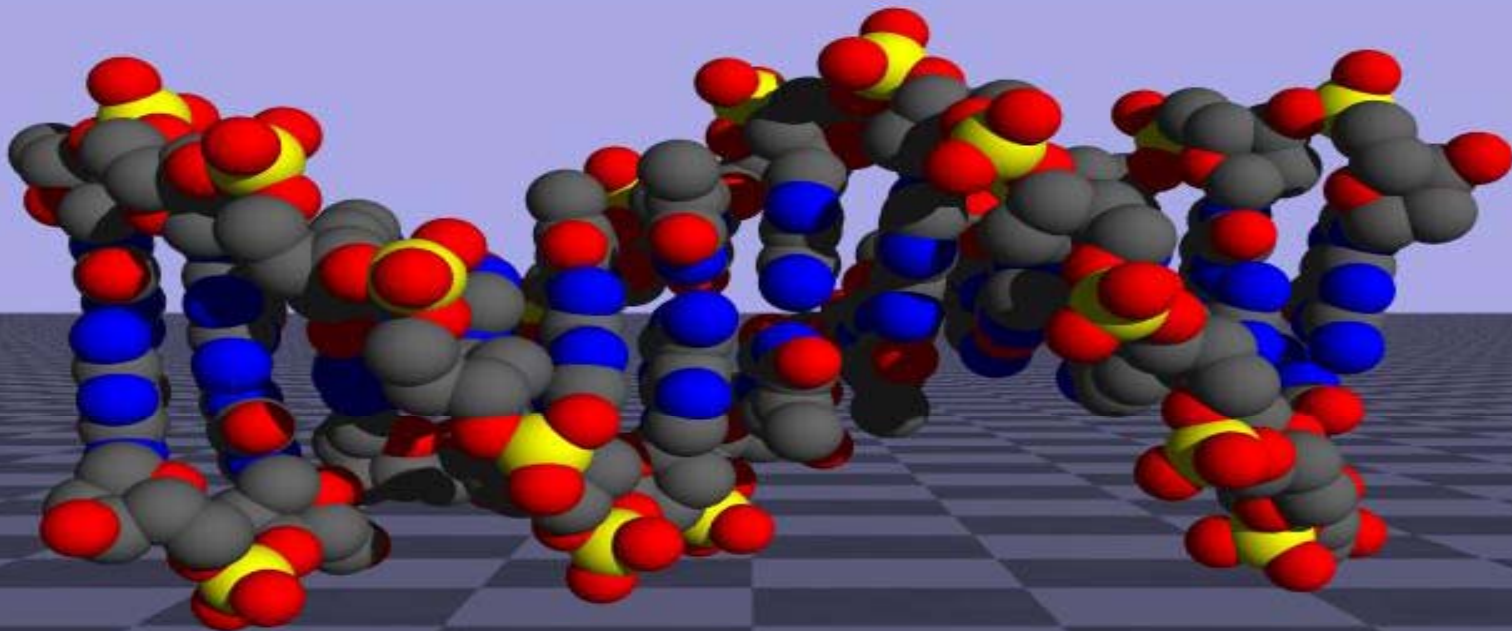
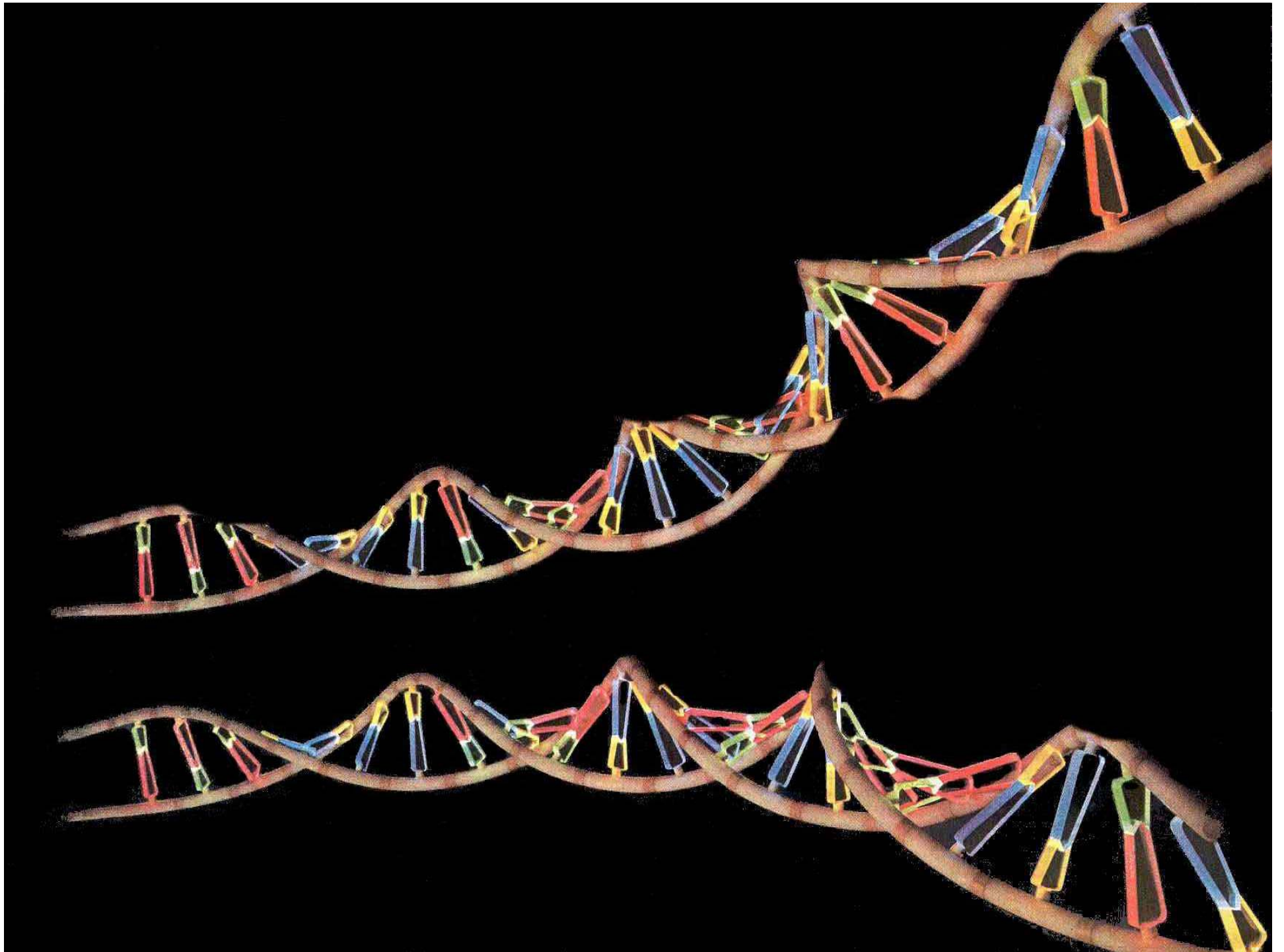


Fundamentals of Genetics



Chapter 9



Heredity: the transmission of genetic information from one generation to the next.

Genes:

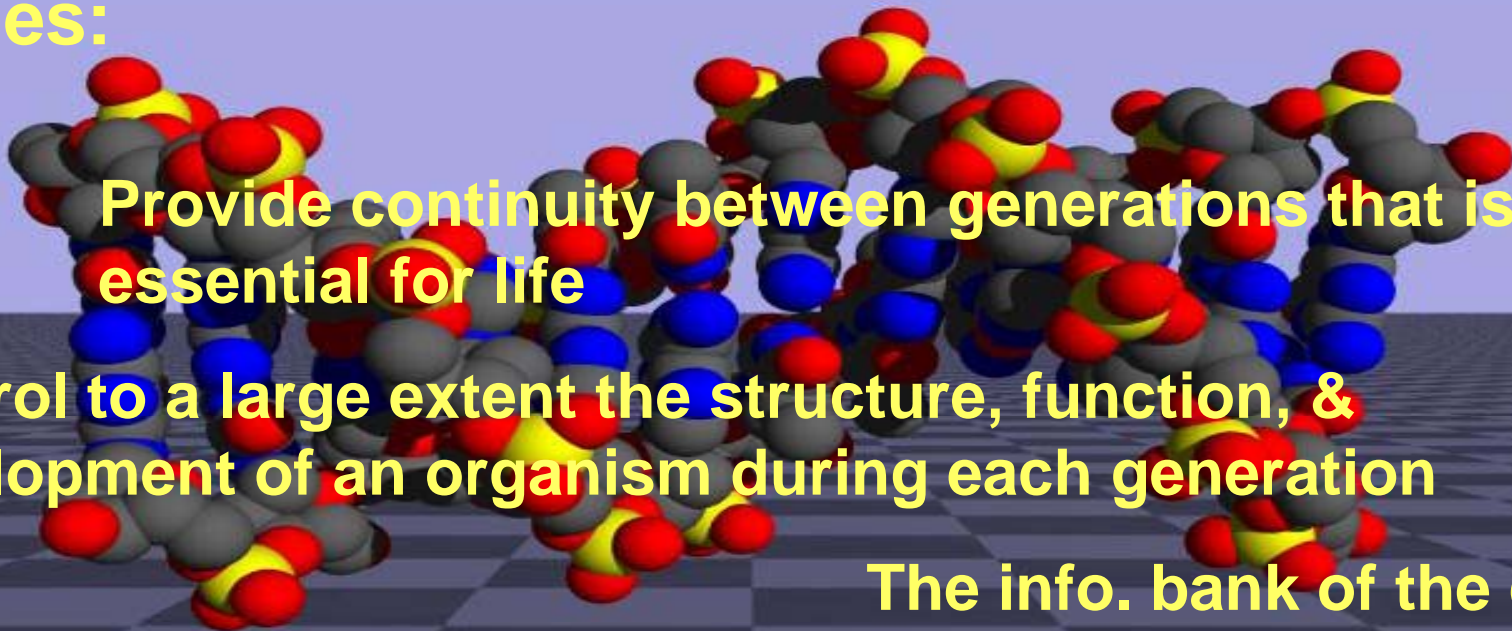
Provide continuity between generations that is essential for life

Control to a large extent the structure, function, & development of an organism during each generation

The info. bank of the cell

Store the info. in a molecular code

Provide a set of instructions, a genetic program, for the development of an individual





Mendelian Genetics

Gregor Mendel



- Trained mathematician & natural scientist who discovered the basic rules of heredity
- Interested in the inheritance of animal & plant features --- traits or characteristics

→ Hybrid: offspring expressing traits from both parents

- Experiments differed in 4 important ways from those of other scientists:
 - a. He concentrated on one trait at time
 - b. He used large #'s of organisms so that his data was statistically sound
 - c. He combined the results of many identical experiments
 - d. He used the rules of probability to analyze his results

Mendel experimented with

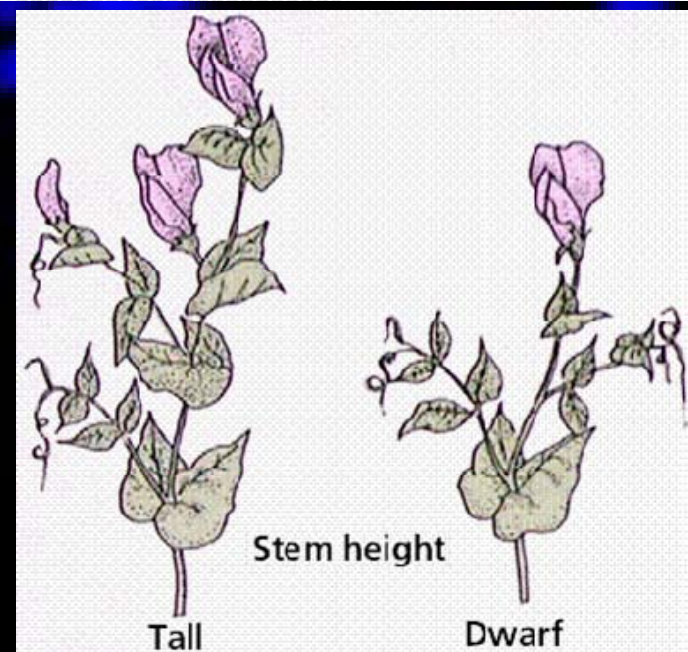
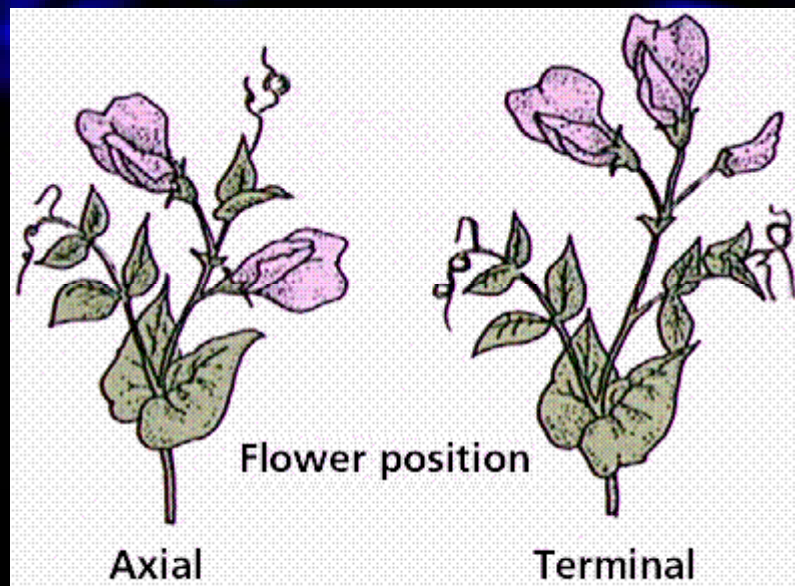
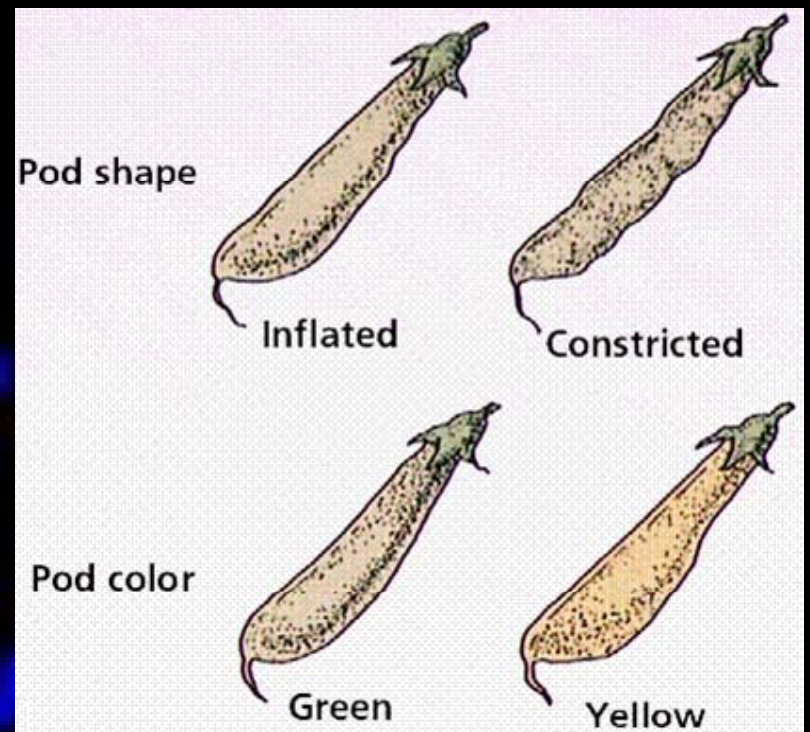
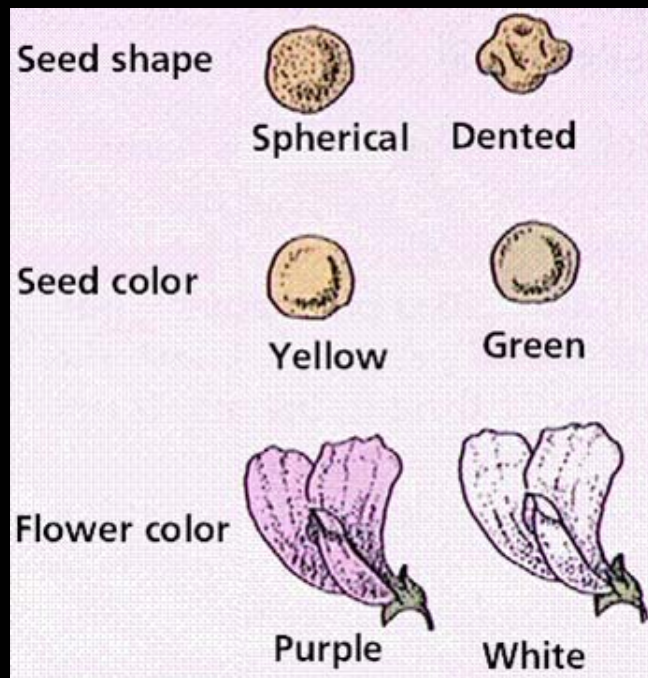
Pea Plants

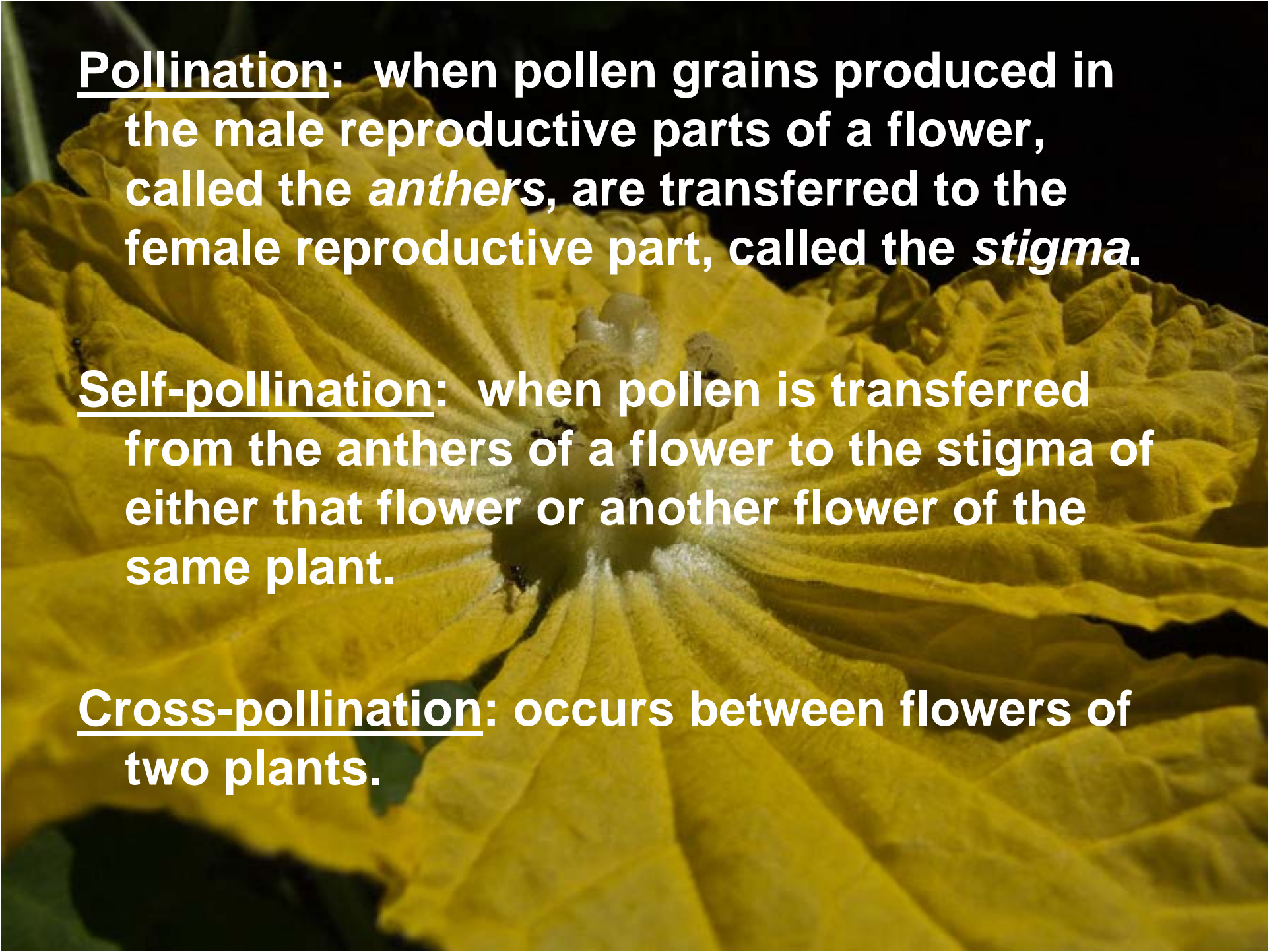


- He chose strains that showed 2 different forms of the same trait.

ex: length - tall/short green/yellow seed color

- Worked with 7 different traits in pea plants:
 - a. seed shape – round, wrinkled
 - b. seed color – yellow, green
 - c. flower color – colored, white
 - d. pod shape – inflated, constricted
 - e. pod color – green, yellow
 - f. flower position – axial, terminal
 - g. stem length – long, short





Pollination: when pollen grains produced in the male reproductive parts of a flower, called the *anthers*, are transferred to the female reproductive part, called the *stigma*.

Self-pollination: when pollen is transferred from the anthers of a flower to the stigma of either that flower or another flower of the same plant.

Cross-pollination: occurs between flowers of two plants.

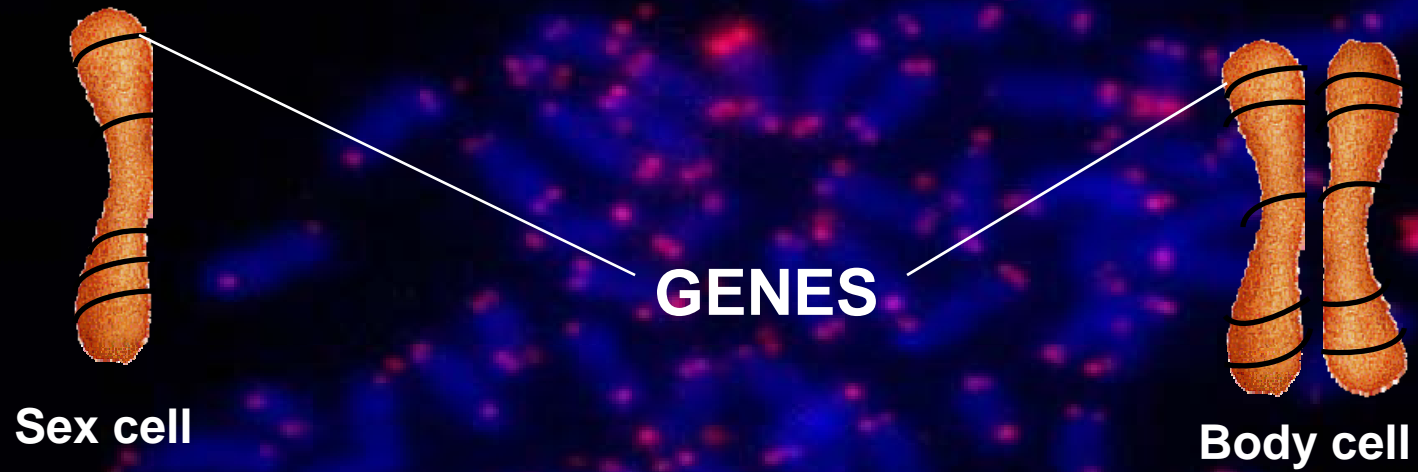
- In his 1st experiment, he crossed pure-breeding plants round seeds with pure-breeding wrinkled seeds P_1 = Parental generation

All were round seeds

In his 2nd experiment, he allowed these seeds to grow & self-pollinate F_1 = Filial Generation

$\frac{3}{4}$ round (75%) $\frac{1}{4}$ wrinkled (25%)

Chromosomes



Predict:

To make a statement with a certain amount of confidence.

What is the probability of the number 5 coming up on one roll of the die?

Ans. = $1/6$

→ Prediction in heredity is expressed in terms of *probability*

2 types of GENES:

dominant: exerting a controlling influence on the expression of a trait.

recessive: the one that disappears temporarily.



Dominant



Recessive

- 
- A microscopic image of plant cells, likely from a seed, showing a complex network of cell walls and internal structures. The cells are stained, with some appearing yellowish and others more greenish. The background is dark, making the cellular structures stand out.
- Assigned symbols to different genes

ex: R – dominant gene (round)

r – recessive gene (wrinkled)

Alleles: the 2 different forms of one gene R & r

RR – purebreed for round

rr – purebreed for wrinkled



Homozygous: having both alleles the same

RR or rr

Heterozygous: the 2 paired alleles have different genetic information

Rr

Genotype: the genetic makeup of the organism. It does not tell us what the organism will look like

Phenotype: the description of an organism's appearance



Mendel's Laws

Law of Segregation: a pair of factors is segregated, or separated, during the formation of gametes.

Each gamete receives one trait for each pair.

Law of Independent Assortment: factors separate independently of one another during the formation of gametes.

PUNNETT SQUARES

A way to show which genes can combine when egg and sperm join.

capital letter → Dominant

lower case → Recessive

ex: earlobes free F

attached f

FF → Pure Dominant Free

Ff → Heterozygous Free

ff → Pure Recessive Attached

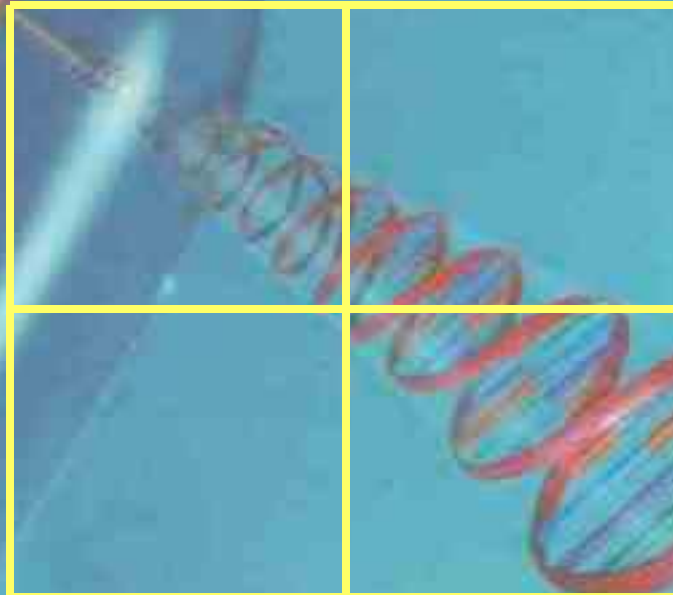
MONOHYBRID CROSS

Cross a *homozygous free earlobes* male
with a *homozygous free earlobes*
female.



To Determine Possible Combinations:

1. Set up the key.
2. Determine the cross.
3. Draw a Punnett Square.



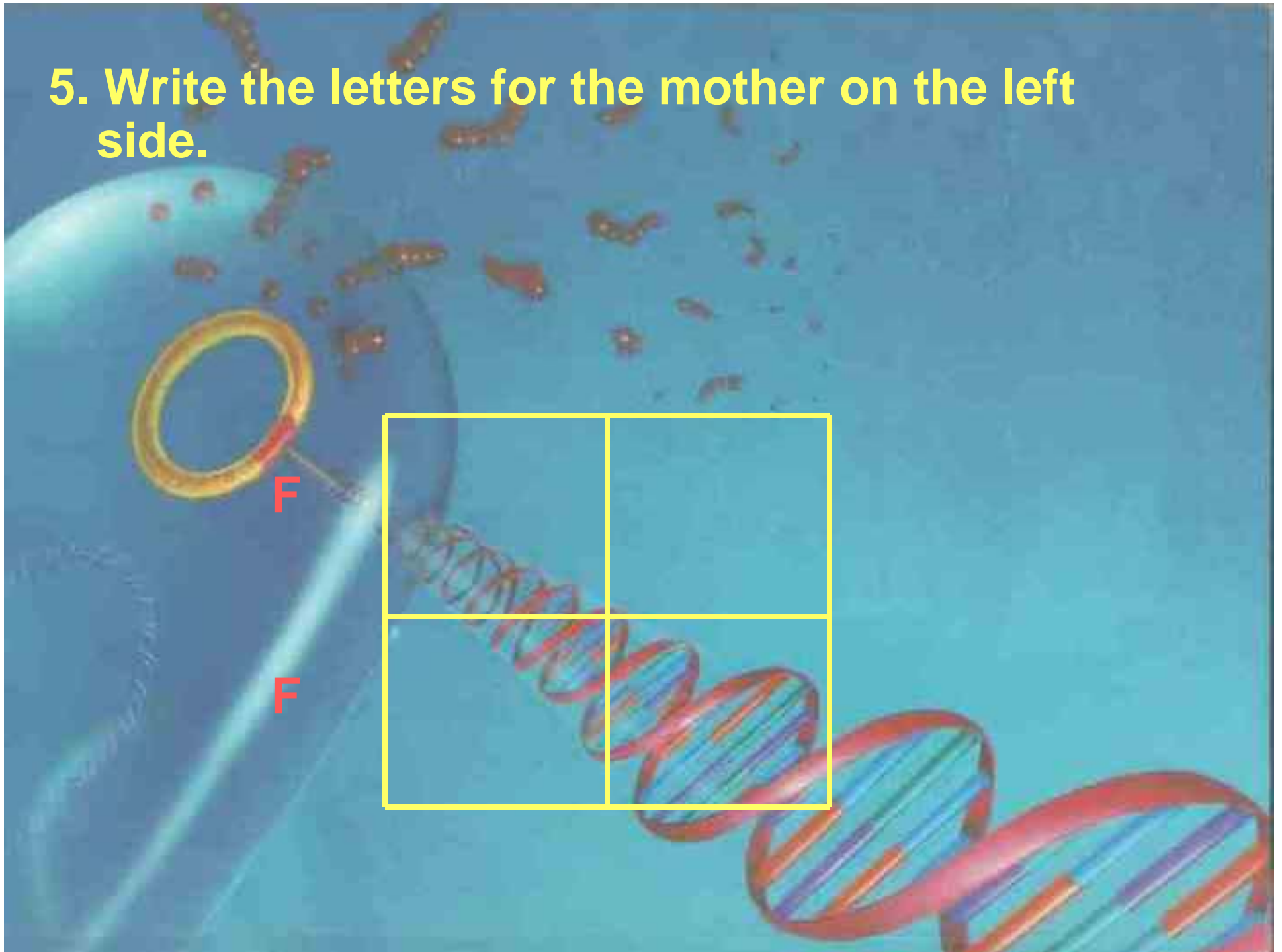
4. Decide what kind of genes will be in the sex cells of each parent. Write the letters for the father on top.

FF x **FF**

F

F

5. Write the letters for the mother on the left side.



6. Copy the letters that appear on top into each box below each letter.

7. Copy the letters that appear on the side into each box.

F

F

F

F

8. Look at the small boxes to determine combination.

Expected Results: *GENOTYPE* - the genetic makeup of the organism. It does not tell us what it will look like.

Observed Results: *PHENOTYPE* – the description of an organisms appearance.

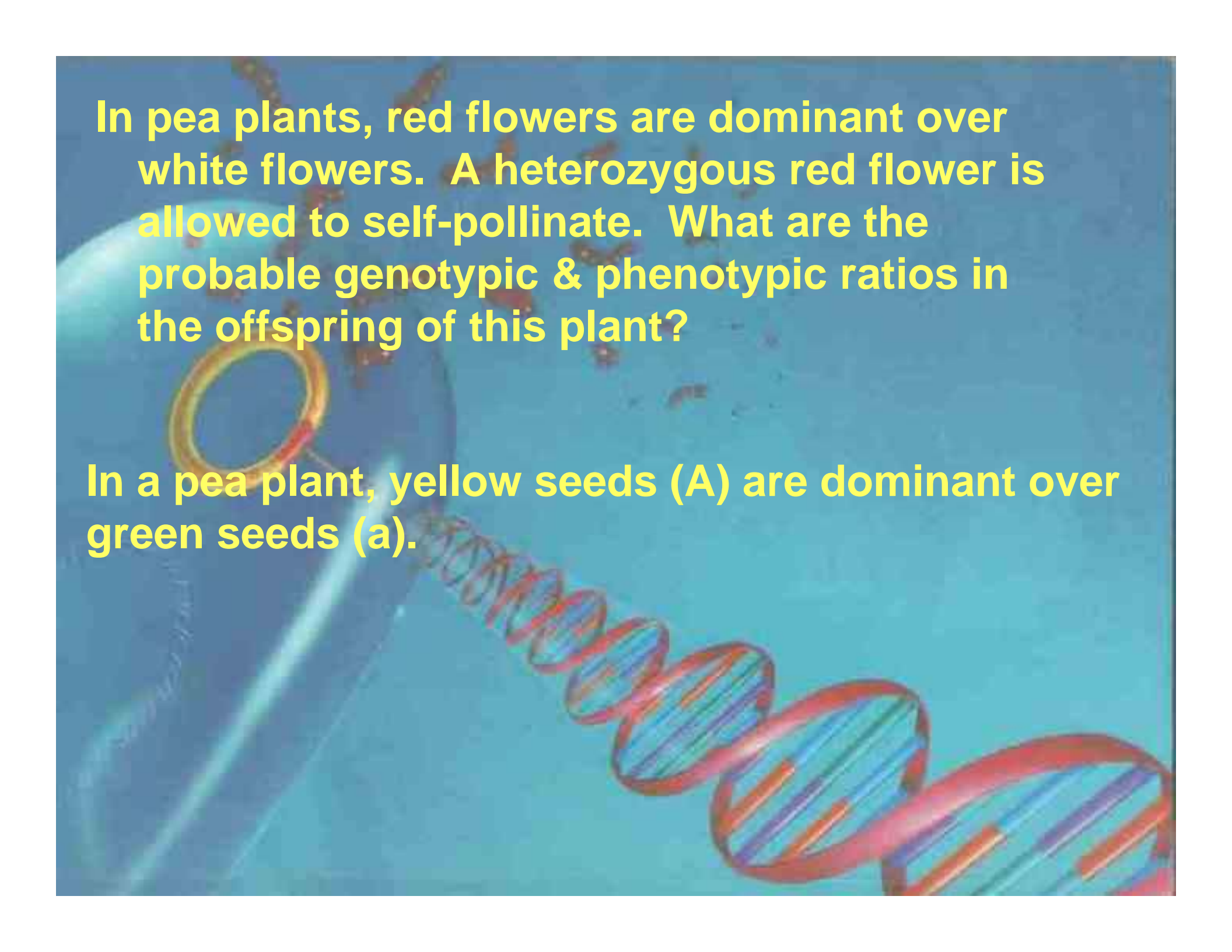
F F	F F
F F	F F

Genotype

FF 100% 4 out of 4

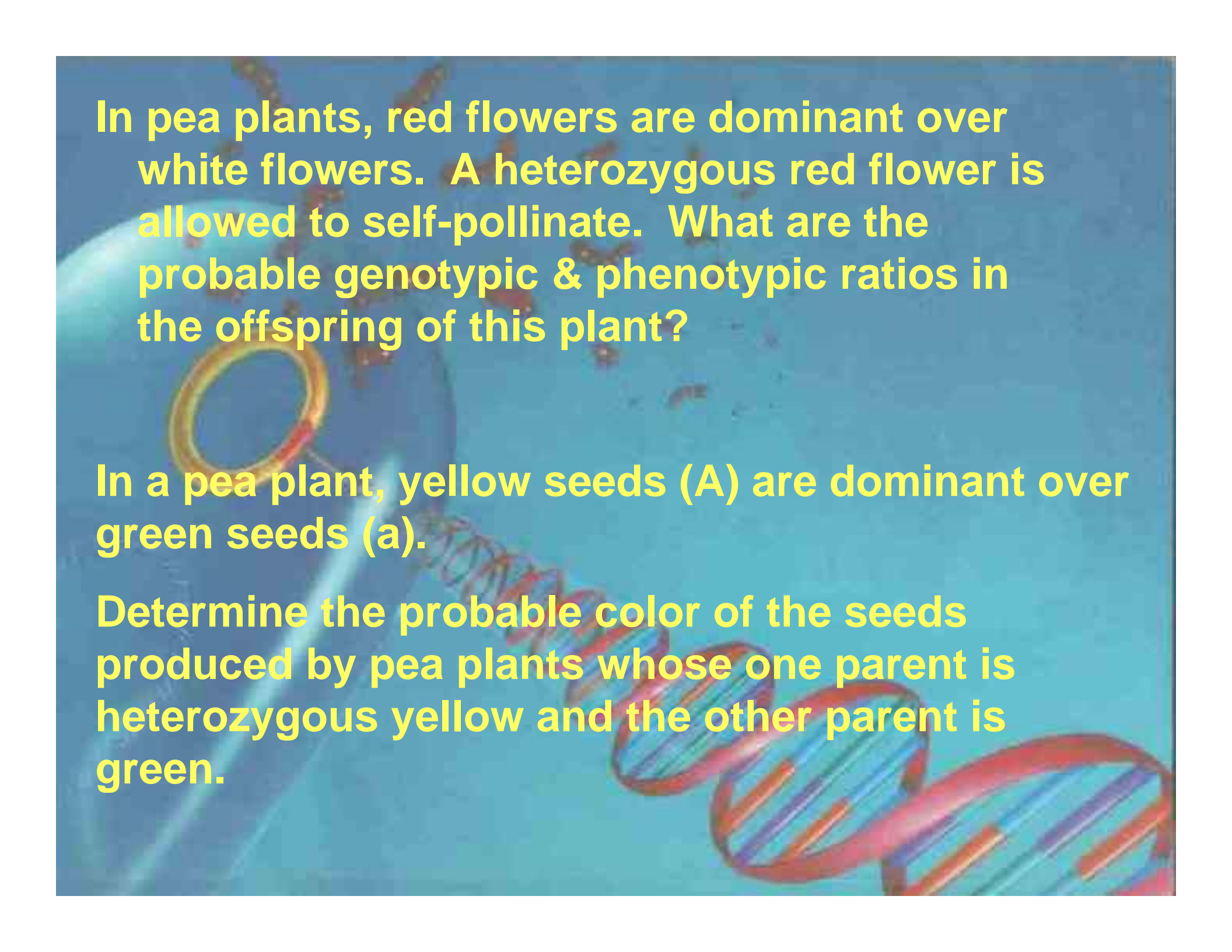
Phenotype

Free earlobes 100% 4 out of 4



In pea plants, red flowers are dominant over white flowers. A heterozygous red flower is allowed to self-pollinate. What are the probable genotypic & phenotypic ratios in the offspring of this plant?


In a pea plant, yellow seeds (A) are dominant over green seeds (a).



In pea plants, red flowers are dominant over white flowers. A heterozygous red flower is allowed to self-pollinate. What are the probable genotypic & phenotypic ratios in the offspring of this plant?

In a pea plant, yellow seeds (A) are dominant over green seeds (a).

Determine the probable color of the seeds produced by pea plants whose one parent is heterozygous yellow and the other parent is green.

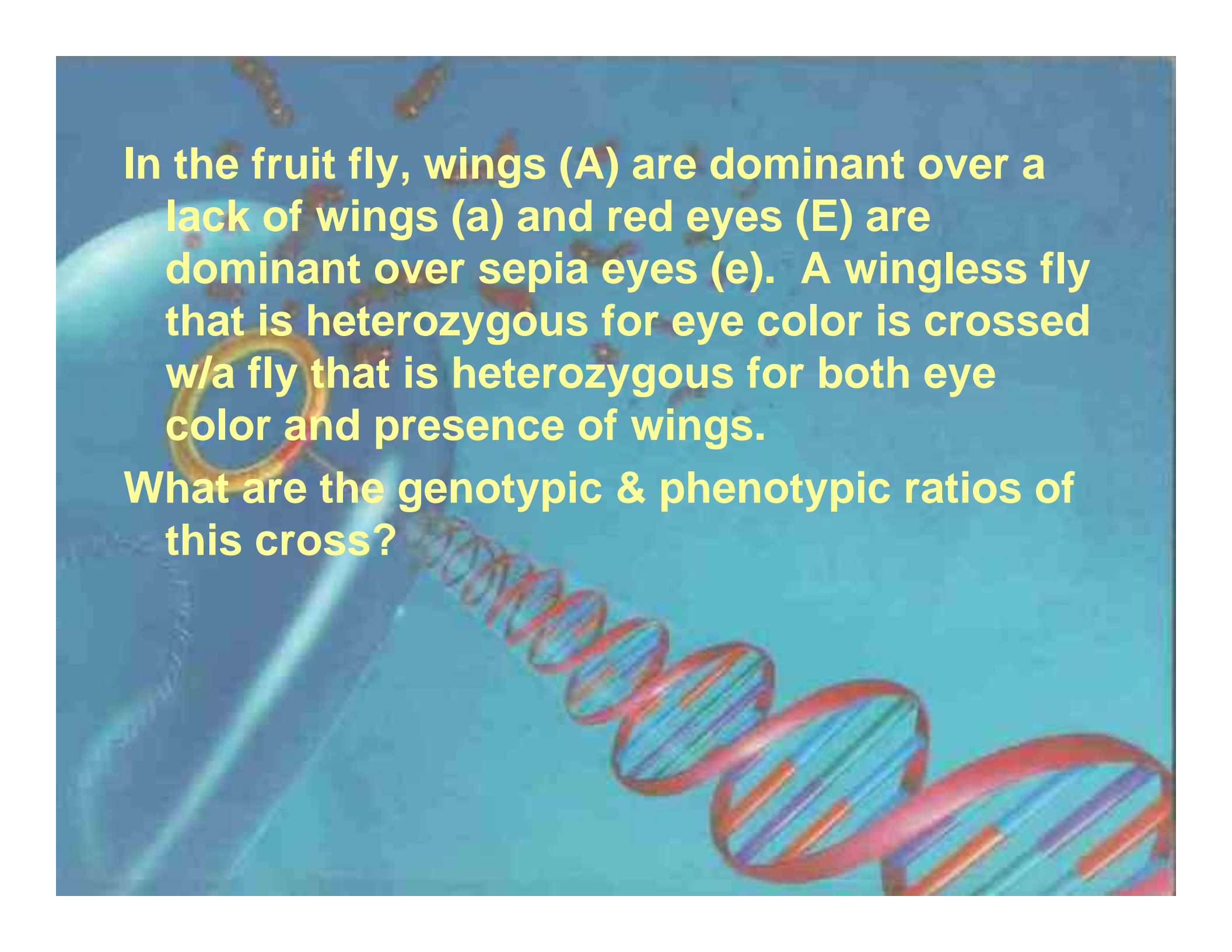
The background of the slide is a solid blue color. In the lower right corner, there is a 3D rendering of a DNA double helix, with red and blue ribbons forming the sugar-phosphate backbone and horizontal bars representing the nitrogenous base pairs. On the left side, there is a faint, semi-transparent image of a magnifying glass with a wooden handle and a metal rim, as if it were focusing on the text.

In guinea pigs, rough coat is dominant and smooth coat is recessive. Two heterozygous guinea pigs were crossed. What are the genotypic and phenotypic ratios of the offspring?

The background of the slide is a solid blue color. In the lower right corner, there is a 3D illustration of a DNA double helix, with red and blue ribbons forming the sugar-phosphate backbone and horizontal bars representing the nitrogenous base pairs. In the upper left corner, there is a glowing blue sphere, possibly representing a planet or a cell, with a bright white light source creating a lens flare effect. Scattered across the blue background are numerous small, brown, rod-shaped structures, likely representing bacteria or microorganisms.

Solving

Dihybrid Cross

The background of the slide is a solid blue color. In the lower right corner, there is a 3D rendering of a DNA double helix, with red and blue ribbons forming the structure. In the lower left corner, there is a magnifying glass with a yellow handle and a silver frame, focusing on a small, glowing blue sphere. The text is written in a bold, yellow, sans-serif font.

In the fruit fly, wings (A) are dominant over a lack of wings (a) and red eyes (E) are dominant over sepia eyes (e). A wingless fly that is heterozygous for eye color is crossed w/a fly that is heterozygous for both eye color and presence of wings.

What are the genotypic & phenotypic ratios of this cross?

Step 1: Set up the key

A – wings

a - lack of wings

E – red eyes

e – sepia eyes

Step 2: Write the cross

aaEe x AaEe

The background of the slide is a deep blue. In the lower right, a DNA double helix is depicted with red and blue strands. In the upper left, a glowing, translucent sphere is visible, surrounded by small, dark, irregular shapes that resemble particles or cells. The text is overlaid on this background.

**Step 3: Split the letters and
separate with parenthesis**

$(a+a)(E+e) \times (A+a)(E+e)$

Step 4: Use *FOIL Method* to determine alleles

F - first O - outer I - inner L - last

$(a+a)(E+e) \times (A+a)(E+e)$

$aE + ae + aE + ae \times$

$AE + Ae + aE + ae$

Step 5: Set up Punnett Square. Place one set of alleles on top and the other set of alleles on the side.

	aE	ae	aE	ae
AE				
Ae				
aE				
ae				

Step 6: Fill in each square with the corresponding letters.

aE

ae

aE

ae

AE

AaEE

AaEe

AaEE

AaEe

Ae

AaEe

Aaee

AaEe

Aaee

aE

aaEE

aaEe

aaEE

aaEe

ae

aaEe

aaee

aaEe

aaee

Step 6: Determine the Genotype & Phenotype

	aE	ae	aE	ae	<u>Genotype</u>
AE	AaEE	AaEe	AaEE	AaEe	AaEE - 2 AaEe - 4
Ae	AaEe	Aaee	AaEe	Aaee	Aaee - 2 aaEE - 2
aE	aaEE	aaEe	aaEE	aaEe	aaEe - 4 aace - 2
ae	aaEe	aaee	aaEe	aaee	1:2:1:1:2:1

	aE	ae	aE	ae	
AE	AaEE	AaEe	AaEE	AaEe	6:2:6:2
Ae	AaEe	Aaee	AaEe	Aaee	3:1:3:1
aE	aaEE	aaEe	aaEE	aaEe	
ae	aaEe	aaee	aaEe	aaee	

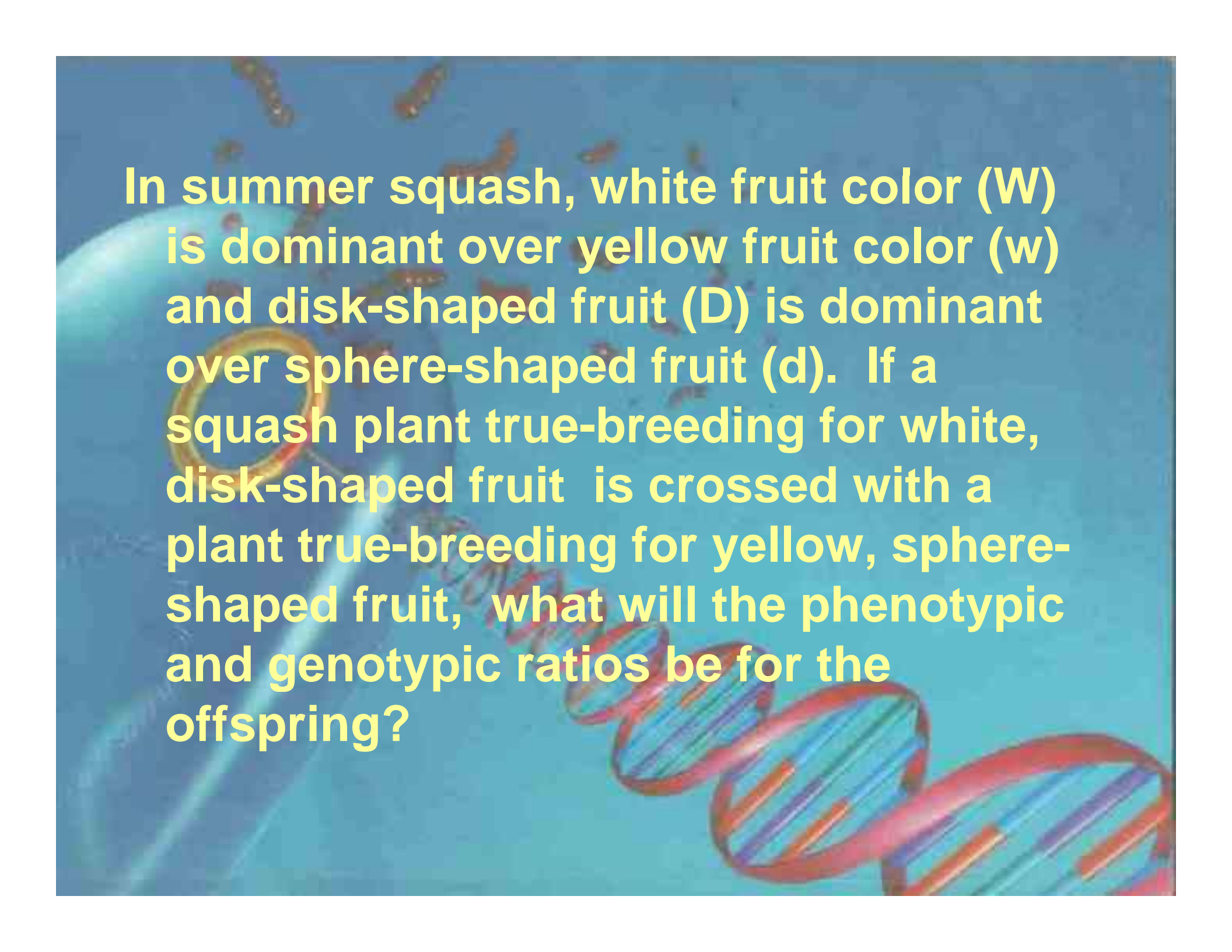
Phenotypes:

Wings, red eyes - 6

Wings, sepia eyes - 2

Wingless, red eyes - 6

Wingless, sepia eyes - 2



In summer squash, white fruit color (W) is dominant over yellow fruit color (w) and disk-shaped fruit (D) is dominant over sphere-shaped fruit (d). If a squash plant true-breeding for white, disk-shaped fruit is crossed with a plant true-breeding for yellow, sphere-shaped fruit, what will the phenotypic and genotypic ratios be for the offspring?

Incomplete Dominance

A case in which neither gene is totally dominant to the other.

The new trait is a blend of the dominant and recessive traits.

Red four o'clock flowers have the genotype RR and white flowers have the genotype rr . What is expected in the offspring from a cross between red and white flowers?

All flowers will be PINK



**What would be expected in the offspring
from a cross between 2 pink four
o'clocks?**

**What would be expected in the cross
between pink four o'clocks and a
white? Pink and red?**

Multiple Alleles

More than 2 kinds of alleles for any trait.
Resulting in more than 3 phenotypes.

Normally an individual has only 2 of these alleles for any trait – One gene from the male, the other from the female.



BLOOD

Types:

A

B

AB

O

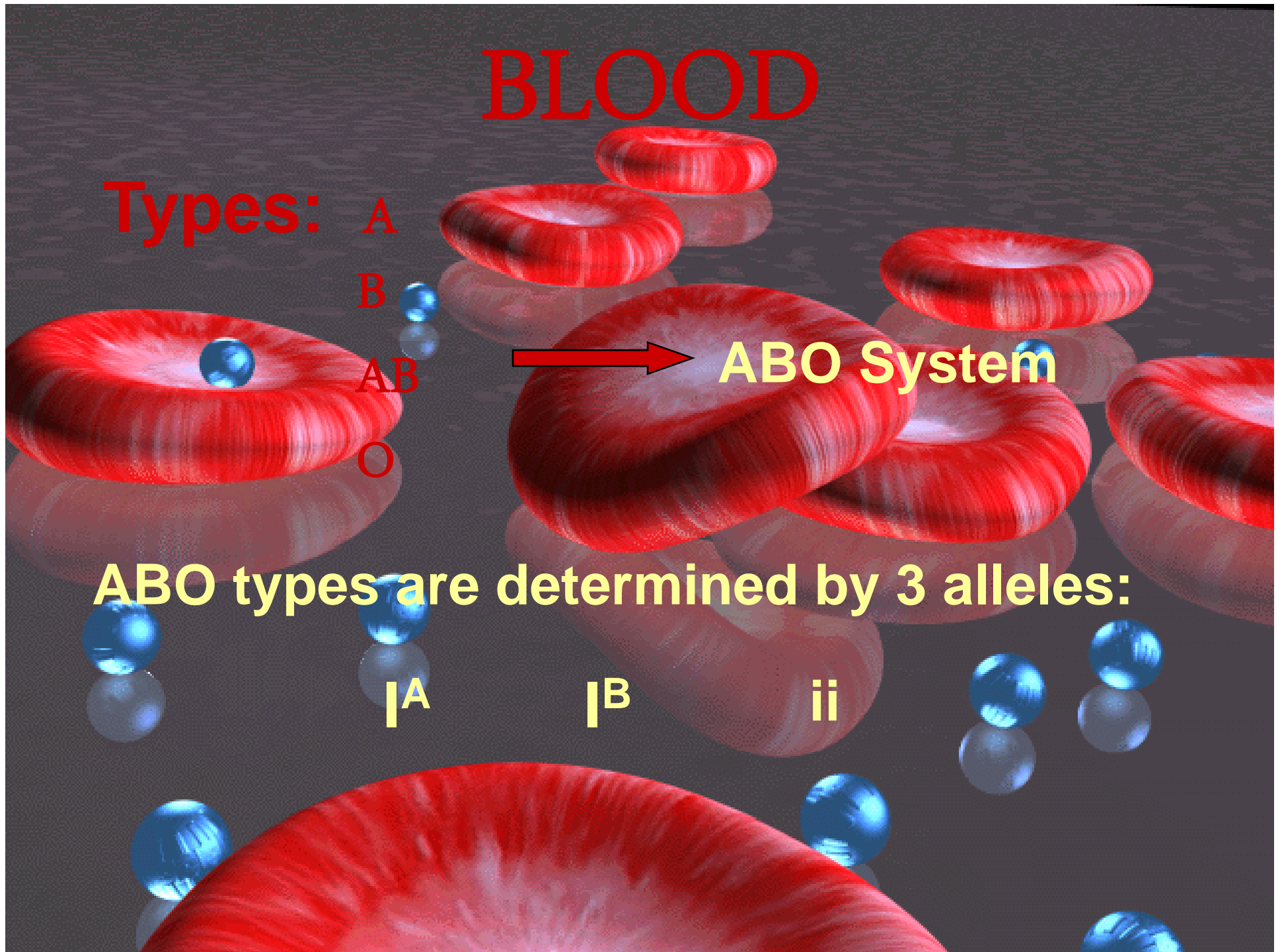
ABO System

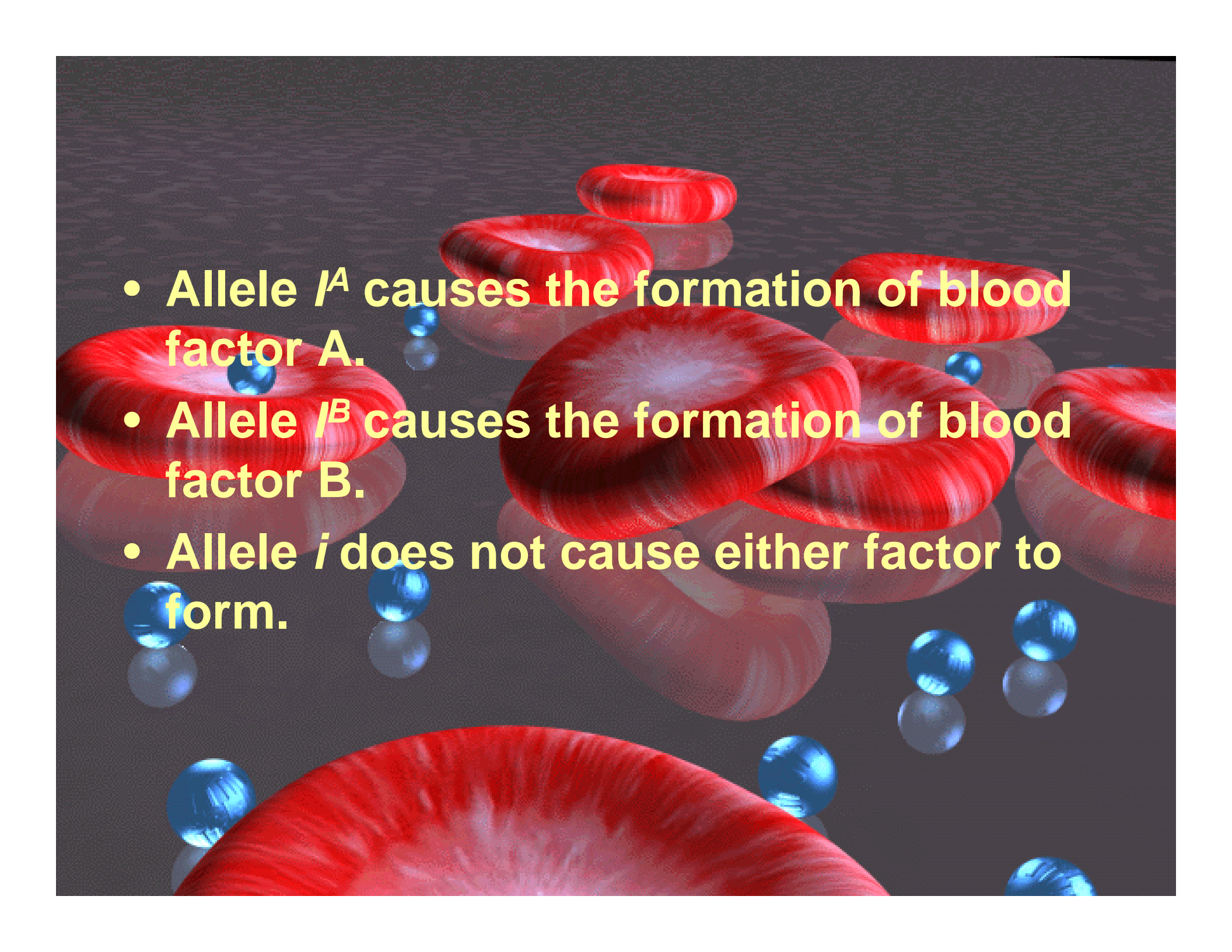
ABO types are determined by 3 alleles:

I^A

I^B

i



- 
- The background of the slide is a dark, textured grey. It features several large, red, biconcave disc-shaped cells, resembling red blood cells, which are slightly out of focus. Scattered among these cells are numerous small, bright blue, spherical molecules, possibly representing antigens or antibodies. The lighting creates soft highlights and shadows on the cells and molecules, giving them a three-dimensional appearance.
- Allele I^A causes the formation of blood factor A.
 - Allele I^B causes the formation of blood factor B.
 - Allele i does not cause either factor to form.

GENOTYPE

BLOOD TYPE

$I^A I^A$ or $I^A i$

AA or AO

A

$I^B I^B$ or $I^B i$

BB or BO

B

$I^A I^B$

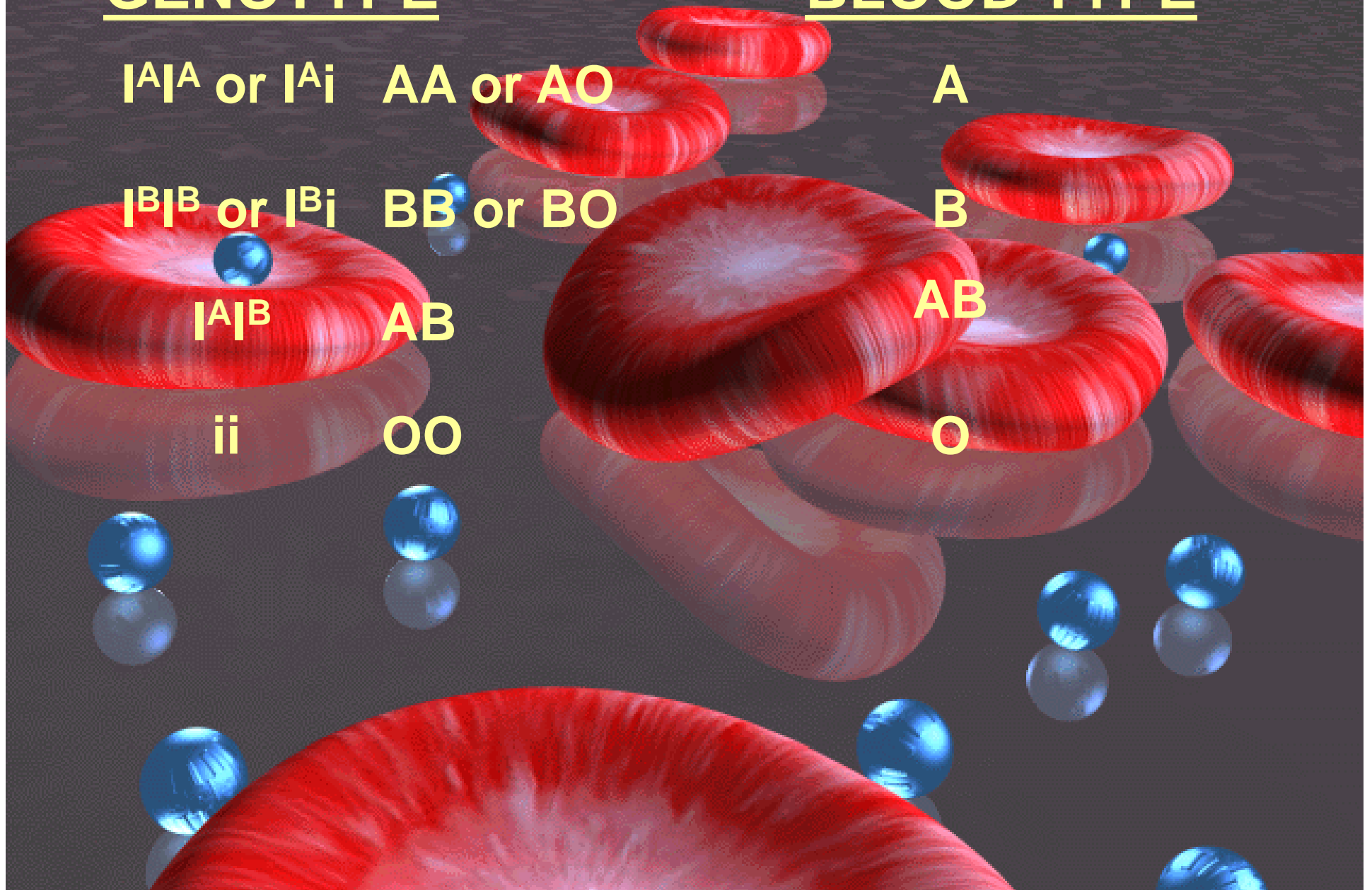
AB

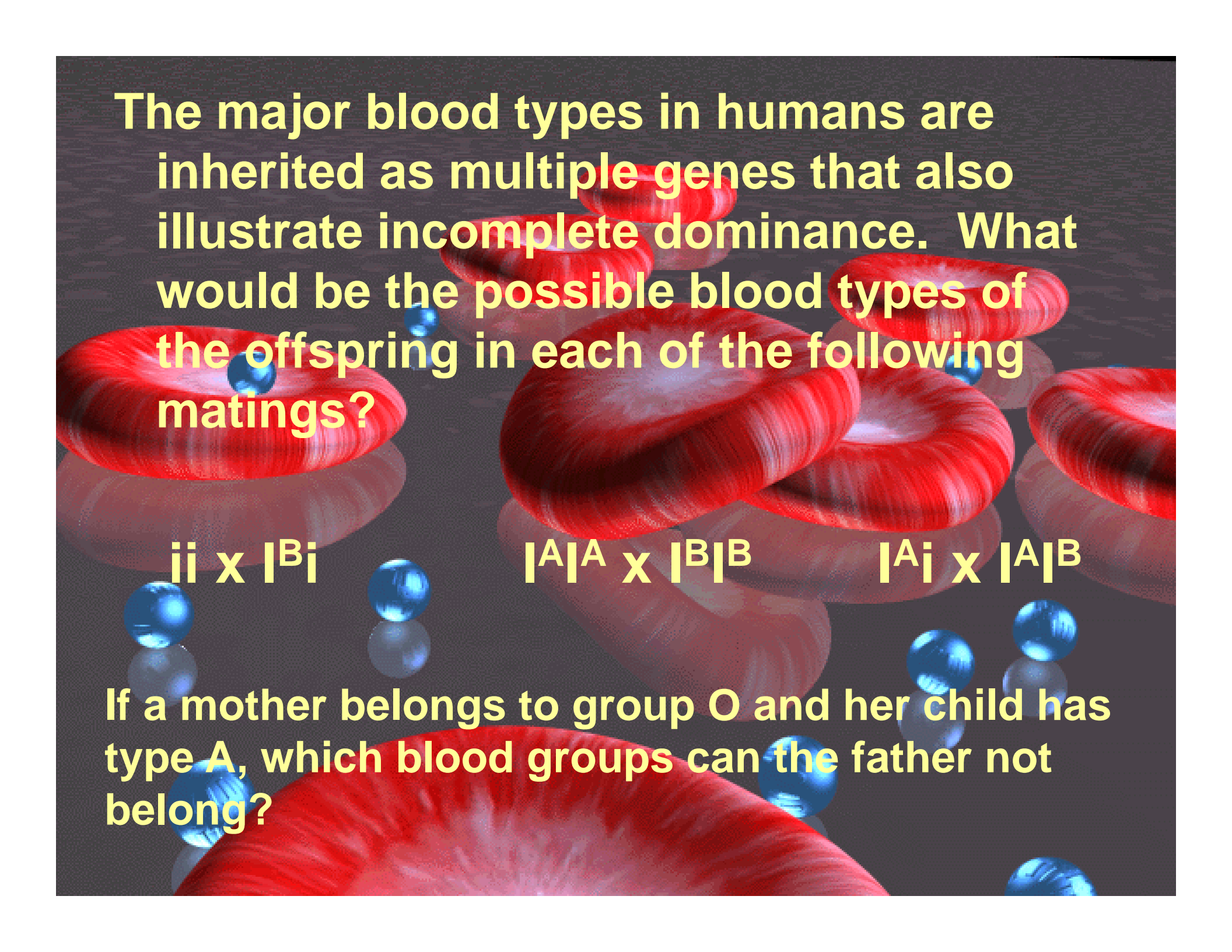
AB

ii

OO

O



The background of the slide features a dark, textured surface with several large, red, biconcave disc-shaped cells, resembling red blood cells, and smaller, translucent blue spheres scattered throughout. The text is overlaid on this background.

The major blood types in humans are inherited as multiple genes that also illustrate incomplete dominance. What would be the possible blood types of the offspring in each of the following matings?

$ii \times I^B i$

$I^A I^A \times I^B I^B$

$I^A i \times I^A I^B$

If a mother belongs to group O and her child has type A, which blood groups can the father not belong?

X – linked Traits

A trait determined by alleles that are carried by the X chromosomes but are absent from Y chromosomes.



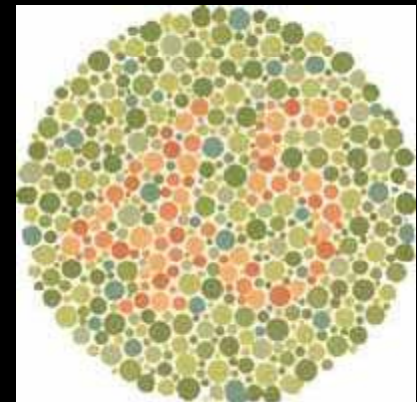
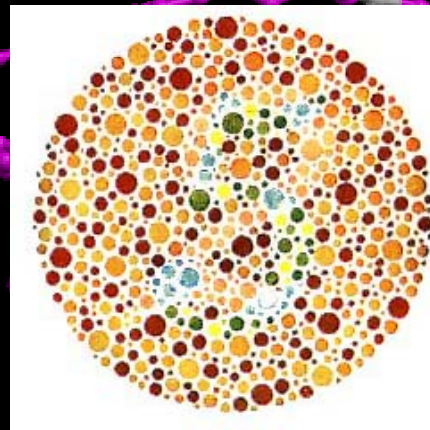
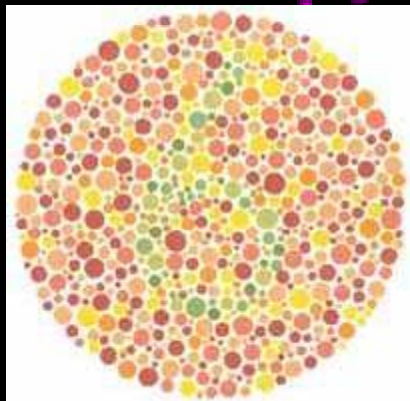
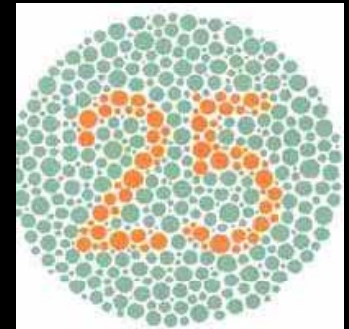
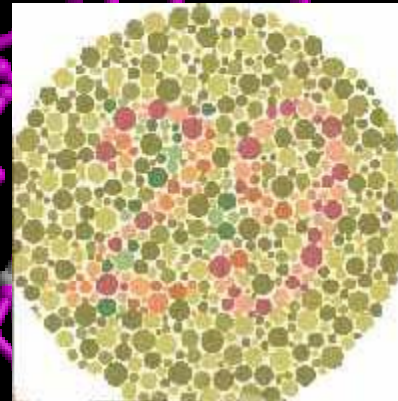
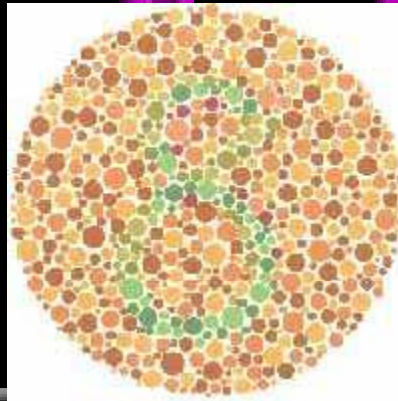
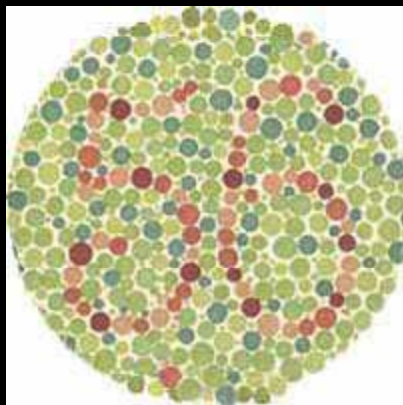
Recessive traits controlled by X-linked genes are expressed in males. There are no alleles for the dominant trait to mask them.



In females, a recessive X-linked trait does not appear unless there are 2 alleles for that trait, one in each of her X chromosomes.

Color Blindness

Problem in which red & green look like shades of gray or other colors.



C – dominant

c - recessive

female

CC Red/green

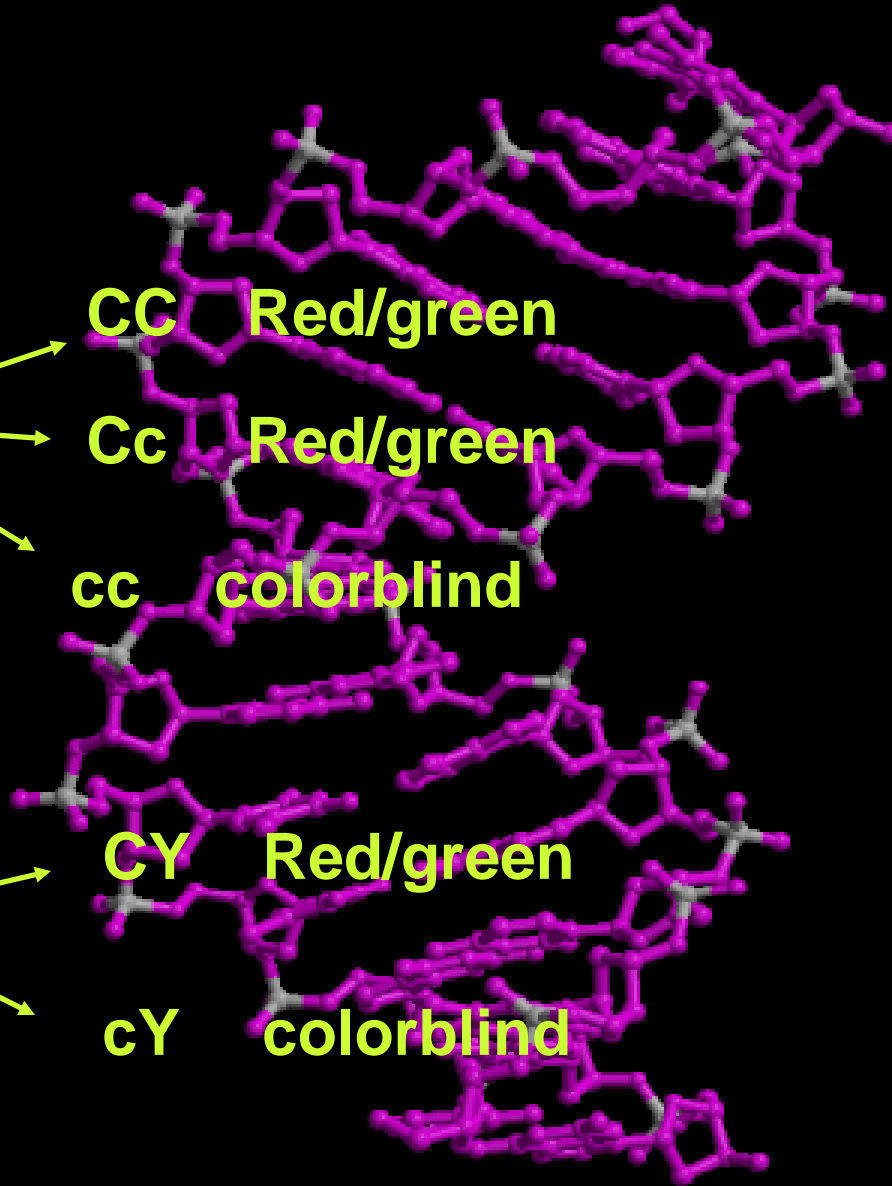
Cc Red/green

cc colorblind

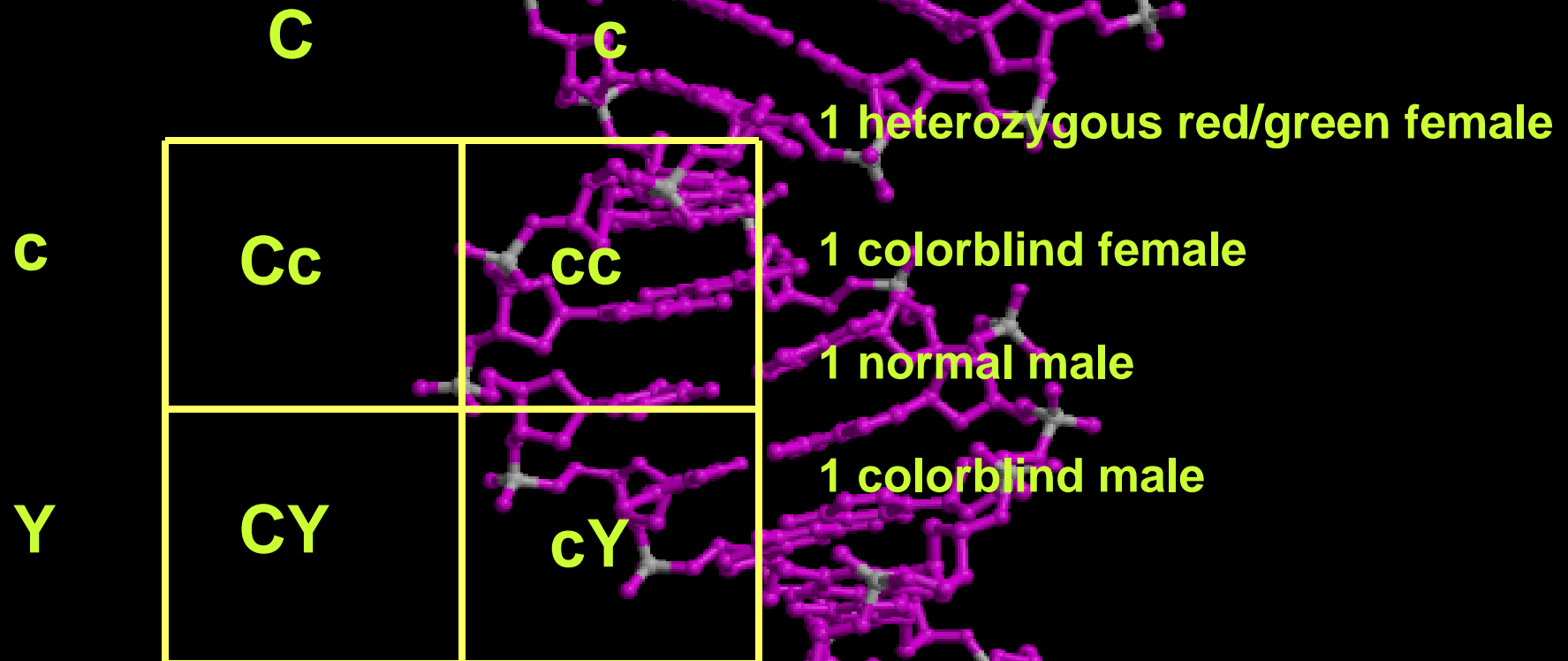
male

CY Red/green

cY colorblind



What would happen if a woman with Cc genes and a man with a c gene on his X chromosome had children?



HEMOPHILIA

Disorder in which a person's blood does not clot. Bleeding from a cut or bruise may take hours to stop. Almost always shows up in male children.

