

**STUDY GUIDE - Ch. 13.1 - Offspring Acquire Genes from Parents by Inheriting Chromosomes**  
**- Ch. 13.2 - Fertilization and Meiosis Alternate in Sexual Life Cycles**

NAME: \_\_\_\_\_

- **PHYSICALLY PRINT OUT** this PDF and **HANDWRITE** (with a black or blue pen) your answers directly on this PDF. Typed or digitally-written work is **not** accepted. Do **not** answer questions on separate paper.
- **Importantly, study guides are NOT GROUP PROJECTS!!!** You, and you alone, are to answer the questions as you **read** your assigned textbook. You are **not** to share answers with other students. You are **not** to copy any answers from any other source, including the internet.
- **Get in the habit of writing LEGIBLY, neatly, and in a medium-sized font.** AP essay readers and I will skip grading anything that cannot be easily read so start perfecting your handwriting, and don't write so large you can't add all the relevant details and key elaborations in the space provided.
- **SCAN** physical documents in color and with good resolution. Then, upload your final work as **PDFs to Archie**. Avoid uploading dark, shaded, washed-out, sideways, or upside-down scans of homework. Keep completed physical study guides organized in your biology binder to use as future study and review tools.
- **READ FOR UNDERSTANDING** and not merely to complete an assignment. **First**, read a section quickly to get an overview of the topic covered. Then, read it a **second** time slowly, paraphrasing each paragraph **out loud** and analyzing every figure. Finally, read it a **third** time as you answer the study guide questions if assigned and start building your memory. Try to write answers out in your own words, when possible, and try to purposefully and accurately use all new terminology introduced.

1. Define the following terms:
  - a. Heredity:
  - b. Genetics:
2. a. Remember, **genes are those sections of DNA of chromosomes that encode the information a cell needs in order to make proteins or RNA molecules.** DNA can be replicated so that parents can pass down copies of these genes to their offspring. What are **gametes**?
  - b. What are the two types of **human gametes** called that are **made in gonads** (organs that produce reproductive cells)?
    1. \_\_\_\_\_
    2. \_\_\_\_\_
  - c. What is the process called when **male and female gametes unite** to form a new somatic cell?
3. a. Though most DNA of **eukaryotes** is found in the \_\_\_\_\_ as **linear** molecules, small amounts of **circular** DNA in eukaryotes are found in the \_\_\_\_\_ and \_\_\_\_\_ as well.
  - b. Though **prokaryotes** have **one** circular chromosome, different eukaryotic species vary in the \_\_\_\_\_ of linear chromosomes in their bodies' cells.
  - c. How **many chromosomes are in human (somatic) cells**?
  - d. How many **genes are found per eukaryotic chromosome**?
  - e. What exactly are **somatic cells**?
  - f. Give your own example of two human somatic cell types?
  - g. What is a **locus** (loci – plural)?

4. a. Some species reproduce asexually, some only sexually, and some can engage in both types! What does it mean when an organism **reproduces asexually**?
- b. Does an organism that engages in asexual reproduction have to produce reproductive cells like sperm or eggs?
- c. We say that asexual reproduction leads to clones of the parent. What is a **clone**?
- d. **Prokaryotes reproduce asexually via binary fission**. What **method is used by eukaryotes to reproduce asexually**?
5. a. What does it mean when an organism **reproduces sexually**?
- b. Why are the **offspring of sexually reproducing parents NOT considered clones of each other and of their parents**?
6. In Ch.12, you learned that cells have a cell cycle. Full organisms have a life cycle. What is meant by the term **life cycle**?
7. a. **Homologous chromosomes** are also known as **homologs**. How are **homologous chromosomes (homologs) similar** with regards to the types of genes this pair of chromosomes carry?
- b. **What three physical features do homologous chromosomes (homologs) have in common**?
1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_
- c. How **many homologous PAIRS of chromosomes do human somatic cells contain**?
8. a. Read Figure 13.3. What is a **karyotype**?
- b. List the steps that must be taken to **prepare a karyotype**?
- c. Looking at the karyotype presented in Figure 13.3, what are **three items that can be determined from a karyotype**?
1. \_\_\_\_\_ 2. \_\_\_\_\_
3. \_\_\_\_\_
- d. Analyzing the labeled homologs drawn in Figure 13.3, and referring back to figures 12.6 and 12.7, why does **each** homologous chromosome in the karyotype consist of **two** sister chromatids instead of just one double-stranded molecule of DNA (**dsDNA**)?

9. a. Humans chromosomes include autosomes and sex chromosomes. Why do we make this distinction between our chromosomes? So, said another way, what differentiates **sex chromosomes** from **autosomes**?
- b. Are any parts of the two human sex chromosomes homologous to each other (carrying similar genetic information)?
- c. How do the **two types of human sex chromosomes differ from each other?** *How are they not homologous?*
- d. How does the **karyotype of a human female differ from that of a human male?**
- e. How does the **karyotype of a human female look the same from that of a human male?**
10. a. What does the **variable “n” stand for** when taking about cells and their chromosomes?
- b. What is a **diploid cell**?
- c. What is the **(2n) diploid (total) number of chromosomes in human somatic cells?** **2n = \_\_\_\_\_**
- d. What is a **haploid cell**?
- e. What is the **(1n or n) haploid number of chromosomes in human gametic cells?** **n = \_\_\_\_\_**
- f. How many autosomes vs. sex chromosomes do humans have among **one set (n)** of human chromosomes?  
**# of autosomes among a set of human chromosomes =**  
**# of sex chromosomes among a set of human chromosomes =**
11. a. What is meant by the term **fertilization**?
- b. What is the resulting **fertilized egg** called?
- c. Study Figure 13.5 well showcasing the **Human Life Cycle** (*although most animals' life cycles look similar*). What is the **ploidy** (number of chromosome sets in a cell) **of the fertilized human egg**: Haploid (n) or diploid (2n)?
- d. **Gonads** are the organs where gametes are produced. As you see in the figure, what are the gonads called in human males and human females?  
**Male Gonad = \_\_\_\_\_**      **Female Gonad = \_\_\_\_\_**

12. Now you know that cells which have only **ONE OF EACH** type of chromosome for that species are said to be **haploid**, a condition that is represented by ***n***, while cells that have **TWO OF EACH** type of chromosome for that species are said to be **diploid** or ***2n***. For each of the following, is the cell haploid (*n*) or diploid (*2n*)?

- a. Human lung cell = \_\_\_\_\_  
 b. Human gamete = \_\_\_\_\_  
 c. Human zygote = \_\_\_\_\_  
 d. Human skin cell = \_\_\_\_\_  
 e. Human sperm = \_\_\_\_\_  
 f. Human somatic cell = \_\_\_\_\_

13. The intestinal cells of an Opossum have 22 chromosomes. Fill in the chromosome number in its....

Bone cell = \_\_\_\_\_ Egg cell = \_\_\_\_\_ Somatic cells = \_\_\_\_\_ Zygote = \_\_\_\_\_ Haploid cells = \_\_\_\_\_



14. Each sperm of a pea plant contains 7 chromosomes. What are the haploid & diploid chromosome numbers for peas?

Haploid (*n*) number = \_\_\_\_\_ Diploid (*2n*) number = \_\_\_\_\_



15. **Gametes are made when germ cells** (types of somatic cells) **in gonads** (organs where gametes are produced) **divide**. This division of the nuclear material is **NOT** done by mitosis, however, but by meiosis. What differs in the daughter cells of somatic (germ line) cells that undergo **meiosis** (as opposed to if those cells would have undergone mitosis)?

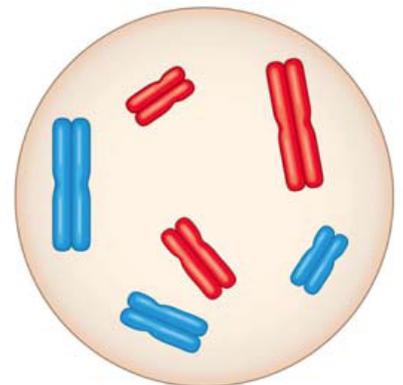
16. How does the **alternation of meiosis AND fertilization in the life cycle of sexually reproducing organisms maintain the normal chromosome count for each species?** *Walk us through the consequences of each process in sequence.*

17. Let's return to Figure 13.4. Memorize all you see in Figure 13.4. Once have studied it well, let's see if you understood.

a. In the cell to the right, the chromosomes are shaded in two colors to represent the two parents of origin. On this sketch, **identify/label clearly:**

1. one pair of sister chromatids
2. one pair of homologous chromosomes
3. one centromere (of a sister chromatid)
4. one replicated chromosome
5. the maternal vs paternal chromosomes

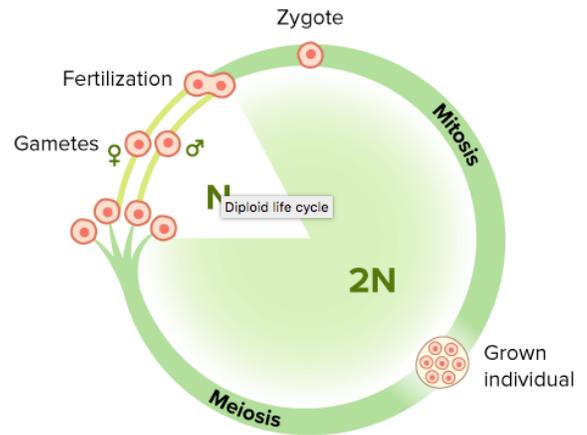
- b. How many **total chromosomes** does this cell have?  
 c. How many **homologous pairs** does this cell have?  
 d. How many **chromatids** are found in this cell in total?  
 e. Is this cell haploid or diploid?



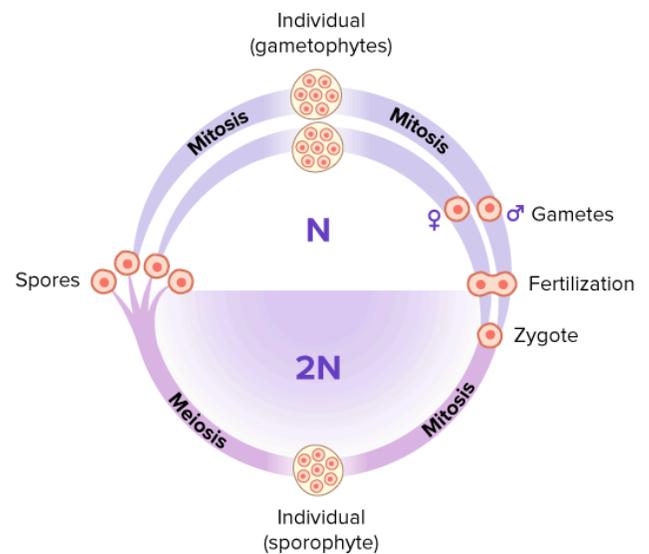
*(Remember the "ploid" part of these words refers to ***n*** = the number of **SETS** of chromosomes in the cell)*

18. Study the **three types of sexual life cycles of eukaryotes** explained in your text and illustrated in Figure 13.6 and in the figures below. Once you feel you understand, imagine you are teacher and your students are learning about varying life cycles in sexually reproducing organisms for the first time. Describe to your students, carefully, methodically, and correctly, the major similarities and differences between the three distinct types of sexual life cycles, making sure to use all relevant terms (mitosis, diploid cells, meiosis, haploid cells, gametes, fertilization, zygote, etc). **Would you be able to draw each of these life cycles on an exam yourself if asked to do so?!**

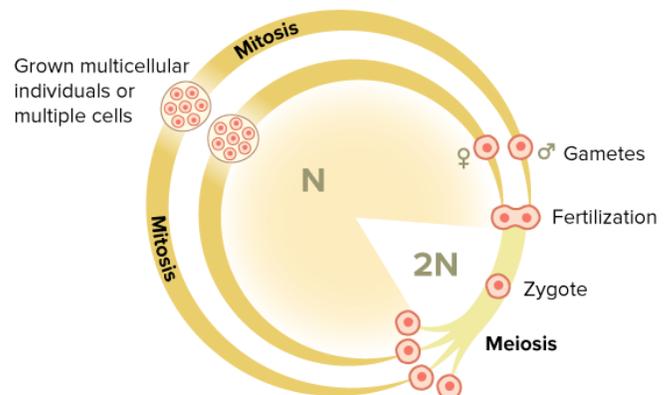
1. **Diploid Life Cycle** (of Animals)



2. **Alternation of Generation Life Cycle** (of Plants and some algae, the latter being a photosynthetic protist)



3. **Haploid Life Cycle** (of most Fungi & some Protists)



19. a. Which two of the three life cycles above involve haploid cells forming, but **not** acting as gametes, the haploid cells first undergoing mitosis to make more independent haploid cells or a multicellular haploid-celled structure, only later some of the haploid cells acting as gametes and undergoing fertilization, uniting to form a diploid zygote?

1. \_\_\_\_\_ 2. \_\_\_\_\_

b. Which one of the three life cycles above involve haploid cells forming, and acting immediately as reproductive cells (gametes), looking to engage in in fertilization, forming the diploid zygote?

1. \_\_\_\_\_

20. As you learned, plants have a life cycle that involves the forming of spores, which form as a result of meiosis, so these **spores are haploid**. Notice also that **BOTH haploid and diploid cells can divide by mitosis, identical haploid or diploid cells forming as a result**. However, meiosis always begins with cells that are at minimum \_\_\_\_\_, and as a result of meiosis, daughter cells are formed that are at minimum \_\_\_\_\_. **These cells can be gametes (in animals) or spores (in plants) or certain types of haploid single-celled protists even.**

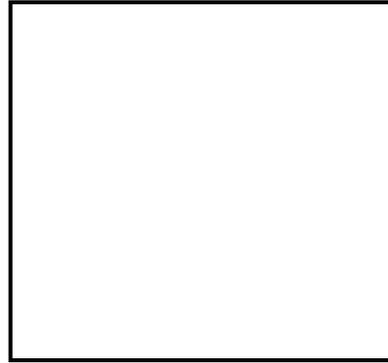
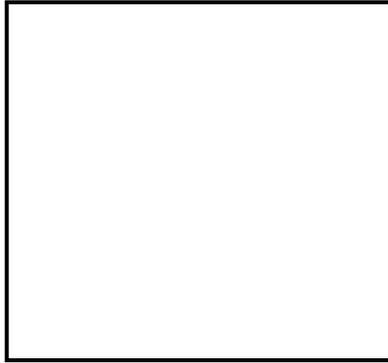
21. a. Before we move on to really learning how meiosis differs from mitosis, let's make sure you understand mitosis well. **STUDY Figure 12.7 in Ch.12 first!** Using simple drawings for chromosomes, such as the one illustrated here to your right (*ignoring that chromosomes exist in a less condensed form of chromatin when in interphase and a very condensed, supercoiled, form during mitosis*), **draw a hypothetical HAPLOID cell nucleus in G1, the cell containing 3 different types of chromosomes in one chromosome set**. During G1, chromosomes would **not** be organized or lined up in any particular way so your drawing should reflect this.



b. Draw this same haploid "nucleus" after it has **finished S and G2 phases**, and is now in **metaphase of MITOSIS**. Draw the chromosomes attached to the mitotic spindle, assuming the poles are on to the right and left of the box.

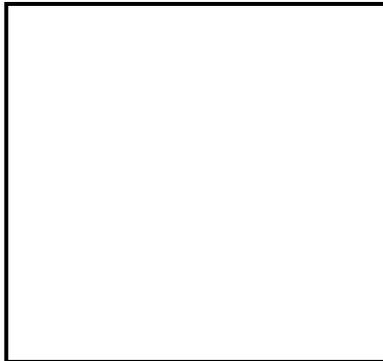


c. Next, draw the two daughter cell nuclei after the cell completes mitosis and cytokinesis. These two cells should **each** look identical to what you drew in 20.a. **Mitosis results in making daughter cells that are clones of and genetically identical to the parent cell.** *An haploid or n parent cell forms two haploid or n daughter cells.*

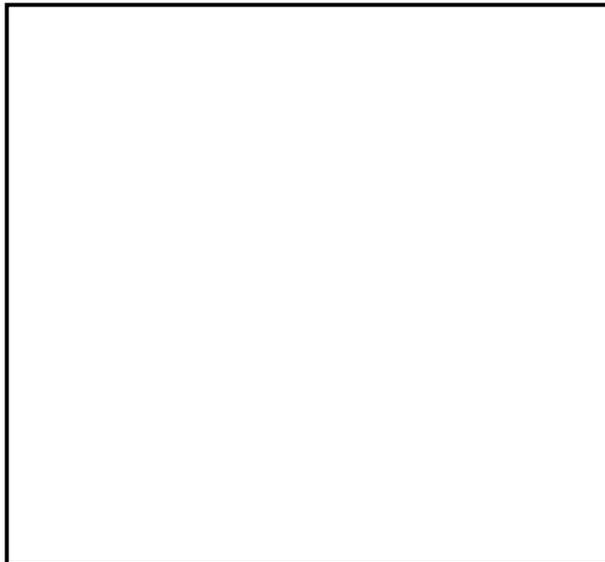


d. Now, **draw the hypothetical cell's nucleus in G1 from 20.a. if the cell were instead triploid and not haploid.**

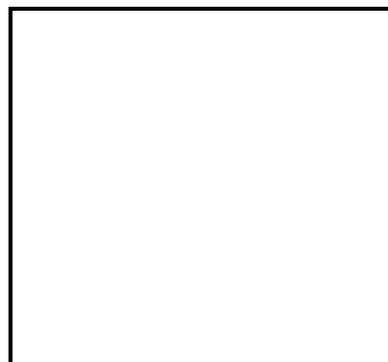
*\*\*\* Remember again that the "ploid" part of these words refers to  $n$  = the number of SETS of chromosomes.*



e. Draw this same triploid "nucleus" after it has **finished S and G2 phases**, and is now in **metaphase of MITOSIS**.



f. Draw the two daughter cell nuclei after the cell completes mitosis and cytokinesis. These two cells should **each** look identical to what you drew in 20.d. **Mitosis results in making daughter cells that are clones of and genetically identical to the parent cell.** An triploid or  $3n$  parent cell forms two triploid or  $3n$  daughter cells.



22. a. In Figure 13.4, how many DNA molecules (**double helices**) are present (see Figure 12.5)?
- b. What is the haploid number of this cell?
- c. In general, is one set of chromosomes haploid or diploid? Explain.

*(Check your answers by going to the [Ch.13.2 Concept Check Question #1](#) answers in Appendix A)*

23. a. In the karyotype in Figure 13.3, how many pairs of chromosomes are present?
- b. How many sets are present in this same karyotype?

*(Check your answers by going to the [Ch.13.2 Concept Check Question #2](#) answers in Appendix A)*

24. Using shoes as an analogy for chromosomes, how would you describe the collection of “shoes” in human diploid and haploid cells?

Shoes in diploid cell =

Shoes in haploid cell =

*(Check your answers by going to the [Ch.13.2 Concept Check Question #3](#) answers in Appendix A)*

25. A certain eukaryote lives as a unicellular organism, but during environmental stress, it produces gametes. The gametes fuse, and the resulting zygote with has double the sets of chromosomes then undergoes meiosis, generating new single cells that again have half the number of sets of chromosomes than the zygote. What type of organism could this be? *Review again your explanations of each type of eukaryotic organisms life cycle as outlined in question 18 above.*

*(Check your answers by going to the [Ch.13.2 Concept Check Question #4](#) answers in Appendix A)*