

REPRODUCTION

Unit Overview

Learning Outcomes Addressed in this Unit

1. Explain the process of cell division

- identify the contents of the nucleus: chromosomes, DNA, genes, and nucleolus
- explain the significance of cell division, with reference to the basic relationship between genes and proteins
- describe, in sequence the stages and features of the cell cycle, including mitosis and cytokinesis
- describe factors that may lead to changes in a cell's genetic information
- describe cancer as abnormal cell division
- distinguish meiosis from mitosis in terms of outcomes (ie. number of chromosomes and number of daughter cells)

2. Relate the processes of cell division and emerging reproductive technologies to embryonic development

- distinguish between male and female gametes
- describe the process by which a single zygote forms (fertilization) and develops
- explain the role of stem cells in embryonic development

3. Compare sexual and asexual reproduction in terms of advantages and disadvantages

- distinguish between sexual reproduction and asexual reproduction in representative organisms
- relate sexual and asexual reproduction to adaptability of organisms

Unit Outline

Below is a list of resources included for this unit.

Please note that each category will show as a separate folder in your desktop once you have selected and opened the unit folder.

Each item is listed in the recommended order of presentation.

Templated Notes & Power Point Presentations

Note: please review each teacher master which includes a list of materials needed and/or time required as well as larger copies of the notes to be copied into overheads.

Learning Outcome Addressed

- | | |
|--|---|
| <ul style="list-style-type: none"> • The Nucleus – Student Notesheet • The Nucleus – Teacher Master • The Nucleus – Power Point Presentation | <ul style="list-style-type: none"> • 1 |
| <ul style="list-style-type: none"> • Mitosis – Student Notesheet • Mitosis – Teacher Master • Mitosis – Power Point Presentation | <ul style="list-style-type: none"> • 1 |
| <ul style="list-style-type: none"> • Mutations and Cancer – Student Notesheet • Mutations and Cancer – Teacher Master • Mutations and Cancer – Power Point Presentation | <ul style="list-style-type: none"> • 1 |

<ul style="list-style-type: none"> • Meiosis and Diversity – Student Notesheet • Meiosis and Diversity – Teacher Master • Meiosis and Diversity – Power Point Presentation 	• 1
<ul style="list-style-type: none"> • Human Reproduction and Fertilization – Student Notesheet • Human Reproduction and Fertilization – Teacher Master • Human Reproduction and Fertilization – Power Point Presentation 	• 2
<ul style="list-style-type: none"> • Asexual Reproduction – Student Notesheet • Asexual Reproduction – Teacher Master • Asexual Reproduction – Power Point Presentation 	• 3
<p><u>Lab and Class Activities</u></p> <p><i>Note: please review each teacher master for a list of materials needed and time required</i></p>	
	Learning Outcome Addressed
<ul style="list-style-type: none"> • Cell Reproduction Illustration Assignment - Teacher Master & Student Copy 	• 1
<ul style="list-style-type: none"> • Cell Reproduction Lab - Mitosis in an Onion Root Tip - Teacher Master & Student Copy 	• 1
<ul style="list-style-type: none"> • Meiosis Flip Book Assignment - Teacher Master & Student Copy 	• 1
<ul style="list-style-type: none"> • Comparing Mitosis and Meiosis Worksheet - Teacher Master & Student Copy 	• 1
<ul style="list-style-type: none"> • Reproductive Technologies Position Paper - Teacher Master 	• 2
<p><u>Review Games</u></p>	
	Learning Outcome Addressed
<ul style="list-style-type: none"> • Reproduction Review - Reprolingo - How to Play • Reproduction Review - Reprolingo - Playing Card • Reproduction Review - Reprolingo - Vocabulary List 1 • Reproduction Review - Reprolingo - Vocabulary List 2 	<ul style="list-style-type: none"> • 1 • 2, 3
<p><u>Quizzes</u></p>	
	Learning Outcome Addressed
<ul style="list-style-type: none"> • The Nucleus Quiz – Student • The Nucleus Quiz – Teacher Master 	• 1
<ul style="list-style-type: none"> • Mitosis Quiz – Student • Mitosis Quiz – Teacher Master 	• 1

<ul style="list-style-type: none"> • Mutations and Cancer Quiz – Student • Mutations and Cancer Quiz – Teacher Master 	<ul style="list-style-type: none"> • 1
<ul style="list-style-type: none"> • Meiosis Quiz – Student • Meiosis Quiz – Teacher Master 	<ul style="list-style-type: none"> • 1
<ul style="list-style-type: none"> • Human Reproduction and Fertilization BIG Quiz – Student • Human Reproduction and Fertilization BIG Quiz – Teacher Master 	<ul style="list-style-type: none"> • 2
<ul style="list-style-type: none"> • Asexual Reproduction Quiz – Student • Asexual Reproduction Quiz – Teacher Master 	<ul style="list-style-type: none"> • 3
<p><u>Tests</u></p>	
<ul style="list-style-type: none"> • Cell Reproduction – Student • Cell Reproduction – Teacher Master 	<ul style="list-style-type: none"> • 1
<p><i>Learning Outcome Addressed</i></p>	

MEIOSIS AND DIVERSITY

NAME _____

DATE _____

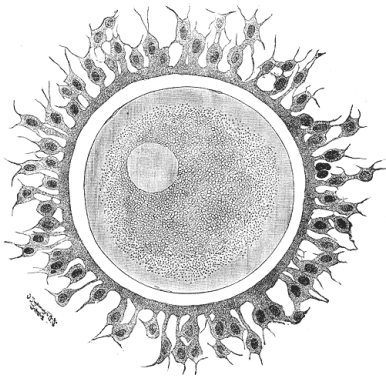
In this set of notes we will:

- distinguish meiosis from mitosis in terms of outcomes (ie. number of chromosomes and number of daughter cells)

Sexual Reproduction requires the _____ (gametes)
which function only during _____

Female gametes: _____

Male gametes: _____



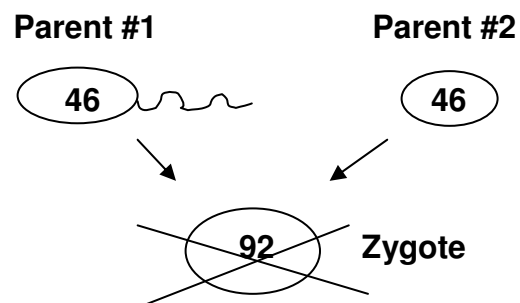
These gametes are formed using the process of _____.

During the process of meiosis, gametes are formed which have _____
_____. (called _____ cells) The
complete set of chromosomes carried by the parent is called the _____.

Remember: The karyotype of humans is 46 chromosomes, or 23 pairs of homologous chromosomes.

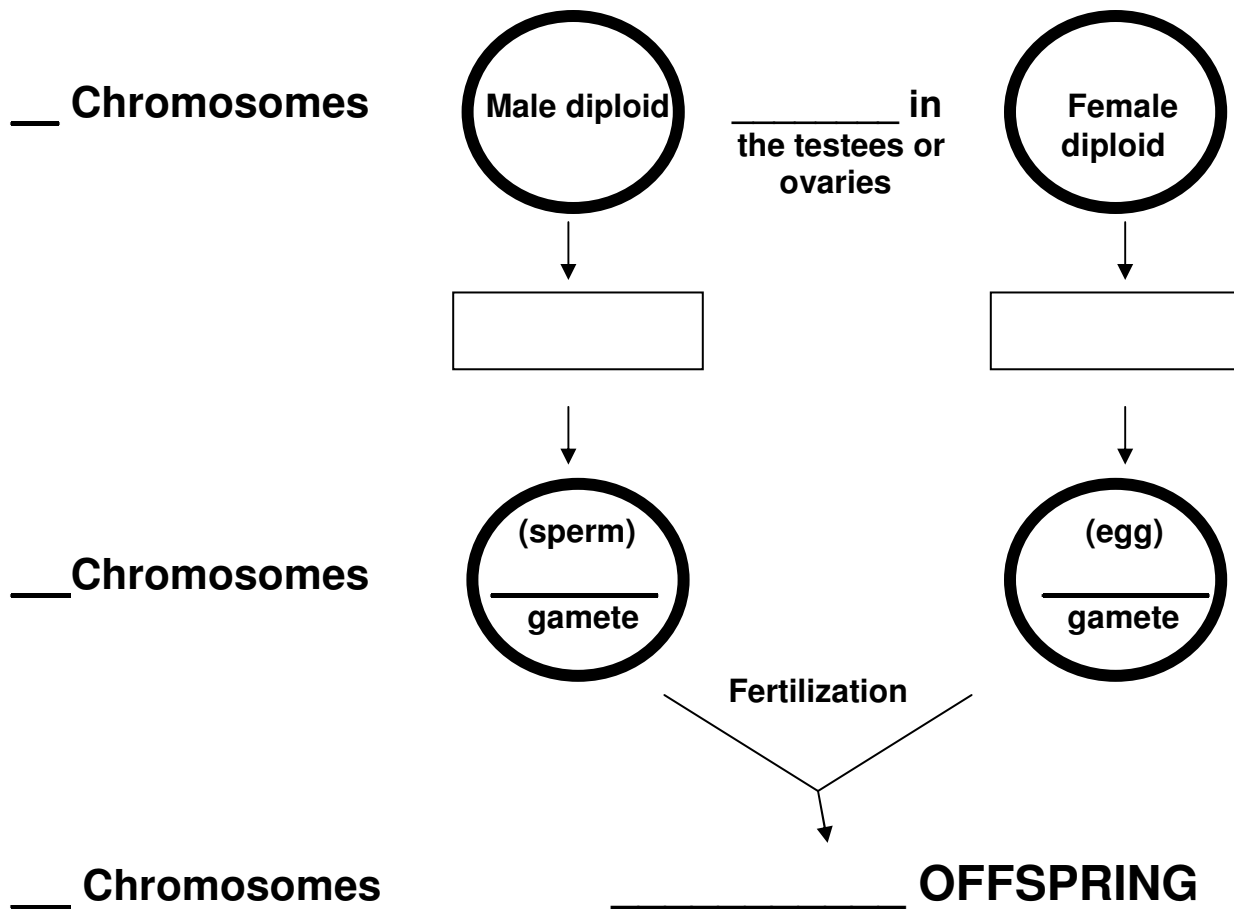
Let's think about this for a second.....

Why would there be a problem if the process of meiosis didn't happen and sperm and eggs cells carried full sets of chromosomes?



(AH! TOO MANY CHROMOSOMES!! THIS CELL WOULD DIE!!!)

This problem is avoided by _____.



The process of Meiosis I and II

Interphase

- A germ cell in the testes or ovaries spends most of its time _____ to get ready for when it will undergo Meiosis
- The cell has _____ (23 pairs)
- At the end of Interphase the _____ (now has 92 chromosomes: 46 pairs)

MEIOSIS I

Prophase I

- Chromosomes condense into _____ (tetrads)
- _____ occurs
 - _____... this provides genetic diversity....
 - The place where crossing over occurs on the chromosome is called the _____. This actually helps to hold the chromosomes together as they line up in the process of Metaphase I



- If crossing over did not occur all of our egg and sperm cells would be exactly the same.... Thus all of our kids would look exactly the same.... Why might this be a problem?

- _____(disintegrates)
- _____
 - Centrioles migrate to the poles of the cell
 - Microtubules attach to kinetochores of centromeres of tetrads

Metaphase I

- Chromosomes tetrads _____

Anaphase I

- Homologous chromosomes _____ to opposite sides of the cell

Telophase I

- Chromosomes _____
- _____ disappear
- _____ reform
- _____ and forms _____ each with _____ (23 pairs)

MEIOSIS II

Prophase II

- _____ from the 2 daughter cells
- Chromatids _____
- _____, spindle fibres form and attach to the _____

Metaphase II

- Paired chromosomes _____

Anaphase II

- Sister chromatids are _____

Telophase II

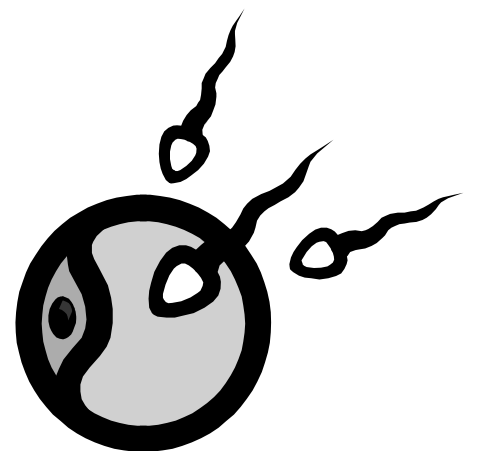
- Chromosomes _____
- _____ disappear
- _____ reforms
- _____ thus forming 4 daughter cells each with _____ (no pairs as each cell only has half of the paired chromosomes)

RESULT:

_____ each with _____ of the parent cell
(called _____ cells: have _____ chromosomes)

The actual process of forming sperm cells is called: _____

The actual process of forming egg cells is called: _____



MEIOSIS AND DIVERSITY***In this set of notes we will:***

- distinguish meiosis from mitosis in terms of outcomes (ie. Number of chromosomes and number of daughter cells

- **Recommended time required for presentation of this set of notes:**
 - 30 – 45 minutes

- **Materials Needed:** see special notes

- **Special Notes:**
 - These notes should be accompanied by a good diagram of the process of Meiosis from a text book. If you have access to the computer an excellent video of the process of Meiosis can be found at <http://www.johnkyrk.com/meiosis.html>

 - A good video of the process of crossing over can be found at <http://trc.ucdavis.edu/biosci10v/bis10v/media/ch07/crossover.html>

 - A really interesting website to consider with your class can be found at http://www.sciencecases.org/mitosis_meiosis/mitosis_meiosis2.asp and considers a trial called the The Case of the Dividing Cell: Mitosis and Meiosis in the Cellular Court

 - May want to also introduce the concept of meiosis with a video before giving the notes as students often have a hard time visualizing the process of meiosis.

TEMPLATED NOTES BEGIN ON NEXT PAGE SO THAT THEY CAN EASILY BE PRINTED OR COPIED ONTO AN OVERHEAD TRANSPARENCY

MEIOSIS AND DIVERSITY

NAME _____
DATE _____

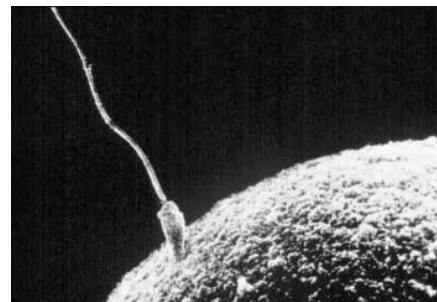
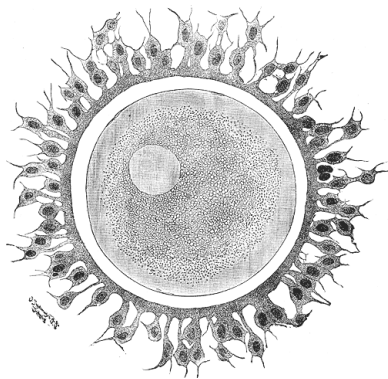
In this set of notes we will:

- distinguish meiosis from mitosis in terms of outcomes (ie. number of chromosomes and number of daughter cells)

Sexual Reproduction requires the **formation of special cells** (gametes) which function only during **reproduction**.

Female gametes: **EGGS**

Male gametes: **SPERM**



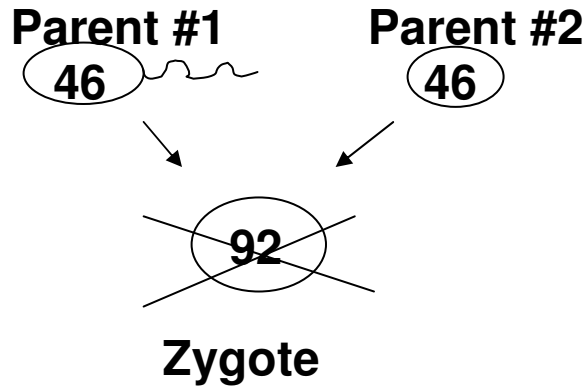
These gametes are formed using the process of **MEIOSIS**.

During the process of meiosis, gametes are formed which have **half the number of chromosomes of the parent**. (called **HAPLOID** cells) The complete set of chromosomes carried by the parent is called the **KARYOTYPE**.

Remember: The karyotype of humans is 46 chromosomes, or 23 pairs of homologous chromosomes.

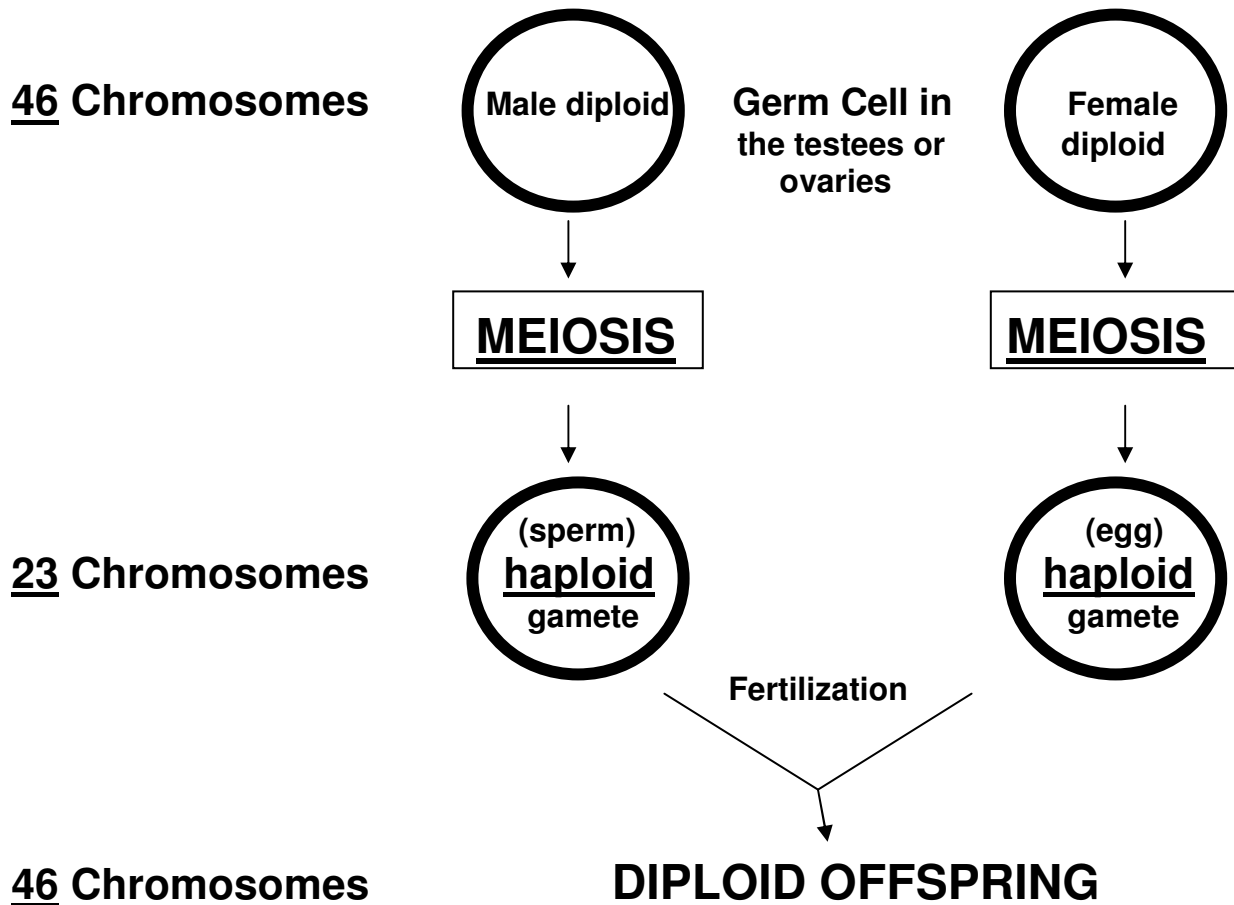
Let's think about this for a second.....

Why would there be a problem if the process of meiosis didn't happen and sperm and eggs cells carried full sets of chromosomes....



(AH! TOO MANY CHROMOSOMES!! THIS CELL WOULD DIE!!!)

This problem is avoided by MEIOSIS.



The process of Meiosis I and II

Interphase

- A germ cell in the testes or ovaries spends most of its time **growing and making proteins** to get ready for when it will undergo Meiosis
- The cell has **46 chromosomes** (23 pairs)
- At the end of Interphase the **genetic material is replicated** (now has 92 chromosomes: 46 pairs)

MEIOSIS I

Prophase I

- Chromosomes condense into **homologous chromosome pairs** (tetrads)
- **Crossing over** occurs
 - **Random segments of paired chromosomes are exchanged**... this provides genetic diversity....
 - The place where crossing over occurs on the chromosome is called the **Chiasmata**. This actually helps to hold the chromosomes together as they line up in the process of Metaphase I



- If crossing over did not occur all of our egg and sperm cells would be exactly the same.... Thus all of our kids would look exactly the same.... Why might this be a problem?

(genetic diversity allows a species to adapt to its environment and survive, on fertilized egg has over 70 trillion different genetic possibilities)

- **Nucleolus and nuclear membrane disappears**
(disintegrates)
- **Meiotic spindle forms**
 - Centrioles migrate to the poles of the cell
 - Microtubules attach to kinetochores of centromeres of tetrads

Metaphase I

- Chromosomes tetrads **line up in the middle of the cell**

Anaphase I

- Homologous chromosomes **tetrads are pulled apart** to opposite sides of the cell

Telophase I

- Chromosomes **arrive at the poles**
- **Microtubules** disappear
- **Nuclear membranes** reform
- **Cytokinesis occurs** and forms **2 daughter cells** each with **46 chromosomes** (23 pairs)

MEIOSIS II

Prophase II

- **Nucleoli and nuclear membranes disappear** from the 2 daughter cells
- Chromatids **thicken back into chromosome pairs**
- **Centrioles move to the poles**, spindle fibres form and attach to the **kinetochores**

Metaphase II

- Paired chromosomes **line up at the equator**

Anaphase II

- Sister chromatids are **pulled apart to opposite sides of the cell**

Telophase II

- Chromosomes **uncoil**
- **Microtubules** disappear
- **Nuclear membrane** reforms
- **Cytokinesis occurs** thus forming 4 daughter cells each with **23 chromosomes** (no pairs as each cell only has half of the paired chromosomes)

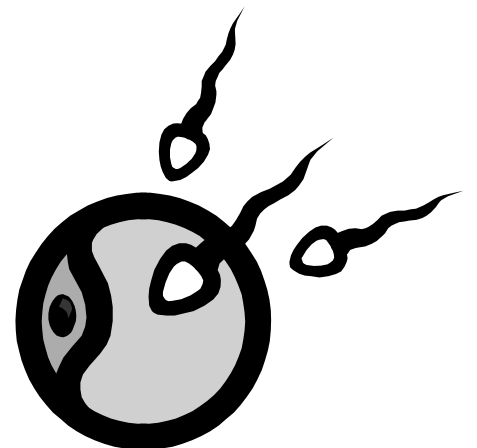
RESULT:

4 daughter cells

each with **1/2 the DNA** of the parent cell
(called **HAPLOID** cells: have **23** chromosomes)

The actual process of forming sperm cells is called: **spermatogenesis**

The actual process of forming egg cells is called: **oogenesis**



MEIOSIS QUIZ

NAME _____

DATE _____

____ /10

Multiple Choice (8 marks)

Please select the letter of the phrase that best completes the question or statement. Write the letter in the space provided.

- | | |
|---|--|
| <p>_____ 1. How many chromosomes are found in an egg cell?
 a) 23 pairs
 b) 46 pairs
 c) 23
 d) 46</p> <p>_____ 2. How many chromosomes does a germ cell have at the very end of interphase (before prophase I)?
 a) 23
 b) 46
 c) 92
 d) 23 pairs</p> <p>_____ 3. In which stage of meiosis does the process of crossing over occur?
 a) Prophase I
 b) Metaphase I
 c) Prophase II
 d) Metaphase II</p> <p>_____ 4. In which phase of meiosis are the chromosomes found at some point in tetrads?
 a) Meiosis I
 b) Meiosis II
 c) Interphase
 d) Cytokinesis</p> | <p>_____ 5. Which of the following statements is FALSE regarding the process of Telophase I?
 a) chromosomes arrive at the poles
 b) microtubules disappear
 c) nuclear membranes reform
 d) cytokinesis occurs and forms 4 daughter cells</p> <p>_____ 6. Chiasmata is the term given to...
 a) the attachment place of spindle fibres to the centromeres
 b) the place where crossing over has occurred
 c) the thickening of chromosome pairs
 d) random segments of chromosomes that are lost during crossing over</p> <p>_____ 7. Daughter cells that have half of the genetic material as the parent cells are called...
 a) Deformed
 b) Diploid
 c) Haploid
 d) None of the above</p> <p>_____ 8. In anaphase II...
 a) chromosomes line up at the equator of the cell
 b) nuclear membranes reform
 c) chromosome tetrads are pulled apart to opposite sides of the cell
 d) sister chromatids are pulled apart to opposite sides of the cell</p> |
|---|--|

Short Answer (2 marks)

Please answer the following question(s) in the space provided. If necessary please show all your work.

9. Why is it important that the process of crossing over occur in the process of meiosis? (1 mark)
- **to allow for genetic diversity**

10. What is the term given to the process of forming human egg cells by the process of Meiosis? (1 mark) - **oogenesis**