

The Biology of the Cell

Teacher's Guide

This teacher's guide is designed to help you better prepare your students for their upcoming visit to the *Northern Stars Planetarium* for a presentation of **The Biology of the Cell**. This guide will provide you with vocabulary, study questions, activities, and general background information on this subject. Parts of this guide may seem either too advanced or too simplistic for your particular class; please use just what you feel is appropriate for your students.

As you may know, cellular biology is very complex. We have been very careful to present this subject in a way that elementary school and middle school students will be able to understand. The emphasis will not be on the complex terminology, but instead we will pursue an understanding of the workings of the cell and its place within the context of an entire organism.

Presentation Outline:

I. Life Forms found on Earth

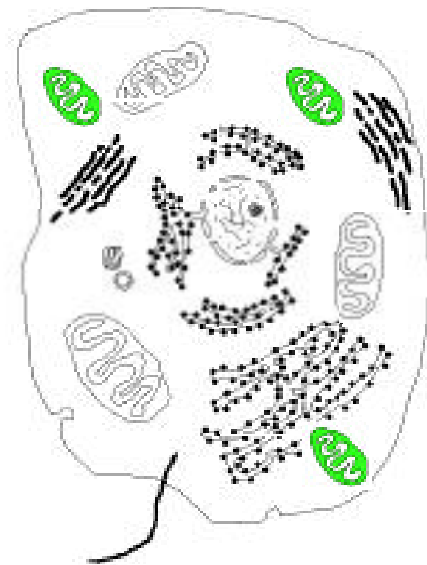
- A. People and Animals
- B. Plants
- C. Micro-organisms

II. Needs of Life

- A. Safe Environment
- B. Food & Water
- C. Reproduction

III. Systems of the Body

- A. Muscular & Skeletal Systems
- B. Nervous System
- C. Digestive System
- D. Circulatory System
- E. Endocrine System (glands and hormones)



IV. The Cell--The Basic Unit of Life

- A. Zoom downward from a person to a cell to give a sense of size.
- B. The tool for examining cells--the Microscope
- C. The Cell (comparing an individual cell to an entire organism)
 - 1. The Major Parts of the Cell and their purpose
 - 2. Mitosis
 - 3. Review the Cell using our *1,000,000 X Giant Cell Effect!*

Vocabulary of the Cell

Cytology The study of cells.

Cell The cell is the smallest unit of life. All life is comprised of cells. Some life-forms have only one cell, but many have millions of cells. The average human being contains 100 trillion cells! The basic cell can be divided into two components, the *Cytoplasm* and the *Nucleus*.

Organelles The small organ-like components of a cell that perform the functions of cellular activity.

Nucleus The most important organelle within the cell, the nucleus is the site of the *DNA*, which contains all the genetic material that defines what the cell is, and ultimately what the life form shall be.

Parts of the Nucleus::

Nucleolus The nucleolus is a mass of fine threads and particles that are largely a sequence of identical units of specialized genetic material. This is where *Ribosomes* are assembled.

Chromosomes These thread-like units carry genetic material such as *DNA* that defines what kind of cell this cell will be, and whether it will be a single cell organism or a multiple-celled organism such as an animal or plant. Chromosomes are only readily visible just prior to cell division, the rest of the time they are less organized structurally and are known as *Chromatin*.

Chromatin These are unorganized *chromosomes* which separate during cell division and form into the more defined *chromosomes* at that time. They carry the same genetic material as chromosomes.

Genes The packets of genetic code that define various characteristics of an organism.

DNA *Deoxyribonucleic Acid* The long complex molecules that make up genes. DNA contains the genetic code that defines a life-form's characteristics.

Cytoplasm The cytoplasm is everything outside of the cell nucleus and inside the cell membrane. It is made of many different organelles.

Parts of the Cell found in the Cytoplasm:

Endoplasmic Reticulum This is a network of tubules that connect the *nucleus* with the rest of the cell. *Ribosomes* are most frequently attached to these tubules.

Ribosomes These are small particles attached to the *Endoplasmic Reticulum* which help circulate proteins throughout the cell for functional and structural processes.

Mitochondria The mitochondria combines food and oxygen for energy production. It has a smooth outer membrane and a highly folded inner membrane called the *Cristae*. Different cells have different numbers of mitochondria, some cells have only a few, while some cells such as liver cells may contain more than a thousand! The energy produced in the mitochondria is used for cell growth, repair, reproduction, and maintenance.

Golgi Complex These are groups of flat or elongated sacs that package waste materials for removal from the cell. Each sac is called a *sacculle*. A typical animal cell will have 10 to 20 golgi complexes. Plant cells usually have more than 200, although they are generally much smaller than those found in animal cells.

Vacuoles These are groups of sacs that are used in the absorption of water and materials into and out of the cell.

Lysosomes These organelles produce enzymes that break down larger complex molecules into smaller and simpler particles that can then be used by the cell. It is not known why lysosomes do not break down their own membrane walls, because if the wall is broken the lysosome enzymes will then digest or break down the entire cell itself!

Microvilla The finger-like projections along a cell wall, these increase surface area which aids in absorption.

Cilium These are hairlike projections that are used by some cells for movement.

Centrioles The centrioles are cylindrical bundles of microtubules that aid in cell reproduction. Most animal cells have a pair of centrioles lined up 90° to each other. During mitosis (cell reproduction) a second pair is formed and they migrate to opposite sides of the cell, which will ultimately leave each new cell with one pair in the end.

Cell Membrane The outer membrane that encompasses the entire cell and separates it from other cells. Plant cells have a very rigid cell wall, while in animal cells, it's a thinner, less rigid membrane. The cell membrane holds the cell together and controls what enters and leaves the cell.

Mitosis is the process of cell division and reproduction. All cells are created this way. There are five “*phases*” to mitosis. (*See diagram on page 9.*)

- 1. Interphase:** The period between cell divisions. Here the cell grows and goes about its life functions. The cell often has one pair of centrioles set at right angles to each other.
- 2. Prophase:** The long thin chromosomes shorten and thicken. The centriole pair duplicates, then the two pair migrate to opposite sides of the cell. Microtubules form and stretch between the centrioles to form the *spindle apparatus*. The nuclear membrane disintegrates.
- 3. Metaphase:** The chromosomes line up across the middle of the cell, aligning with the *spindle apparatus*, with the centrioles at each end.
- 4. Anaphase:** The chromosomes separate from the daughter chromosomes and then migrate to opposite sides of the cell.
- 5. Telophase:** A nuclear membrane now forms around each set of chromosomes, which uncoil and become chromatins again. The spindles dissolve, and a new cell membrane forms between the two new cells.

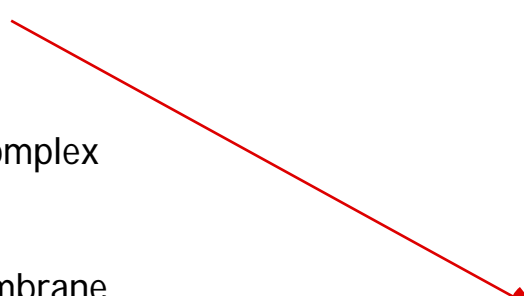
Answers to the microscope parts worksheet on page 8:

Eyepiece=F, Course Focus=E, Fine Focus=G, Arm=A, Slide=I,
Stage Platform=D, High & Low Powered Lenses=B,
Light Reflecting Mirror=H, Base=C, Iris=J.

Match Game

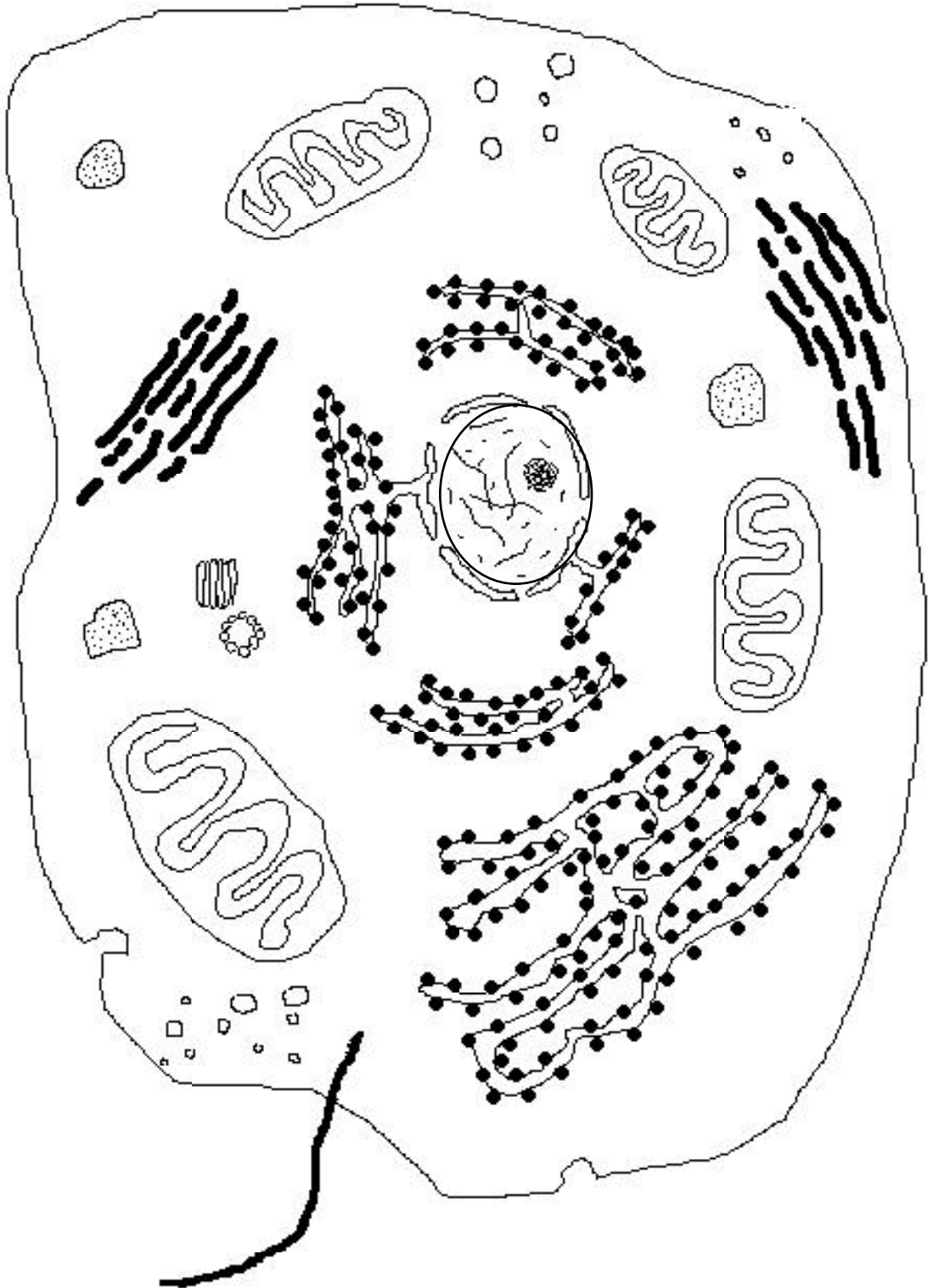
Match the Organelle with its Function in the Cell

Nucleus	Produces Energy by combining food & Oxygen
Golgi Complex	Hair-like projections used for movement
Cell Membrane	Contains Chromosomes & nucleolus
Mitochondria	Flattened Sacs that hold waste materials
Cilium	Produce Enzymes that break down complex molecules
Vacuoles	Open Sacs that are used in absorption
Lysosomes	The wall that holds the cell together
Endoplasmic Reticulum	Helps make and circulate proteins
Ribosomes	Tubules connected to the nucleus membrane and the site of many ribosomes
Chromosomes	Found in the nucleus, these hold genes that define an organism's characteristics

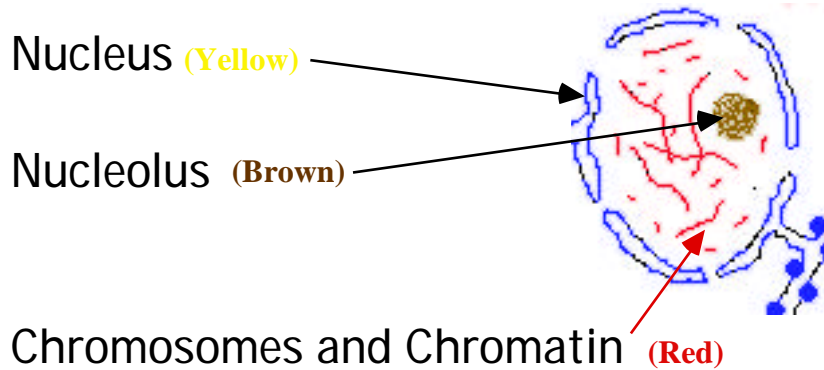


The Cell Coloring Page

An Animal Cell. See Coloring Instructions on page 7.



Find these Organelles in the Cell on Page 6 and color them as instructed.



Endoplasmic Reticulum & Ribosomes (Blue)



Mitochondria (Green)



Centrioles (Orange)



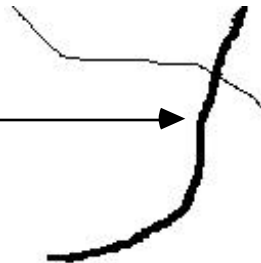
Lysosomes (Yellow)



Vacuoles (Purple)



Cilium (Brown)



Golgi Complex (Red)



The Microscope

Match the letters to the parts of the microscope

___ Eyepiece

___ Course Focus

___ Fine Focus

___ Arm

___ Slide

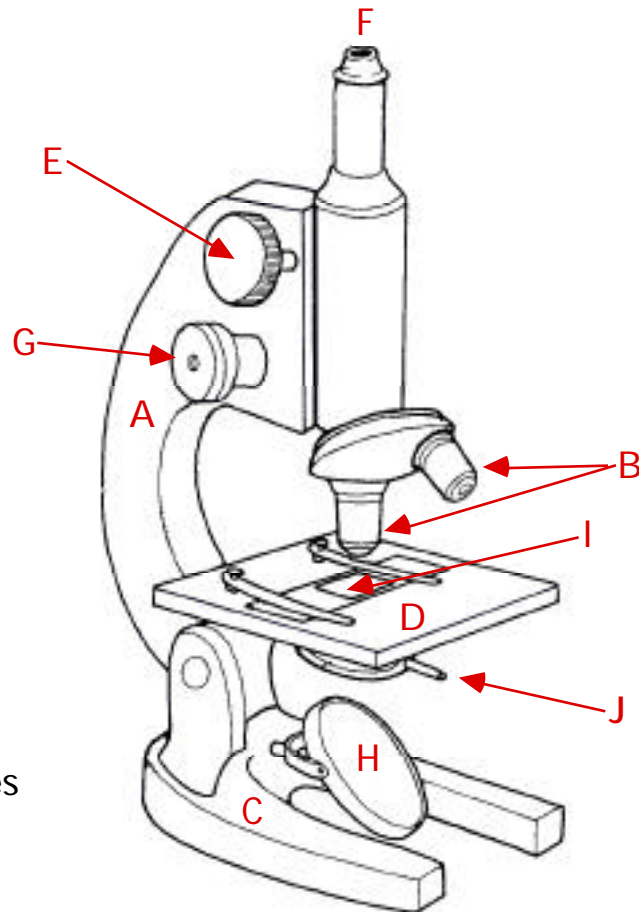
___ Stage Platform

___ High & Low Powered Lenses

___ Light Reflecting Mirror

___ Base

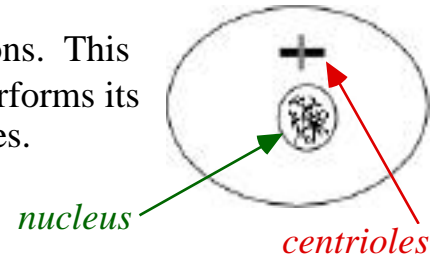
___ Iris Diaphragm for changing light contrast and brightness



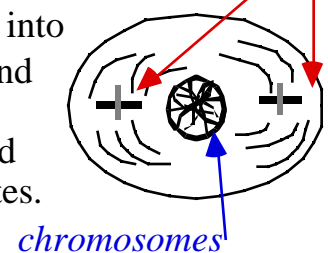
Mitosis

The Five "Phases"

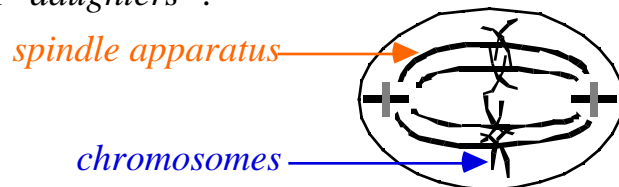
Interphase: This is the phase between cell divisions. This marks the time of cell growth when the cell simply performs its regular life functions. The cell has one set of centrioles.



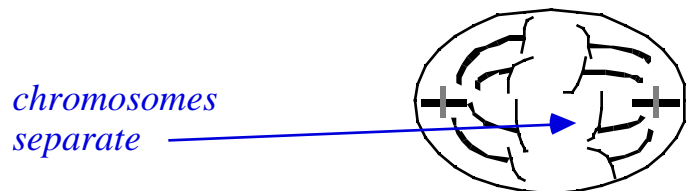
Prophase: The long thin chromatins shorten and thicken into chromosomes. The pair of centrioles duplicate themselves and migrate to opposite sides of the cell. Microtubules form and stretch between the opposing centrioles, the tubules are called the "Spindle Apparatus". The nuclear membrane disintegrates.



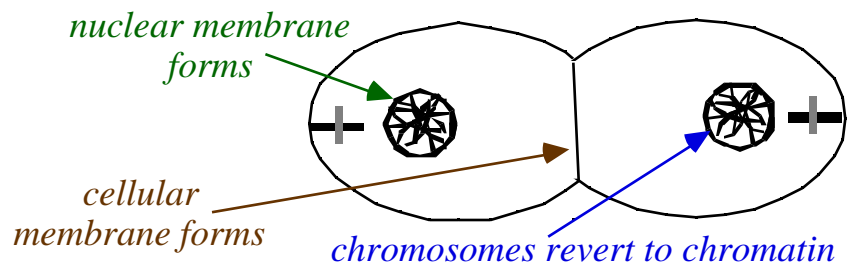
Metaphase: The chromosomes line up across the middle of the cell aligning with the spindle apparatus between the centrioles. The chromosomes have duplicated themselves creating identical "daughters".



Anaphase: The chromosomes separate from the daughters and migrate to opposite sides of the cell.



Telophase: A nuclear membrane now reforms around each set of chromosomes, which in turn uncoil and become chromatins again. The spindle apparatus dissolve, and a new cell membrane forms between the two new cells.



Study Questions & True/False

1. What is the smallest unit to have all the properties of life? (*The cell*)
2. The nucleus of a cell contains chromosomes. Why are chromosomes important? (*They contain genes and genetic information*)
3. True or False The cell can be divided into two basic components, the nucleus and the cytoplasm. (*True*)
4. The mitochondria combine food and oxygen to create what? (*Energy*)
5. True or False The Endoplasmic Reticulum connects the nucleus with ribosomes in the cytoplasm. (*True*)
6. Name five major components of the cell. (*Nucleus, mitochondria, golgi complex, cell membrane, lysosomes, cilium, endoplasmic reticulum, ribosomes, chromosomes, nucleolus, vacuoles, chromatin, cytoplasm, microvilli, centrioles*)
7. The cellular membrane surrounds what? (*The entire cell*)
8. Ribosomes are the sites of the production of what? (*Proteins*)
9. DNA molecules are what comprise genes. Genes are found in what part of the cell? (*Nucleus*)
10. True or False Mitosis is the process that ribosomes use to create proteins. (*False, mitosis is the process of cell division*)
11. True or False Lysosomes create strong enzymes that break down complex molecules into simpler molecules that the cell can then use. (*True*)
12. True or False Cilium are hair-like features of some cells used to keep the cell warm like fur. (*False, cilium are hair-like features used to create movement*)
13. The Golgi Complex is a series of flattened sacs that transport what away from the cell? (*Waste*)
14. The nucleolus is located in what part of the cell? (*Nucleus*)
15. Which type of cell has a more rigid cellular membrane, an animal cell or a plant cell? (*A plant cell*)

