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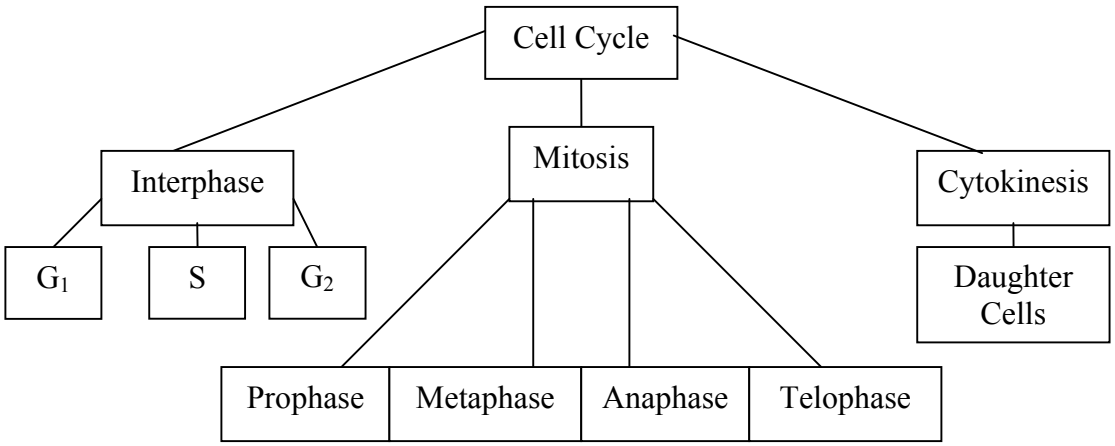
Mitosis Lab Activity

Background:
As a cell grows, it reaches a certain size where it can no longer function efficiently (due to surface/ volume ratio). At this point the cell must divide. During interphase (S, G_2), the cell prepares for division. During Mitosis the cell divides its nuclear material and then during Cytokinesis the cytoplasm divides, creating two daughter cells from one parent cell.



Vocabulary:

Replication	Chromosome	Nuclear Membrane	Diploid
Chromatin	Chromatid	Spindle Fibers	Centromere

Objectives: To follow DNA (in the form of chromosomes) through the Cell Cycle and be able to visualize what happens to chromosomes during the phases of Mitosis.

Materials:
- Chromosomes – 12 pipe cleaners (2 each color)
- Centromeres – 6 white beads
- Cell – 1 Large blue sheet of construction paper
- Chromatin Indicators – 2 small sheets of pink construction paper
- Nuclear Membranes – 2 loops of string
- Spindle Fibers – 2 pieces of black thread

Procedure:

On a sheet of white paper, draw each stage as you make it.

Interphase:
G_1 Growth – The cell doubles in size and number of organelles. Place the nuclear membrane (loop of string) on the cell (blue paper). Place your chromosomes (pipe cleaners) in the nucleus – one of each color. You should have 6 chromosomes. (If this were a human cell, it would have 46 chromosomes in the cell nucleus.)

NOTE: DNA actually only exists in chromosome form during mitosis – not throughout the cell cycle. The rest of the time DNA exists as Chromatin – partially coiled DNA. To show that you are aware of this, place one sheet of pink paper next to your chromosomes at any time in the cell cycle when DNA exists as chromatin, during interphase.

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Notice that some of the chromosomes are of similar color (e.g. dark and light blue). In a Diploid organism, chromosomes exist in pairs e.g. chromosome 1's genes are arranged in the same order as chromosome 2's genes, and chromosome 3's genes are in the same order as chromosome 4's and so on – hence the similar colors. Note: while chromosome 1 and 2 are similar (known as homologous chromosomes) they are not exact copies of each other.

A haploid organism has only one copy of each type of chromosome. If humans were haploid, they would have only 23 chromosomes.

S Phase – Synthesis – this is when DNA replication takes place. To show this, replicate each of your 6 chromosomes. Each of your different color chromosomes will now have and exact copy attached to it at the centromere. (l → X).

G_2 Phase – Growth of enzymes and structures needed for the process of division. (No visible changes in our model).

Mitosis (Nuclear Division)
Four phases based on when certain structures appear. Note: For simplicity, the formation and disappearance of the centrioles and the nucleolus have been omitted.

Prophase
1. Chromatin (DNA) coils tightly to form chromosomes (remove the chromatin indicator – pink paper). Each half of a duplicated chromosome is called a chromatid. Note that the word "chromosome" is used interchangeably to mean either the single structure (l) or the duplicate structure (X).
2. The nuclear membrane breaks down. (Remove the nuclear membrane – string)
3. Spindle fibers form (put in a spindle fiber (black thread) on each side)

Metaphase
1. Chromosomes line up along the center of the cell. (Line them up)

Anaphase
1. Centromere dissolves, chromosomes separate and are moved to opposite sides of the cell by the spindle fibers. (Separate the chromosomes and move them)

Telophase
Two identical sets of chromosomes clustered at opposite ends of the cell.
1. Spindle fibers dissolve (Remove the Black thread)
2. Two new nuclear membranes form around each set of chromosomes. (Place the string loops around the chromosomes)
3. Chromosomes relax to become chromatin (insert the pink chromatin indicator next to each nucleus.)

Cytokinesis (Cell Division)
Cytoplasm splits – parent cell becomes two daughter cells. Cytokinesis differs slightly between plants and animals

When you and your group understand this lab (Cell Cycle) well enough to explain it to the teacher without notes, call the teacher over to demonstrate your knowledge.

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Student Answer Sheet

Analysis Questions: (Answer in Complete Sentences for Credit, Unless Otherwise Indicated)

1. Name the three major phases of the Cell Cycle.

2. What is Mitosis? (Two Words)

3. What is Cytokinesis? (Two Words)

4. What happens during the S phase?

5. In reality DNA exists in condensed chromosome form only during which of the three stages of the Cell Cycle?

6. During what two phases of Mitosis can chromosomes be seen in chromatin form?

7. Each half of the duplicated chromosome in Metaphase is called a _____.

8. Define Chromatin and Sister Chromatids.

9. What phase of the Cell Cycle comes after Cytokinesis?