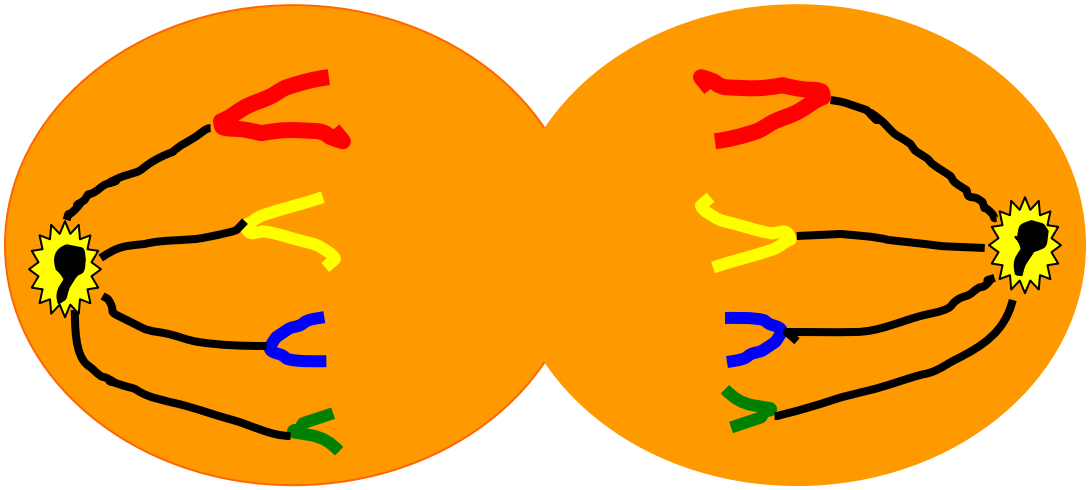
MITOSIS
(my-toe-sis)

Another quality hands on teaching system in the genetics series

Designed by teachers! Tested by Teachers!



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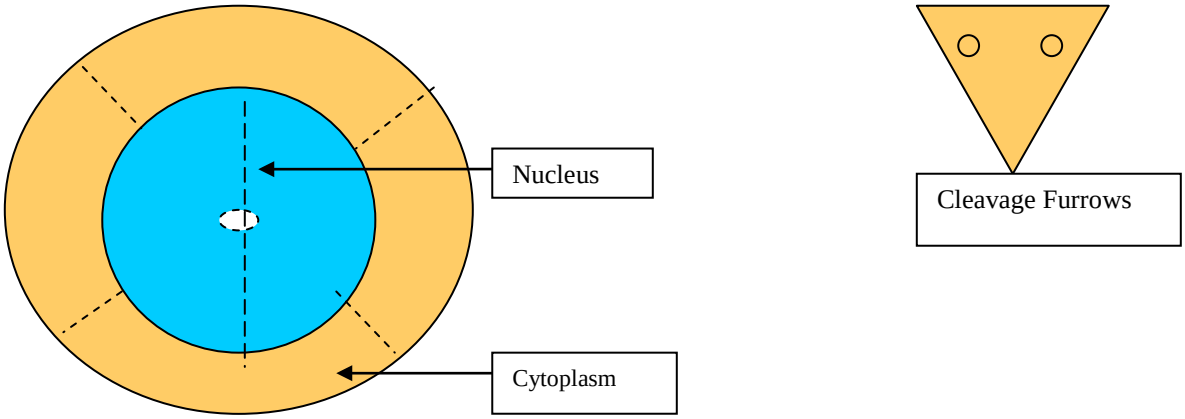
Preparing Teacher Manipulatives for Your First Classroom Demonstration

A complete parts list is included at the end of this manual. You can order new parts to replace any lost or broken by contacting your kit supplier/dealer. Note that the cytoplasm, nucleus and cleavage furrows have magnets attached.



Teacher Manipulatives

PART Description	PART No.	Qty./Set
Cell Cytoplasm ¼ Fragments	T-1	8
Nucleus (blue, halves)	T-2	4
Nucleus (orange, halves)	T-3	4
Anaphase Cleavage Furrow	T-7	2
Telophase Cleavage Furrow	T-8	2

The magnets are used to hold these parts to a metallic white board. If magnets become unglued, they can be re-glued using any epoxy or hot glue adhesive.

All other parts in the kit have a magnetic backing and adhere to the surface of the nucleus, cytoplasm and/or cleavage furrows.

Mitosis Teacher Manual

Thank you for the purchase of the Mitosis Manipulative Kit. This kit was designed and developed for use in the science classroom by a science teacher. All of us are aware that abstract concepts can be difficult for our students. I'm confident that this product can make it easier for you to teach, and for your students to learn, Mitosis.
In this manual, I will give you some ideas on how to get started using your new kit. The included CD will also be useful for this purpose. I'm sure, that

in time you will discover a host of new applications and situations in which it can be used.

I. Teacher Introduction
A. Setting the Stage for Learning

All learners need to become engaged before they begin to learn. The question "why do we need to learn this" can be anticipated and needs to be answered. In the case of mitosis there are many fascinating questions and examples that the instructor can use to initiate discussion or student investigation. I recommend asking students questions that might stimulate their natural curiosity such as:

1. ***Given proper diet and the absence of disease; why does the body grow old and eventually cease to function?***
…..Posing this question will engage student thinking about replacement of damaged and worn out cells.
Concepts introduced might include:

- The limited mitotic activity of most animal cells. Most cells undergo mitosis about 50 times and then cease mitotic activity. Others like red blood cell and cancer cells continue mitosis indefinitely.
- Advanced students might research telomeres and their influence on mitosis

2. ***What is cancer? What is the difference between a cancer cell and a normal cell?***
…..Posing this question will engage student thinking about how knowledge of mitosis is essential to the understanding of cancer.

Concepts introduced might include:

- Cancer is uncontrolled mitosis
- The immortal nature of cancer cell
- Cancer tissue identification by mitotic activity

3. ***Would life exist without mitosis?***
…..Posing this question will engage student thinking about how knowledge of mitosis is essential to the understanding of life.
Concepts introduced might include:

- Growth from a single cell to a multi-cellular organism
- Cell differentiation
- Cloning

I. Teacher Introduction
B. Prerequisite Knowledge

Students should understand these concepts before beginning the study of mitosis:

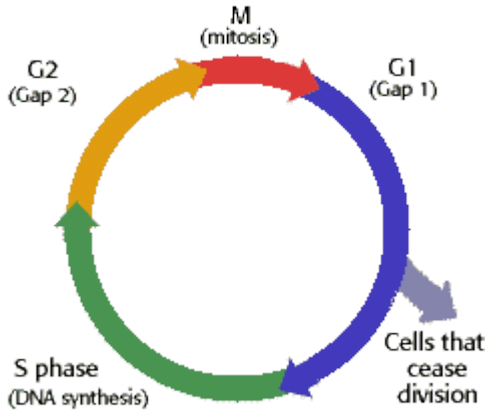
- Structure and function of the cell
- The role of the cell in tissue and organ structure and function
- The structure and function of DNA
- Basic Mendelian genetics

Continuation of learning in genetics should include:

- Protein Synthesis – order United Scientific Kit (PSY-Kit)
- Recombinant DNA, Genetic Engineering – order United Scientific Kit (DNA-Kit)

I. Teacher Introduction
C. The Cell Cycle

Students will need to understand that mitosis is but one phase in the cell cycle. During development from stem to fully differentiated, cells in the body alternately divide (mitosis) and "appear" to be resting (interphase). This sequence of activities exhibited by cells is called the cell cycle. A diagram of the cycle is presented below:



G1: cell growth and duplication of organelles, cytoplasm… takes ~12 hours

S: chromosome (DNA) replication ~6 hours

G2: more cell growth and final preparation to divide ~6 hours

*All three of the above phases are collectively know as interphase

M: Mitotic phase ~30 minutes

The required depth of understanding of the cycle will depend on your students. Beginning students (Middle and High School) will most likely need little more than knowledge of the existence of the cycle and its phases. Advanced students (College Genetics) may need to understand control of the cycle.

Teacher Kit
D. Interphase

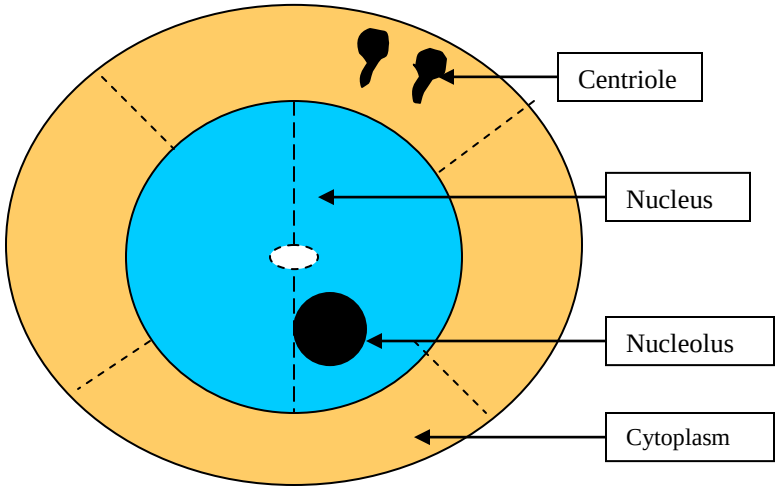
Keep in mind; interphase is NOT a part of mitosis. Interphase encompasses the G1, S and G2 phases of the cell cycle.
A cell not in the mitosis phase of the cell cycle exists in a state called *interphase*. Before the cell enters the mitosis phase, it first undergoes a *synthesis* or *S* phase where each chromosome is duplicated and consists of two sister *chromatids* joined together by a specific DNA sequence known as a *centromere*. Centromeres are crucial to segregation of the daughter chromatids during mitosis.

The Teacher Demonstration Kit can begin with a model of a cell in interphase consisting of:

Manipulatives

- Cell cytoplasm represented by 4 orange fragments made to form a circle
- A cell nucleus represented by 2 blue half circles that fit inside the circle formed by the cell cytoplasm
- A nucleolus represented by the black oblique oval structure
- Centrioles (without asters) represented by 2 small black drumstick shaped objects

1. Arrange these manipulatives on the board to represent a cell in interphase.



2. Point out the features of the model.

- Chromosomes not visible (not in highly coiled structure). Chromosome number goes from 2n to 4n after S phase of cell cycle.
- Centrioles will play a key role in subsequent phases. Centrioles are made of microtubules, they duplicate during interphase by forming daughter centrioles. Later they will be linked to the chromatids via spindle fibers.

Teacher Kit
E. Early Prophase

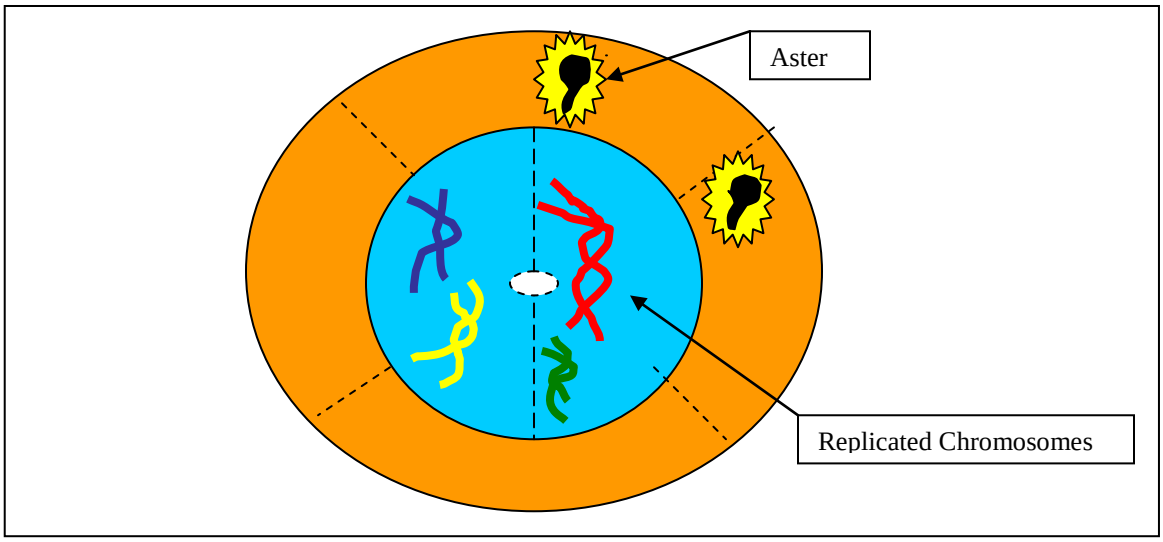
Prophase is the first stage of cell division. The cell prepares itself for division. The nucleus swells, the nuclear envelope starts to break up and chromosomes become visible. The nuclear chromatin starts to become organized and condenses into thick strands that eventually become chromosomes. In animal cells, the centrioles move apart and microtubules radiate from them in all directions, forming asters.

Manipulatives

- All from interphase minus the nucleolus
- Asters represented by 2 yellow and black manipulatives that fit around each centriole

- Double stranded chromosomes (1-red, 1-yellow, 1-blue and 1-green) represented by two twisted linear strands joined at three or more places.

1. Arrange these manipulatives on the board to represent a cell in early prophase.



2. Point out the features of the model.
   - Chromosomes are now visible. Each chromosome replicated itself in the S phase of the cell cycle. The chromosomes structure has changed. Chromosomes have condensed and thickened because of increased coiling.
   - Nucleolus is disappearing.
   - Asters form around the centrioles.

Teacher Kit
F. Middle and Late Prophase

Each chromosome now has two chromatids as a result of duplication of the DNA which took place during interphase. The two chromatids are linked together at a centromere.

During this period the chromosomes continue to condense and gradually shorten and thicken until they have completely formed the sister chromatids that will undergo mitosis. The nucleolus also completely disappears before the next phase; metaphase. The cytoskeleton (composed of cytoplasmic