

1 Cell Biology

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2 Cell Theory

- All organisms are made up of cells
- All substances in organisms are products of cells
- Cells come from other cells by reproduction

3 Types of Cells

4 Cell Size

- Cells are small
- Seeing them requires the use of a microscope of some kind

5 Processes of Living Cells

- Nutrition-food for energy and growth
- Digestion-breakdown of foodstuff
- Absorption-of nutrients after digestion
- Biosynthesis-organization of absorbed nutrients into protoplasm for growth or repair
- Respiration-the chemical breakdown of molecules (glucose) to release energy
- Secretion-expelling of products from inside the cell (hormones, oil, etc.)
- Response-to stimuli
- Excretion-removal of waste products
- Reproduction-splitting of cells to form two or more cells

6 Prokaryote vs Eukaryote Cells *

1 Prokaryotes *

- Bacteria
- No nucleus
- No internal membranes
- Fewer organelles

2 Eukaryotes *

- Yeast – plant - human cells
- Numerous membrane-bound organelles *
- Nucleus *
- Internal membranes

7 Organelles

- An organelle is a small structure within the cell that performs a particular function *
- Many organelles within eukaryotic cells have a membrane that surrounds it and separates it from the rest of the cell *
- It separates chemical reactions in space *

8 Cell membrane

9 Cell membrane

- It is a bag that surrounds the cell
- The cell membrane is selective about what goes in or comes out
- They are found around all animal and plant cells

- It is composed of a lipid bilayer * with numerous proteins

10 **Cell membrane**

1

- **The cell membrane has many other names for it**
 - Plasma membrane
 - Plasmalemma
 - Neurilemma, sarcolemma etc.

2

- It is **NOT** also called the cell wall
- **Plant cells and bacterial cells have cell walls and they also have cell membranes**

11 **Nucleus** (nuclei – plural form)

12 **Nucleus**

- control center of the cell
- all human cells have a nucleus except the mammalian RBC
- without the nucleus the cell will die

13 **Nucleus**

- contains DNA - the hereditary material
- DNA is bound to proteins called histones

14 **Nucleus**

- surrounded by the nuclear membrane
- has nuclear pores

15 **Nucleus**

- Cloning is the removal of one nucleus from an organism and the insertion of it into another cell (zygote)

16 **Nucleolus** (nucleoli - plural form)

17 **Nucleolus**

- small dot(s) inside of the nuclei of most cells
- concentrated RNA
- site of RNA synthesis *
- Three kinds of RNA *
 - Ribosomal RNA
 - Transfer RNA
 - Messenger RNA
- ribosomal subunits are assembled here *

18 **Cytoplasm (cytosol)**

1

- Cytoplasm = cell fluid
- Fills the cell
- Organelles "float" in the cytoplasm

2

- Most chemical reactions occur here
- Not technically an organelle

19  Cytoskeleton

20  Cytoskeleton

- Definition of the cytoskeleton:

an interconnected series of tubules and fibers that gives a cell the ability to move, provides internal organization and causes cell shape

21  Cytoskeleton

- The cytoskeleton is composed of three main components * :
 - Microfilaments *
 - Intermediate filaments *
 - Microtubules *

22  Cytoskeleton

- microfilaments * -provide support and strength
- **myosin and actin** * are contractile filamentous proteins that are found in muscle tissue
- extremely conserved over evolutionary time

23  Cytoskeleton

- Actin and myosin are the basis for muscle contraction

24  Cytoskeleton

- Intermediate filaments play important roles in cellular activities
- They strengthen cells and organelles
 - Desmin – attaches muscle proteins together to allow contraction of myosin and actin
 - Keratin – found in skin, nails and hair – very tough
 - Neurofilaments – exact function unknown to me, but useful to nerve impulse conduction

25  Cytoskeleton

- Microtubules are larger than microfilaments and are hollow
- They are composed of the protein tubulin * both alpha and beta subunits *
- Microtubules are used in cells division and cell movement
- Microtubules give shape to cells (allows shape changes)

26  Cytoskeleton

2

- Microtubules are found in cilia and flagella for motility or movement *

27  Cytoskeleton

- The action of microtubules can be inhibited by several drugs
 - Colchicine – stops cell division – used to make mitosis slides for biology
 - Taxol – stops cell division and is used in cancer treatment (rapidly dividing cells)

28  Endoplasmic reticulum

29  Endoplasmic reticulum

1

- means "inside fluid channel"

2

- the cell's pipeline *

- 30  **Endoplasmic reticulum**
- materials can be transported throughout the cell by this organelle
 - connects with the cell membrane and the nuclear membrane
- 31  **Endoplasmic reticulum**
- attachment site for ribosomes (granular E. R.) when they are making proteins for export or membrane proteins
- 32  **Endoplasmic reticulum**
- Smooth E.R. does not have ribosomes and is involved with lipid synthesis
- 33  **Ribosome**
- 34  **Ribosome**
- protein factories
 - they are involved with protein synthesis *
 - made of RNA, and proteins
 - sometimes found connected to the endoplasmic reticulum
 - when ribosomes are connected to the endoplasmic reticulum this is called rough E.R. or granular E. R. *
- 35  **Ribosome**
- Ribosomes come in two states within the cell
 - Attached ribosomes
 - connected to the endoplasmic reticulum
 - Free ribosomes
 - float freely within the cytosol
 - Ribosomes move from one state to the other freely
- 36  **Ribosome**
- Polysomes form when several ribosomes attach to one piece of mRNA
 - Each one makes a single strand of new protein
- 37  **Ribosome**
- 1
- The job of the ribosome is to “read” the messenger RNA and make a new protein
- 38  **Ribosome**
- Translation is the final step on the way from DNA to protein. It is the synthesis of proteins directed by a mRNA template. The information contained in the nucleotide sequence of the mRNA is read as three letter

words (triplets), called codons. Each word stands for one amino acid.

- 39 **Ribosome**
- If a ribosome translates a signal sequence at the start of protein synthesis, the ribosome attaches to the endoplasmic reticulum
- 40 **Ribosome**
- 41 **Mitochondrion** (mitochondria - plural form)
- 42 **Mitochondrion**
- powerhouse of the cell
 - site of cellular respiration
 - mitochondrion is the location for the conversion of energy stored in glucose into ATP *
 - ATP is produced in the mitochondrion *
- 43 **Mitochondrion**
- 1 ▪ inner folds of the mitochondrial membrane are called cristae
- 2
- 44 **Mitochondrion**
- many mitochondria are found wherever energy is needed - such as in muscles
- 45 **Mitochondrion**
- 1 ▪ Mitochondria are thought to have been separate organisms at one time
- They are self-replicating
- 2 ▪ They have mDNA - sign of endosymbiotic origin
- All your mitochondria come from your mother
- 46 **Centriole**
- 47 **Centriole**
- Centrioles are can-shaped organelles that assist in cell division
 - They are found in an area close to the nucleus called the centrosome
- 48 **Centriole**
- Centrioles are made of nine fused triplets of microtubules
- 49 **Centriole**
- They serve as centers for the attachment of the spindle apparatus
 - Centrioles are self-replicating-have their own DNA (endosymbiotic)
 - Each parent donates one centriole during reproduction
- 50 **Lysosome**
- 51 **Lysosome**
- They are called suicide bags or sacks
 - They contain digestive enzymes *
 - Lysosomes are used to digest * bacteria and "foreign" material

- 52  **Lysosome**
- Lysosomes are shown as black blobs in this electron micrograph
- 53  **Lysosome**
- Incorrect lysosomal activity can lead to defects like syndactyly where the digits of the hand do not fully separate (vitamin A?)
- 54  **Lysosome**
- Incorrect lysosomal function can also lead to Tay Sachs disease
 - Tay-Sachs disease is a disease that affects infants. Symptoms generally appear by six months of age. While symptoms vary from one child to the next, there is always a slowing down of development. Gradually, Tay-Sachs children lose motor skills and mental functions. Over time, the child becomes blind, deaf, mentally retarded, paralyzed and non-responsive to the environment.
 - Tay-Sachs children usually die by age five.
- 55  **Golgi**
- 56  **Golgi**
- The Golgi is known by many names
 - Golgi Body
 - Golgi Complex
 - Golgi Apparatus
 - Dictyosome
 - It was discovered by Camillo Golgi, an Italian scientist
- 57  **Golgi**
- At first most in the scientific community did not embrace Golgi's new organelle; only when it was seen in the electron microscope was his finding accepted
- 58  **Golgi**
- There are three segments of the Golgi:
 - cis (vesicles join here from E.R.)
 - medial
 - trans (vesicles bud off here toward lysosomes or plasma membrane)
- 59  **Golgi**
- Golgi cuts proteins and adds carbohydrates
- 60  **Golgi**
- They are the packaging and shipping centers of the cell *
 - They are most numerous in cells actively secreting substances (glands)
- 61  **Plant Cells**
- 62  **Plant Cells**
- External surfaces of Plant and animal cells compared
- 63  **Plant Cells**
- 1  **Animal cells ***
- Organelles evenly distributed throughout cytoplasm

- 2
- Plant cells *
 - Organelles compressed toward outer edges of the cell
 - Chloroplasts *
 - Cell wall *

64  **Plastids**

- 65  **Plastids**
- Plastids are chemical factories or storage centers

- They are usually highly colored, but also come in white

66  **Plastids**

- Chloroplasts
 - They are found in all green plant cells
 - They are green
 - Chloroplasts * contains chlorophyll, the pigment needed for photosynthesis (the making of sugar from sunlight, carbon dioxide, and water *

67  **Plastids**

- Leucoplasts
 - They are white in color
 - Leucoplasts are starch storage bodies in plants
 - Leucoplasts are plentiful in the main staples of food in the world:
 - Rice
 - Potatoes
 - Wheat
 - Pasta
 - Beans

68  **Plastids**

- Chromoplasts are colored storage containers within plant cells
- They contain various plant pigments

69  **Plastids**

- Plant Pigments
 - carotene-orange; found in carrots and peppers
 - xanthophyll-yellow; found in bananas and peppers
 - chlorophyll-green; the predominate color in plants