

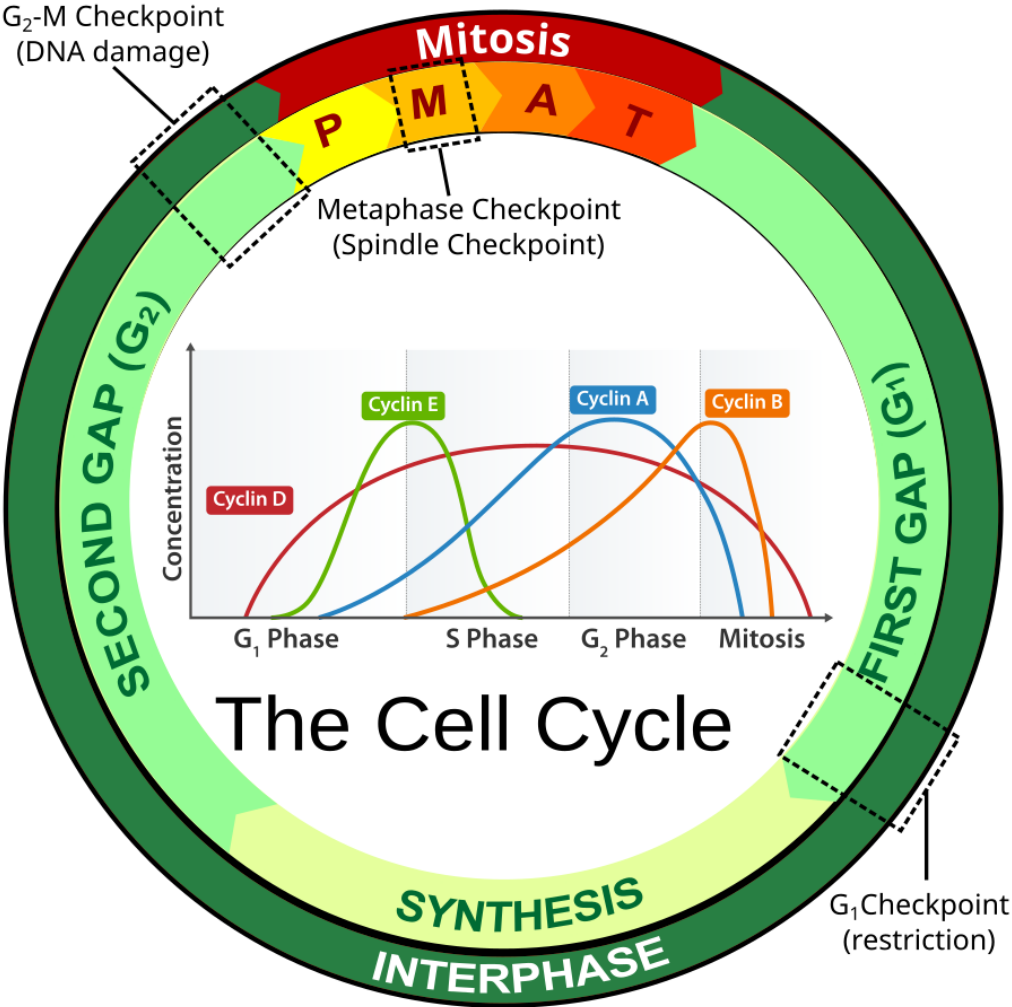


Discuss the molecular composition of the eukaryotic chromosome.  
Explain the importance of cell division in the lives of organisms.  
Distinguish between the prokaryotic cell cycle and the eukaryotic cell cycle.  
Explain what is meant by the cell cycle.  
List the three parts of interphase, and explain the events that occur in each.  
Give examples showing how cell types differ in their regulation of the cell cycle.  
List the various components of the mitotic spindle, and explain the difference between a centromere and a kinetochore.  
Describe the role of the microtubule organizing center (MTOC).  
List the phases of mitosis, and describe the events that occur in each.  
Compare cytokinesis in animal and plant cells.  
Discuss the relationship between mitosis and asexual reproduction.

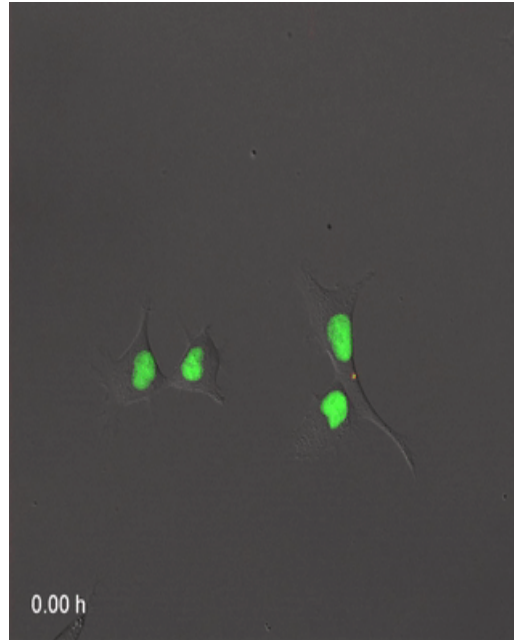
Contents

### **Introduction: The Cell Cycle and Mitosis**

The cell cycle refers to the a series of events that describe the metabolic processes of growth and replication of cells. The bulk of the cell cycle is spent in the “living phase”, known as **interphase**. Interphase is further broken down in to 3 distinct phases:  $G_1$  (Gap 1), S (Synthesis) and  $G_2$  (Gap 2).  **$G_1$**  is the phase of growth when the cell is accumulating resources to live and grow. After attaining a certain size and having amassed enough raw materials, a checkpoint is reached where the cell uses biochemical markers to decide if the next phase should be entered. If the cell is in an environment with enough nutrients in the environment, enough space and having reached the appropriate size, the cell will enter the S phase. **S phase** is when metabolism is shifted towards the replication (or synthesis) of the genetic material. During S phase, the amount of DNA in the nucleus is doubled and copied exactly in preparation to divide. The chromosomes at the end of  $G_1$  consist of a single **chromatid**. At the end of S phase, each chromosome consists of two identical **sister chromatids** joined at the **centromere**. When the DNA synthesis is complete, the cell continues on to the second growth phase called  **$G_2$** . Another checkpoint takes place at the end of  $G_2$  to ensure the fidelity of the replicated DNA and to re-establish the success of the cell’s capacity to divide in the environment. If conditions are favorable, the cell continues on to mitosis.



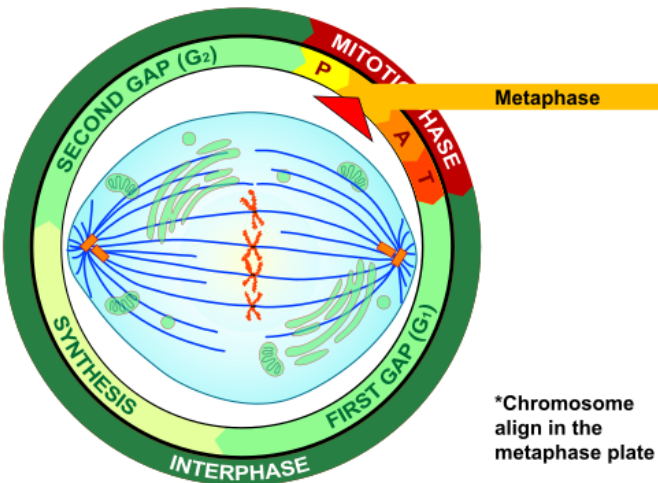
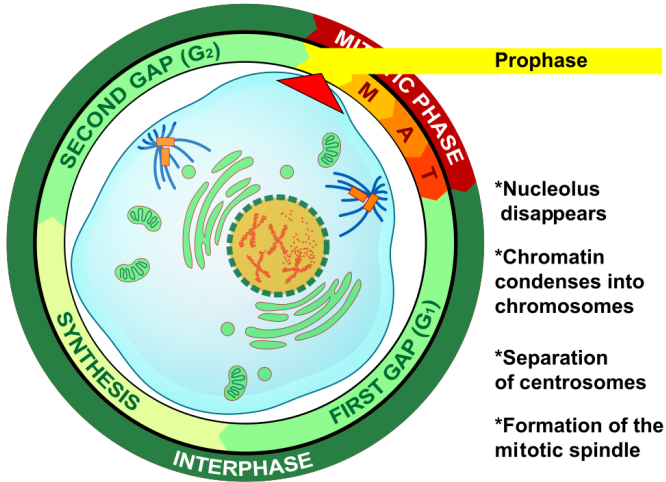
*Eukaryotic cell cycle is governed by expression of cyclin proteins along with their activity. Credit: Jeremy Seto (CC-BY-SA)*



*Mammalian cells in culture going through the Cell Cycle. Green marker proteins expressed during the G1 phase. Red marker proteins are expressed during S/G2/M. During the G1 to S transition, fluorescence disappears as the marker proteins also transition in expression.*

<https://youtu.be/542CMooowNY>

**Mitosis** is the process of nuclear division used in conjunction with cytokinesis to produce 2 identical daughter cells. **Cytokinesis** is the actual separation of these two cells enclosed in their own cellular membranes. Unicellular organisms utilize this process of division in order to reproduce asexually. Prokaryotic organisms lack a nucleus, therefore they undergo a different process called binary fission.



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