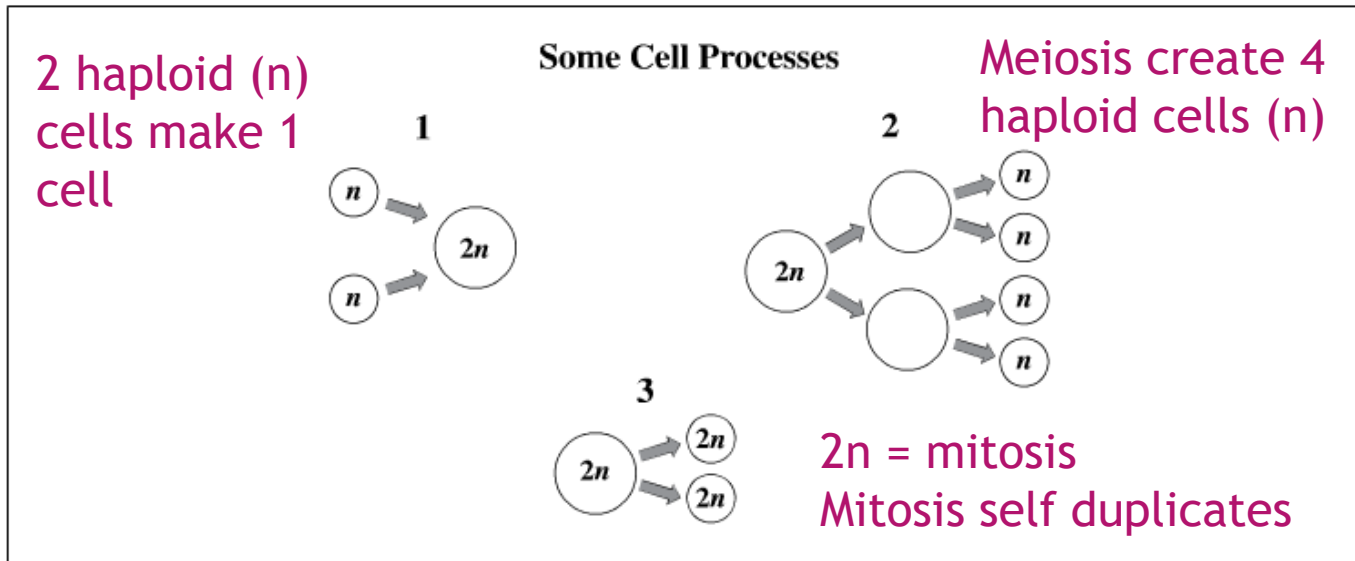


Sample Diploma Questions

Use the following information to answer numerical-response question 4.



Numerical Response

4. Match each diagram numbered above with the cell process that it represents, as given below.

Meiosis 2 (Record in the **first** box)

Fertilization 1 (Record in the **second** box)

Mitosis 3 (Record in the **third** box)

(Record your answer in the response boxes at the bottom of the screen.)

Sample Diploma Questions

Use the following information to answer question 21.

Scientists have recently fused an egg cell from each of two normal female mice.

21. The sex chromosomes in the zygote formed by the fusion of two female egg cells would be

A. XXXX

B. XXY

C. XY

D. XX

Egg = X

2 x's fused together

Sample Diploma Questions

Use the following information to answer question 27.

Bird feathers and mammal hair are made up of a tough structural material called keratin. Keratin has a high proportion of the amino acids alanine and glycine.

27. Keratin, the structural material in feathers and hair, is classified as
- A. a sugar
 - B. a protein
 - C. an antigen
 - D. an antibody

Assignment

1. Match the following terms with the analogy that best describes each term.

DNA	a cookbook with several recipes in it
Gene	an entire library of cookbooks neatly arranged in order from the largest book to the smallest book
Protein	the cake produced by following recipe instructions
Chromosome	the letters and words in a recipe
karyotype	the instructions for making a cake

2. How many chromosomes are in a normal human autosomal cell? How many chromosomes are in a normal human gamete?
3. Determine the gender of an individual who has two X chromosomes in each autosomal cell instead of an X and a Y chromosome.

Assignment

4. Dogs have 78 chromosomes, cats have 34 chromosomes, and goldfish have 94 chromosomes. Explain why the usual number of chromosomes in autosomal cells for any species is always an even number.
5. Describe what would happen if the process of meiosis did not occur and two cells with two sets of chromosomes combined to produce a new child. Why is meiosis necessary?

Assignment

- ▶ Draw a diagram of meiosis and mitosis labelling how many chromosomes are present in each step using n or $2n$.

Punnett Squares

CELL DIVISION

$$\begin{array}{r} 42 \\ 7 \overline{) 294} \\ \underline{28} \\ 14 \\ \underline{14} \\ 0 \end{array}$$



Curriculum

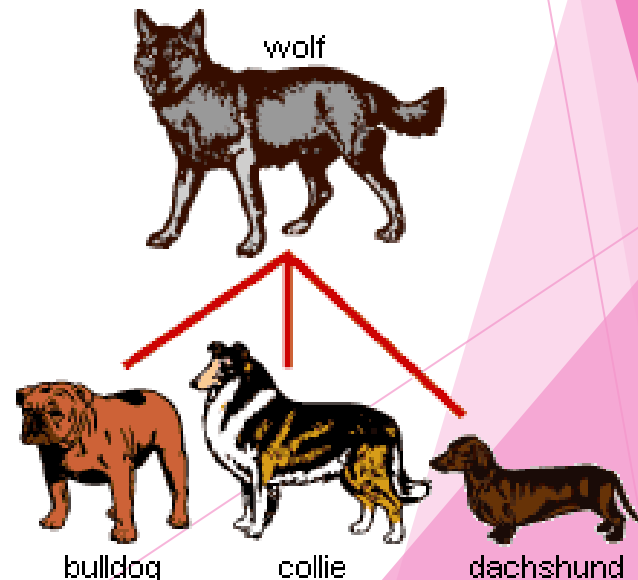
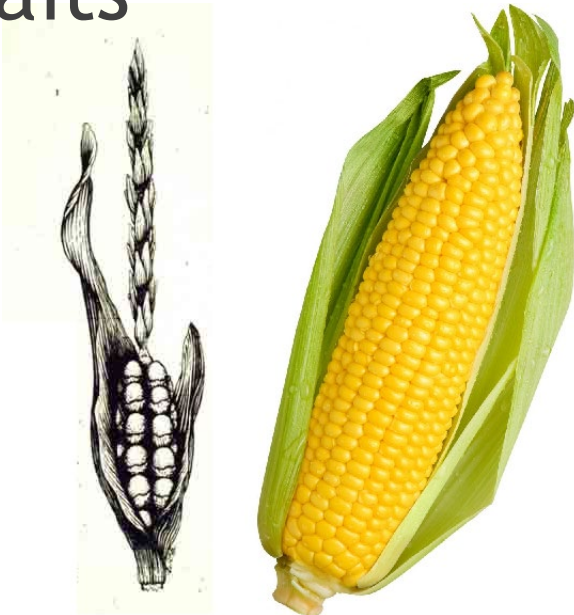
- ▶ explain, with the aid of Punnett squares, the inheritance of single traits by applying current understanding of the gene, segregation and dominance
- ▶ distinguish autosomal from sex-linked patterns of inheritance
- ▶ predict, quantitatively, the probability of acquiring a particular trait in autosomal and sex-linked patterns of inheritance

Domesticating animals (10 min)

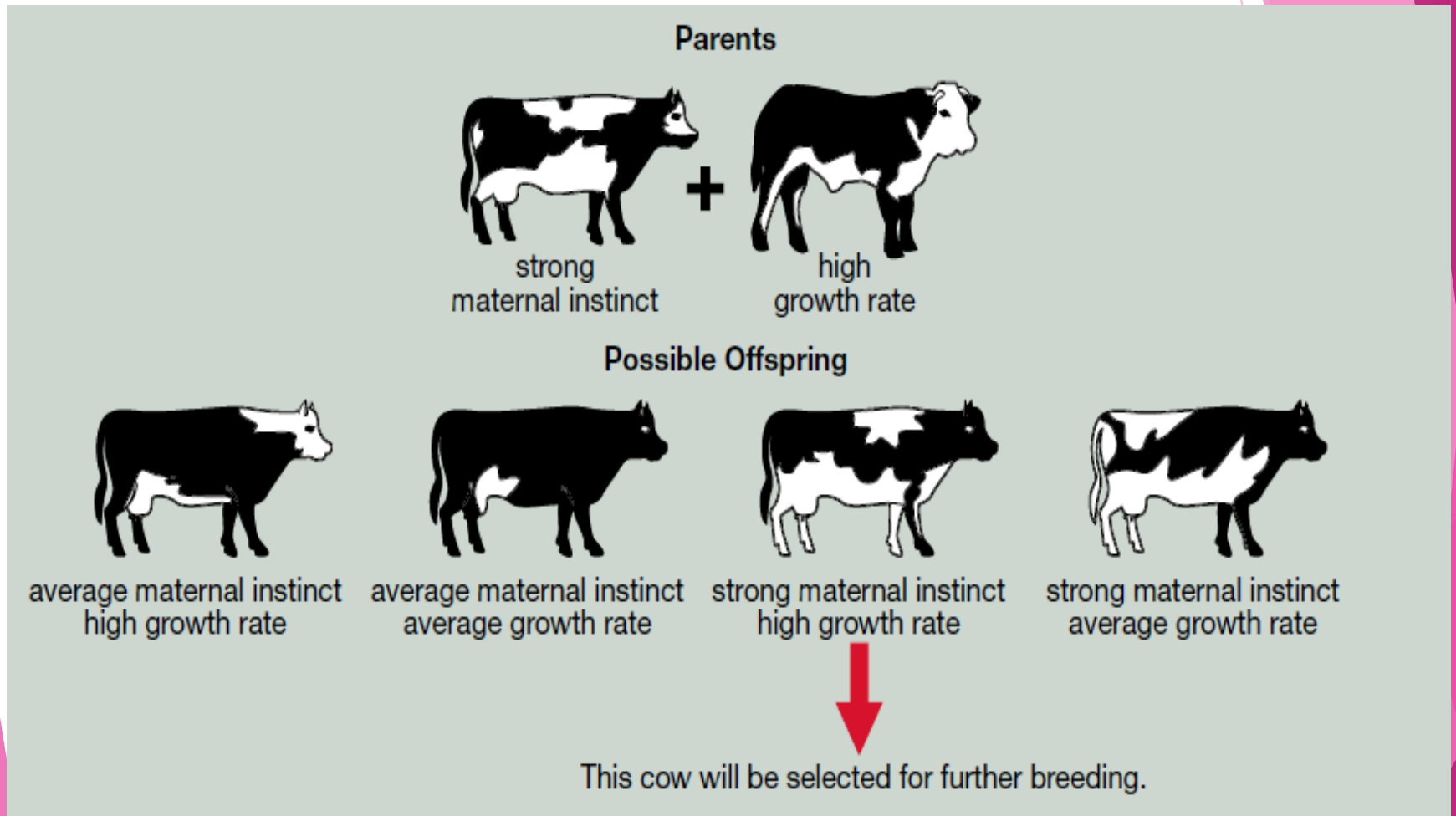
- ▶ https://www.youtube.com/watch?v=4dwjS_el-lQ

Selecting Desirable Traits

- ▶ Humans have used **selective breeding** for thousands of years
- ▶ This produces breeds of plants and animals that have particular desired traits

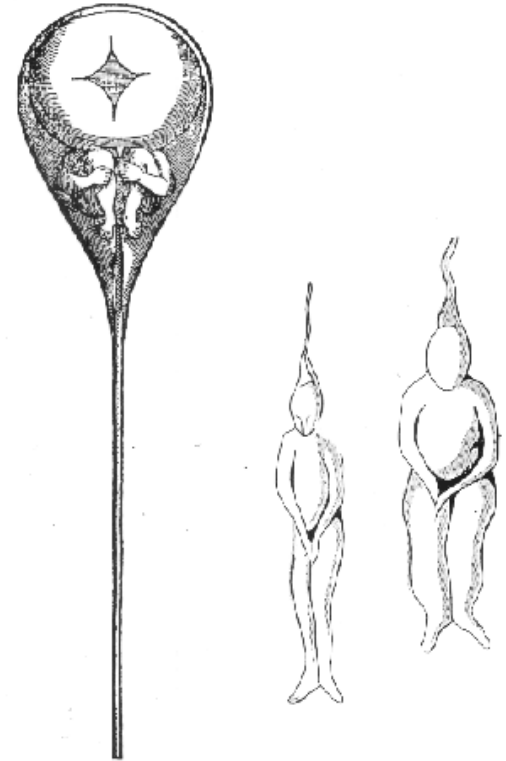


Selective Breeding



Early Ideas about Inheritance

- ▶ **Preformation theory** is the idea that all body parts in the sperm or egg were already formed and then grew from there but there was debate whether the preformed body was in the sperm or egg
- ▶ Charles Darwin said that organisms who survive are best suited to their environment but could not explain how characteristics were passed on



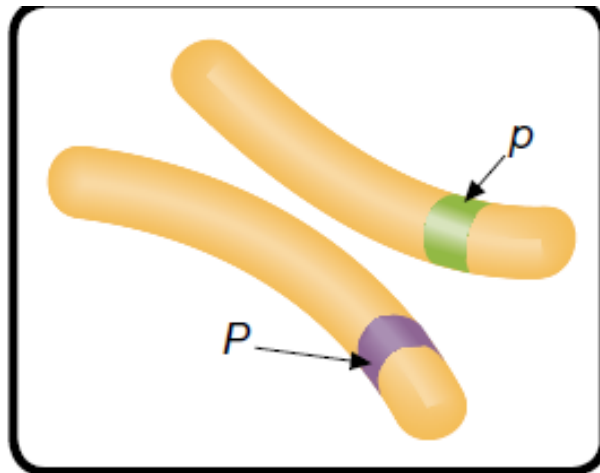
Acquired vs. Inherited

- ▶ An **acquired trait** is a skill or characteristic that you receive after you are born
- ▶ Ex. Straight teeth after braces, losing a limb

- ▶ An **inherited trait** is something genetically passed on from you by your parents
- ▶ Ex. Eye color, animal fur color

Alleles

- ▶ Different forms of genes are called **alleles**
- ▶ All dogs have hairy coats which is an inherited characteristic
- ▶ Dogs can have straight or curly, short or long, course or fine, and different colored hair
- ▶ Alleles represent all of the different possibilities of genes that give a dog their certain hair type



Genes vs. Alleles (3 min)



Gregor Mendel

- ▶ Mendel was a monk who did experiments on pea plants in his monastery who later become known as the father of genetics
- ▶ He used **cross pollination** to do his experiments which is transferring pollen from one plant to another
- ▶ His experiment was on pea plants but we are going to look at it with cats:

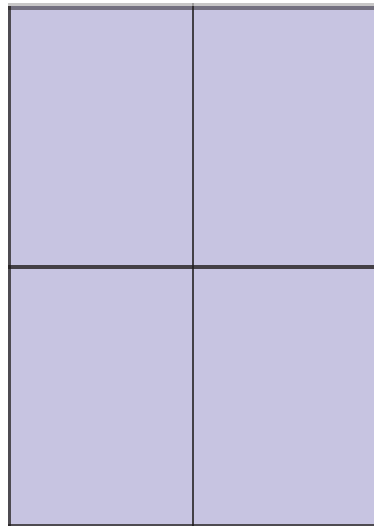
Cat Breeding



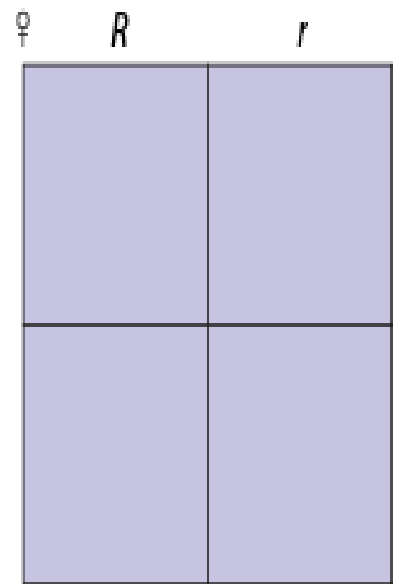
Punnett Squares

- ▶ A Punnett square is a table to help predict the probability of an offspring having a certain genetic makeup or genotype

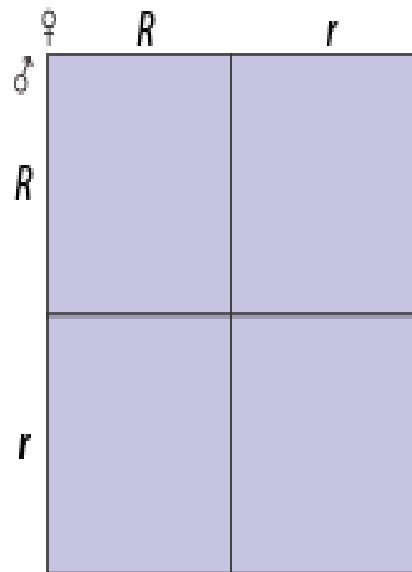
- A** When working with one gene, make a box and divide it into four squares.



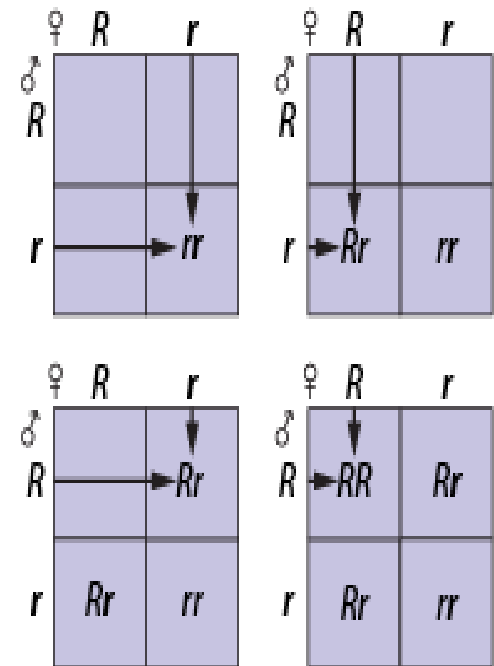
- B** Above the squares, write the genotypes of the gametes from the female parent. The ♀ symbol represents gametes from the female parent. (Some resources do not include this symbol.)



- C** Beside the squares, on the left, write the genotypes of the gametes from the male parent. The ♂ symbol represents gametes from the male parent.

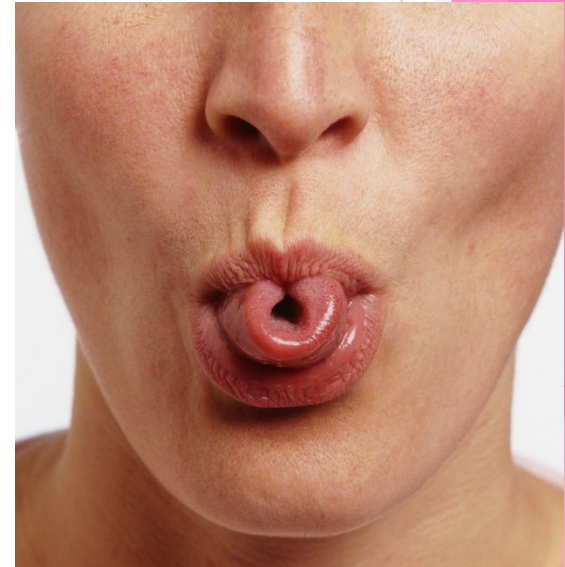


- D** Inside each square, write the symbols for the allele above it and the allele beside it. The genotypes inside the squares are the genotypes of the offspring in the ratio that would be expected for the cross.



Dominant vs. Recessive

- ▶ A **dominant trait** are caused by dominant alleles
- ▶ If an offspring has a dominant allele it will always show up
- ▶ The **recessive trait** will only be expressed if both alleles are recessive
- ▶ Being able to roll your tongue is a dominant trait so if you can't, its because you have two recessive genes



Homozygous and Heterozygous

- ▶ When an organism possesses two of the same allele (either dominant or recessive) they are **homozygous**
- ▶ **HH** dominant homozygous
- ▶ **hh** recessive homozygous



<http://twistedgifter.com/2012/01/10-bizarre-hybrid-animals/>

Homozygous and Heterozygous

- ▶ When an organism possesses two different alleles (one dominant and one recessive) they are **heterozygous**
- ▶ **Hh (heterozygous)**



<http://twistedrifter.com/2012/01/10-bizarre-hybrid-animals/>

Genotype vs. Phenotype

- ▶ Your **genotype** is a description of the alleles you possess (RR, Rr)
- ▶ Expressed as:
 - ▶ homozygous dominant, heterozygous, or homozygous recessive
- ▶ A person who is heterozygous is considered a **carrier**
- ▶ **Phenotype** is the traits you actually physically show
 - ▶ Expressed as dominant or recessive
 - ▶ Expressed as the trait observed

Example

- ▶ Black fur (B) in guinea pigs is dominant over white fur (b).
- ▶ State the phenotypes for the following genotypes and label them as heterozygous, homozygous dominant or homozygous recessive
 - ▶ BB
 - ▶ Bb
 - ▶ bb

Example

- ▶ Black fur (B) in guinea pigs is dominant over white fur (b).
- ▶ Draw a punnett square for a square from a cross between two heterozygous guinea pigs

Board Question

- ▶ Nectarines and peaches are genetic variations of the same fruit. The fuzzy skin of a peach is produced by a dominant allele, F , and the smooth skin of a nectarine is produced by a recessive allele, f .
- ▶ State whether the phenotype of the following individuals will be fuzzy or smooth

- ▶ FF

- ▶ Ff

- ▶ ff



Board Question

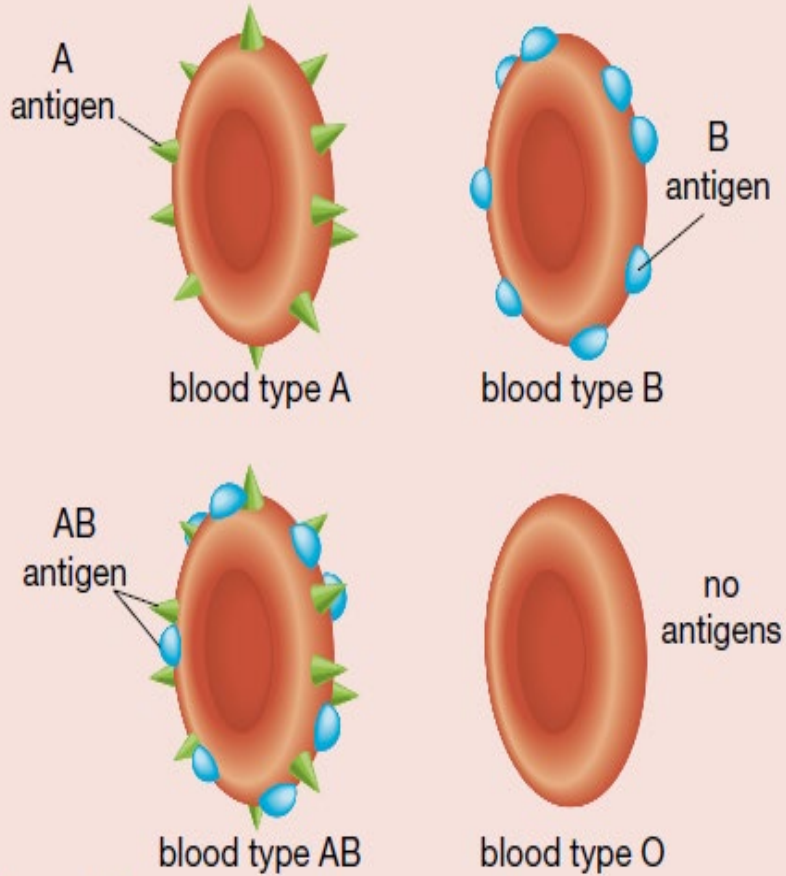


- ▶ Nectarines and peaches are genetic variations of the same fruit. The fuzzy skin of a peach is produced by a dominant allele, F , and the smooth skin of a nectarine is produced by a recessive allele, f .
- ▶ Using the letters F and f , write out the genotype for a:
 - ▶ Heterozygous peach
 - ▶ Homozygous nectarine
- ▶ Draw a punnett square for a cross between a heterozygous peach and a homozygous nectarine

Blood

- ▶ What we learn in science 30 is a very simplified version of what determines your genes
- ▶ Blood type is an example of something that has more than two possible alleles
- ▶ In blood you can have A, B, or O allele
- ▶ These three alleles can form 4 different blood phenotypes
- ▶ A and B are **co-dominant** which means both can be expressed at the same time

Blood



Note: Antigens are not drawn to scale.

Table of Blood Types

Genotype	Phenotype
OO	blood type O
AA or AO	blood type A
BB or BO	blood type B
AB	blood type AB

Donating Blood

		DONOR			
		O	A	B	AB
RECIPIENT	AB	✓	✓	✓	✓
	B	✓		✓	
	A	✓	✓		
	O	✓			

Blood Types (7 min)



Who's your daddy?

		Father's Blood Type				
		A	B	AB	O	
Mother's Blood Type	A	A or O	A, B, AB, or O	A, B, or AB	A or O	Child's Blood type Must Be
	B	A, B, AB or O	B or O	A, B, or AB	B or O	
	AB	A, B, or AB	A, B, or AB	A, B, or AB	A or B	
	O	A or O	B or O	A or B	O	

		Child's Blood Type				
		A	B	AB	O	
Mother's Blood Type	A	A, B, AB or O	B or AB	B or AB	A, B, or O	Father's Blood Type Must Be
	B	A or AB	A, B, AB or O	A or AB	A, B, or O	
	AB	A, B, AB or O	A, B, AB or O	A, B, or AB		
	O	A or AB	B or AB		A, B, or O	

Day 2 Board Question

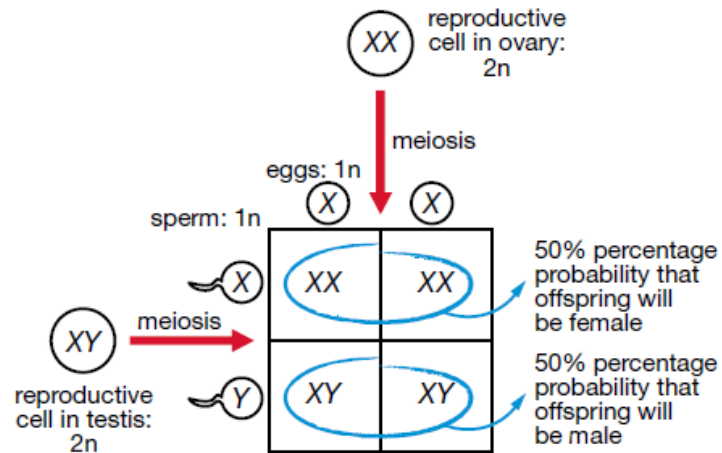
- ▶ Having dimples is dominant over not having dimples. If a homozygous man with dimples has a child with a homozygous woman without dimples:
- ▶ What are the genotypes of the mom and the dad?
- ▶ Draw a Punnett square to predict probability that their children will **have** dimples.
- ▶ If one of the children grows up and has a child with a heterozygous male, what is the probability their children will **have** dimples?

Sex Linked Inheritance

- ▶ 22 of your 23 pairs of chromosomes look the same between males and females
- ▶ The only chromosome that different is the last one, the sex chromosome
- ▶ Males have X Y and females have X X

Example

- ▶ When a man and a woman have a baby, what is the probability of the baby being a boy or a girl?



Sex linked inheritance (6 min)

- ▶ <https://www.youtube.com/watch?v=h2xufrHWG3E>

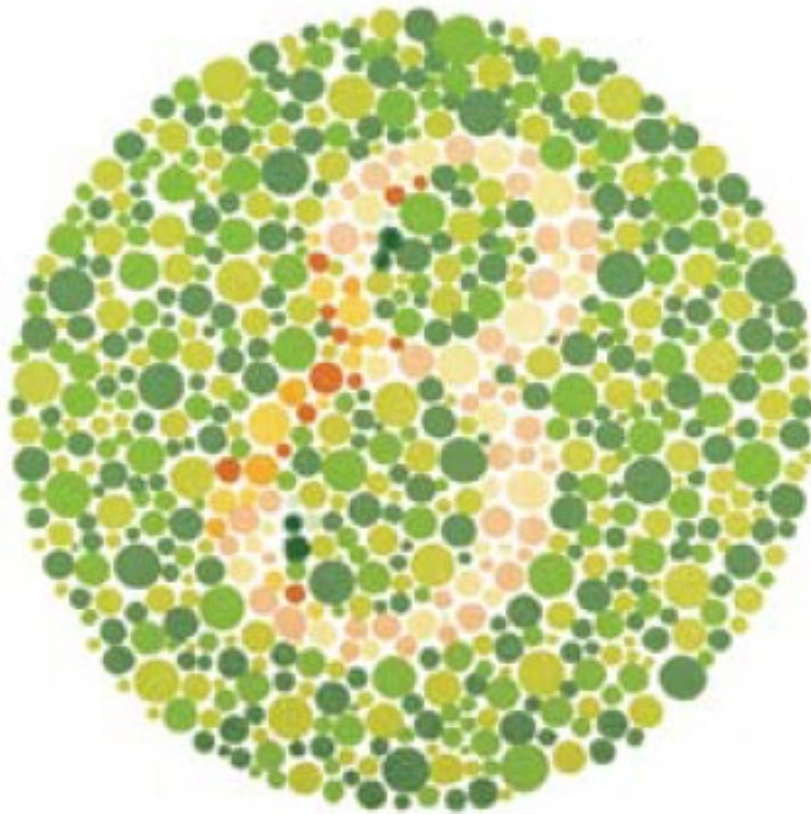
Sex Linked Inheritance

- ▶ Some traits are caused by genes are carried on the Y and X chromosomes that have nothing to do with gender, these are called **sex linked inheritance**
- ▶ All traits controlled by genes present on the other 22 chromosomes are called **autosomal inheritance**
- ▶ **Colorblindness** is an example of a **sex linked** trait
 - ▶ It is found on the X chromosome and not carried on the Y
- ▶ If a trait is X sex linked, boys are more likely to receive the recessive trait than girls

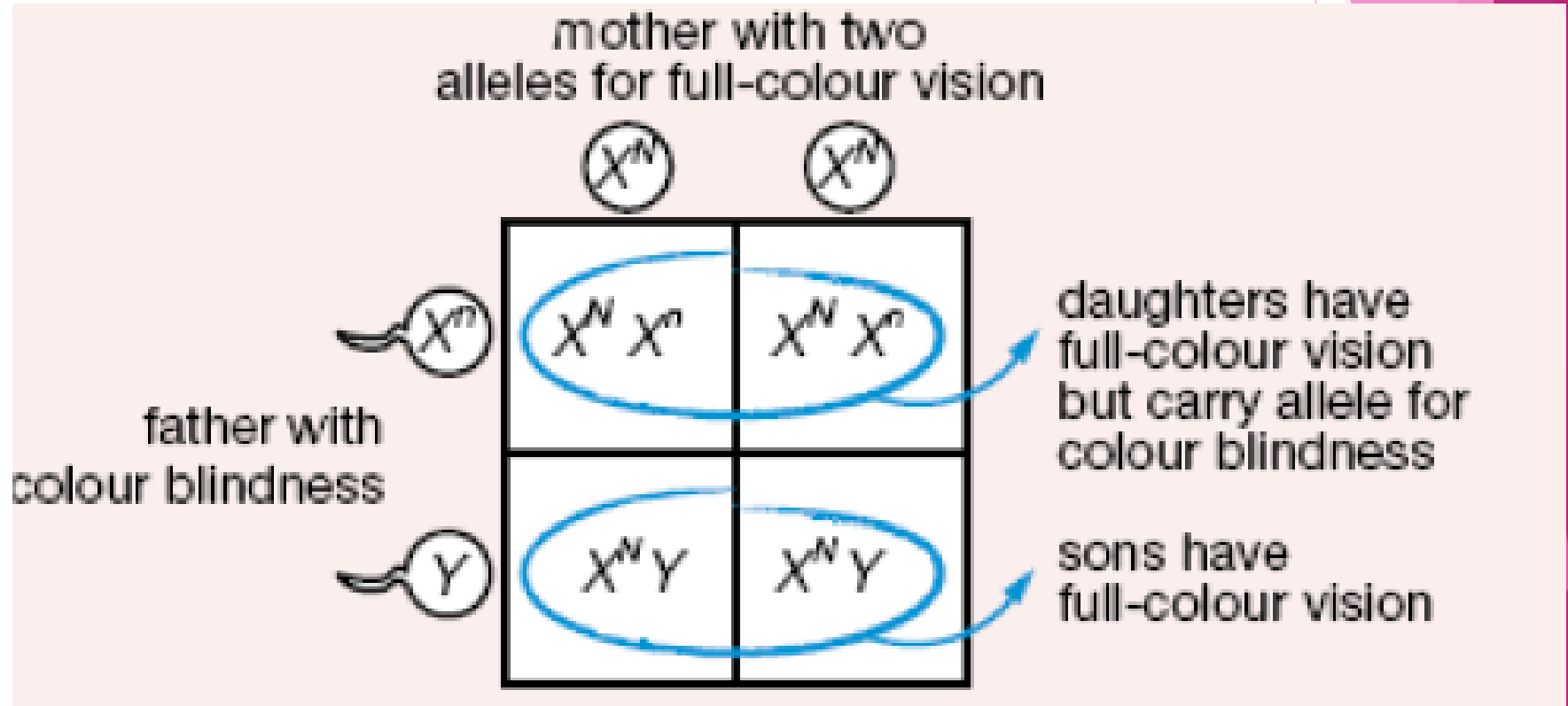


"It's evolution. Women are not color blind because they need it for shopping."

Color Blindness Test



Punnett Square for sex linked inheritance



Example

- ▶ A homozygous woman who has two alleles for full color vision has children with a colorblind man
 - ▶ Describe the genotype of each parent
 - ▶ Build a Punnett square to predict the genotypes of each child
 - ▶ What is the probability of the boys being colorblind?
 - ▶ What is the probability of the girls being colorblind?

Example

- ▶ A heterozygous woman is a carrier for color blindness has children with a full color vision man.
 - ▶ Describe the genotype of each parent
 - ▶ Build a punnett square to predict the genotypes of each child
 - ▶ What is the probability of the boys being colorblind?
 - ▶ What is the probability of the girls being colorblind?

Board Question

The ginger color in cats is caused by a sex linked trait carried by the X chromosome, black color (C) is dominant and over the ginger color (c)

- ▶ Write the genotype for a male ginger cat
- ▶ What is the phenotype of a cat with the genotype X^CY ?
- ▶ Describe the phenotype of a cat with a genotype X^CX^c
- ▶ If a female cat is ginger, what are the two possible genotypes her parents could have had?

