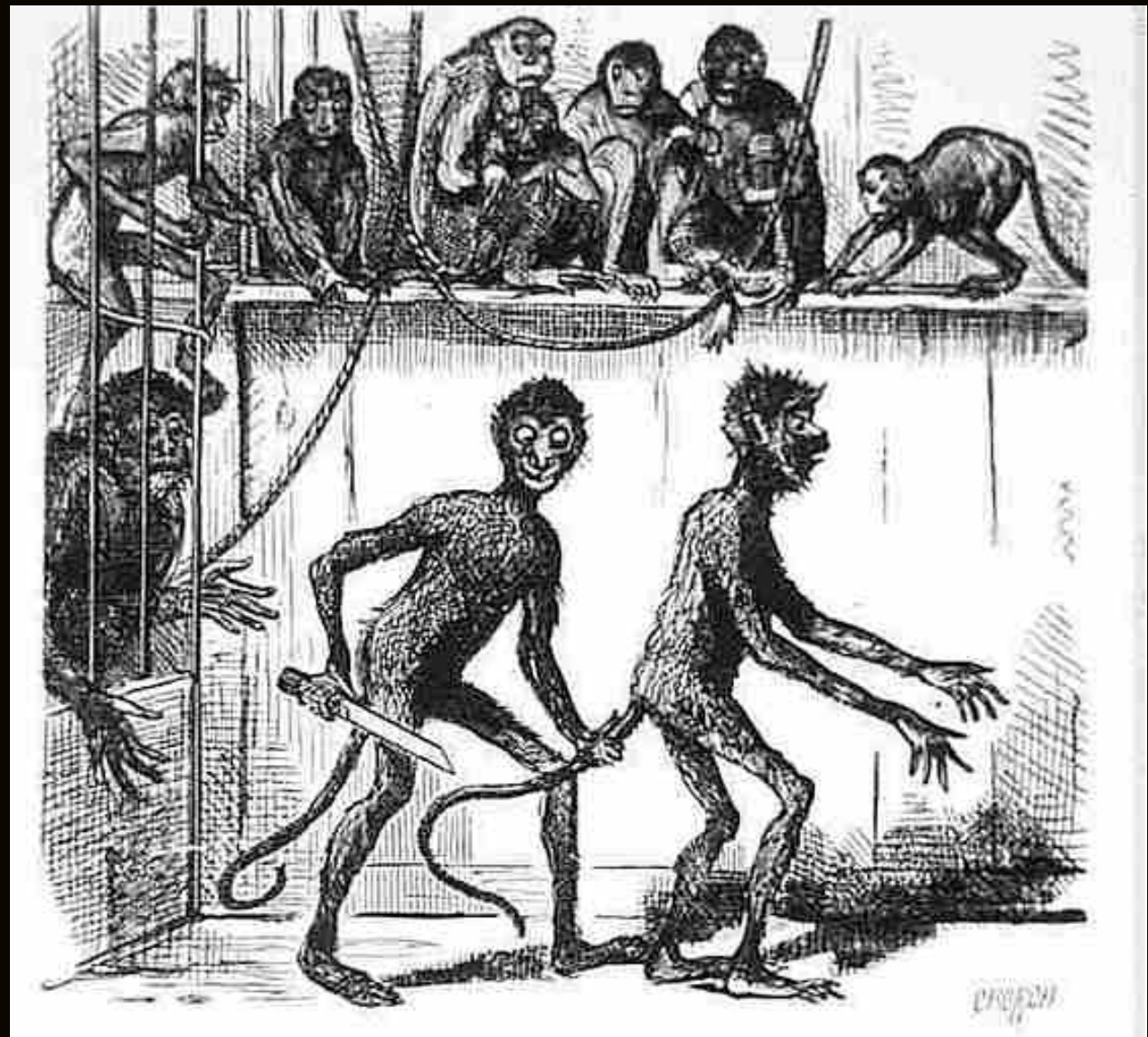
Charles Darwin

1871

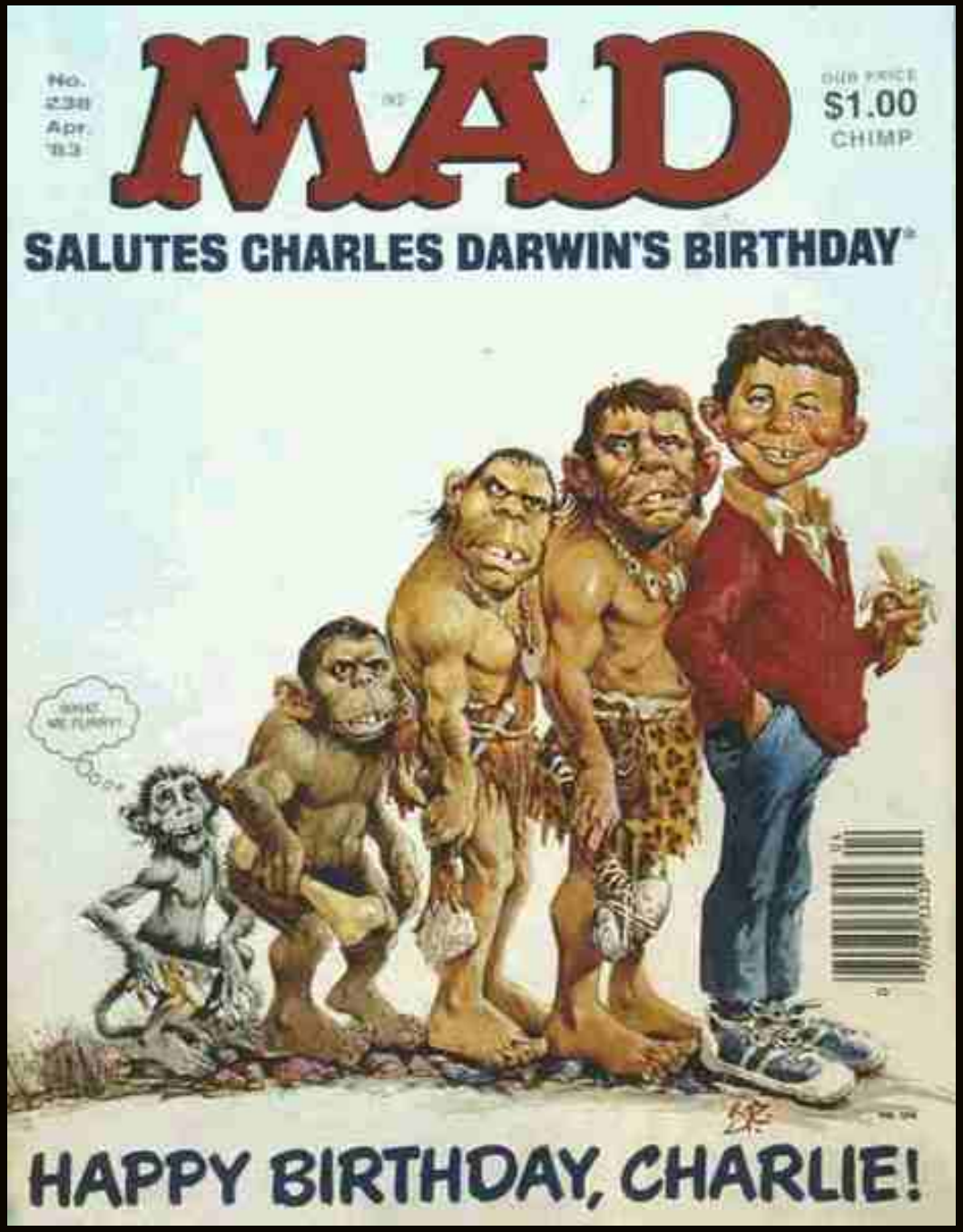








One caged monkey requests another in an 1876 Harper's Bazaar to amputate his tail so that he can more quickly take on his august role as a man.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SALUTES CHARLES DARWIN'S BIRTHDAY*
HAPPY BIRTHDAY, CHARLIE!

Prehistoric Cultures

Continue on to Set #06B

Conceptual Changes Between the 18th and 20th Centuries