Have you ever wondered why the same medication works perfectly for one person but causes terrible side effects in another? Or why your doctor might say, “We need to try a different drug for you”? The answer might be hiding inside every single cell of your body. In your DNA!

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SafePolyMed.eu

Improving Safety in Polymedication by Managing Drug-Drug-Gene Interactions

Safety in Polypharmacy training 2026

Session 3 - Video 1/3

Drug-Gene & Drug-Drug-Gene Interactions

Your DNA Decoded: Genetics Foundations for Drug Safety

Rachel Giles, Olga Millán

LeukaNET Leukemia Advocates Network

Patvocates PATIENT ENGAGEMENT IS IN OUR DNA

Funded by the European Union

AI Disclosure: *Avatars, voices, and some visual elements in this video were generated using HeyGen & Copilot. The educational content was created by humans and subsequently edited and summarised with AI assistance.*

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Why Genetics Matters for Patient Advocates

Understanding genetics helps patients, caregivers, and advocates engage with modern medicine



Clinical trial data

Understand why trials select patients by genetic markers



Patient selection

Grasp the value and logic of genetic patient selection



Access advocacy

Push for access to treatments that need genetic testing



Future developments

Prepare for advances like CRISPR gene editing



Polypharmacy limits

See how genetics adds complexity to multi-drug interactions

DNA - Deoxyribonucleic acid

A step-by-step zoom from your cells down to your genetic code

1 **DNA is the molecule inside cells that contains the genetic information responsible for the development and functioning of an organism.**

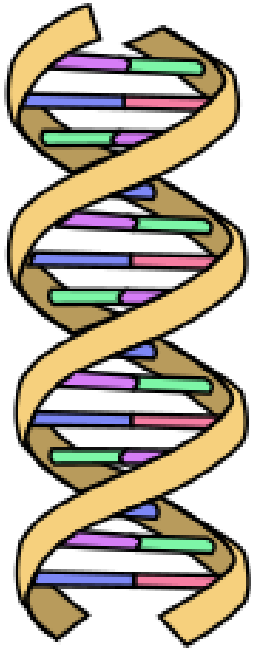
A double-stranded helix built from four chemical letters: A–T and C–G.

= Adenine
= Thymine
= Cytosine
= Guanine

Organised in pairs in a double-stranded helix

Adenine (A) pairs with Thymine (T)

Guanine (G) pairs with Cytosine (C)



DNA

https://www.cancer.gov/publications/dictionaries/genetics-dictionary
Forluvoft, DNA simple2.svg, Wikimedia Commons, public domain | https://commons.wikimedia.org/wiki/File:DNA_simple2.svg

DNA, Genes, Chromosomes: The Building Blocks

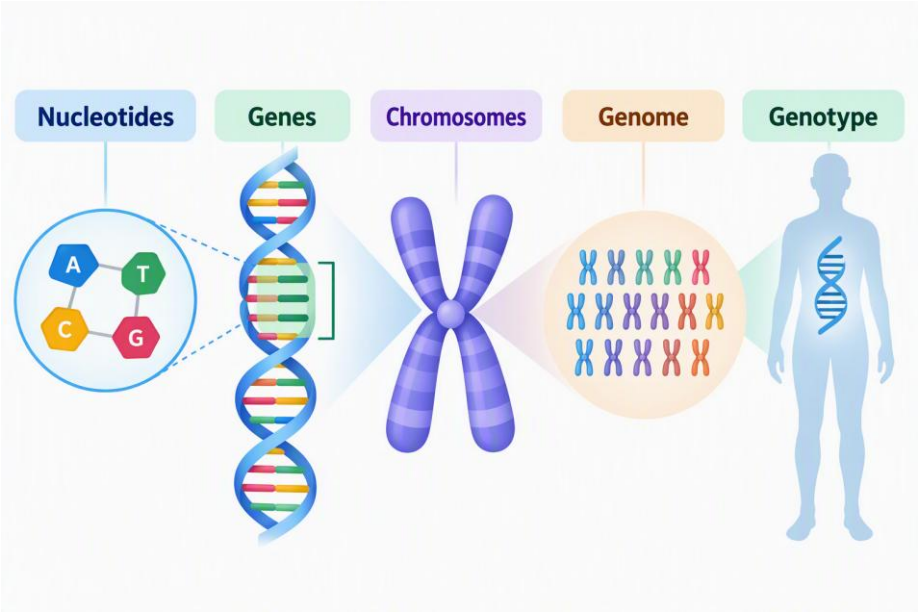
A step-by-step zoom from your cells down to your genetic code

2 **Genes:** Sections of DNA that code for specific functions. Recipes in a cookbook.

3 **Chromosomes:** Compact structures organizing genes. Humans have 23 pairs (46 total) one set from each parent.

4 **Genome:** Your complete collection of DNA across all chromosomes.

5 **Genotype:** Your own unique version of that genome.



Genome = your complete instruction manual

https://www.cancer.gov/publications/dictionaries/genetics-dictionary

Genotype vs. Phenotype: Instructions vs. Results



Genotype

Your full set of genetic instructions. The complete cookbook.



+ Environment
(diet, exercise, meds, stress)



Phenotype

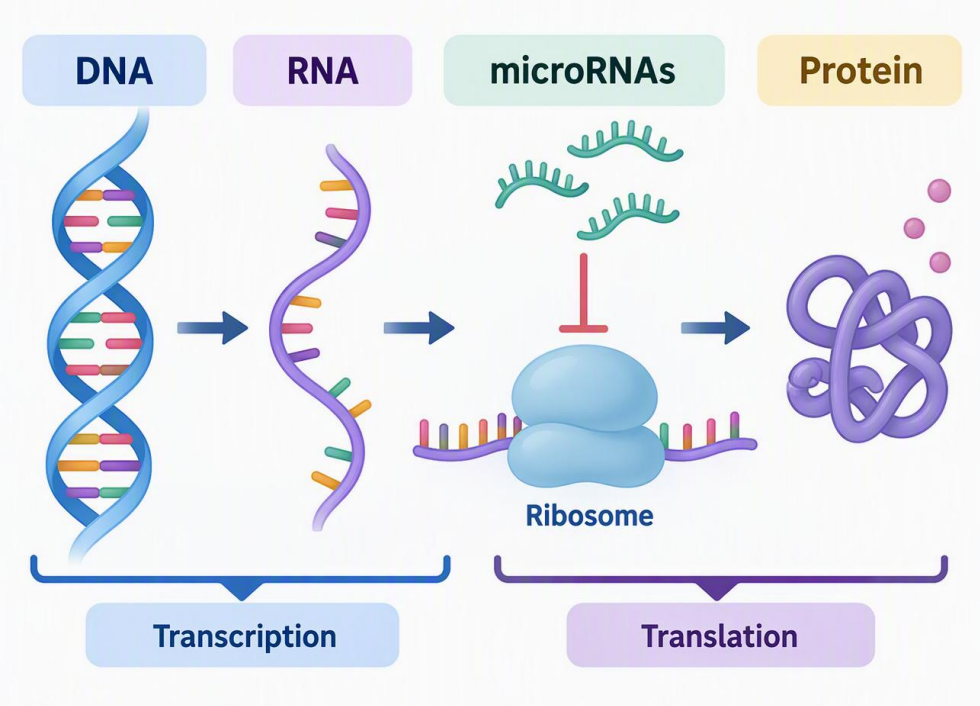
What actually shows up: appearance, function, behavior. The finished dish.

💡 Two people with the same gene might end up with different outcomes because they live in different environments.

https://humanbiology.pressbooks.tru.ca/chapter/5-16-the-human-genome/
https://microbenotes.com/phenotype-vs-genotype/

microRNA: The Fine-Tuning Knobs

Tiny molecules that regulate how much of a gene gets expressed



"microRNAs = volume control for your genes"

Nobel Prize in Physiology or Medicine, 2024

Gene Expression & Environment

Gene expression changes over time. Your environment can turn genes ON or OFF

Genomes are designed to promote adaptation to the environment



Caloric restriction in mice

Restricted diets changed gene expression for metabolism, inflammation and stress response. Mice lived longer, healthier lives.



Lactose intolerance

A dairy-farming mutation keeps the lactase gene active into adulthood in many Europeans; others lose it after childhood.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4685725/
https://doi.org/10.1371/journal.pbio.3000742

Epigenetics

Discipline that studies how age and exposure to environmental factors cause changes in the way genes are switched on/off, without changing the individual's DNA sequence.

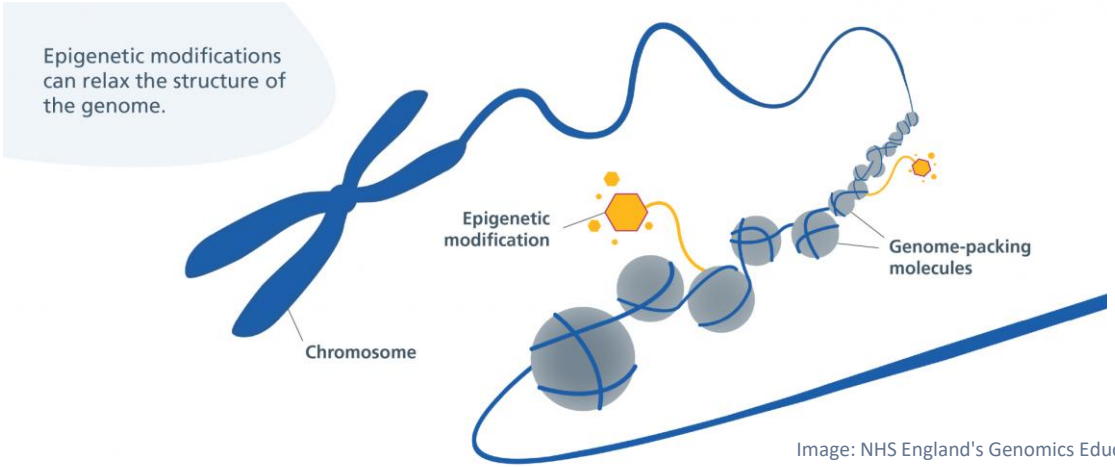


Image: NHS England's Genomics Education Programme. CC BY-NC license.

💡 *Both genetic and epigenetic differences can affect how you respond to a drug.*

https://www.cancer.gov/publications/dictionaries/cancer-terms/def/epigenetics
https://www.genomicseducation.hee.nhs.uk/education/core-concepts/what-is-epigenetics/

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Key Takeaways

- DNA → Genes → Chromosomes → Genome
- Genotype + Environment = Phenotype
- Epigenetics adds another layer on top of your DNA sequence
- All of this shapes how you respond to medications

Coming up next: Video 2 — what happens when those instructions contain errors — mutations — and how they affect drug safety.

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Credits & Attributions

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AI disclosure

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Figures

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