



# The Gene Story

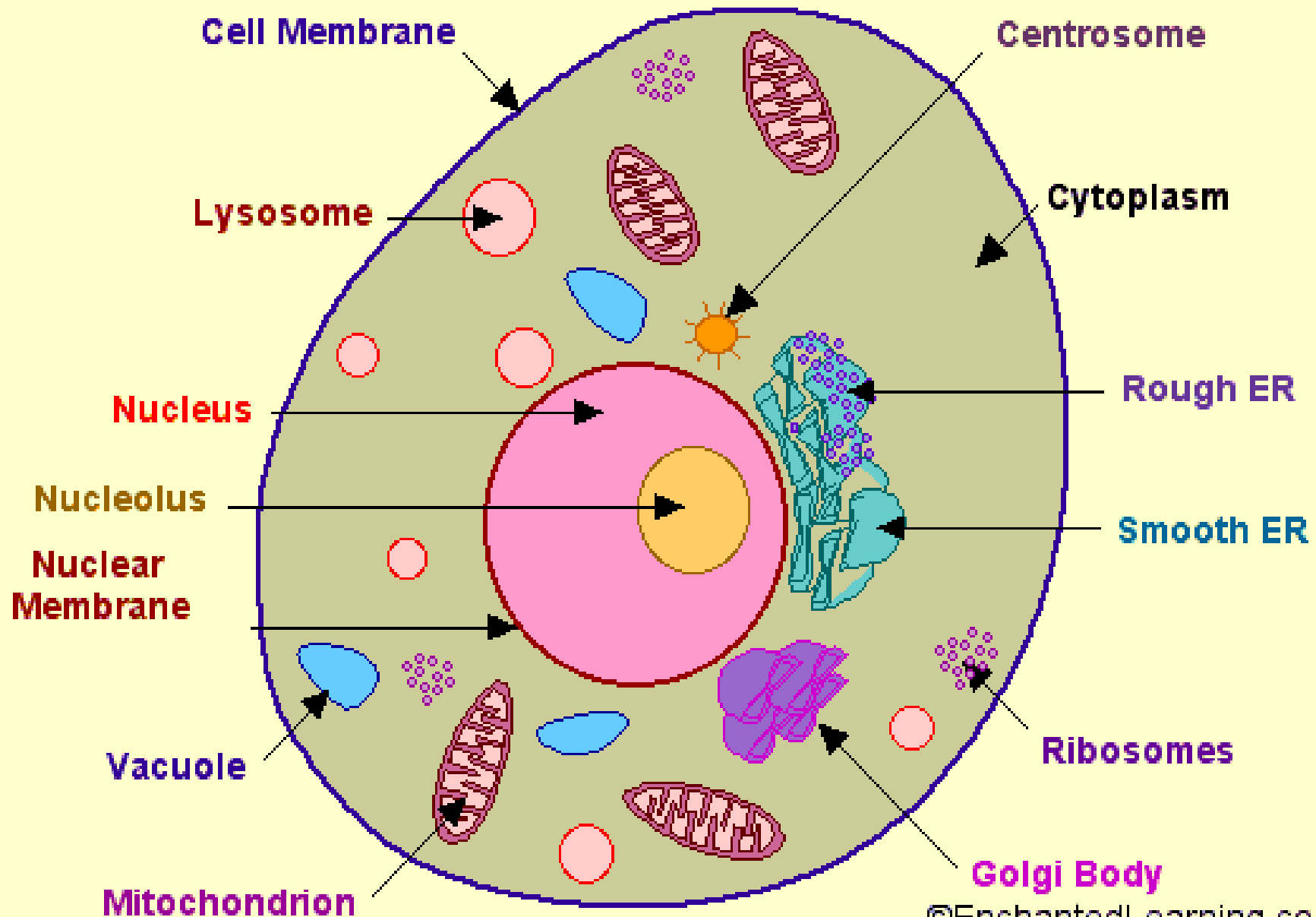
**DR M K DATTA**

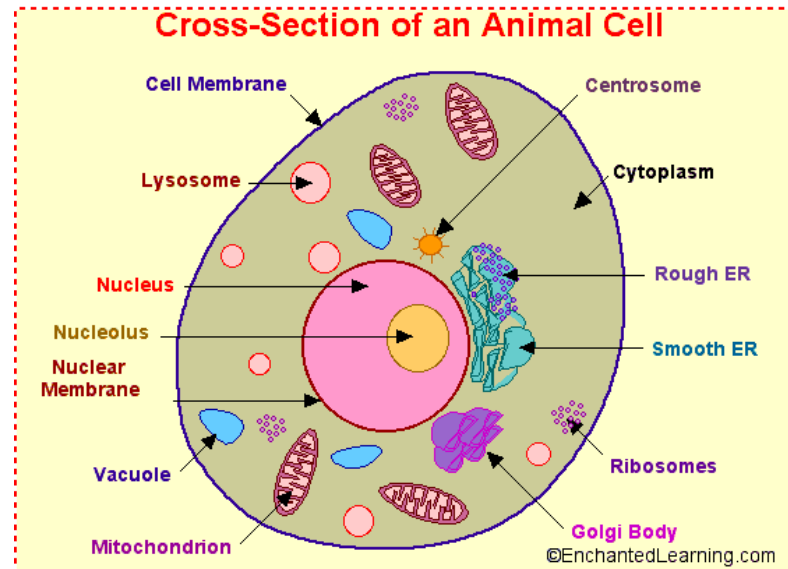
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# Introduction



# Cross-Section of an Animal Cell





**The following is a glossary of animal cell terms:**

- cell membrane** - the thin layer of protein and fat that surrounds the cell. The cell membrane is semipermeable, allowing some substances to pass into the cell and blocking others.

**centrosome** - (also called the "microtubule organizing center") a small body located near the nucleus - it has a dense center and radiating tubules. The centrosomes is where microtubules are made. During cell division (mitosis), the centrosome divides and the two parts move to opposite sides of the dividing cell. The centriole is the dense center of the centrosome.

**cytoplasm** - the jellylike material outside the cell nucleus in which the organelles are located.

**Golgi body** - (also called the Golgi apparatus or golgi complex) a flattened, layered, sac-like organelle that looks like a stack of pancakes and is located near the nucleus. It produces the membranes that surround the lysosomes. The Golgi body packages proteins and carbohydrates into membrane-bound vesicles for "export" from the cell.

**lysosome** - (also called cell vesicles) round organelles surrounded by a membrane and containing digestive enzymes. This is where the digestion of cell nutrients takes place.

**mitochondrion** - spherical to rod-shaped organelles with a double membrane. The inner membrane is infolded many times, forming a series of projections (called cristae). The mitochondrion converts the energy stored in glucose into ATP (adenosine triphosphate) for the cell.

**nuclear membrane** - the membrane that surrounds the nucleus.

- nucleolus** - an organelle within the nucleus - it is where ribosomal RNA is produced. Some cells have more than one nucleolus.

**nucleus** - spherical body containing many organelles, including the nucleolus. The nucleus controls many of the functions of the cell (by controlling protein synthesis) and contains DNA (in chromosomes). The nucleus is surrounded by the nuclear membrane.

**ribosome** - small organelles composed of RNA-rich cytoplasmic granules that are sites of protein synthesis.

**rough endoplasmic reticulum** - (rough ER) a vast system of interconnected, membranous, infolded and convoluted sacks that are located in the cell's cytoplasm (the ER is continuous with the outer nuclear membrane). Rough ER is covered with ribosomes that give it a rough appearance. Rough ER transports materials through the cell and produces proteins in sacks called cisternae (which are sent to the Golgi body, or inserted into the cell membrane).

**smooth endoplasmic reticulum** - (smooth ER) a vast system of interconnected, membranous, infolded and convoluted tubes that are located in the cell's cytoplasm (the ER is continuous with the outer nuclear membrane). The space within the ER is called the ER lumen. Smooth ER transports materials through the cell. It contains enzymes and produces and digests lipids (fats) and membrane proteins; smooth ER buds off from rough ER, moving the newly-made proteins and lipids to the Golgi body, lysosomes, and membranes.

**vacuole** - fluid-filled, membrane-surrounded cavities inside a cell. The vacuole fills with food being digested and waste material that is on its way out of the cell.

# What are CHROMOSOMES?

- There are 23 pairs of chromosomes in the nucleus of any one of your cells
- Each chromosome has a single strand of DNA (deoxyribonucleic acid) which carries the code for a couple of thousand genes

# Who was Gregor Mendel?

- Curiosity about the connection between the color of a pea flower and the type of seed that same plant produced inspired him to begin experimenting with garden peas in 1856.
- Made careful use of scientific methods, which resulted in the first recorded study of how traits pass from one generation to the next.

# Who was Gregor Mendel?

- Austrian monk who studied mathematics and science
- As a boy he could predict the possible types of flowers and fruits that would result from crossbreeding two plants in his father's garden

# What is a GENE?

- The material that controls which traits are expressed in an organism
- Genes come in pairs and offspring inherit one copy of each gene from each parent



# What is a Mutation?

- A mutation is a permanent change in the DNA sequence of a GENE.
- Mutations in a gene's DNA sequence can alter the amino acid sequence of the protein encoded by the gene.

# Define TRAIT

- Ways of looking, thinking, or being
- Traits that are genetic are passed down through the genes from parents to offspring

# Describe CO-DOMINANCE

- When an organism has two different alleles for a gene that does not follow the dominant/recessive pattern
- The organism shows a trait that is a blend of the traits represented by the two alleles
- Also called INCOMPLETE DOMINANCE

# Describe CO-DOMINANCE

*For example:*

The gene for the color of some flowers has one allele for red and one for white. When both alleles are present, neither is dominant, and the flower color is pink

# Define GENOTYPE

- An organism's genetic makeup

# What is Allele

- One of the variant forms of a gene at a particular locus, or location, on a chromosome.
- Different alleles produce variation in inherited characteristics such as hair colour or blood type.
- In an individual, one form of the allele (the dominant one) may be expressed more than another form (the recessive one)

# What is meant by MULTIPLE ALLELES?

- A trait that is controlled by more than two alleles is said to be controlled by multiple alleles
- Traits controlled by multiple alleles produce more than three phenotypes of that trait

# Define PHENOTYPE

Outward physical appearance  
and  
behavior of an organism



# List the 3 Principles of Heredity

- Traits are controlled by alleles on chromosomes
- An allele's effect is dominant or recessive
- When a pair of chromosomes separate during meiosis the different alleles for a trait move into separate sex cells

- NATURE vs NURTURE

GENETICIST vs PSYCHOLOGIST

**THE PISSARROS**  
Impressionists Across Three Centuries

**THE BROWNS**  
A Tight Quintet

**Talent  
Dynasties**

**THE WAUGHS**  
Every Generation a Rewrite

**THE HOFSTADTERS**  
Power Laws and Family Loops

*Some families pass talent and skill down the generations like monarchs pass a crown. Their reign of success is forged in a crucible of closeness and competition – and in the freedom to break away. By Carlin Flora*

# Douglas Hostadter

- Father – Robert Noble Prize Winner in Physics
- Father did not push him to science
- Student of physics
- 1980 – won a Pulitzer Prize
- Gödel, Escher, Bach
- The book examines similarities between the work and lives of logician – Kurt Gödel
- Artist – MC Escher
- Composer – Sebastian Bach

# Douglas Hostadter

- He suddenly got interested in Cognitive Science
- *“Eventually, I found a niche in which a combination of abilities allowed me to flourish”*
- His titles:
- Prof of Cognitive Science and Computer Science
- Adjunct Prof of History and Philosophy of Science, Philosophy, Comparative Literature and Psychology and Director of the Centre for Research on Concepts and Cognition

# Lelia Pissarro

- Her great grand father [Camille Pissarro] – 1830
- Founder of French Impressionism Lelia says,  
*“We are 19 artists across four generations”*  
*“As a child I wanted to be a vet”*
- Influence of the family environment encouraged her to be an artist
- She believes Genetic talent does not help the developing artist

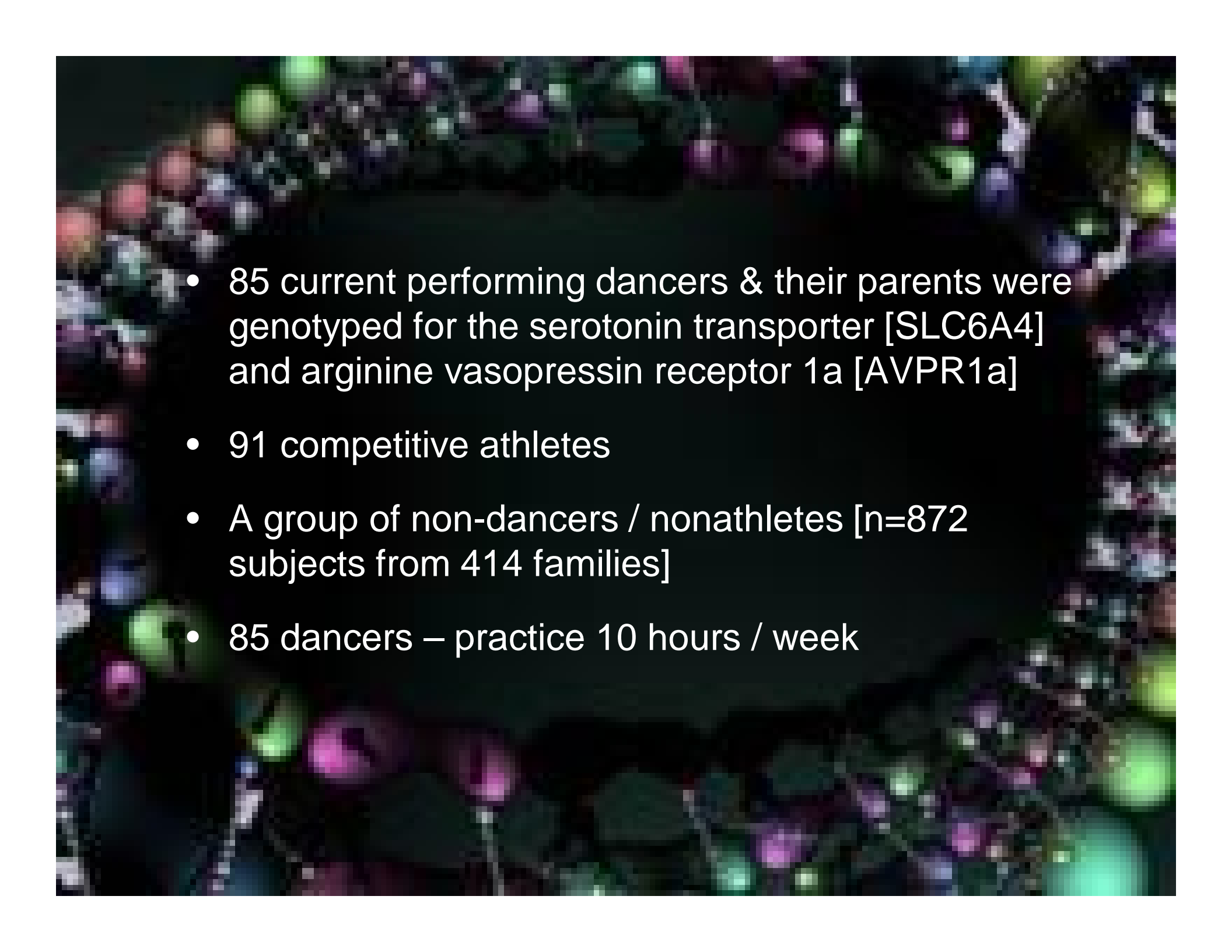
# The Browns

- Keith and Lisa Brown managed to give each of their 5 children piano lessons
- Piano lessons cost them 30% more than their monthly mortgage
- *“Initial differences in aptitude were obliterated by incessant practice. If you do something for 3 or 4 hrs/day for 10 yrs with just a reasonable amount of aptitude, you are going to get good”*
- Anders Ericsson Prof of Psychology at Florida State University has spent his career proving that point
- He studied expert performers in sports, music, and chess and has concluded that *“they were made not born”*

# AVPR1a and SLC6A4 Gene Polymorphisms Are Associated with Creative Dance Performance.

- Rachel Bachner-Melman<sup>1</sup>, Christian Dina<sup>2</sup>, Ada H Zohar<sup>3</sup>, Naama Constantini<sup>4</sup>, Elad Lerer<sup>5</sup>, Sarah Hoch<sup>5</sup>, Sarah Sella<sup>5</sup>, Lubov Nemanov<sup>5</sup>, Inga Gritsenko<sup>5</sup>, Pesach Lichtenberg<sup>5</sup>, Roni Granot<sup>6</sup>, Richard P Ebstein<sup>1,5</sup>
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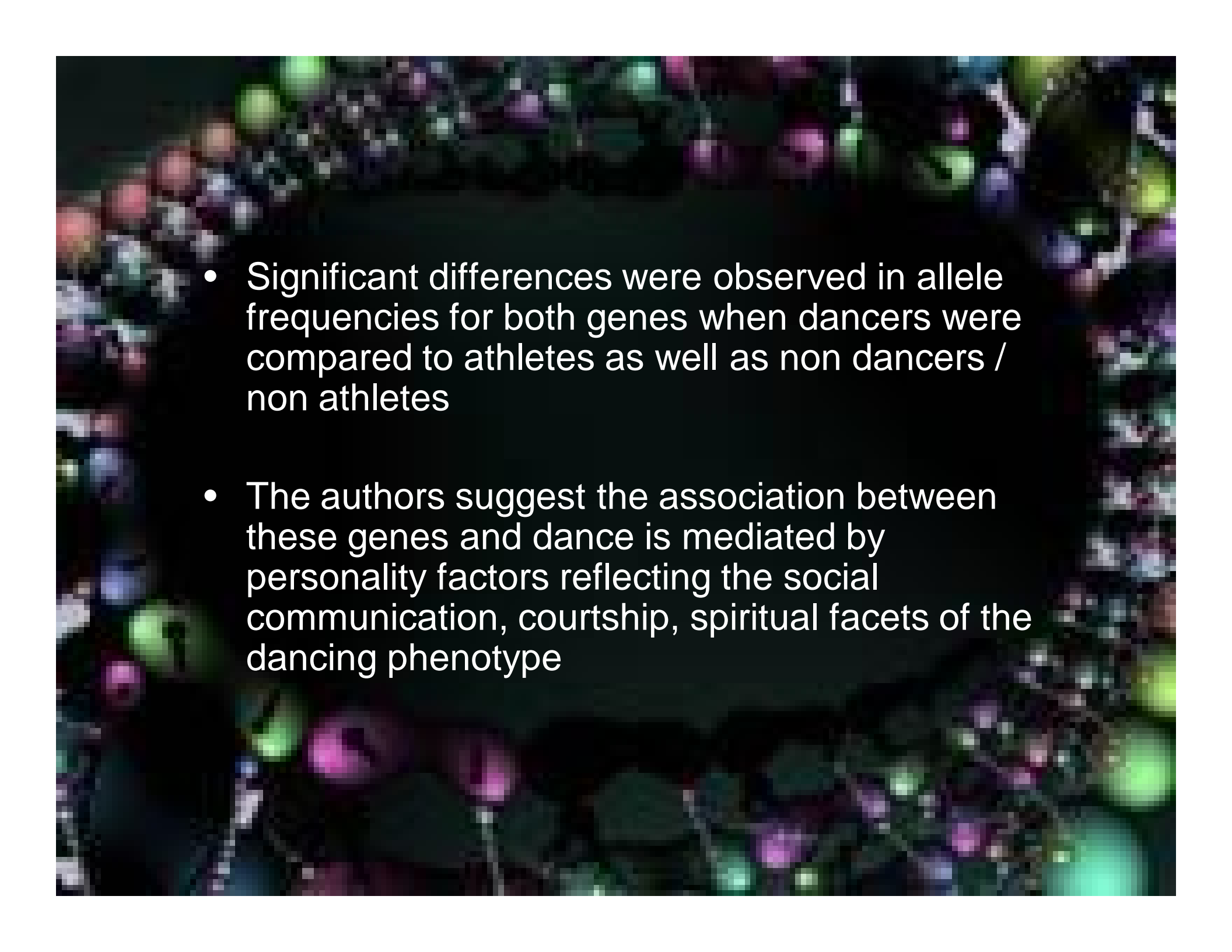


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- 85 current performing dancers & their parents were genotyped for the serotonin transporter [SLC6A4] and arginine vasopressin receptor 1a [AVPR1a]
  - 91 competitive athletes
  - A group of non-dancers / nonathletes [n=872 subjects from 414 families]
  - 85 dancers – practice 10 hours / week

- AVPR1a might contribute to the dance phenotype
  - This genes role:
    - A) affiliative
    - B) social
    - C) courtship behaviours
- } All are vital for dancing
- Use of ecstasy – a serotonergic neurotoxin
  - At rave dance / dance club – further link to both serotonin and stages of altered consciousness
  - Two phenomena also linked in the absence of drugs
  - Serotonin enhances vasopressin in the brain showing gene – gene interaction

## AVPR1a and SLC6A4 Gene Polymorphisms Are Associated with Creative Dance Performance.

“Dancing, which is integrally related to music, likely has its origins close to the birth of Homo sapiens, and throughout our history, dancing has been universally practiced in all societies. We hypothesized that there are differences among individuals in aptitude, propensity, and need for dancing that may partially be based on differences in common genetic polymorphisms. Identifying such differences may lead to an understanding of the neurobiological basis of one of mankind's most universal and appealing behavioral traits-dancing.”

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- Significant differences were observed in allele frequencies for both genes when dancers were compared to athletes as well as non dancers / non athletes
  - The authors suggest the association between these genes and dance is mediated by personality factors reflecting the social communication, courtship, spiritual facets of the dancing phenotype

# Thomas Alva Edison - quotes

*“Genius is one percent inspiration and 99 percent perspiration”*

*“I never did anything worth doing by accident, nor did any of my inventions come by accident. They came by work.”*

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- Leonardo da Vinci
  - Mozart
  
  - The Moon – folklore
  - Neil Armstrong 1966