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Exploring the Cellular Reproduction Mechanism and Its Impact on Diseases and Malignancy

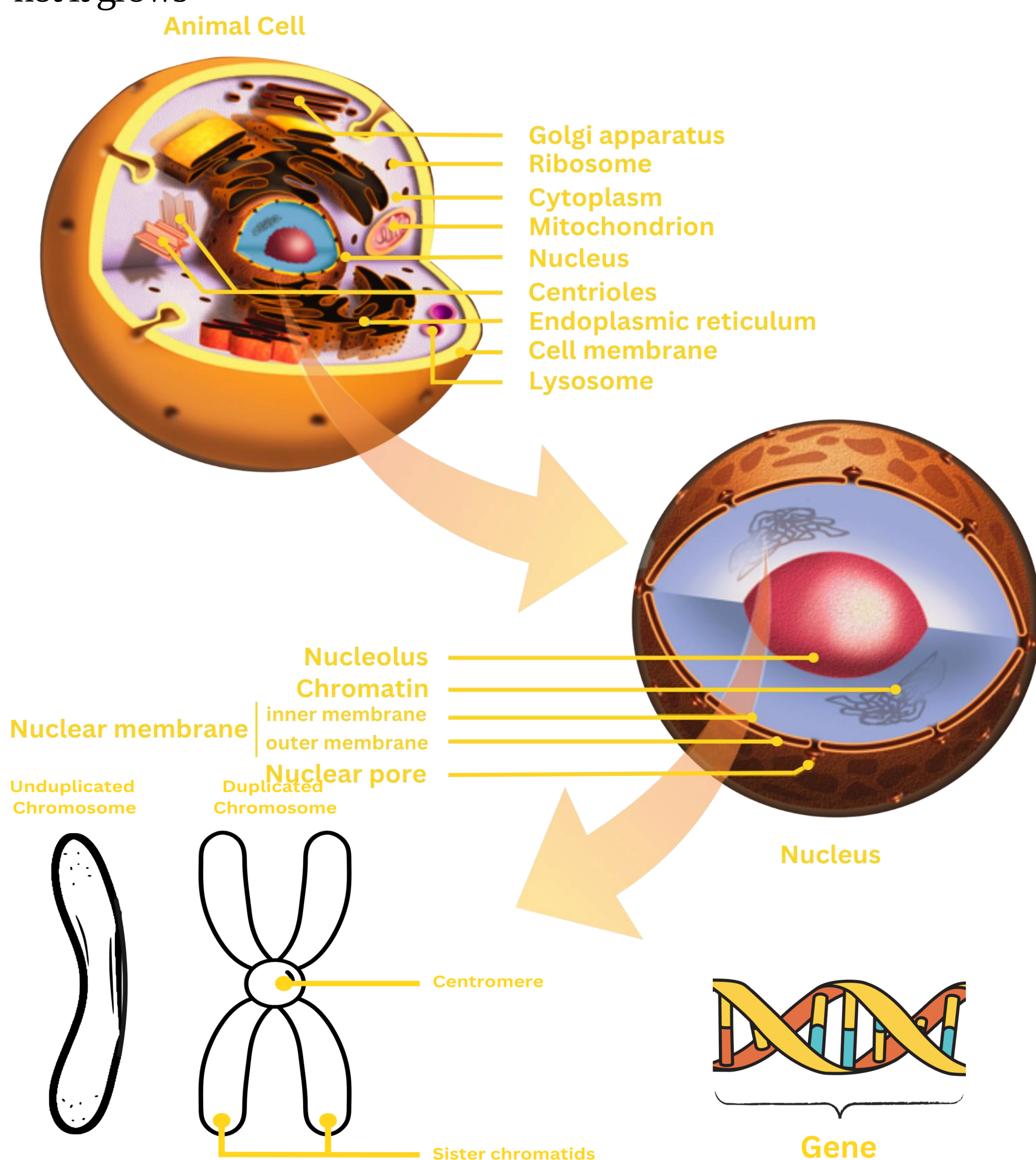
Ligia-Elena Berzava, Gabi Dumitrescu, Liliana Petculescu Ciochină, Ioan Peț, Roxana Popescu, Patricia-Lorena Berzava

University of Life Sciences "King Mihai I" from Timișoara, Faculty of Bioengineering of Animal Resources, Calea Aradului 119, 300645 Timișoara, Romania

Abstract: The objective of this review is to investigate the mechanism of cellular reproduction, which gives rise to new cells, as well as the potential for cellular damage, disease, and malignancy. All living entities are composed of cellular structures, which serve as the fundamental units of life. Each individual cell is equipped with a plasma membrane, which functions as a barrier separating its internal constituents from the surrounding external environment. The cell cycle comprises four distinct phases, namely G1, S, G2, and M phases. Throughout each phase of the cell cycle, the many organelles and components inside the cell collaborate harmoniously to facilitate precise replication and division of the initial genetic information. In the event of an error occurring in the course of this phases, cellular structures have the potential to incur harm, acquire diseases, or develop malignancies. The proliferation and replication of these aberrant cells frequently persist autonomously, resulting in the formation of substantial cell clusters that may pose a threat, contingent upon the specific genes impacted. Damage can arise from various external factors, including but not limited to environmental pollutants, pathogenic agents, radiation, and genetic mutations occurring inside cellular DNA. Understanding the cell cycle and abnormal cell formation is essential for scientific study and cancer treatment.

In conducting this study, a comprehensive review of scientific literature was undertaken to examine the intricate processes involved in cellular replication, as well as the plausible implications of cellular harm, pathological conditions, and cancer. Within the realm of scientific literature that has been examined, I would like to highlight the subsequent works: Cell biology (Gabi Dumitrescu, 2021), Regulation of Cell Cycle Entry and Exit: A Single Cell Perspective (Hilary A. Collier, 2019), Molecular Biology of the Cell (Bruce Alberts, 2002), Cell Movement in Health and Disease (Wanyu Zhao, 2022), Histology, Cell (Yusuf S. Khan, 2023) etc.

Cells are the basic structural units of every living organism. Organelles are specialized structures that help the cell operate and are found inside of cells. The nucleus of the cell is where all of the important decisions are made. It is in charge of everything that the cell does, including how it reproduces and whether or not it grows



The genes responsible for regulating the cell cycle are frequently found to be altered in many types of malignancies.

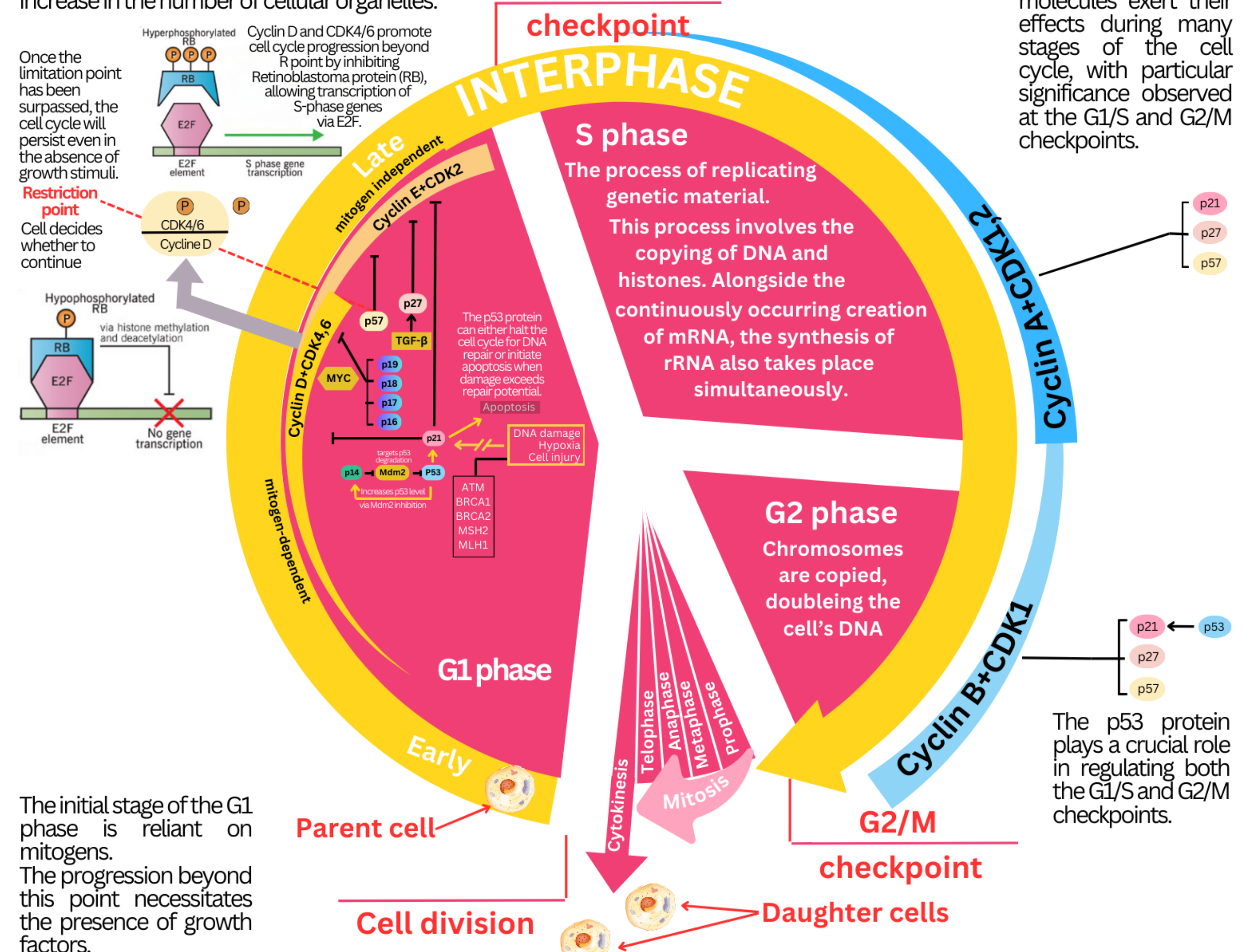
GENE (CHROMOSOME)	Product	Type of alteration	Role in cell cycle	Involvement in cancer
p53 (17p13)	p53	Mutations, deletions	Control of p21, 14-3-3 σ , etc.	Altered in over 50% of all cancers
CDKN2A (9p22)	p16 and p19 ^{***}	Mutations, deletions, hypermethylation	Inhibition of CDK4 and 6	Altered in 30-60% of all cancers
RB1 (13q14)	pRb	Deletions	Inhibition of E2Fs	Lost in retinoblastomas, altered in 8-10% of other cancers
CCND1	Cyclin D 1	Amplification	Progression into G1	10-40% of many carcinomas
CDC25A, CDC25B	cdc25	Overexpression	Progression in G1, G2	10-50% of many carcinomas
KIP1	p27	Down-regulation	Progression in G1/S	Breast, colon and prostate cancers

Cells divide by condensing their chromatin into rod-shaped chromosomes. After replication, a chromosome has two chromatids linked by a centromere. A chromosome contains DNA and protein. Discrete DNA segments called genes shape an organism's growth, development, and phenotype.

G1 phase - which is a presynthetic stage that comes before the beginning of the process of DNA synthesis. The enormous synthesis of mRNA, proteins, and enzymes that takes place as a result of this process ultimately results in the accumulation of ATP and an increase in the number of cellular organelles.

DNA replication takes place during the S phase of the cell cycle. The G1/S checkpoint facilitates the examination of DNA integrity prior to the replication of cellular DNA.

CDK inhibitors impede the evolution of the cell cycle by the inhibition of cyclins and CDKs. These molecules exert their effects during many stages of the cell cycle, with particular significance observed at the G1/S and G2/M checkpoints.



The initial stage of the G1 phase is reliant on mitogens. The progression beyond this point necessitates the presence of growth factors. After the cell surpasses the R point, the need for mitogens in order to proceed through the cell cycle is eliminated.

After the completion of the G1 phase, the cell is compelled to proceed and engage in the process of mitosis. The G2/M checkpoint facilitates a brief stop in the progression of the cell cycle, specifically prior to the initiation of mitosis.

The absence of inhibitory mechanisms or the acquisition of functional alterations, both of which might contribute to the development of cancer.

Oncogenes	Tumour suppressors
Cyclins Cyclin-dependent kinases (CDKs) E2F MYC Mdm2	RB p52 p21, p27, p57 (CIP/KIP/WAF) p14/ARF p16/INK4a, p17, p18, p19 TGF- β receptor BRCA1, BRCA2 ATM

The increased inhibition or impairment of its function will result in the development of cancer.