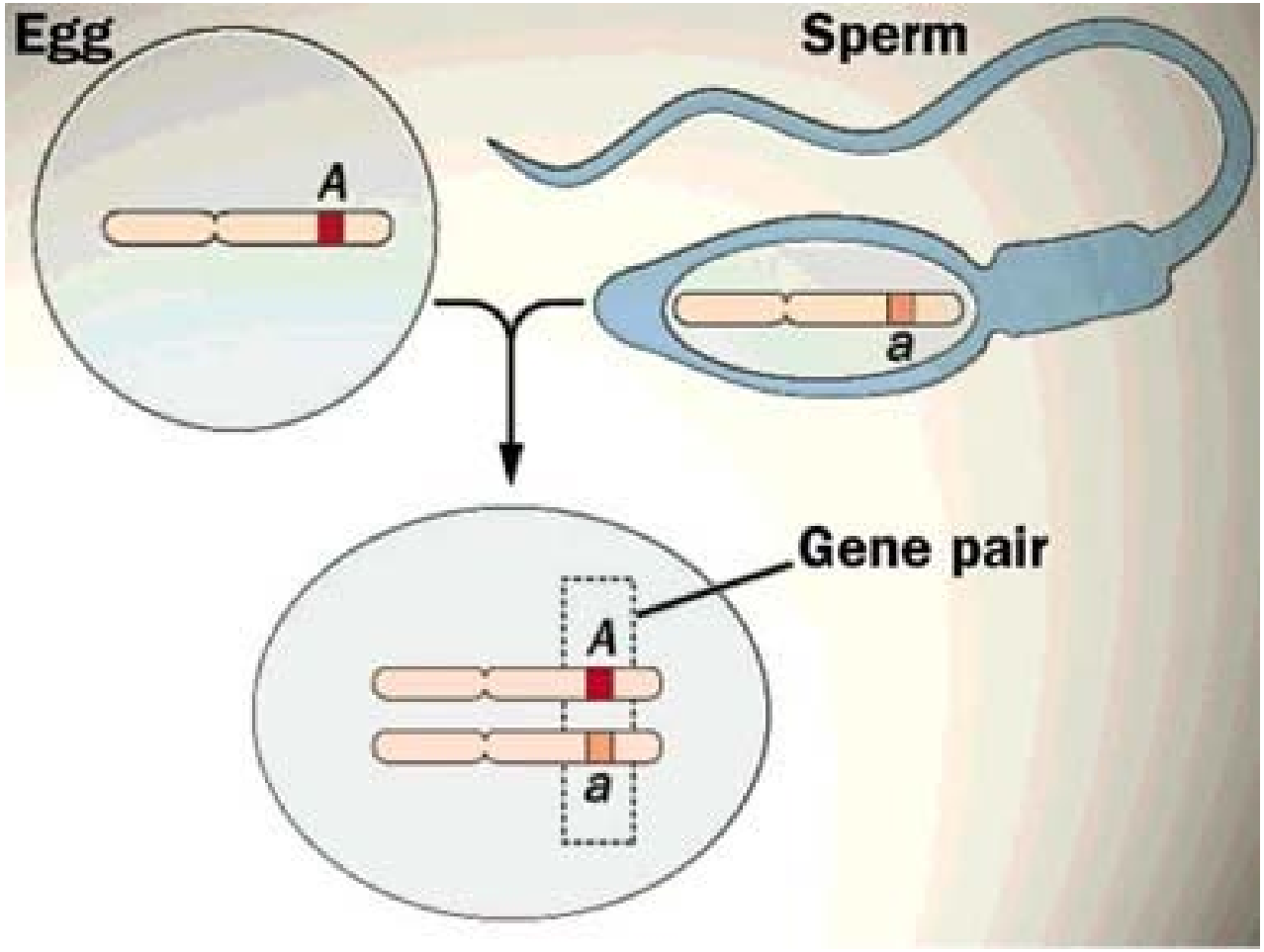
Introduction to Genetics

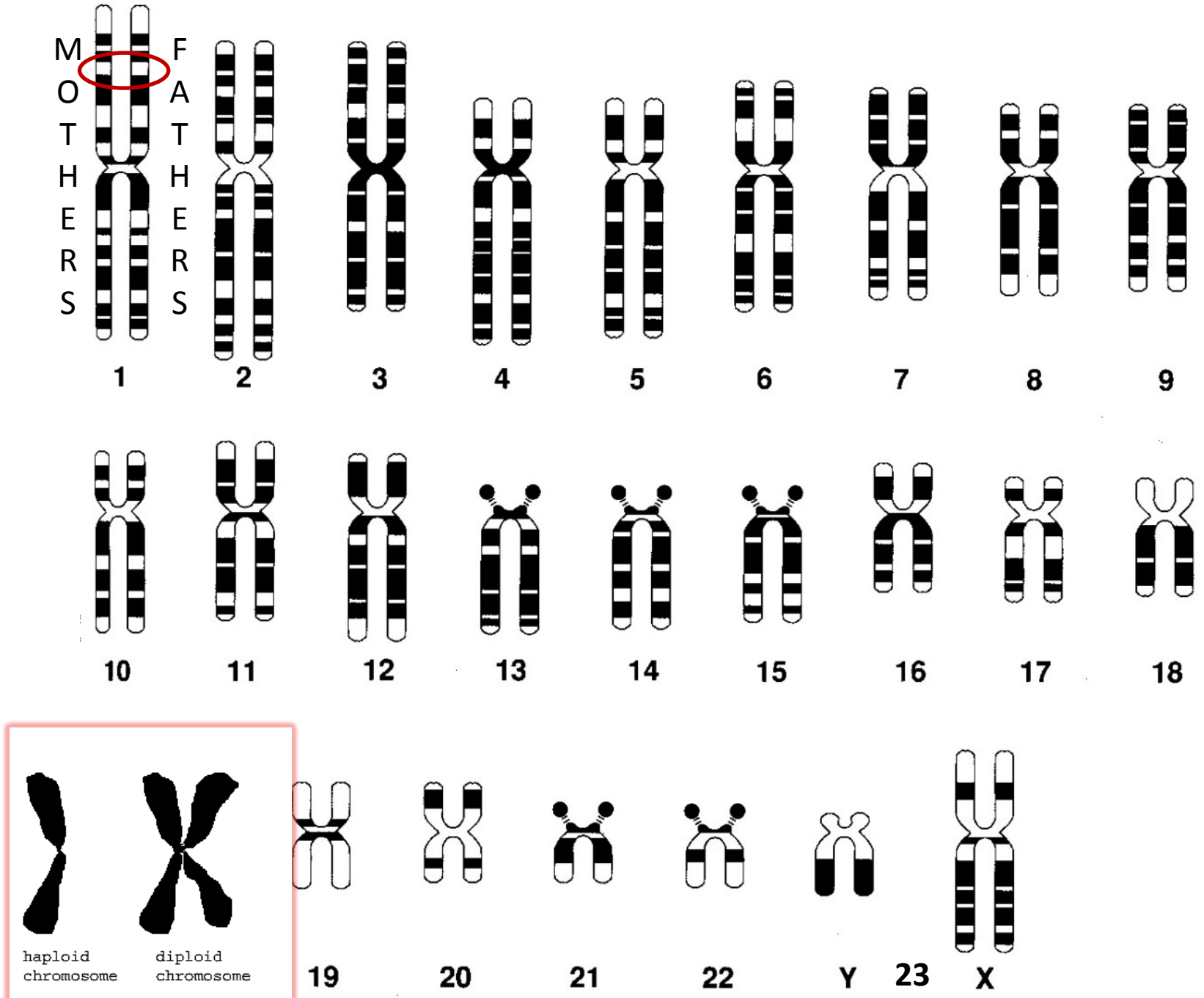
Punnet Squares

- determining the outcomes of a cross

Traits

Which trait will the offspring have?

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haploid chromosome
diploid chromosome
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Y
23
X

vocabulary

- **Gene** – location on a chromosome for a certain trait.
- **Allele** - one form of a gene.
- **Cross** – fertilization (mate).
- **Principle of Dominance** – an organism with at least one dominant allele will express that trait. The recessive trait will be expressed only when both alleles are recessive.

Law of Segregation

- During gamete formation, the alleles for each gene segregate from each other, so that each gamete carries only one allele for each gene

Genotype Versus Phenotype

Genotype	*Genotype*	*Phenotype*
TT	Homozygous dominant	Tall plant
Tt	Heterozygous	Tall plant
tt	Homozygous recessive	Short plant

Genotype - allele combination

determines

Phenotype - observable characteristics (the way an organism looks)

Punnett Square

- A probability tool – used to predict the possible outcomes of a genetic cross

Types of genotypes

- If both alleles for the trait are the same, the genotype is homozygous
  - homozygous dominant (AA)
  - Homozygous recessive (aa)
- If the two alleles for the trait are different, the genotype is heterozygous
  - Heterozygous (Aa)

Some basic rules

1. Same letter for the same trait
2. Capital letter for dominant allele
3. Small letter for recessive allele
4. Dominant allele is shown first in each pair.

Trait – eye color

E = dominant allele
e = recessive allele

Homozygous dominant = EE
Heterozygous = Ee
Homozygous recessive = ee

Monohybrid cross

- **Definition:** A monohybrid cross is a cross between organisms that differ in **one** trait.
  Step 1, make a key

Flower color

In flowers, Red (R) is dominant to white (r)

Possible phenotypes/genotypes

Red

RR Rr

White

rr

Monohybrid cross

- **Step 2-** write out parental genotypes
- Cross – Cross a white parent with a red parent
- **Step 3** – Punnett Square

Homozygous parents

RR x rr

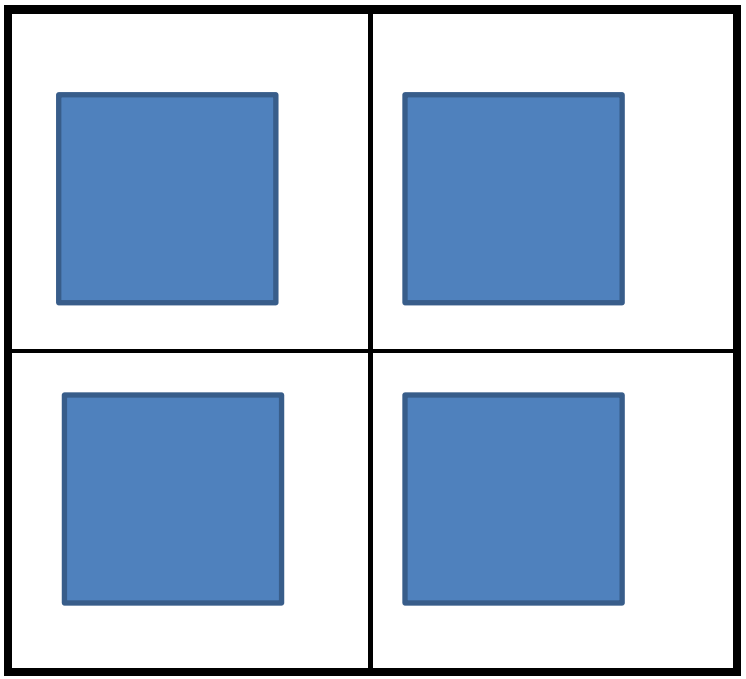
RED parent

R R

WHITE parent

r

r



Genotypes and Phenotypes

Step 4 – record results

Genotype

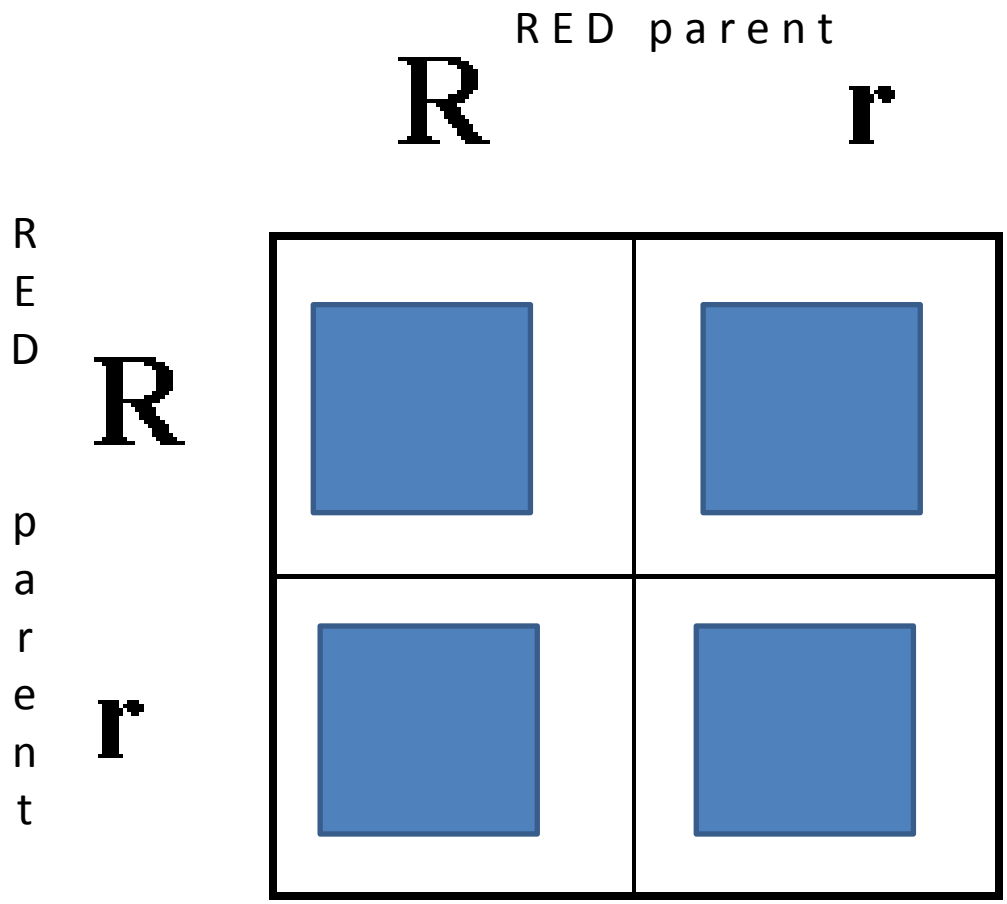
100% - Heterozygous (Rr) genotype

Phenotype

100% - Red phenotype

Heterozygous parents

Rr x Rr



Genotypes and Phenotypes

25% - RR (homozygous dominant) genotype

50% - Rr (Heterozygous)genotype

25% - rr (homozygous recessive) genotype

75% - Red phenotype (RR + Rr)

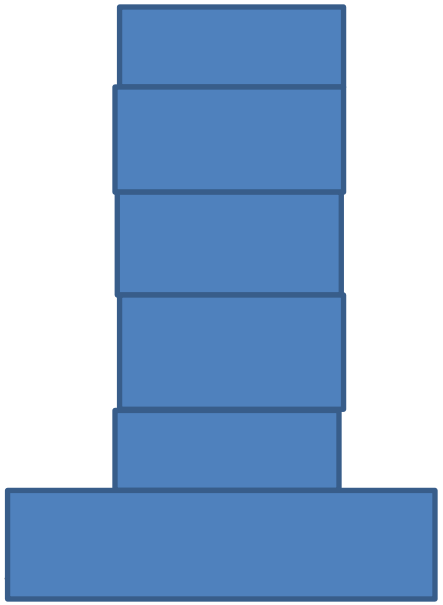
25% - white phenotype (rr)

Dihybrid Cross

- **Definition:** A dihybrid cross is a cross between organisms that differ in **two** traits.

Dihybrid Cross

Possible gametes in the following genotypes:

Genotypes	Possible gamete combinations
AABb	
Aabb	
aaBB	
aaBb	
aabb	
AaBb	

Dihybrid Cross

R – red

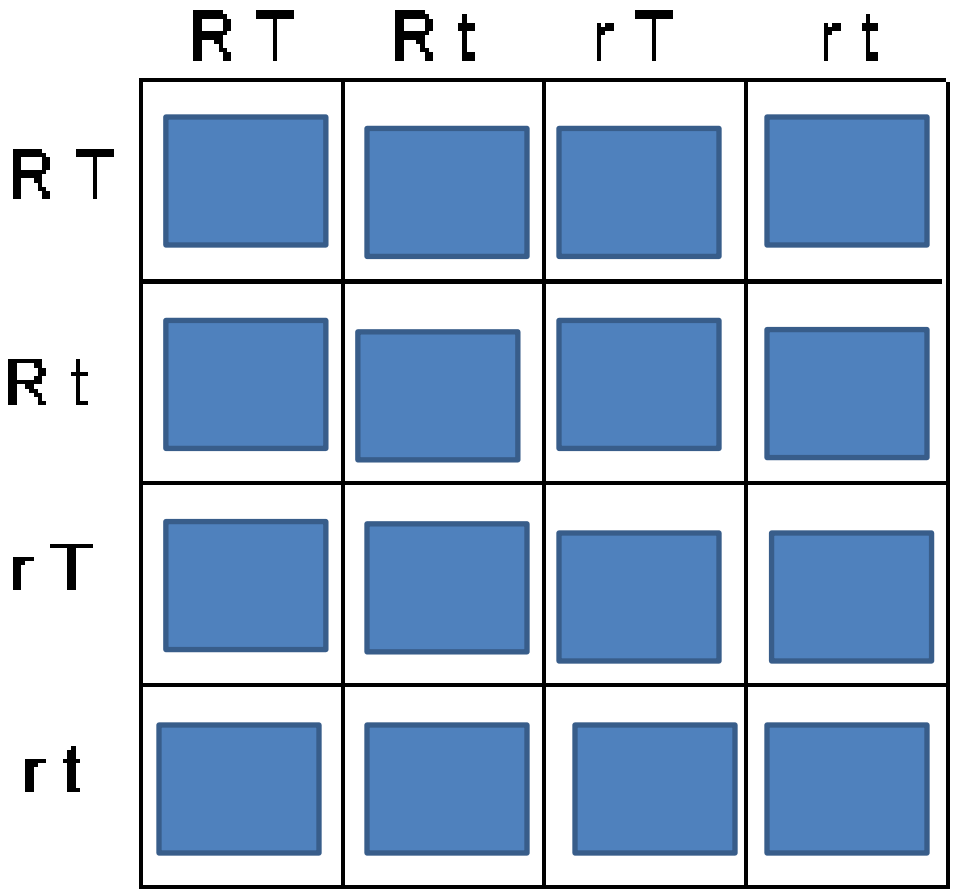
r – white

T – tall

t – short

Dihybrid Cross

RrTt x RrTt



Genotypes

RRTT (1/16) – 6.25 %

RRTt (2/16) – 12.5%

RrTT (2/16) – 12.5%

RrTt (4/16) – 25%

RRtt (1/16) – 6.25%

Rrtt (2/16) – 12.5%

rrTT (1/16) – 6.25%

rrTt (2/16) – 12.5%

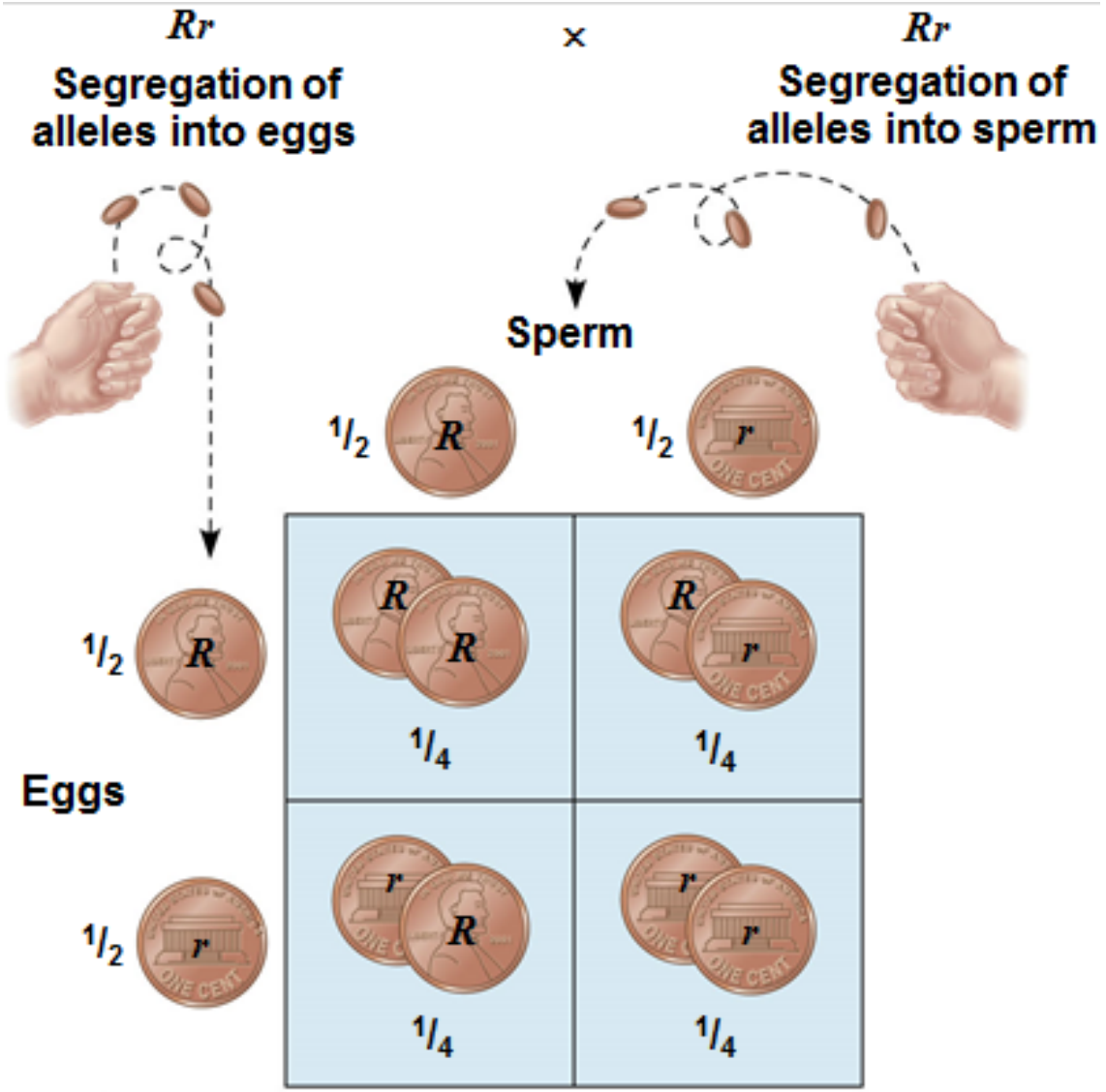
rrtt (1/16) – 6.25%

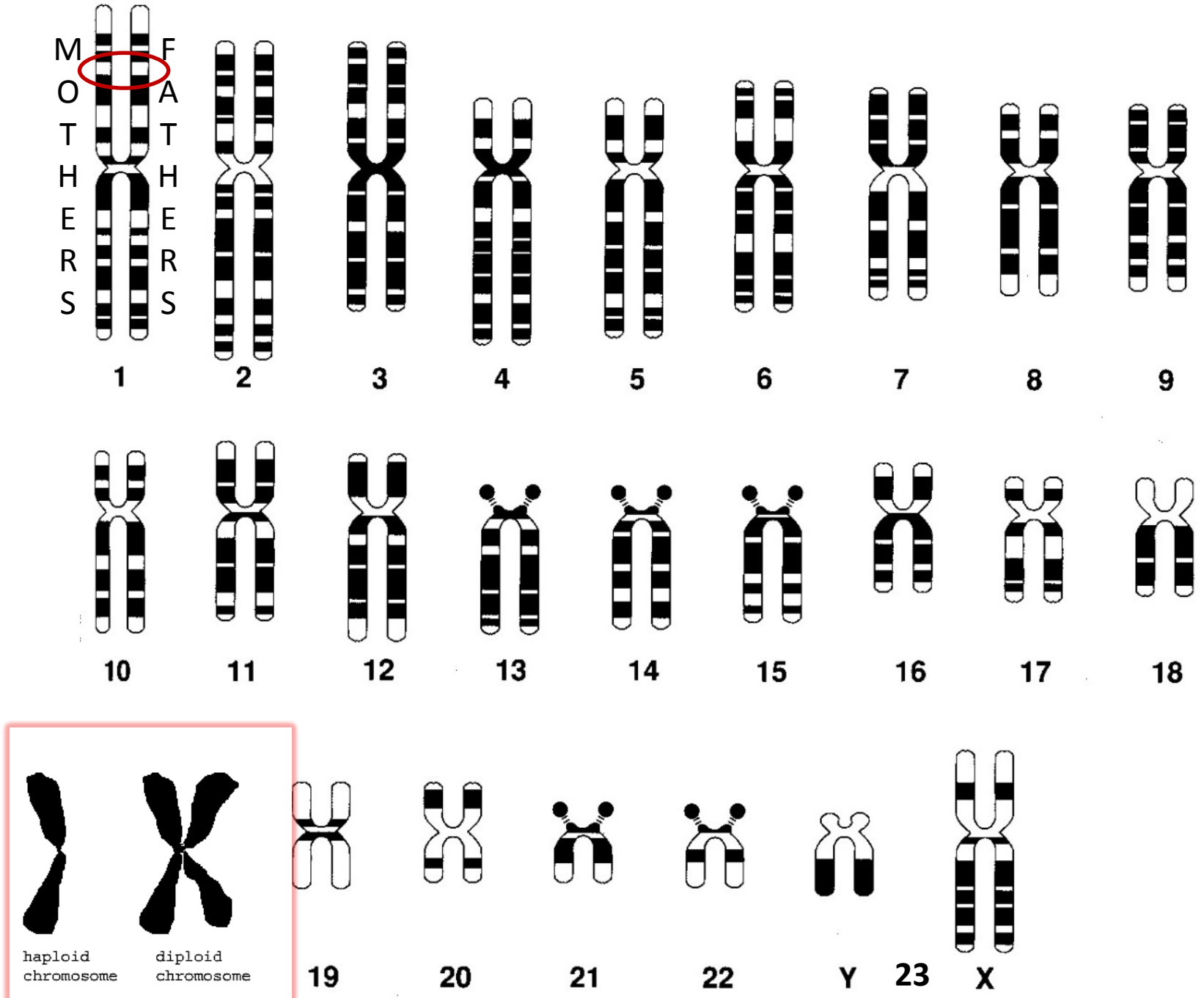
Phenotypes

RT	*red, tall*	(9/16) – 56.25%
Rt	*red, short*	(3/16) – 18.75%
rT	*white, tall*	(3/16) – 18.75%
rt	*white, short*	(1/16) – 6.25%

Understanding the coin toss

- Two possible outcomes.
- Only one result.

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haploid chromosome
diploid chromosome
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Y
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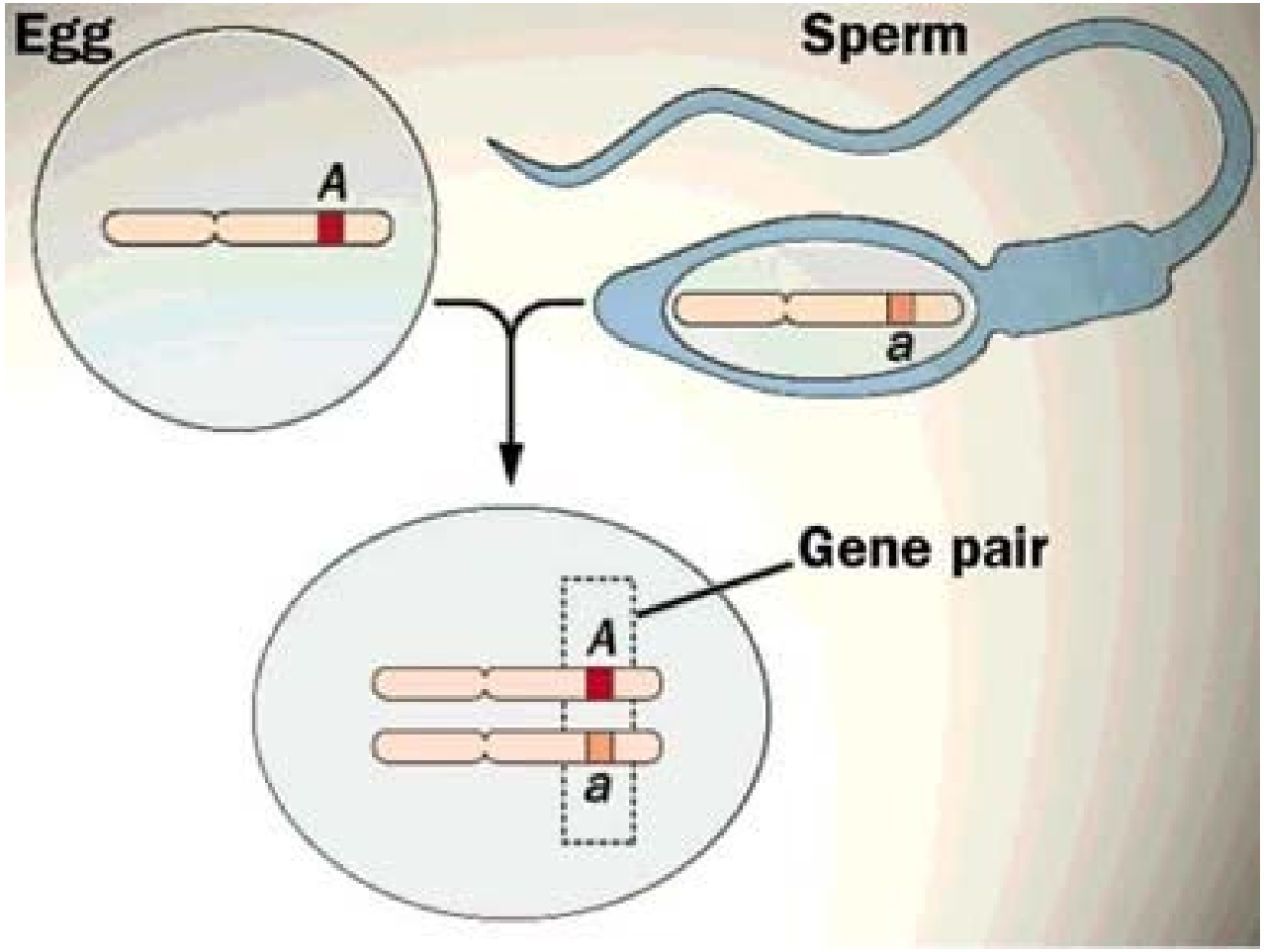
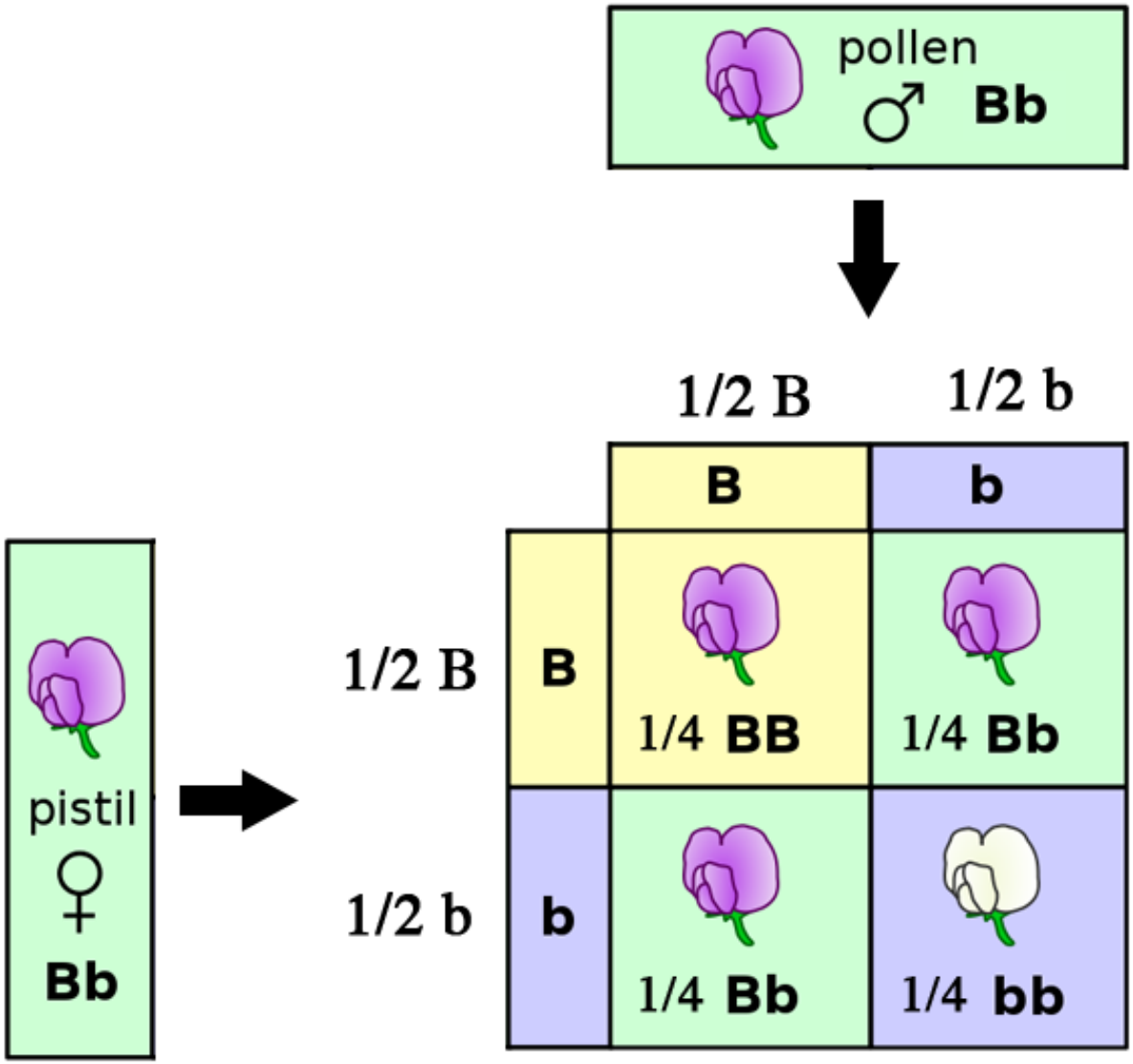
X

Traits

Which trait will the offspring have?



Two possible alleles – one from each parent.
Only one goes to each gamete.



Dihybrid – two traits

Each parent has two coins

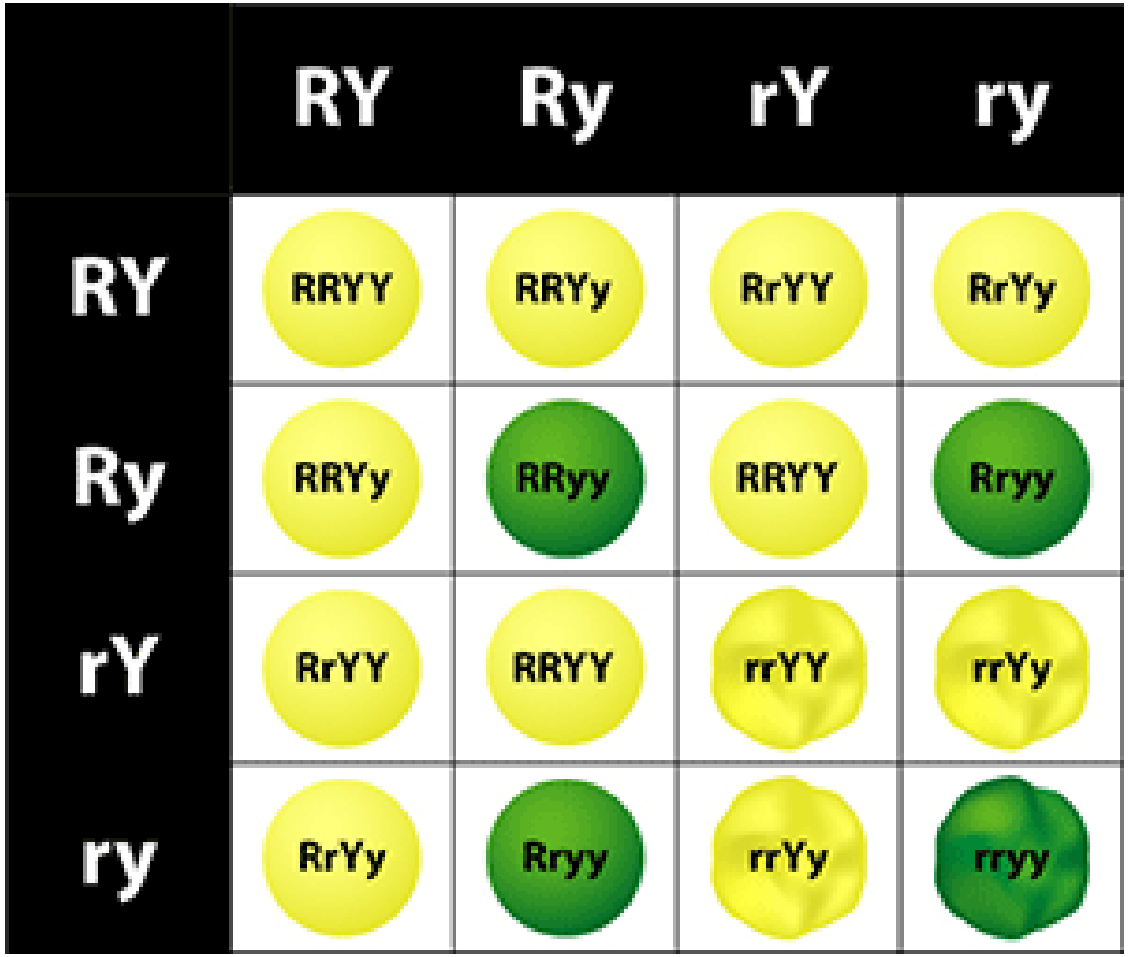
Simply working with two traits

Surface
R = smooth
r = rough

Color
Y = Yellow
y = green

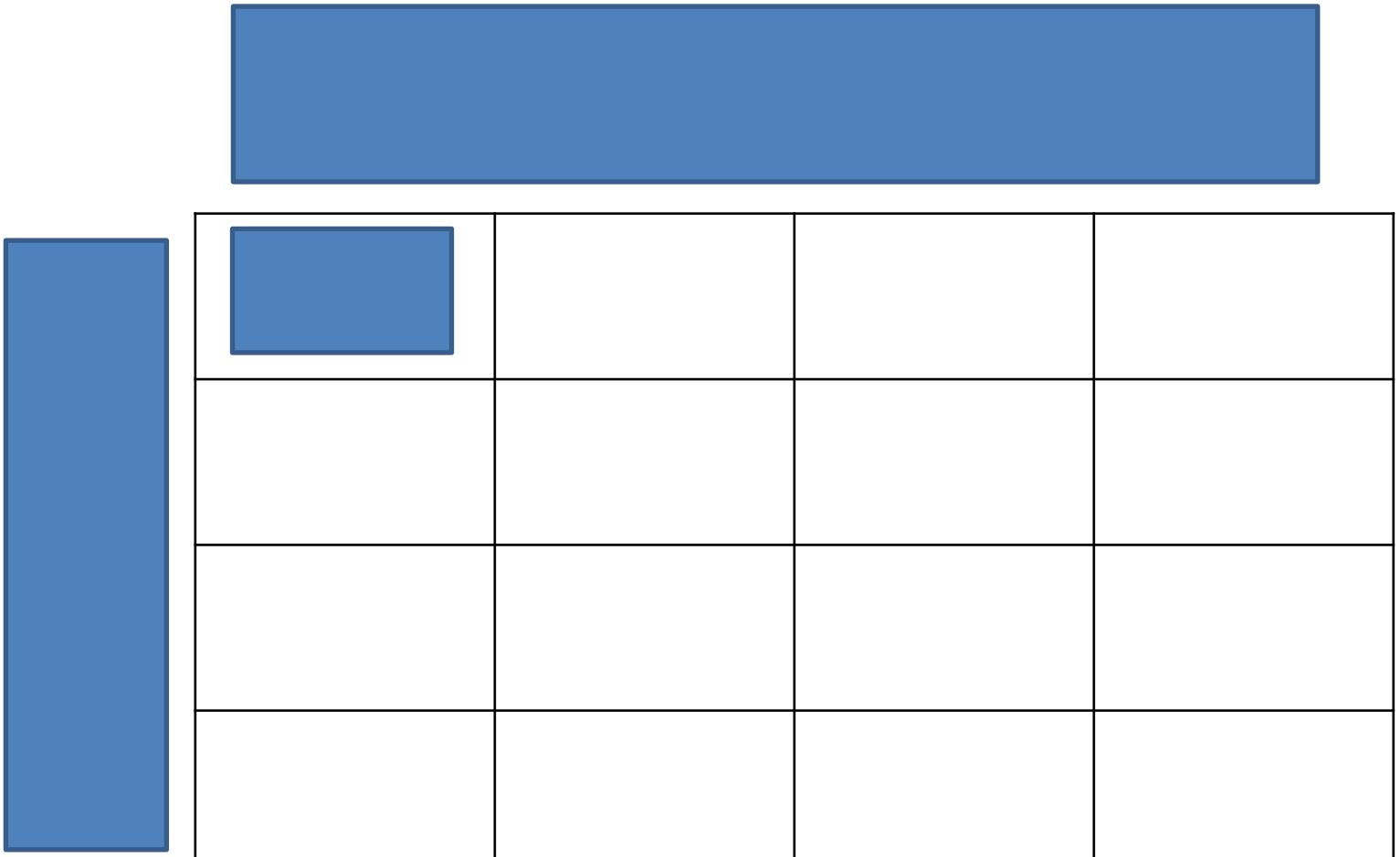
Heterozygous Smooth and Yellow
RrYy

Heterozygous
RrYy
Smooth
and
Yellow



Dihybrid Cross

RRTT x rrtt



Dihybrid Cross

SSbb x ssBB

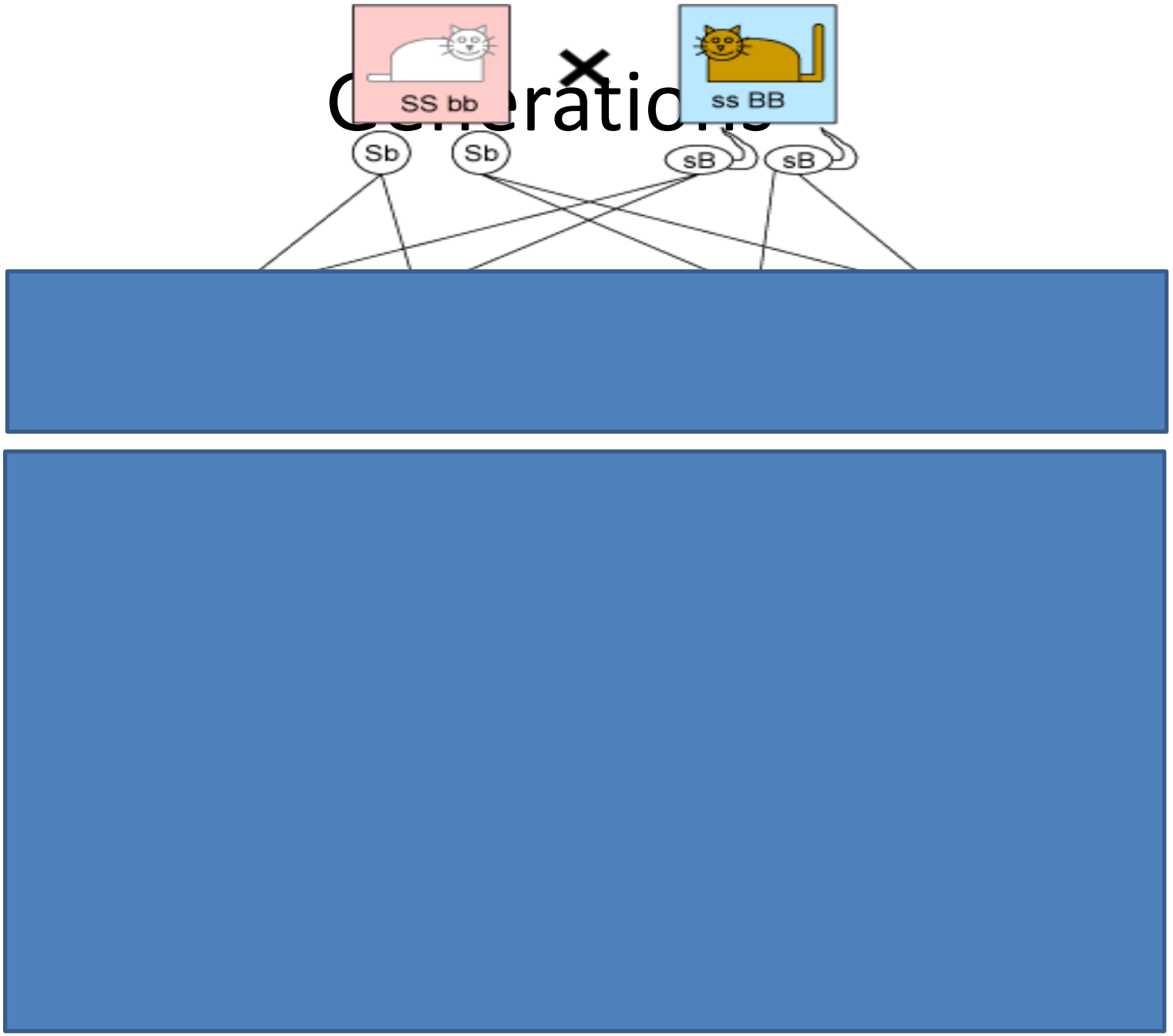
tail length (S or s)

- short is dominant
- long is recessive

color of fur (B or b)

- brown is dominant
- white is recessive

Generations

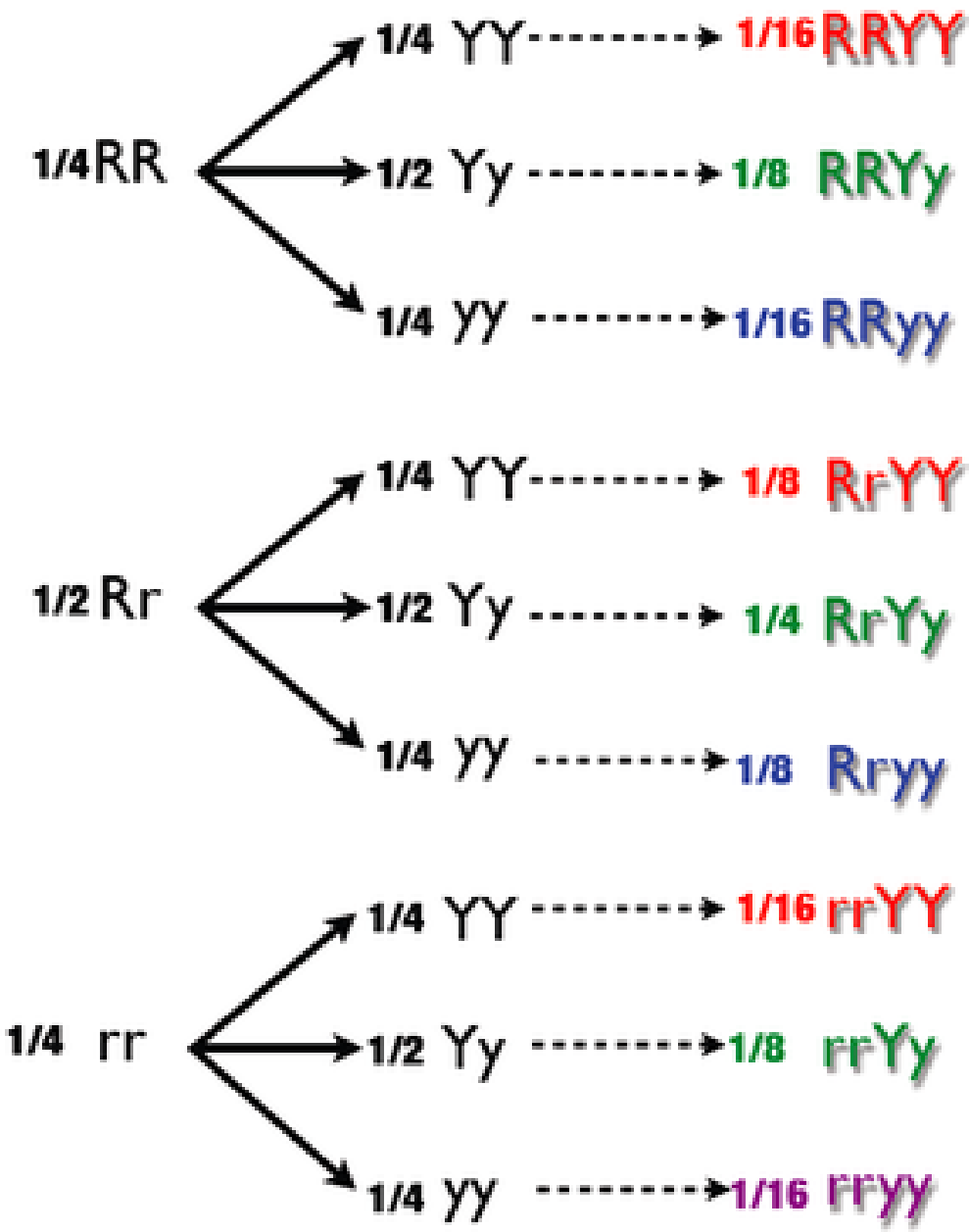


Or . . . Work with each trait separately.

RrYy x RrYy

	R	r
R	RR	Rr
r	Rr	rr

	Y	y
Y	YY	Yy
y	Yy	yy



	DOMINANT TRAITS	RECESSIVE TRAITS
Eye coloring	brown eyes	grey, green, hazel, blue eyes
Vision	farsightedness normal vision normal vision normal vision	normal vision nearsightedness night blindness color blindness*
Hair	dark hair non-red hair curly hair full head of hair widow's peak	blonde, light, red hair red hair straight hair baldness* normal hairline
Facial features	dimples unattached earlobes freckles broad lips	no dimples attached earlobes no freckles thin lips
Appendages	extra digits fused digits short digits fingers lack 1 joint limb dwarfing clubbed thumb double-jointedness	normal number normal digits normal digits normal joints normal proportion normal thumb normal joints
Other	immunity to poison ivy normal pigmented skin normal blood clotting normal hearing normal hearing and speaking normal- no PKU	susceptibility to poison ivy albinism hemophilia* congenital deafness deaf mutism phenylketonuria (PKU)

- sex-linked characteristic