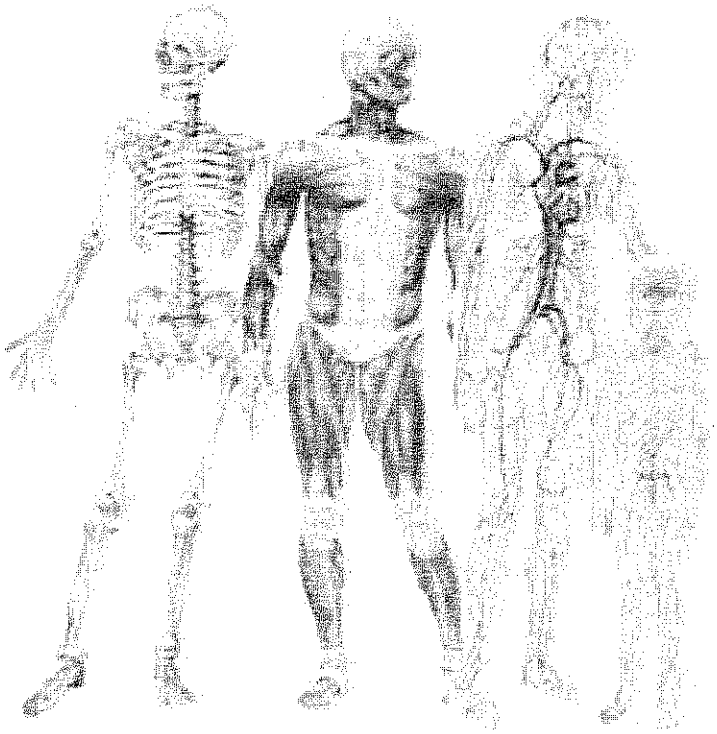
Bio-B Unit 1

Cell Division, Embryology, & Human Biology



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WORDS TO KNOW

Cell Division	Asexual/Sexual	Cell Cycle	Mitosis
Meiosis	Haploid	Diploid	Gametes
Somatic Cell	DNA	Chromosome	XX/XY
Homologous	Crossing Over	Independent Assortment	
Genetic Variation	Organism	Multicellular	Unicellular
Embryology	Fertilization	Cleavage	Gastrulation
Zygote	Embryo	Differentiation	Metamorphosis
Homeostasis	Feedback	Disease Agent	Temperature
Blood pH	Insulin	Organ	Organ System

LEARNING GOALS

After completing this unit you should be able to…

- Understand how cell division results in daughter cells
- Compare and contrast mitosis and meiosis
- Explain how events in meiosis (crossing over & independent assortment) contribute to genetic variation
- Identify homologous pairs of chromosomes
- Describe how autosomes and sex chromosomes are different
- Explain how a zygote forms
- Describe the developmental organization of organisms
- Understand the three major stages of embryonic development
- Explain the importance of differentiation and its relationship to body systems
- Identify causes that lead to disruptions in homeostasis and how the body uses feedback systems to account for disruptions
- Explain how the nervous and endocrine systems help to maintain homeostasis
- Identify the 11 major human body systems, their components, and functions.

Bio Notes

Meiosis - Reproduction of Sex Cells

I: History

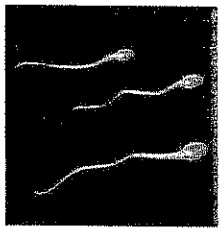
- In 1882 a scientist observed the sex cells of roundworms contained different numbers of chromosomes in comparison to the somatic cells or body cells of the individuals.
- These observations lead scientist to believe that a different type of cell division occurred that reduced the number of chromosomes in half.
  - **In a human and other eukaryotic organisms there are two types of cells.**

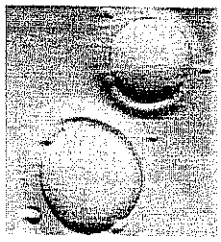
1. Somatic cells or basic _____ cells that have _____ chromosomes or _____.

   -Diploid cells contain a _____ of chromosomes

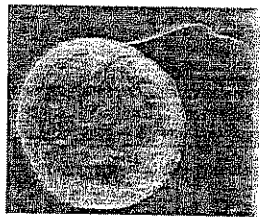
2. Gametes or _____ cells that have _____ chromosomes

   -Haploid cells have _____ the number of chromosomes





- This was important because when 2 sex cells fused together during a process called _____ they produced a new _____ cell called a _____.



II: Human Chromosome Types:

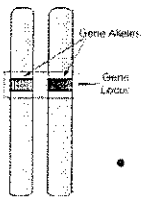
- Within a diploid cell there are two different types of chromosomes.

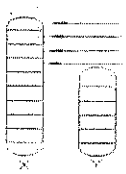
1. _____ (non-sex chromosomes): 44 chromsomes (23 sets)

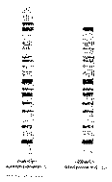
   -Most are _____ or pairs of **inherited** chromosomes from mom and dad that are **alike** and carry the same genetic traits

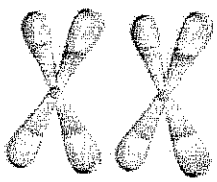
   - Each pair have genes in the _____ location
   - _____ **sex** chromosomes are _____homologous

Label the following as either homologous or nonhomologous:



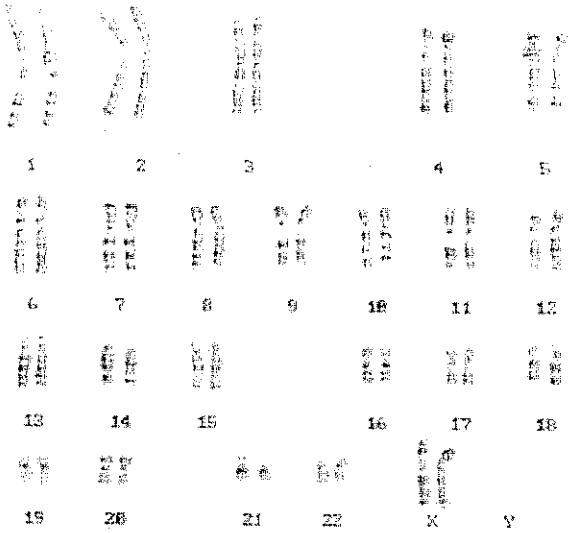






2. _____ **chromosomes**: determine the gender: 2 chromosomes (1 set)
   a. _____ – female
   b. _____ – male (non-homolgous)

➢ Chromosomes can be seen during different stages of the cell cycle. A _____ is a photograph that shows these chromosomes.



III: The Sexual Life Cycle

A. MEIOSIS: _____ of a diploid cell to produce _____ with _____ chromosomes

KEY POINTS:

1. _____ meiosis and fertilization represent _____reproduction.
2. _____ cells produced *are* **haploid sperm and egg**
3. Results in _____ genetically _____ daughter cells
4. Ensures _____ by the mixing of genes

RESULT:

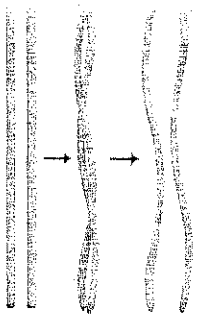
1. Through the process of sexual reproduction _____ will pass **genetic information** on to the **next generation**
2. The offspring will _____ a great variety of gene combinations

IV: A closer look at Meiosis (Human and Animal)

- **Two** rounds of cell division called **MEIOSIS I** and **MEIOSIS II**
  - ➢ DNA replication only occurs 1 time between the nuclear divisions to reduce the original chromosome number by half

V: Phases of Meiosis I:

- Too really understand why haploid cells are genetically different **Meiosis** I will be explained:
  A. Interphase: chromosomes copy (s phase)
  B. During Prophase:
    - _____ and _____.
    - **Crossing over:** ensures genetic variability in the offspring because of the _____ or _____ **of genetic material**

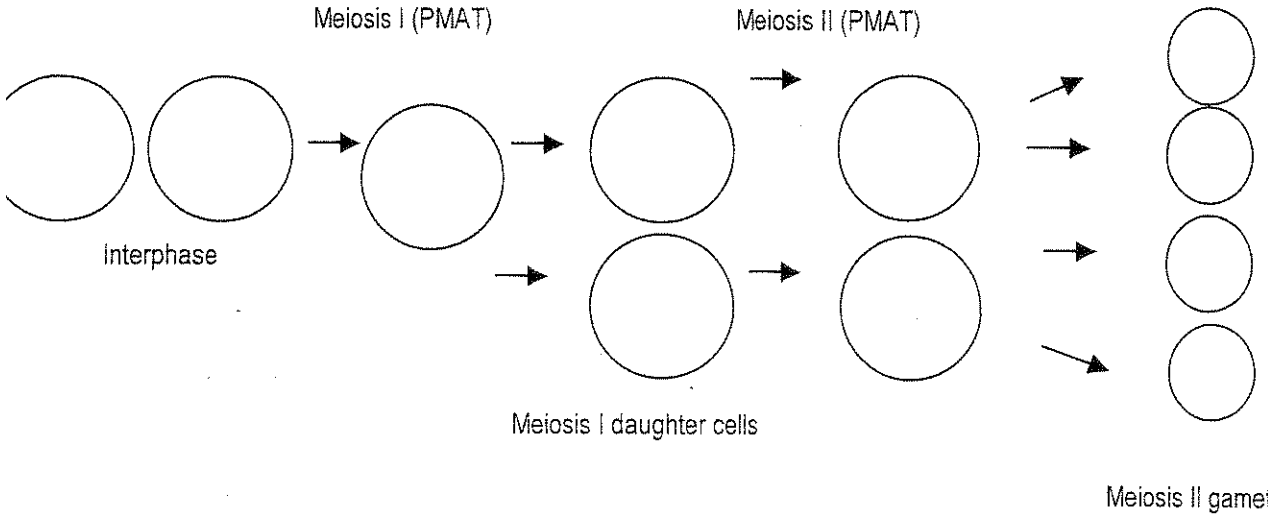


D. During Anaphase
  - _____ occurs
  - After metaphase, pairs of chromosomes _____ **and** _____ **randomly** during cell division to produce gametes containing one chromosome of each type.

E. Telophase and cytokinesis:
  - Pairs are separated into two new cells

VI: Phases of Meiosis II:

- _____ _____ occurs between two divisions, the new cells produced will have a _____ in chromosome number and only have **half the number of chromosomes**
- **PMAT, cytokinesis** occurs: **This looks like mitosis**
- _____ cells will _____ and will be **non-identical due to the crossing over** of homologous pairs and the **random separation** of chromosomes

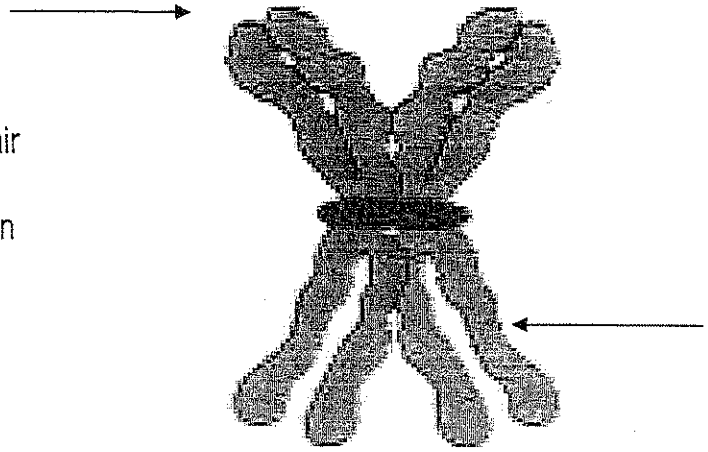


Pairing of HOMOLOGOUS CHROMOSOMES

- **Homologous Pairs** – one chromosome pair from mom attaches to a pair from dad

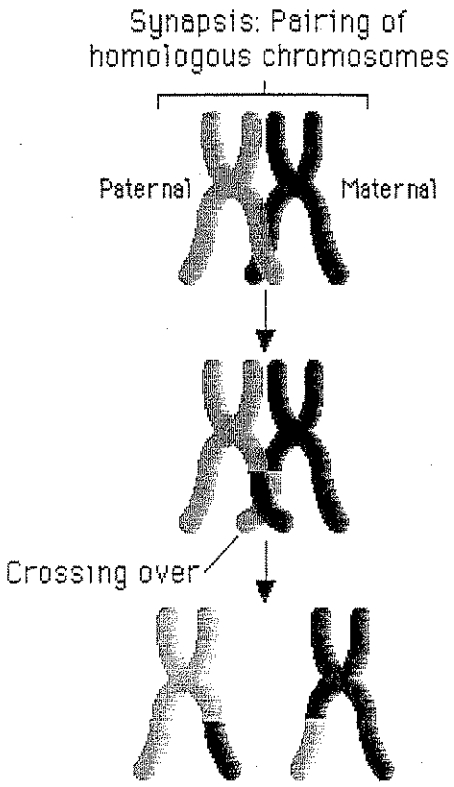
****Pairing is Precise!**

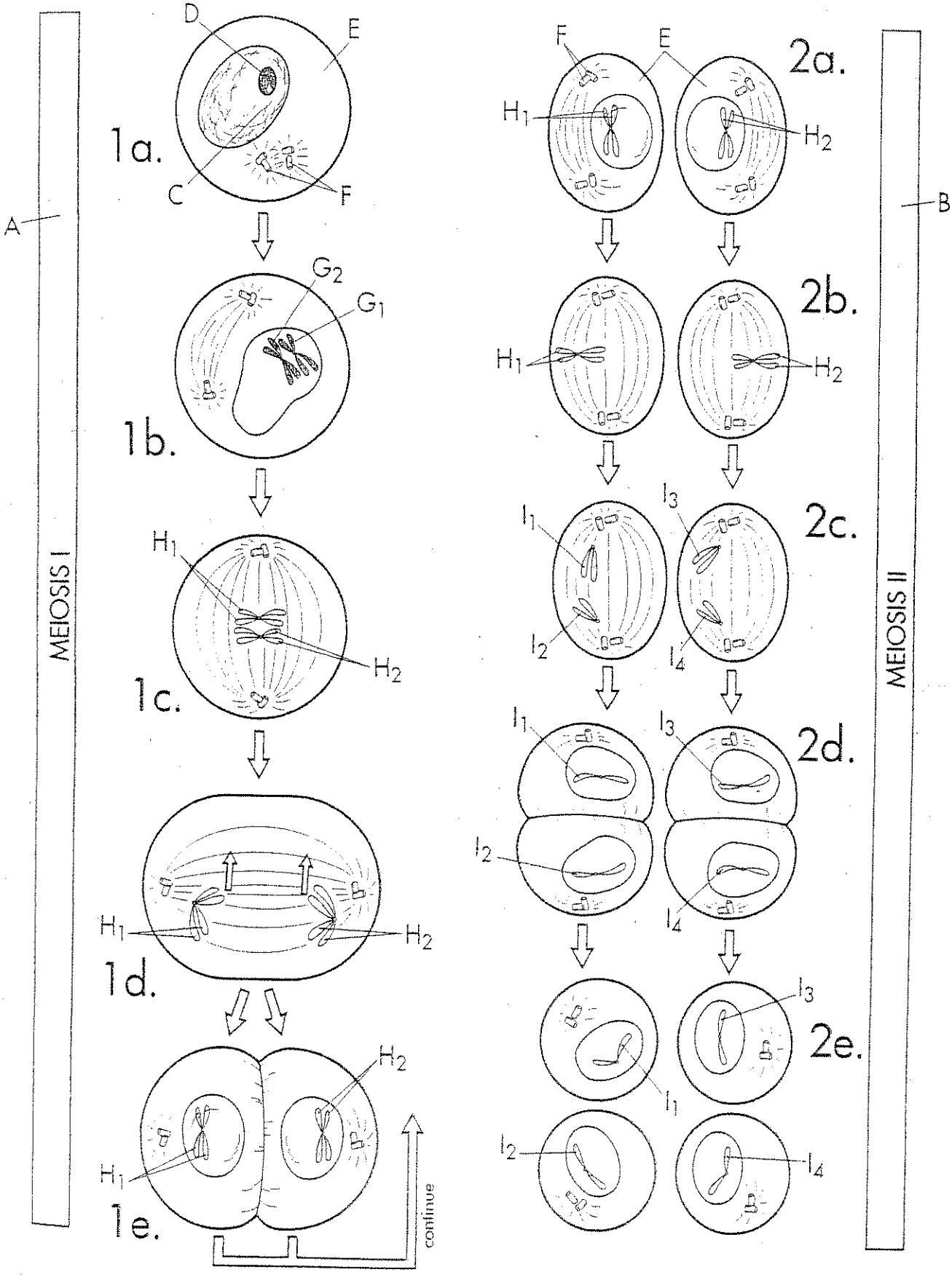
The genes from one pair are adjacent to the corresponding genes on the other pair



Crossing Over

The **recombination or shuffling of genes** to increase the chances of **Genetic Variation**





○ Chromosome 1 ..... I_1
○ Chromosome 2 ..... I_2
○ Chromosome 3 ..... I_3
○ Chromosome 4 ..... I_4

Chapter 2-17: Meiosis

The process of mitosis, discussed in the previous plate, occurs in cells that are reproducing during growth and wound healing, and the replacement of dead cells. The two cells that arise from mitosis are genetically identical to their parent cell. Certain cells undergo another form of cell division known as meiosis. In this process, a single parent cell produces four cells, each of which has half the number of parental chromosomes. The parent has two sets of chromosomes and is said to be diploid (2N), while the cells that result from meiosis each have a single set of chromosomes and are said to be haploid (N).

Meiosis takes place in the reproductive organs and results in cells that are used during reproduction. These cells, which are sperm and egg cells, are called gametes. At fertilization, the fusion of two haploid gametes forms a single cell, called the zygote, which is diploid.

In this plate, we trace the two main phases of meiosis. Many of these processes are similar to those of mitosis, and you should refer to the previous plate whenever necessary. We will follow a single pair of chromosomes through the process of meiosis and will note how they are distributed to four cells.

The process of meiosis involves two rounds of cell division, known as **meiosis I (A)** and **meiosis II (B)**. The bars that indicate these two rounds should be colored. The first round results in daughter cells that have reduced numbers of chromatids. In the second round, these chromatids are distributed to the gametes. Each round of meiosis contains a prophase, metaphase, anaphase, and telophase, as is the case in mitosis.

We will begin with meiosis I. Here we see a parent cell with a distinctive **nucleus (C)** and **nucleolus (D)**. The **cytoplasm (E)** should be colored in a pale color. The **centriole (F)** functions in meiosis as it does in mitosis. The phase designated 1a represents prophase.

Prophase continues in view 1b. Here a single pair of chromosomes is considered (remember that humans have twenty-three pairs of chromosomes per cell). We see **homologous chromosome 1 (G_1)** and **homologous chromosome 2 (G_2)**. The DNA in each chromosome has replicated. Here, the chromosomes have come together, and crossing over (chapter 3) may take place.

View 1c represents metaphase. The homologous chromosomes line up along the equator of the cell, and we see that each consists of sister chromatids. Chromosome 1 has **sister chromatids 1 (H_1)**, and chromosome 2 consists of **sister chromatids 2 (H_2)**.

Anaphase is shown in view 1d. Sister chromatids 1 move to the left pole of the cell while sister chromatids 2 move to the right. In telophase, sister chromatids 1 are contained in the left daughter cell, and sister chromatids 2 are in the right daughter cell. This marks the end of meiosis I.

At the end of meiosis I, the chromosome pair has separated and a chromosome that consists of two sister chromatids has moved to each daughter cell. The sister chromatids are held together at the centromere. Each of the two daughter cells will now enter meiosis II.

The two daughter cells now enter meiosis II, shown at the top of the second column. View 2a shows prophase. Again, we see the centrioles (F) and the cytoplasm (E), which should be colored in a pale color. Sister chromatids 1 (H_1) are in the left cell, and sister chromatids 2 (H_2) are in the right cell. In view 2b, the sister chromatids line up along the equator of each cell. Then the kinetochores separate the sister chromatids.

Now, in view 2c, anaphase is in process, and the sister chromatids are considered chromosomes. In the left cell, **chromosome 1 (I_1)** moves to one side of the cell, while **chromosome 2 (I_2)** moves to the other. **Chromosome 3 (I_3)** and **chromosome 4 (I_4)** separate in the second cell. As telophase commences, in view 2d, the chromosomes are situated at the poles, and the nuclei are taking shape once again. Cell division (cytokinesis) begins.

In the final view, 2e, we see the four cells that result from cytokinesis. Each cell is haploid, meaning that it contains a single chromosome from the original chromosome pair. Recall that we began with two chromosomes. Now in the final view, each cell has one chromosome from that original pair. In the human male, these cells will undergo further development to become sperm cells, and in the human female, one of these cells will become an egg cell.

Meiosis is linked to sexual reproduction in plants and animals because haploid cells join to form a fertilized diploid cell. In animals, the haploid stage is very brief, but in simple plants, the haploid stage predominates over the diploid stage, as you will see in the plates on plant biology.

Meiosis

- ○ Meiosis I ..... A
- ○ Meiosis II ..... B
- ○ Nucleus C
- ○ Nucleolus ..... D
- ○ Cytoplasm ..... E
- ○ Centrioles ..... F
- ○ Homologous Chromosome 1 ..... G_1
- ○ Homologous Chromosome 2 ..... G_2
- ○ Sister Chromatids 1 ..... H_1
- ○ Sister Chromatids 2 ..... H_2

Bio Notes
Embryology and Human Biology

REPRODUCTION AND EMBRYONIC DEVELOPMENT OF AN ORGANISM:

- Organisms have the ability to reproduce by sexual or asexual means

I: EMBRYONIC DEVELOPMENT, the basic body plan is established early in development.

- Process of _____ a multicellular _____ is quite complex and takes many steps:

A. _____: fusion of egg and sperm during sexual reproduction to form a diploid zygote cell.

B. _____:

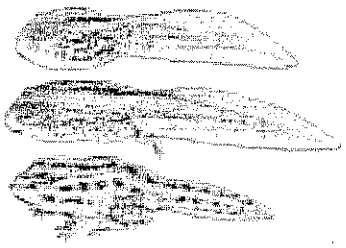
- Repeated mitotic cell divisions of a zygote that makes a mass of cells

C. _____: development of a multilayered embryo

- **Cell Differentiation**: embryo forms _____ tissue layers and cells _____ to carry out a particular _____
  1. Ex. Various organisms have developed different specializations to accomplish a particular function. Ie. Cellular Respiration – most organisms will use this process to make ATP
- **Cause**:
  a. Different _____ are _____ and signal cells to have these different functions. (Example: liver, heart, RBC, WBC, muscle cells)
  b. The _____ can also influence differentiation
     - **Ex. Metamorphosis**
     - **Ex. Nutrition or Lifestyle**

Metamorphosis:

- _____ in an animal's _____ or structure from one stage to another through cell growth or differentiation.
- May be influenced by change in _____ or behavior.



Tadpole to Frog

Nutrition/Lifestyle:

- Diabetes: poor diet high in sugar may lead to insulin insensitivity
  **body's insulin tries to push the "gas pedal" but system does not react

II. THE HUMAN BODY

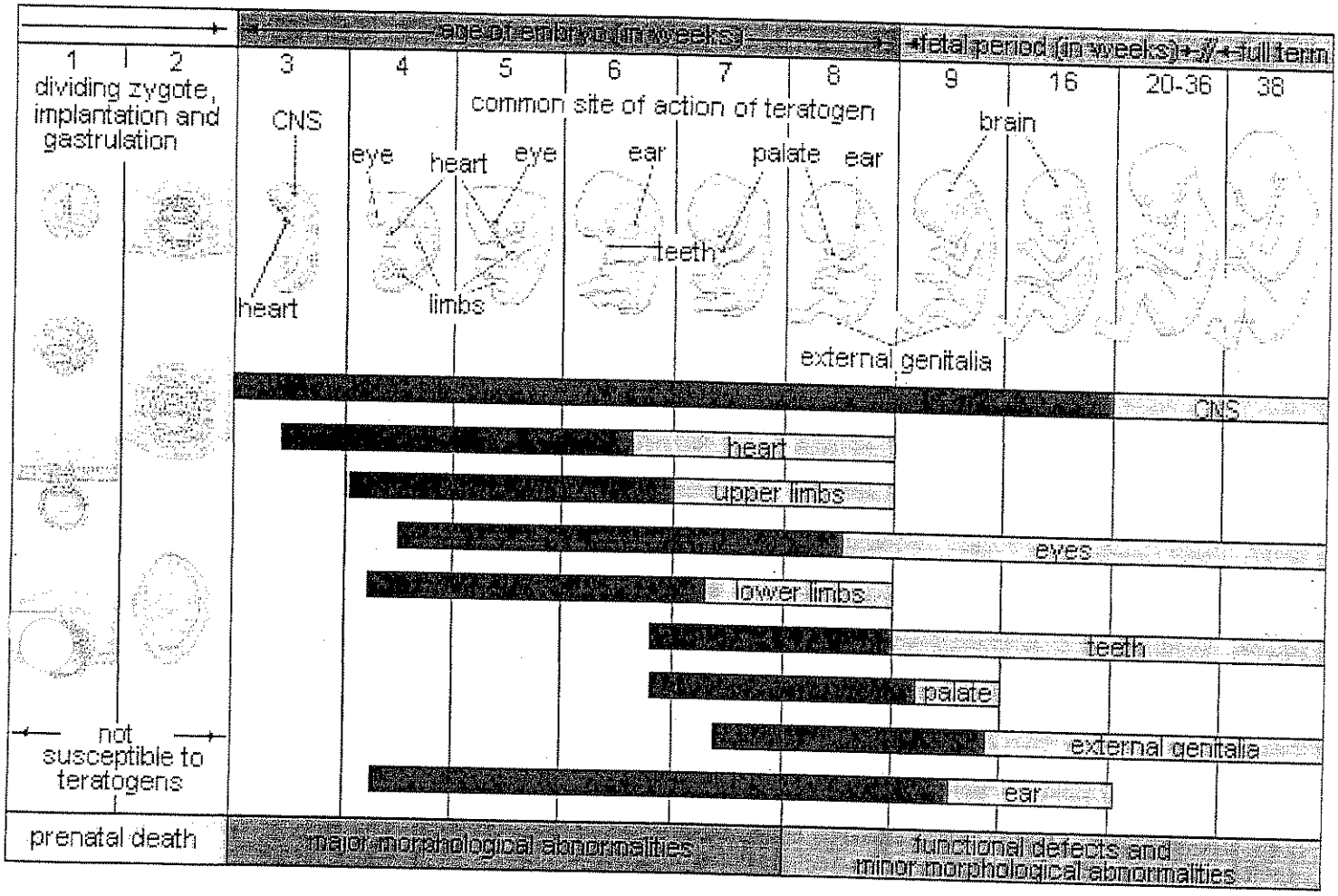
- Later in embryonic development, organs, made up of various tissue types, and organ systems work together to support the needs of the entire organism.

- The body has been organized into _____ body systems that work to together to maintain homeostasis and _____ the major _____ required for _____.
  - ❖ _____: steady internal state or condition
  - ❖ The body has _____ **mechanisms** that respond to changes in an organism's environment and will _____ the direction of the _____ **change**.
  - ❖ The body's _____ and _____ systems along with others monitor body conditions from both inside and outside the body.
  - ❖ Changes in an organisms homeostasis could be due to:
    a. _____ **agents**
    b. changing _____, _____ or _____ conditions

III. EXAMPLES OF HOMEOSTASIS:

- Cells function in a _____ of physical conditions
  a. **Temperature**: body sweats to maintain normal levels
  b. **Blood pH**: breathing controls the amount of CO_2 in blood
  c. **Blood sugar**: insulin is secreted to remove glucose from blood

EMBRYOLOGY HANDOUT
PICTURES



Human Body Systems

System	Components	Functions
Integumentary		
Skeletal		
Muscular		
Nervous		
Endocrine		

System	Components	Functions
Cardiovascular		
Lymphatic/Immune		
Respiratory		
Reproductive		
Digestive		
Urinary		