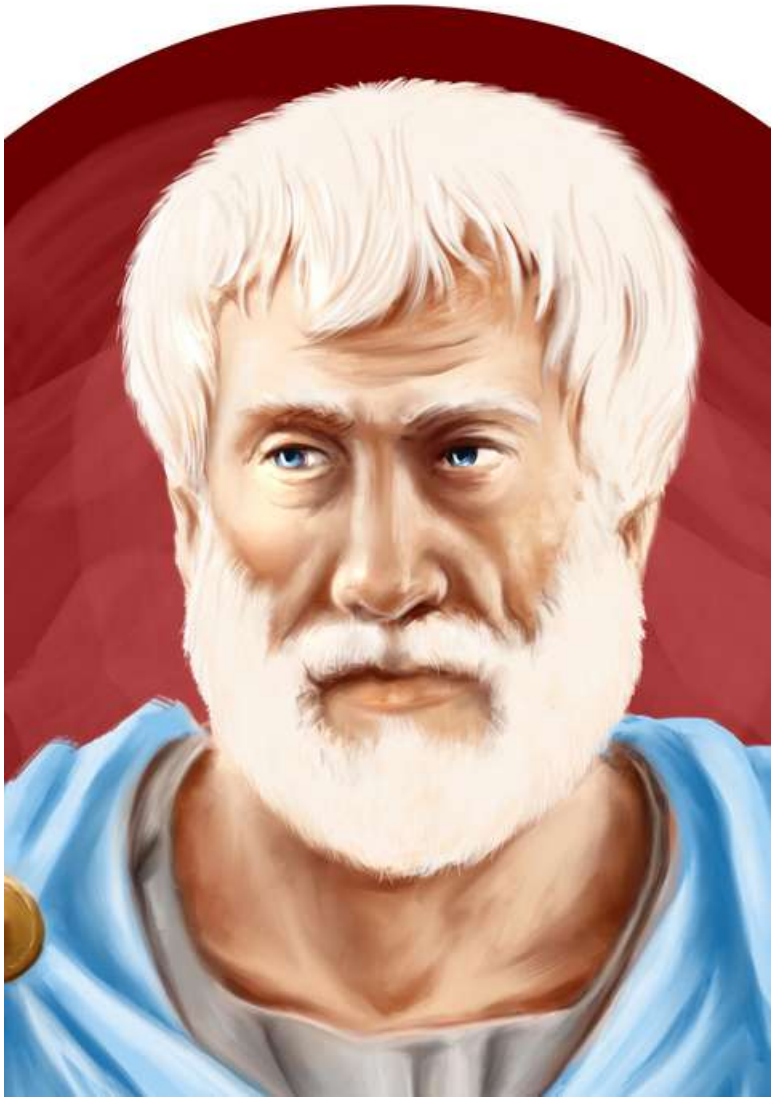

Heredity
Genetics



terms are

- blood relatives
- pureblood
- blood lines

Later in history the development of microscopes and discovery of eggs and sperms also started new speculations:

Genetics and the cell theory

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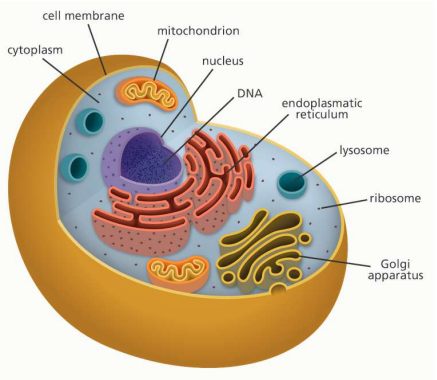


= Genetics

Dogma:
New cells always
coming from existing cells

Variation – differences and similarities
one type or species of animal: *Homo sapiens*

Similarities:

- ***same general body shape***
- ***faces have similar features***

Some of your characteristics come from your mother and some come from your father.

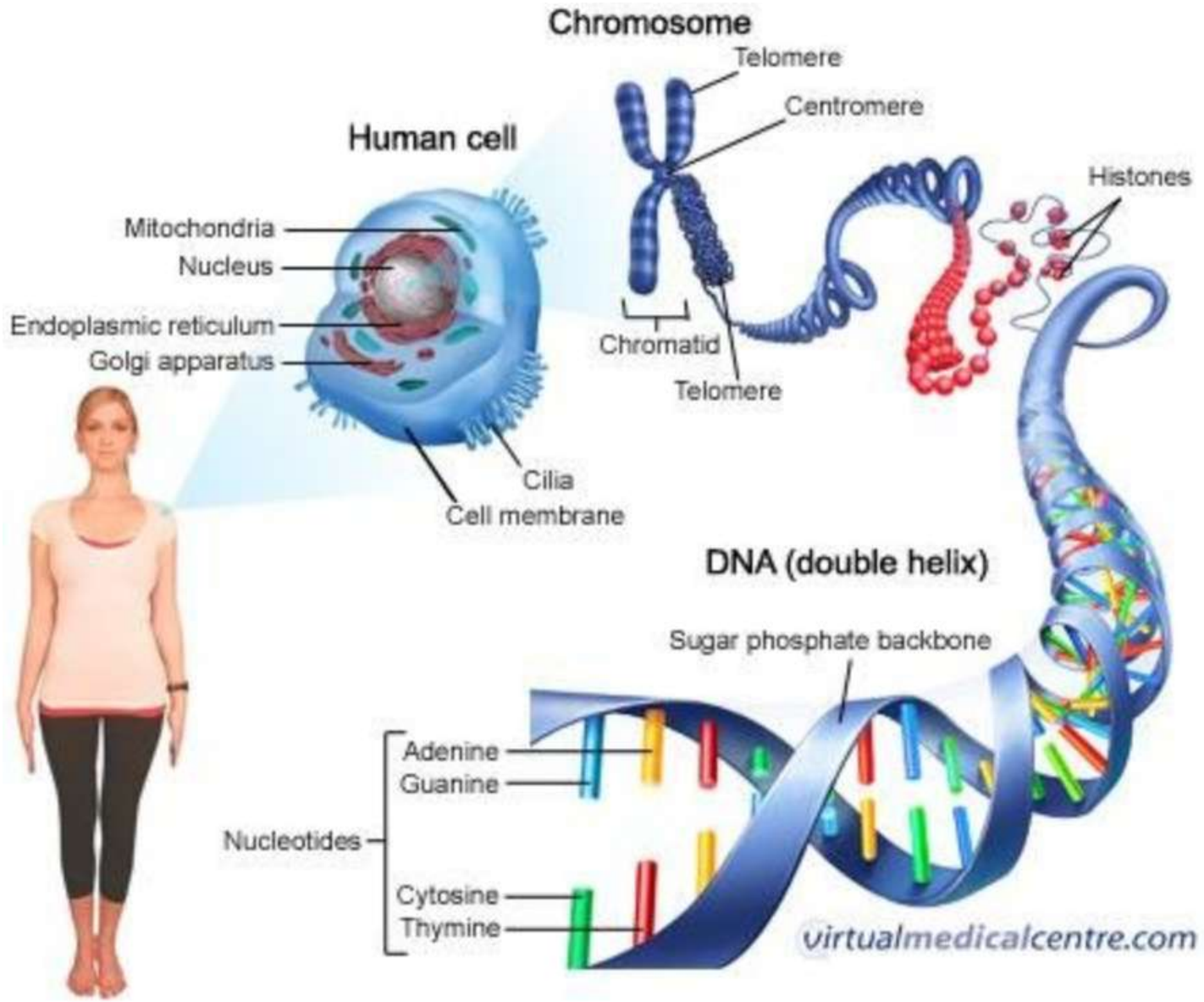
<u>Variations (Continuous)</u>

- ***Different hair colour***
- ***body height***
- ***Weight***
- ***skin colour*** →

<u>Variations (discontinuous)</u>

- ***roll your tongue*** →

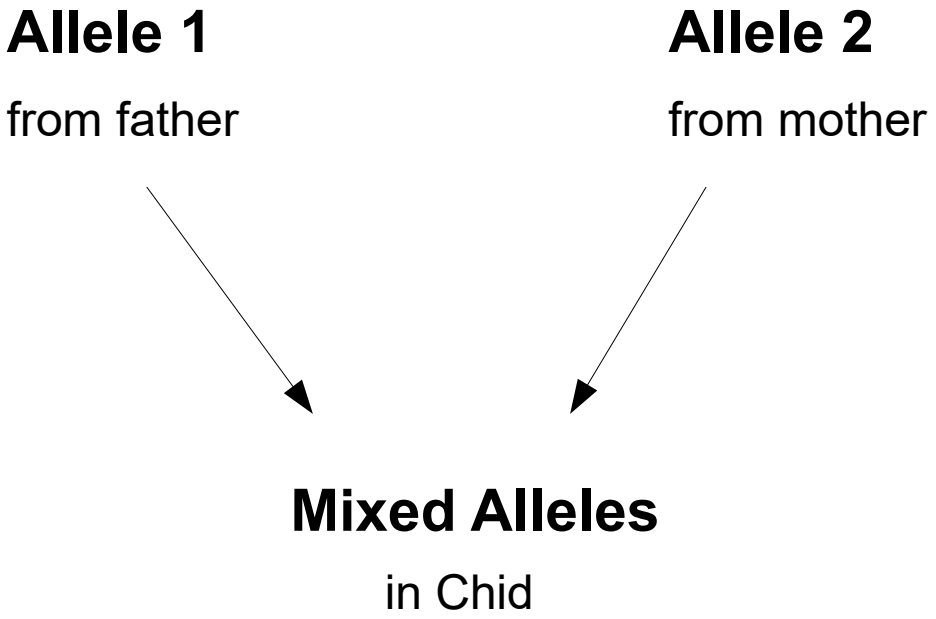
Genes



Discontinuously varying traits are often inherited by a single gene, whereas continuously varying traits are inherited by several genes.

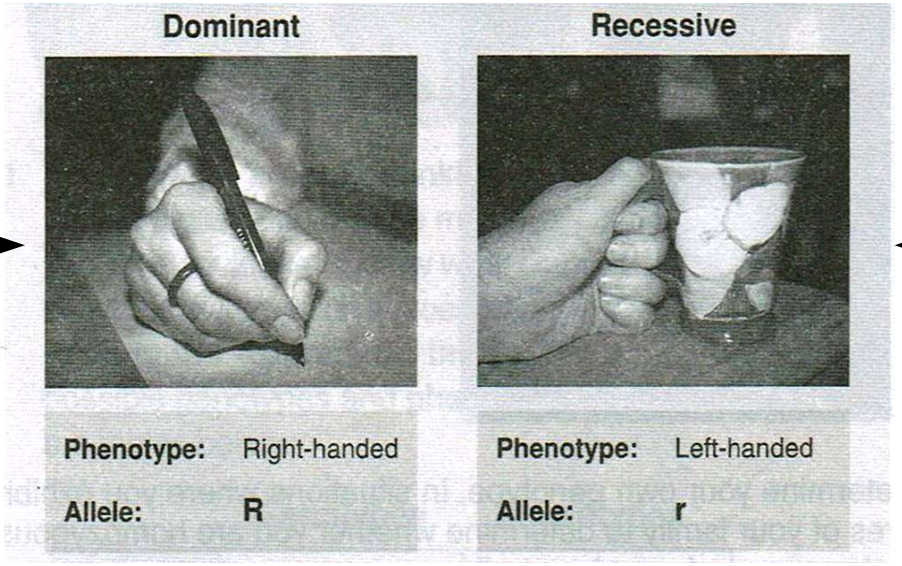
Phenotype and genotype

- **Genes** exist in varying forms that are called **alleles**.
- For each discontinuously varying trait human beings have two alleles in their DNA.
- Either the exact same alleles or two different alleles.



Phenotype and genotype (Example: Handedness)

Dominand (R) →



← Recessive (r)

Genotype
collection of all genes / alleles in your DNA

Phenotype
"what you see / are"

homozygous

RR → right-handed

Rr ← heterozygous → right-handed

rr → left-handed

Task 1: Read the text, list all new terms shown in bold letters and provide a short definition/explanation for these terms according to the text.

- **cell theory** – theory stating that the cell is the smallest unit of life
- **new cells always coming from existing cells** – a central dogma of cell theory
- **trait** – characteristic or property determined by an allele of a gene
- **continuous variation** – a trait that changes gradually over a range of values among individuals is said to display continuous variation
- **discontinuous variation** - a trait that is either present or absent is said to display discontinuous variation
- **genes** – entities in the DNA that contain information for, i.e. “encode”, a trait
- **allele** – one variant of many of a gene
- **dominant allele** – allele whose information overwrites that of a recessive allele and is detectable as a trait
- **recessive allele** - allele whose information is overwritten by that of a dominant allele
- **phenotype** - the collection of traits or characteristics an individual has
- **genotype** - the collection of all the genes (alleles) in one’s DNA
- **homozygous** – having two identical alleles of a gene in one’s DNA, e.g. two dominant or two recessive
- **heterozygous** - having two different alleles of a gene in one’s DNA, e.g. a dominant and a recessive

Task 2:

- Check out the traits listed in the slides obove and determine your individual phenotype and genotype.
- Use the table below (Tab. 1) to document your results.
- In case of a dominant trait you have to write down the homozygous as well as the heterozygous genotype for this trait, since you do not know which one you really have.

Your traits:	Thumb	Ear lobes	Chin cleft	Middle digit hair	Handedness	Hand clasp
Phenotype:						
Genotype:						

Task 2:

- Check out the traits listed in the slides obove and determine your individual phenotype and genotype.
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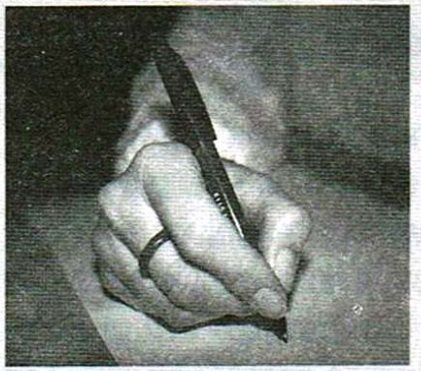
Your traits:	Thumb	Ear lobes	Chin cleft	Middle digit hair	Handedness	Hand clasp
Phenotype:					**right-handed**	
Genotype:					**RR / Rr**	

Trait 1: Handedness

Trait: Handedness

Dominant	Recessive
	
Phenotype: Right-handed	**Phenotype:** Left-handed
Allele: R	**Allele:** r

The trait of left or right handedness is genetically determined. Right-handed people have the dominant allele, while left handedness is recessive. People that consider themselves ambidextrous can assume they have the dominant allele for this trait.

Trait 2: Hand clasp

Trait: Hand clasp

Dominant	Recessive
	
Phenotype: Left thumb on top	**Phenotype:** Right thumb on top
Allele: C	**Allele:** c

Like handedness, hand clasping shows dominance/recessiveness. When the hands are clasped together, either the left or the right thumb will naturally come to rest on top. The left thumb on top is the dominant trait (C), while the right thumb on top is recessive (c).

Trait 3: Dimpled chin

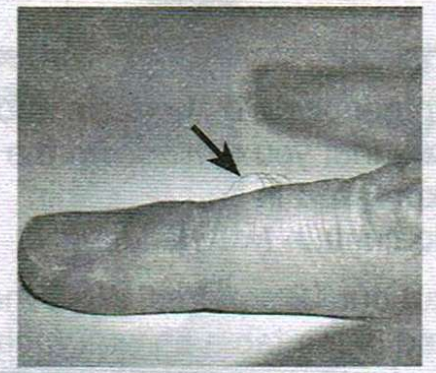
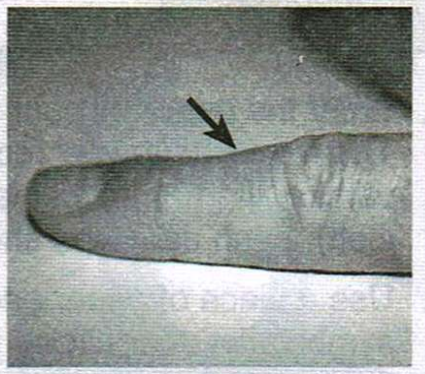
Trait: Dimpled chin

Dominant	Recessive
	
Phenotype: Chin cleft	**Phenotype:** No chin cleft
Allele: **D**	**Allele:** **d**

A cleft or dimple on the chin is inherited. A cleft is dominant (D), while the absence of a cleft is recessive (d), although this gene shows **variable penetrance**, probably as a result of modifier genes.

Trait 4: Middle digit hair

Trait: Middle digit hair

Dominant	Recessive
	
Phenotype: Hair on middle segment	**Phenotype:** No hair on mid segment
Allele: **M**	**Allele:** **m**

Some people have a dominant allele that causes hair to grow on the middle segment of their fingers. It may not be present on all fingers, and in some cases may be very fine and hard to see.

Trait 5: Ear lobe shape

Trait: Ear lobe shape

Dominant	Recessive
	
Phenotype: Lobes free	**Phenotype:** Lobes attached
Allele: F	**Allele:** f

In people with only the recessive allele (homozygous recessive), ear lobes are attached to the side of the face. The presence of a dominant allele causes the ear lobe to hang freely.

Trait 6: Thump hyper-extension

Trait: Thumb hyperextension

Dominant	Recessive
	
Phenotype: 'Hitchhiker's thumb'	**Phenotype:** Normal thumb
Allele: H	**Allele:** h

Photos: RA

There is a gene that controls the trait known as 'hitchhiker's thumb' which is technically termed distal hyperextensibility. People with the dominant phenotype are able to curve their thumb backwards without assistance, so that it forms an arc shape.

Which genotype and phenotype would our offspring have?

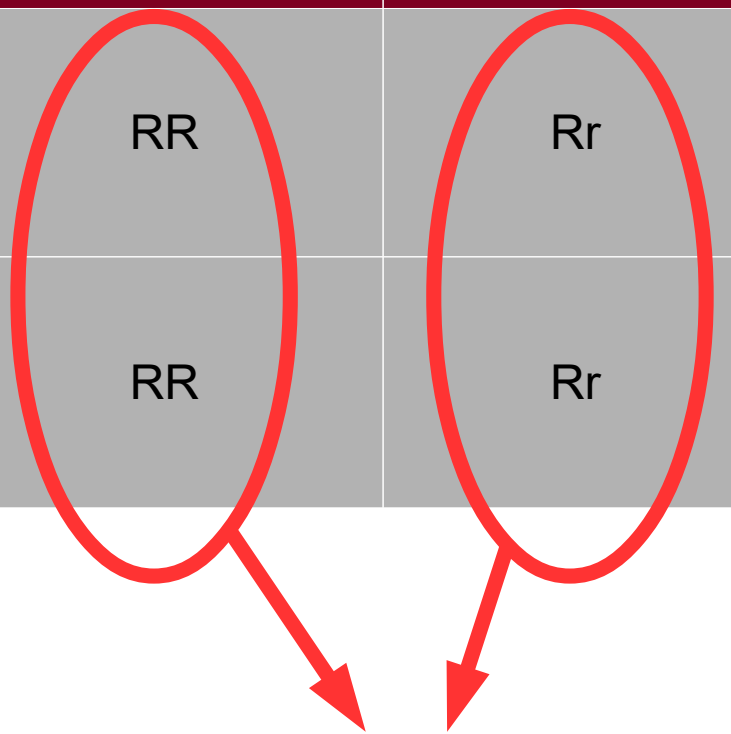
→ Alleles from Partner + you

Parental generation	Female partner Phenotype: right-handed Genotype: RR	Male partner Phenotype: right-handed Genotype: Rr
Possible gametes	R, R	R, r

1st Generation Offspring	♂ Male gametes (sperm cells)→	R	r
♀ Female gametes (egg cells) ↓	R	**RR**	**Rr**
	R	**RR**	**Rr**

So, what do the results tell us?

1st Generation Offspring	♂ Male gametes (sperm cells)→	R	r
♀ Female gametes (egg cells) ↓	R	RR	Rr
	R	RR	Rr



Genotype 1:1 → 50%

Phenotype → 100%

Your task:

- Take your own results and fill in all missing symbols in Table 2 and 3, respectively.
- Mate yourself with the (imaginary) partner whose phenotype and genotype are shown in Table 1.
- When doing the imaginary mating stick to the sentence: “Don’t think you’re smart, use a Punnett square”! You have to use one Punnett square for each trait (see next page)! There is no “cross-combination of alleles” coding for different traits!
- To make it easier for you and to reduce the number of Punnett squares to fill in, in case of dominant traits only use the heterozygous genotype, not the homozygous one. This reduces the number of Punnett squares you have to fill in to six (see next page).
- Finally, use Table 4 to fill in the phenotype and the genotype of your offspring.

Your task:

Table 2: Your partner

Traits	Thumb	Chin cleft	Middle digit hair	Handedness	Earlobes	Hand clasp
Phenotype						
Genotype						
Gametes (sperm- or egg-cells)						

Table 3: You

Traits	Thumb	Chin cleft	Middle digit hair	Handedness	Earlobes	Hand clasp
Phenotype						
Genotype						
Gametes (sperm- or egg-cells)						

Punnett squares for imaginary mating

Thumb

1st Generation Offspring	♂		
♀			

Chin cleft

1st Generation Offspring	♂		
♀			

Table 4: Phenotype and genotype of your offspring

1st Generation Offspring	Thumb	Chin cleft	Middle digit hair	Handedness	Earlobes	Hand clasp
Phenotype (including probability)						
Genotype (including probability)						