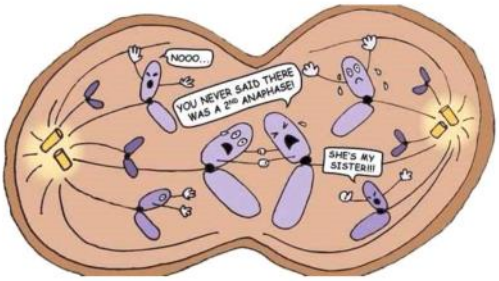
3 Meiosis & Sexual Reproduction

June 11, 2019 9:41 AM

science 9

UNIT 4: BIOLOGY



BOOK 3: MEIOSIS & SEXUAL REPRODUCTION

name: _____ block: _____

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Science 9 Assignment Log

Date	Assignment/Worksheet/Lab	Completed?

Concepts to Review	Facts to Remember

Cell Division and Sexual Reproduction

Here's a summary of what we've learned about cell reproduction so far:

1) **Unicellular organisms and mitosis:** Unicellular organism that undergoes mitosis also means that it undergoes asexual reproduction. (ie. ONE cell/organism is making another single cell/organism) ex. bacteria

2) **Multicellular organisms and mitosis:** A multicellular organism that undergoes mitosis is growing or repairing (ie. each individual cell is making more of the same kind of cell, and the overall organism is getting bigger) eg. human body cell (not nerve cells not sex cells)

3) **Multicellular organisms and asexual reproduction:** A multicellular organism undergoes asexual reproduction by dividing its body to make a smaller copy of itself (ie. each organism divides its body, not a single cell; therefore, this is NOT mitosis) ex. buddings, binary fission, spores, etc.
... it involves mitosis as part of the process.

4) **Multicellular organisms and sexual reproduction:** We haven't learned about this topic yet, but this is where MEIOSIS comes into the picture!

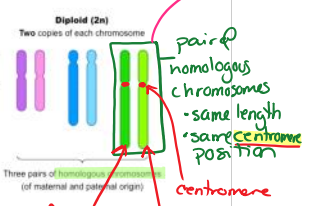
WHAT ARE THE CHARACTERISTICS OF REGULAR BODY CELLS?

Somatic cell "body" cells (NOT sex cells)

- A cell that is NOT specialized for sexual reproduction; a regular body cell.
- How are they made? mitosis (grow + repair)
- What are some examples of somatic cells? muscle cells, skin cells, etc.

Diploid number "2" "homo-" = "same"

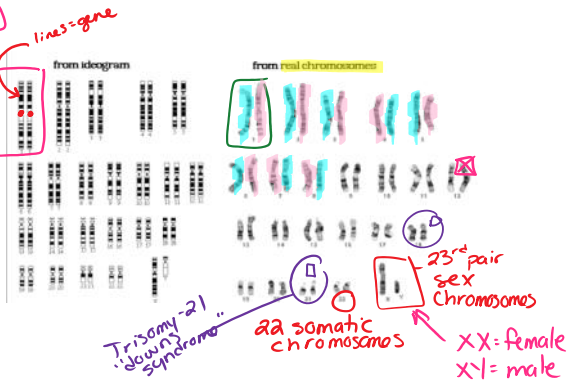
- 2 sets of chromosomes that are homologous
- One set from the mother, one set from the father
- Expressed as 2N, where "2" represents the 2 sets and "n" represents the number of chromosomes in 1 set
- SOMATIC CELLS ("body cells") are DIPLOID



2N (23 pairs of chromosomes)

pair of homologous chromosomes
- same length
- same centromere position

centromere
from dad
from mom



WHY CAN'T REGULAR CELLS BE USED FOR SEXUAL REPRODUCTION?

During **asexual reproduction**, only one cell from one parent is needed.
However, during sexual reproduction, 1 cell from the male parent fertilizes 1 cell from the female parent to make a new organism.
Therefore, two cells are needed! => must be HAPLOID = N

- What would happen if diploid cells were involved in sexual reproduction?

"What if" (does NOT happen)

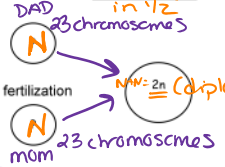
*in many cases too many extra chromosomes leads to the fetus not surviving.

... means 92 chromosomes! That is why 2N cells are NOT used in sexual reproduction!

WHAT KINDS OF CELLS ARE NEEDED FOR SEXUAL REPRODUCTION?

Diploid cells must be divided in ½ so that the number of chromosomes is **halved**. (Haploid = N)

we will learn about meiosis which is how these are made.



23+23=46 chromosomes — will develop into a human fetus.

Haploid number

- A cell that contains 1 set of chromosomes (no homologous pairs)
- Half the number of chromosomes than a diploid cell
- Expressed as "N", where "n" represents number of chromosomes in 1 set
- Gametes are HAPLOID

1 of each chromosome #1-22
DAD - Y or X
mom - X

Gamete cell

- A cell that is specialized for sexual reproduction (ie. sex cell)
- How are they made? meiosis

Gamete cell chromosomes

- A cell that is specialized for sexual reproduction (ie. sex cell)
- How are they made? meiosis
- A female gamete is an egg (N) and a male gamete is a sperm (N)

→ aN

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READING ABOUT: SEXUAL REPRODUCTION

Pg 6 + w/s p7.

Complete the following reading about Meiosis

Be sure to "Mark the Text" and highlight KEY DEFINITIONS as you read along.

ALSO, answer the "Reading Check" questions in the side margin as you go!

Before You Read

Remind yourself: what happens during mitosis? Write your thoughts on the lines below.

in mitosis a cell divides, makes an identical copy.

State the Main Ideas

As you read this section, stop after each paragraph and put what you have just read into your own words.

What is sexual reproduction?

In **sexual reproduction**, genetic information from two parent cells are passed on to an offspring. Female organisms and male organisms make specialized cells called **gametes**. Gametes from female parents are called eggs. Gametes from male parents are called sperm. In sexual reproduction, the gametes from the two parents combine during a process called **fertilization** to form a new cell. The new cell is called a **zygote**. The zygote is the first body cell of a new organism. As the zygote undergoes repeated mitosis and cell division, it matures into an **embryo**.

How do gametes differ from body cells?

All human body cells have 46 chromosomes. These chromosomes are arranged into 23 pairs. You receive one member of each pair of chromosomes from your mother. You receive the other member of each pair from your father.

When a cell has pairs of chromosomes, it is said to be *diploid*. Di- means two or double, referring to the two sets—the pairs—of chromosomes. Human body cells are diploid. Gamete cells, on the other hand, have only one set of chromosomes, for a total of 23 chromosomes. Gametes are said to be *haploid*.

Reading Check

1. How many chromosomes are there in a human body cell?

46 (23 pairs)

How do gametes become haploid?

In order for human body cells to remain diploid, gametes must have one half the number of chromosomes—that is, 23. Only haploid gametes with 23 chromosomes can combine during fertilization to form a diploid zygote with 46 chromosomes. **Meiosis** is the process that ensures that each gamete is haploid. In other words, meiosis produces gametes with one half the number of chromosomes as body cells.

The process of randomly dividing 23 pairs of chromosomes in half creates millions of possible combinations of chromosomes. Any of these combinations may be combined with chromosomes from the other parent in any gamete during fertilization. In this way, sexual reproduction and meiosis increase genetic diversity (variety) in a species.

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Reading Check What is a gamete? a specialized cell for sexual reproduction (sex cell)

Homework **Assignment #1: The Role of Gametes Worksheet**
Complete this assignment in the space provided below.

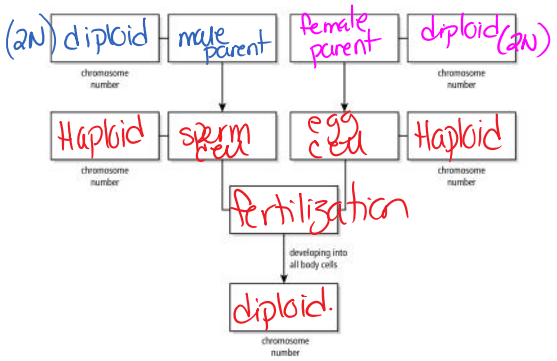
The role of gametes

1. Complete the table to show the number of chromosomes for different organisms. The table has been partially completed to help you.

Organism	Diploid number (2n)	Haploid number (n)
human	46	23
fruit fly	8	4
black bear	76	38
peanut	20	10
chimpanzee	48	24

2. Use the terms in the box below to fill in the blanks in the meiosis flow chart. You can use each term more than once. You will not need to use every term.

Choices for chromosome number	Choices for other blanks
diploid	egg cell
haploid	female parent
	fertilization
	male parent
	sperm cell



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Introduction to Sexual Reproduction

DNA+chromosome

- The process in which an organism receives genetic information from ___two___ parent cells.
- A different process is needed...
  - If a human sperm cell had 46 chromosomes and a human egg cell had 46 chromosomes, then the resulting embryo would have ___92___ chromosomes! That doesn't work! ("not a viable embryo")
  - Somehow the number of chromosomes must be cut in ___HALF___! But those halves must have one of each type of the ___23___ chromosomes.
- The answer is ... ___Meiosis!___

#1-22 chromosomes (somatic)
#23 sex chromosome

Introduction to the Video:

different processes!

1. Mitosis makes ___identical body cells (somatic cells)___
2. Mitosis is important for ___growth, repair + reproduction___
3. Meiosis makes ___sperm___ and ___eggs___ cells also known as gametes.
4. Interphase is when a cell is ___growing___, ___*DNA replication*___ and carrying out cell processes.
5. Interphase happens before ___mitosis___ and ___meiosis___.
6. Meiosis involve ___P___rophase, ___M___etaphase, ___A___naphase and ___T___elophase just like mitosis.

This actually happens 2x in meiosis.

7. How many divisions are involved in meiosis? ___2___
8. A process called "___crossing___ over" occurs in prophase I. Why is this an important process? ___create genetic diversity. differences in a species.___

Amoeba Sisters: Meiosis
https://www.youtube.com/watch?v=VzDMG7ke69g

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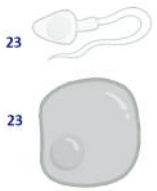
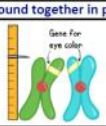
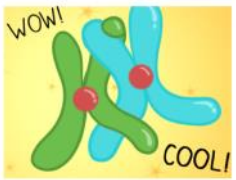
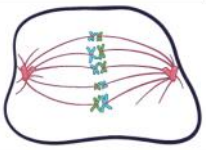
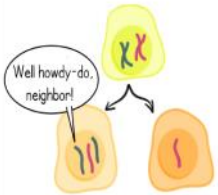
PRACTICE — Amoeba Sisters Video Recap of *Meiosis*

1. The purpose of meiosis is to make **gametes**, also known as sperm and egg cells. In humans, your body cells have 46 chromosomes. How many chromosomes are in a sperm or egg cell if, when they come together to form a fertilized zygote, there are 46 chromosomes? **Write the correct number of chromosomes next to the sperm and egg.** 	2. **Interphase** must occur once before meiosis can happen. (Same thing for mitosis). What would happen if interphase didn't occur first? If interphase did not occur first, then chromosomes would not replicate. This would not allow for chromosome copies to be correctly distributed in daughter cells. 	3. A cell that begins meiosis has 23 chromosomes inherited from the mother (shown in green in the cartoon below) and 23 chromosomes inherited from the father (shown in blue in the cartoon below). In the process of meiosis, chromosomes begin to match up in homologous pairs. How would you know if two chromosomes were homologous? Homologous chromosomes are approximately the same size with the same types of genes (important: this does not mean identical). They can be found together in prophase I. 
4. **Crossing over** is a very important event in Prophase I of meiosis! What happens during crossing over and what is the significance? In crossing over, the homologous chromosomes transfer genes to each other. This is significant because it can lead to genetic variety (recombinant chromosomes). 	5. Meiosis does PMAT twice! That means there is a prophase I and a prophase II. There is a metaphase I and a metaphase II. Etc... If the cartoon below has chromosomes in the middle of the cell, how would you know whether it was in metaphase I or metaphase II? Metaphase I has chromosomes lining up in the middle in homologous pairs. In metaphase II, the chromosomes are lined up in a single file line (not in pairs). The cartoon below shows metaphase I. 	6. Meiosis does not always occur without any difficulties. Describe what occurs during **nondisjunction** and the effect on the resulting cells. Chromosomes are not distributed equally (example could be spindle not separating them correctly). This can result in too many or too few chromosomes per cell. 

NOTE: Interphase only happens once!

PRACTICE

interphase — chromosomes duplicate (46) → duplicate → X

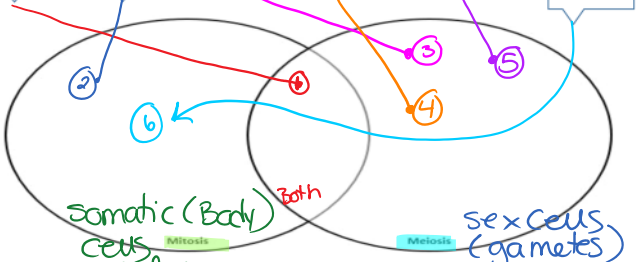
Can you finish the meiosis chain? Write the correct stage that comes next in each circle. Don't forget the number that comes after the stage name! Then write any details about what this stage looks like next to it.

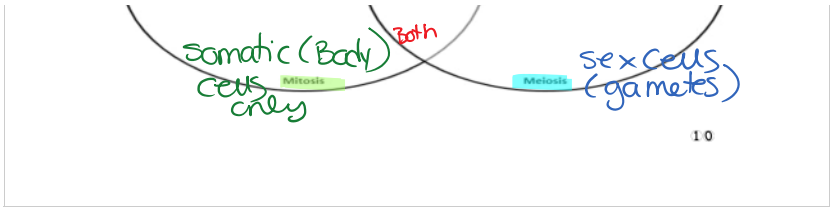
- Prophase I: chromosomes condense, crossing over
- Metaphase I: chromosomes line up in middle in homologous PAIRS
- Anaphase I: pairs are pulled apart
- Telophase I: (now have 2 cells) 2 nuclei will form
- Prophase II: chromosomes in 2 cells are visible; NO crossing over
- Metaphase II: single chromosomes line up in middle
- Anaphase II: chromosomes are pulled away; chromatid
- Telophase II: new nuclei form; now have 4 cells

Now let's play, "Which Clip Would That Be Said In?"

Keeping mitosis and meiosis separate in your mind can be a bit tricky. Read the following speech bubbles. Determine whether they would be correctly placed in the mitosis clip, the meiosis clip, or both by drawing a line to the correct place in the Venn diagram.

1. Interphase occurs once before the process begins.
2. Process ends with identical cells.
3. Produces gametes.
4. Produces 4 cells that each have 23 chromosomes.
5. Crossing Over occurs.
6. Process is important for growth and repair.





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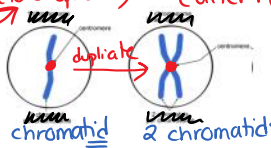
Rember: we replicate chromosomes during Interphase

1 chromosome (before replication)

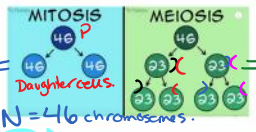
1 chromosome (after replication)

Some other **key ideas** from the video:

BOTH caused chromosomes but with different numbers of chromatids.



1 chromatid 2 chromatids.



create 2 identical daughter cells.

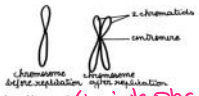
Diploid = 2N = 46 chromosomes.

creates 4 daughter cells that are NOT identical.

Haploid = N = 23 chromosomes.

Meiosis:

- Meiosis occurs in TWO parts.



Part 1: Meiosis I

- Starts with 46 chromosomes (just like mitosis), each of them duplicated (in interphase) → X
  - 46 chromosomes in 23 pairs XX XX XX
  - 92 chromatids) single strand.

92 ÷ 4 = 23 <= (23) (23) (23) (23)

- Chromosomes replicate just like in mitosis! 23. middle
- Like (homologous) chromosomes pair up at the equator of the cell. There are lots of different ways they can line up.
- In meiosis there are 23 sets of chromosomes at the dividing cell's equator. (pairs)

Prophase I <=

- While they are paired up at the equator "crossing" over can happen.
  - In crossing over, bits of chromosome are traded (genes).

Anaphase I <=

  - When chromosomes are pulled to opposite poles they have most likely changed a little bit. (genetic diversity)
- The First episode of cytokinesis happens. => 2 cells

Part 2: Meiosis II

* start with 2 cells

- Starts with 23 chromosomes, but they are each still duplicated → X
  - 23 chromosomes X
  - 46 chromatids (chromatid.)
- In both cells, chromosomes line up at the equator again. This time they are not in => Metaphase II
  homologous pairs... single X
- When chromosomes are pulled apart, the new cells have only 23 chromosomes (and 23 chromatids)!
- The 2nd episode of cytokinesis happens.

chromosome
1 chromatid or 2 chromatids

2 → 4 cells.

1 chromatid →

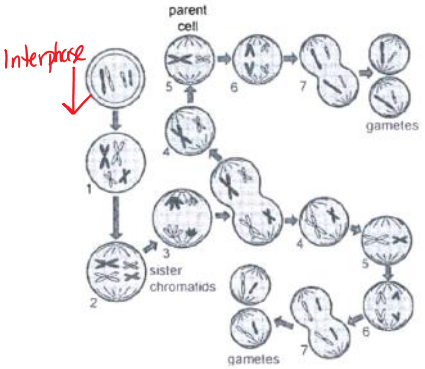
2 chromatids →

2 cells with 23 chromosomes

4 cells with 23 chromosomes

PRACTICE

Use the diagram to answer the questions that follow.



1. Each chromosome doubles itself, forming two identical copies, called sister chromatids.
   (a) How many chromosomes are in diagram 1? 4 (b) How many chromatids? 8
2. The doubled chromosomes come together in matching pairs in diagram 2. Where do they line up? At the cell's equator (middle)
3. (a) The chromosomes separate in diagram 3. Where are they pulled? Top & Bottom
   (b) Are the chromosomes that have been pulled all the same or are they different? Different
4. The first division of meiosis has occurred, and the cell has formed two new cells (diagram 4). What are the contents of these cells? 2 chromosomes & 4 chromatids
5. In diagram 5, the chromosomes again line up along the centre of each new cell. How does this step differ from diagram 2? Line up individually (not in pairs)
6. In diagram 6, the sister chromatids separate and move to opposite ends of the cell. How is this stage of meiosis very similar to mitosis? Same as anaphase of mitosis
7. (a) The cells divide in diagram 7. How many new cells are formed by meiosis? 4
   (b) Compared to the parent cell, how many chromosomes does a new cell have? Half

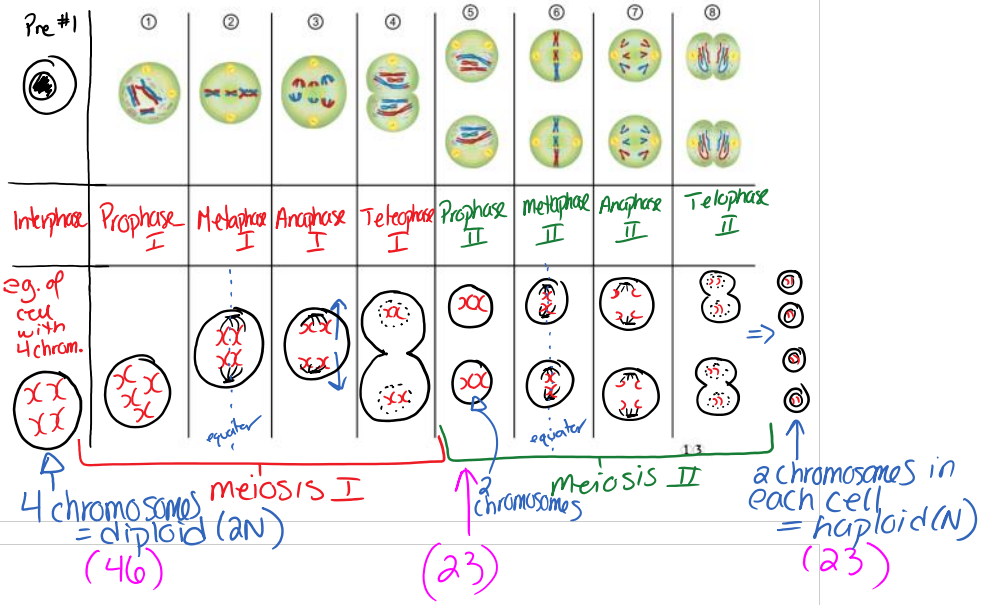
1.2

HOW DOES THE PROCESS OF MEIOSIS WORK?

Meiosis consists of 2 stages called meiosis I and meiosis II.

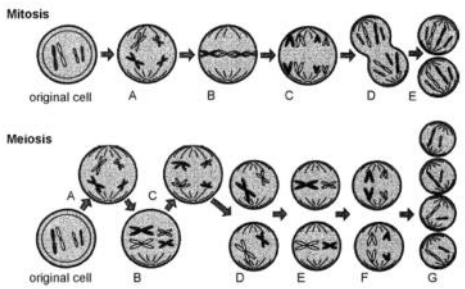
Meiosis is almost the same as running through the process of **mitosis twice**, except that there are **4 differences**.

- During prophase I, parts of non-sister chromatids **cross over** (exchange sections of DNA), which means that the resulting chromosomes have variety (genetic variation). (genes)
- During methaphaseI, the homologous chromosomes line up side by side in pairs (X X) 2 lines instead of 1 line.
- During anaphase I, the two lines of chromosomes move apart, which means that the chromosome centromers stay attached.
- There is no interphase between meiosis I and II, which means that there is no duplication of DNA and cytoplasmic material. ....that's now we get haploid cells at the end.



PRACTICE

Match each of the following descriptions with the corresponding event depicted in the diagram below. Write the correct letter in each blank.



D 1. Chromatids are still joined in meiosis, but not in mitosis.
F 2. Chromatids separate.
A 3. Chromosomes double in both mitosis and meiosis.
E 4. Mitosis is complete, but another division is about to take place in meiosis. The chromosomes line up along the centre of the cell.
C 5. In meiosis, the chromosomes separate but chromatids remain joined. In mitosis, chromatids separate.
B 6. Chromosomes line up in pairs in meiosis but not in mitosis.
G 7. End products of meiosis

Short Answer

8. Use "haploid" and "diploid" to compare the end products of meiosis with the end products of mitosis. How do they differ?

mitosis - 2 diploid daughter cells (Body cells)
meiosis - 4 haploid daughter cells (sex cells)

Meiosis - 4 haploid daughter cells (sex cells)

1.4

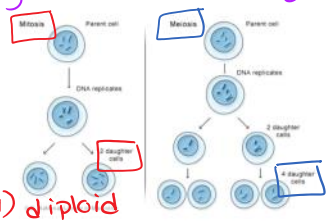
WHAT IS THE RESULT OF MEIOSIS?

Finally we have gametes that can be involved in sexual reproduction.

How are they different from somatic cells and mitosis?

1) haploid (N) cells (½ the number of chromosomes as the somatic cells)

2) "crossing over" of DNA → genetic diversity.



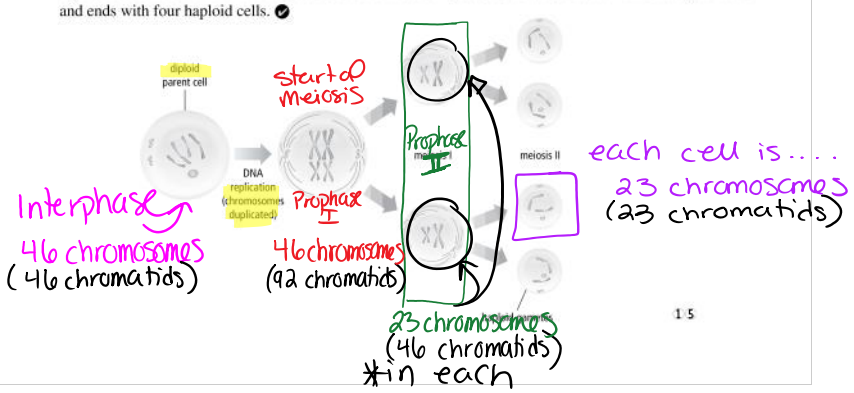
(2N) diploid (N) Haploid.

3) Since the cell is divided twices during meiosis, 4 daughter cells are produced.

Summary: What happens during meiosis?

Examine the diagram below. During meiosis, each chromosome in a cell is duplicated once and then the cell divides twice. The first division of the cell is called meiosis I. Meiosis I is similar to mitosis, but each pair of chromosomes includes one chromosome from each parent. These matching chromosomes are called **homologous chromosomes**. Meiosis I starts with a diploid cell and finishes with two haploid cells.

Each of the two haploid cells undergoes a second division called meiosis II. Meiosis II starts with two haploid cells and ends with four haploid cells. So the overall process of meiosis starts with one diploid cell and ends with four haploid cells. ✔



start of meiosis

Interphase

46 chromosomes (46 chromatids)

46 chromosomes (92 chromatids)

each cell is....

23 chromosomes (23 chromatids)

23 chromosomes (46 chromatids) *in each

1.5

HW June 13th

Homework **Assignment #2: Mitosis vs Meiosis Practice Questions pg. 16-19**

Complete this assignment in the space provided below.

Complete the chart and answer the questions that follow.

Complete the chart and answer the questions that follow.

Comparing Meiosis and Mitosis	Meiosis	Mitosis
1. Type of cell undergoing reproduction	Sex cell	Body Cell
2. Number of chromosomes before cell begins to divide	4	4
3. Number of chromosome pairs in the original cell	2	2
4. Final number of chromosomes in each new cell at the end of division	2	4
5. Chromosome pairs in each new cell at end of division	none	2

6. Compare the location and arrangement of chromosomes in the cell during metaphase I in meiosis and metaphase in mitosis.

- Mitosis: chromosomes NOT paired, lined up at center.
- Meiosis: chromosomes paired, lined up at centre

7. Compare the location and arrangement of chromosomes in the cell during anaphase I in meiosis and anaphase in mitosis.

- Same location
- Arrangement: meiosis duplicated chromatids still attached

8. How do the end results of meiosis and mitosis differ?

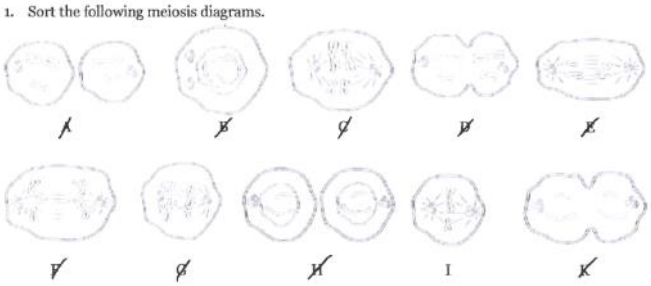
- Arrangement: meiosis duplicated chromatids still attached

8. How do the end results of meiosis and mitosis differ?
   - Mitosis: 2 identical cells
   - Meiosis: 4 cells, each with half the chromosomes

9. Predict what would happen if gametes were produced by mitosis rather than meiosis.
   - The resulting organism would have twice the normal number of chromosomes

PRACTICE

1. Sort the following meiosis diagrams.



The correct order is: B, G, C, F, D, A, I, E, K, H

2. Assume that the cells shown above belongs to an organism with four chromosomes. How can you tell that this type of nuclear division is meiosis?
   - The daughter cells have only two chromosomes.

3. What is happening in diagram "F"?
   - The homologous chromosomes are being pulled away from each other (anaphase I)

4. How are diagrams "C" and "I" similar? How are they different?
   - Both diagrams are during metaphase, where chromosomes line up at the cell equator
   - C: chromosome pairs line up & I: chromosomes line up individually

PRACTICE

True or False:

1. T Human body cells have 46 chromosomes.
2. F Mitosis is the process used to make sex cells (gametes).
3. F The cells produced in meiosis are genetically identical to the parent cell.
4. F Meiosis is used for cellular repair.
5. F Meiosis produces sex cells with double the number of chromosomes.
6. T Four new cells are formed from each parent in meiosis.
7. F In metaphase II, homologous chromosomes pair at the equator of a cell.
8. T A cell with 8 chromosomes undergoes meiosis. It produces 4 cells each with 4 chromosomes.
9. T A cell with 6 chromosomes undergoes mitosis. Each new cell will also have 6 chromosomes.
10. F There are two cell divisions in mitosis.

Matching:

A. Anaphase I	A homologous chromosomes are pulled apart
B. Anaphase II	G matching chromosomes
C. Metaphase I	C homologous chromosomes pair at the equator
D. Metaphase II	E two sets of chromosomes
E. Diploid number	D chromosomes line up at the equator
F. Haploid number	B chromosomes are pulled apart
G. Homologous chromosomes	F one set of chromosomes

18

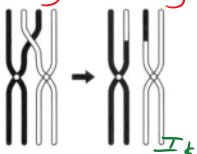
in meiosis the daughter cells are NOT identical to the parent cells

Genetic Variation

Crossing Over

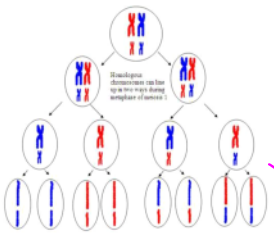
- During metaphase I of meiosis the chromosome pairs (Homologous Chromosomes) are lined up in the middle of the cell
- At this point chromosome pairs will swap pieces: this is called crossing over
- This can happen multiple times and results in a trading/mixing of genes between the two chromosomes

can happen during prophase I or metaphase I



Independent Assortment

- Chromosome pairs line up randomly during metaphase II of meiosis
  - It is random whether a particular chromosome is on the left or the right, top or bottom
- There are 2 possible arrangements for one chromosome pair (2^1), 4 for two pairs (2^2), and over 8 million for all twenty-three pairs (2^{23})!

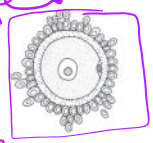


over 8 million different combinations of how these 4 cells end up.

- Crossing over and independent assortment mean that there are an incredibly huge number of possible offspring for any two parents
- This is why you are similar, but different from siblings and why there can never be another human that looks like you
- Variation within species is extremely important: this is the raw material of EVOLUTION.

Sexual Reproduction: Gametes

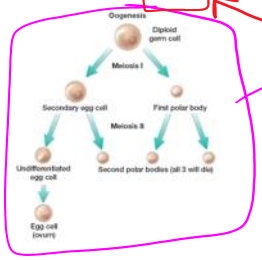
- In sexual reproduction, the haploid cells which combine their DNA are called gametes
  - The male gamete is called sperm and has a flagellum ("tail") which allows it to swim to the egg
  - The female gamete is the egg, it is much larger than the sperm but cannot move itself
- Both gametes result from meiosis of diploid body cells



Meiosis in Humans

Germ cell - cell that becomes a gamete. in males in testis, in females in ovaries.

Gamete Production in MALES

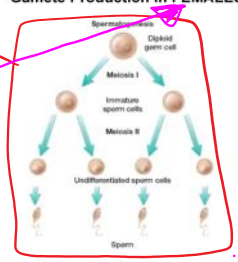


Spermatogenesis occurs in the testes and starts at puberty, and continues indefinitely.

The process of meiosis and maturation to a sperm cell takes about 65-75 days.

Testes produce 200-300 million spermatozoa daily. However, only about half of these become viable sperm.

Gamete Production in FEMALES



Oogenesis occurs in the ovaries

Oogenesis starts during fetal development. All of the cells that will become mature egg cells are present shortly after birth. Although they are present they don't progress past prophase I until puberty.

At puberty and during ovulation, the eggs continue to undergo meiosis until metaphase II. If the egg is fertilized, meiosis will reach completion. If the egg is not fertilized, the egg breaks down and is shed during the menstrual cycle.

Meiosis of one egg occurs every month until menopause. ~50yrs old

20

Sexual Reproduction

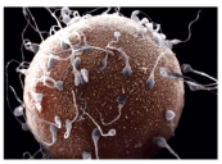
- Many organisms cannot reproduce on their own (asexual) they must combine their genetic material with another organism of the same species
- **Sexual Reproduction** = two parents combine their haploid gametes to produce genetically different offspring (diploid)

Mating

- Mating is the process which brings two compatible organisms together
- It can be as simple as releasing gametes at the same time, or as complicated as elaborate courtship behaviors to attract mates
- Mating will usually occur at a particular time of year for organisms in seasonally (usually to produce offspring in the spring)

Fertilization

- **Fertilization** = the meeting of the male + female gamete and the combination of the haploid nuclei
- Requires the sperm cell to swim to the egg, break through the egg's covering and enter
- Once one sperm enters, the egg's membrane changes and will not allow any further sperm cells to enter



Types of Fertilization

- ***External Fertilization***
  - The gametes meet outside of the body of the parents
  - This type of fertilization is common in aquatic organisms because water allows the sperm to swim to the eggs
  - Example: female frogs lay eggs in ponds and the male releases a cloud of sperm on top
    eg. salmon

2 1

- ***Internal Fertilization***
  - The gametes meet inside the body of the parents, usually the female
  - Offspring develop inside the body of the parent for a time before they are born, and are often protected afterward
  - This type of fertilization is most common in land animals because the sperm can't swim through air
  - Example: in humans the sperm and egg meet inside the oviduct of the female and young develop within the female uterus.

- ***Pollination***
  - This kind of fertilization is found in many plants
  - Sperm cells are carried inside pollen grains to the eggs inside the female organs of the plant
  - Pollen grains can blow in the wind or be carried from plant to plant by animals/insects
  - Example: orchids flowers are pollinated by particular species of bees

Why Sexual Reproduction?

Advantages	Disadvantages
* offspring are genetically different from parents	
External Fertilization - requires less energy to find a mate - produces large numbers of offspring	External Fert • offspring are unprotected (exposed to environment + predators).
Internal Fertilization - offspring are protected + cared for.	Internat Fert. • alot of energy to find a mate. • lower numbers of offspring are produced.

HW

PRACTICE

What happens in meiosis?

Vocabulary	
2	fertilization
3	gametes
4	haploid
23	meiosis
46	meiosis I
body cell	meiosis II
chromosome	mitosis
diploid	zygote
embryo	

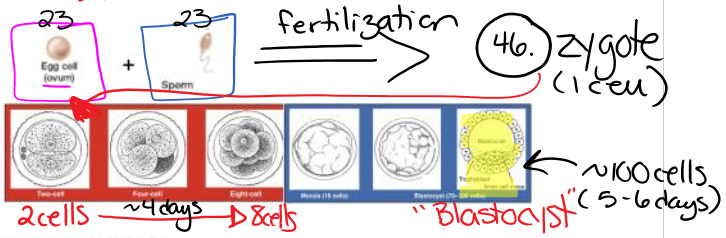
Use the terms in the vocabulary box to fill in the blanks. You can use each term more than once. You will not need to use every term.

1. Female and male organisms produce specialized cells called ___gametes___ that are necessary for reproduction. Eggs are the ___gametes___ from female parents. Sperm are the ___gametes___ from male parents.
2. During sexual reproduction, the gametes from the two parents combine during a process called ___fertilization___ to form a new cell called a ___zygote___.
3. As the zygote undergoes repeated ___mitosis___ and cell division, it matures into a(n) ___embryo___.
4. A human diploid body cell has ___23___ pairs of chromosomes.
5. Human gamete cells have a total of ___23___ chromosomes. Gametes are said to be ___haploid___.
6. During meiosis, each ___chromosome___ in a cell is duplicated once and then the cell divides twice.
7. The first division of the cell is called ___meiosis I___, which starts with a diploid cell and finishes with two haploid cells.
8. Each of the two haploid cells undergoes a second division called ___meiosis II___, which starts with two haploid cells and ends with four haploid cells.
9. Meiosis starts with one ___diploid___ cell and ends with ___4___ haploid cells.

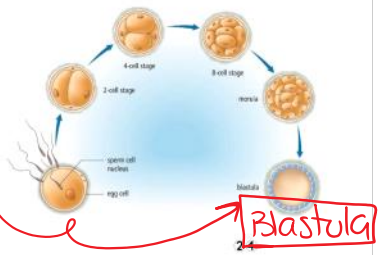
23

Human Embryonic Development

Comparison: Each column below is representing the development of a different animal embryo. Try to guess which animal from the following options : *fish, human, chick, salamander, tortoise, rabbit.*



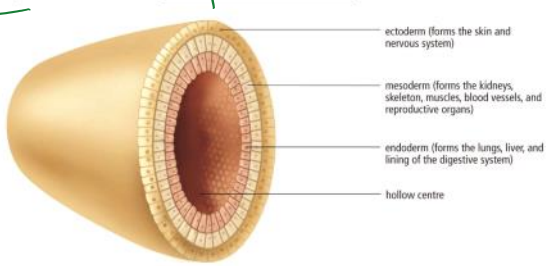
- Once the egg and sperm meet in fertilization, they combine their chromosomes to create a single diploid cell called the zygote
- The zygote goes through mitosis, becoming 2 cells, 4 cells, and so on to form a small hollow ball of cells
- Your cells all have the same chromosomes and genes in them because they were produced by mitosis of the original zygote



Stem Cells and Development

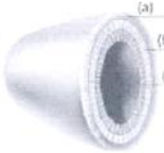
- The cells that form within the embryo are called "embryonic" stem cells: they have the ability to become many other kinds (any) of cells
- As these cells continue to divide within the embryo, they are eventually 'programmed' with different genetic identity
- Each genetic identity involves turning on or off different genes inside the cell, which creates different proteins and different kinds of cells ... that make 1 job.

"Blastula"



Blastula

PRACTICE

Embryonic development	Questions
 (a) Ectoderm (b) Mesoderm (c) Endoderm	1. Label the three layers of blastula cells on the illustration 2. What develops from the ectoderm? - Skin, nervous system 3. What develops from the mesoderm? - Kidneys, skeleton, muscles, blood vessels, reproductive organs 4. What develops from the endoderm? - Lungs, liver, lining of digestive system

Human Embryo/Fetus Development

Fertilization

- sperm swim to meet the egg in the oviduct
- Egg and sperm combine to create the zygote, which begins to divide and form the embryo

zygote

2 weeks (~1mm long)

- Embryo is now a spherical ball of stem cells (Blastula)
- Embryo grows into the uterus to form the placenta

3 weeks (1-2mm long)

- Embryonic stem cells begin to change into specific organs
  - Brain, spinal cord, heart, etc. begin to form

4 weeks (4mm long)

- Brain and spinal cord nearly finished, heart begins to pump blood
- Arms + legs begin as little buds

8 weeks (4cm long)

- face begins to take shape, forming nostrils and eyes
- Arms and legs are paddles

Embryo

12 weeks (9cm long)

- All the important organs are present, reproductive organs begin to form
- Arms and legs have digits (fingers + toes)

12-20 weeks (~35cm long)

- Fetus grow rapidly and by 20 weeks the mother can feel the fetus moving

20-38 weeks (40-50cm long)

- Fetus continues to grow, developing hair, fingernails, and other adult features
- Fetus' eyes open, it can hear and respond to light and sound

Fetus

26

PRACTICE

What happens in meiosis?

Vocabulary	
2	fertilization
3	gametes
4	haploid
23	meiosis
46	meiosis I
body cell	meiosis II
chromosome	mitosis
diploid	zygote
embryo	

Use the terms in the vocabulary box to fill in the blanks. You can use each term more than once. You will not need to use every term.

1. Female and male organisms produce specialized cells called _____ that are necessary for reproduction. Eggs are the _____ from female parents. Sperm are the _____ from male parents.
2. During sexual reproduction, the gametes from the two parents combine during a process called _____ to form a new cell called a _____.
3. As the zygote undergoes repeated _____ and cell division, it matures into a(n) _____.
4. A human diploid body cell has _____ pairs of chromosomes.
5. Human gamete cells have a total of _____ chromosomes. Gametes are said to be _____.
6. During meiosis, each _____ in a cell is duplicated once and then the cell divides twice.
7. The first division of the cell is called _____, which starts with a diploid cell and finishes with two haploid cells.
8. Each of the two haploid cells undergoes a second division called _____, which starts with two haploid cells and ends with four haploid cells.
9. Meiosis starts with one _____ cell and ends with _____ haploid cells.

Duplicate oops!

Reproductive Technologies

- About _____ of human couples cannot have children because of difficulties in _____, hormone imbalances, or other complications
- In these cases, technology is applied to _____ increase the chance of success
- These technologies are also used in breeding _____

Artificial Insemination

- This process involves collecting _____ from the male and _____ them into the body of the female (for internal fertilization)
- First developed for use with farm animals, especially _____, because farmers could choose when to fertilize and which sperm to use
- Artificial Insemination can be used with sperm from anonymous donors or from a _____ _____

In Vitro Fertilization (IVF)

- In vitro means "_____:" this involves fertilization in a petri plate
- Eggs and sperm are collected from the parents and introduced in a laboratory, a couple of days later they are placed into the _____
- Because IVF usually involves fertilizing multiple eggs, the chances of having _____ _____ greatly increases

Artificial Cloning

- _____ technology is a modification of IVF:
- An egg is collected from a donor and the _____ is removed
- A cell from the organism being cloned is removed and its nucleus is injected _____ _____
- The egg is placed into the donor's _____ to develop

Ethical Considerations

- Is it _____ to clone an organism, especially a human being?
- IVF produces multiple zygotes, and _____, what should we do with them?
- Is it right for an _____ donor to contribute sperm to artificial insemination? Should the child know his father?
- If a child develops within another woman's uterus, whose child is it?

28

HW

STOP & READ THIS!

READING ABOUT: SEXUAL REPRODUCTION
PG 32-33

Complete the following reading about sexual reproduction
Be sure to "Mark the Text" and highlight KEY DEFINITIONS as you read along.

ALSO, answer the "Reading Check" questions in the side margin as you go!

Before You Read

You began as a zygote. How many cells were you made up of then? How many cells are you made up of now? Record your ideas on the lines below.

as a zygote you are 1 cell (egg + sperm)
now you are trillions of cells!

Create a Quiz

After you have read this section, create a five-question quiz based on what you have learned. After you have written the questions, be sure to answer them. Then share them with your classmates.

What is the difference between external and internal fertilization?

Mating is the means by which gametes (sperm and egg cells) meet in the same place at the same time. Mating enables fertilization to take place. Recall that fertilization is the joining of a haploid sperm cell with a haploid egg cell to form a diploid zygote.

When sperm and egg cells join outside of the bodies of the parents, the joining is called **external fertilization**. This type of fertilization is common with animals that live in water and with plants that live in moist places.

When sperm and egg cells join inside the body of the female parent, the joining is called **internal fertilization**. This type of fertilization is common with birds, mammals, and flowering and cone-forming plants.

How does the embryo develop?

Embryonic development takes place during the first eight weeks after fertilization. During this time, the embryo develops. Its cells divide constantly, and tissues and organs form. During the first week, the single fertilized cell, the zygote, develops into a mass of many cells. This mass of cells then hollows out and is called a **blastula**. The cells of the blastula are embryonic stem cells. All tissues and organs will develop from these cells.

During the second week, the blastula cells become organized into three distinct layers of cells. The outer layer is called the ectoderm. The middle layer is called the mesoderm. The inner layer is called the endoderm. The illustration on the next page shows which organs and body structures are formed from the

Reading Check

1. When does embryonic development take place?

1. during the first eight weeks after fertilization

1. during the first eight weeks after fertilization

these cells.

During the second week, the blastula cells become organized into three distinct layers of cells. The outer layer is called the ectoderm. The middle layer is called the mesoderm. The inner layer is called the endoderm. The illustration on the next page shows which organs and body structures are formed from the cells of these layers. The development of organs and body structures from these cell layers is called **differentiation**.

What happens during fetal development?

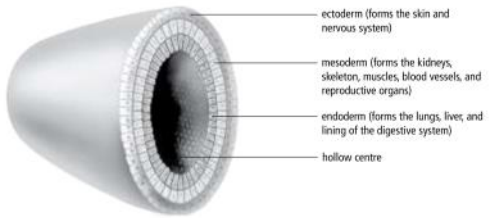
After the first eight weeks of development, the embryo is called a fetus. During fetal development, the organs and parts of the body continue to develop. The body adds a great deal of mass. At birth, the human baby is made up of trillions of cells. The table below summarizes some key events in fetal development.

Trimester (Group of 3 Months)	Stage	Time from Fertilization	Length of Embryo/ Fetus
First	◆ Brain and spinal cord are forming.	4 weeks	4 mm
	◆ Fingers and toes have appeared. Ears, kidneys, lungs, liver, and muscles are developing.	8 weeks	4 cm
	◆ Sexual differentiation almost complete.	12 weeks	9 cm
Second	◆ Fetal movements are felt.	16–18 weeks	20 cm
	◆ Eyelids open. Fetus can survive outside of the mother with specialized care.	24 weeks	35 cm
Third	◆ Rapid weight gain occurs due to the growth and accumulation of fat.	26–38 weeks	40–50 cm

Reading Check

2. What happens during fetal development?

2. organs and parts of the body continue to develop



Blastula cells organize into three layers of cells.

Homework **Assignment #2: Worksheets + Practice Questions pages 33-35**
Complete this assignment in the space provided below.

Answers:

1. mating
2. external, fish
3. internal, birds
4. embryo
5. blastula, embryonic stem cells
6. ectoderm, mesoderm, endoderm
7. differentiation
8. fetus

Embryonic and fetal development

Vocabulary	
birds	fetus
blastula	fish
differentiation	gametes
ectoderm	internal
embryo	mating
embryonic stem cells	mesoderm
endoderm	offspring
external	

Use the terms in the vocabulary box to fill in the blanks. Use each term only once. You will not need to use every term.

1. _____ is how gametes meet in the same place at the same time.
2. When sperm and egg cells join outside of the bodies of the parents, the joining is called _____ fertilization. This type of fertilization is common with _____.
3. When sperm and egg cells join inside the body of the female parent, the joining is called _____ fertilization. This type of fertilization is common with _____.
4. During embryonic development, the _____ develops. Its cells divide constantly, and tissues and organs form.
5. During the first week, the mass of cells hollows out and is called a(n) _____. Its cells are _____. All tissues and organs will develop from these cells.
6. During the second week, the blastula cells become organized into three distinct layers of cells. The outer layer is called the _____. The middle layer is called the _____. The inner layer is called the _____.
7. The development of organs and body structures from the blastula cell layers is called _____.
8. After the first eight weeks of development, the embryo is called a(n) _____.

3-1

Types of sexual reproduction

Complete the following table to compare external fertilization with internal fertilization.

Students' definitions and examples may vary.

	EXTERNAL FERTILIZATION	INTERNAL FERTILIZATION
Definition	A sperm cell and egg cell unite outside the bodies of the parents.	Sperm cells are deposited inside the female's body where they meet an egg cell.
Examples of organisms	Animals that live in water Sea urchins Fish (salmon) Mosses Ferns	Water-dwelling orcas Most land dwelling animals Mountain goats Humans Most plants

3 2