DOCUMENT RESUME

ED 096 145 SE 018 047

AUTHOR Henderson, Paula

TITLE Meiosis.

INSTITUTION Delaware State Dept. of Public Instruction, Dover.; Del Mod System, Dover, Del.
SPONS AGENCY National Science Foundation, Washington, D.C.
REPORT NO NSF-GW-6703
PUB DATE 30 Jun 73
NOTE 10p.

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS *Autoinstructional Programs; Biology; *Cytology; Instruction; *Instructional Materials; *Middle Schools; Science Education; Teacher Developed Materials; Units of Study (Subject Fields)
IDENTIFIERS *Del Mod System

ABSTRACT

This autoinstructional lesson deals with the study of cytology (or cells) with emphasis placed on cell reproduction. Knowledge of the structure of the DNA molecule and of the stages of mitotic cell division are considered prerequisites for this lesson. Approximately 15 minutes is the established time set for the activity. The behavioral objectives are listed and the equipment and materials required are itemized. A vocabulary guide and a self-quiz exercise are included with the student script. (EB)

MEIOSIS

Prepared By

Paula Henderson
Science Teacher
NEWARK SCHOOL DISTRICT

June 30, 1973

Printed and disseminated through the office of the Del Mod Component Coordinator for the State Department of Public Instruction, John G. Townsend Building, Dover, Delaware 19901

Preparation of this monograph was supported by the National Science Foundation Grant No. G.W. 6703 to the Del Mod System, P. O. Box 192, Dover, Delaware 19901

THE COUNCIL OF PRESIDENTS

THE UNIVERSITY OF DELAWARE

E. Arthur Trabant, *President*
Daniel C. Neale, *Coordinating Council on Teacher Education*
Robert L. Uffelman, *Coordinator*

DELAWARE STATE COLLEGE

Luna I. Mishoe, *President*
M. Milford Caldwell, *Coordinating Council on Teacher Education*
Ralph Hazelton, *Coordinator*

DELAWARE TECHNICAL AND COMMUNITY COLLEGE

Paul K. Weatherly, *President*
Ruth M. Laws, *Coordinating Council on Teacher Education*
Ethel L. Lantis, *Coordinator*

STATE DEPARTMENT OF PUBLIC INSTRUCTION

Kenneth C. Madden, *State Superintendent*
Randall L. Broyles, *Coordinating Council on Teacher Education*
John F. Reiher, *Coordinator*

DEL MOD SYSTEM

Charlotte H. Purnell, *State Director*
John A. Bolig, *Research Director*

A-T TEACHER'S GUIDE

Packet Number - AT574.87
Hm

Title - Meiosis

Grade Level - Middle

Subject - Cytology

Prerequisites - Knowledge of the structure of the DNA molecule and of the stages of mitosis

Behavioral Objectives -

1. To be able to list the stages of meiosis and explain briefly what occurs in each.

2. To be able to compare meiosis and mitosis.

3. To be able to cite one reason why meiosis is necessary for sexual reproduction.

Equipment and Material -

Casset tape
Poster with objectives
Six slides
Slide viewer
Tape recorder
Vocabulary sheet and self-quiz

Time - Approximately 15 minutes

Sample Evaluation - Self-quiz to be taken and checked by the student

Space Required - Carrel

MEIOSIS

Hi! You should have learned the concept of mitosis by now. Do you understand it? Make sure that you do since it is a topic that we will be discussing on several occasions during the school year. Remember that all cells of an organism contain identical chromosome material. But what does this mean to you? It means that in the skin cells of your finger are the same 46 chromosomes that are in your liver, bones, muscles, and brain cells. Obviously all those genes on the chromosomes are not active at the same time but they are all present. For example the genes necessary for muscle action are present in the liver but are not active - only the liver genes are. Now answer this question -- How do we get these same identical chromosomes in all cells? -- I hope your answer was by mitosis. Your particular type of chromosomes is what makes you--you! The unit that pulls your body together into one functioning organism is that each cell has the same information.

There is one important exception to this rule - the sex cells. What would happen if a sperm with 46 chromosomes fertilized an egg cell with 46? You would get a resulting individual with 92 chromosomes. Since a normal human has 46 chromosomes this would mean that the resulting baby with 92 would not be a normal human but would be something entirely different. We all know, however, that every day perfectly normal human babies are being born. There must be therefore some special process that occurs in the sex cells to insure that the resulting combination from a human egg and sperm will have the 46 chromosomes necessary for producing a normal human child. The process that insures this is meiosis. Many of the steps of meiosis are similar to those in mitosis but the results are cells with half the number of chromosomes as the original. Remember that in mitosis the results were cells with the identical chromosomes. If sex cells are formed through meiosis and therefore have one-half the number of chromosomes than an egg would have 23 and would be fertilized by a sperm with 23 thereby producing a zygote with 46 chromosomes - the number necessary for producing a normal human child.

In the example used for learning mitosis we used a cell with four chromosomes. It is important for you to know now that chromosomes are present in cells in pairs so that in this cell with four chromosomes there are actually two pair; in a human with 46 chromosomes, there are 23 pair; in a goldfish with 94, there are 47 pair; and in a housefly with 12, there are six pair. It is

sometimes hard for a student to picture pairs of chromosomes which he has never seen, but everyone has seen pairs of shoes.

LOOK AT SLIDE ONE

Look at the pair of purple sneakers. They both have the same parts - but are they identical? -- No! -- One is for the right foot and one is for the left. They have the same parts, but are a little different. For example a pair of chromosomes might both have the gene for eye color, but one would be for brown and one for blue. We will learn more about this when we study genetics.

For the time being let's return to the shoe example. If you can understand the concept of meiosis by working with a more familiar object, you should have no trouble when we compare this to what is really happening with the chromosomes.

Here we see four shoes - 2 pairs. There is a purple pair of sneakers and a green pair of heels. Stretch your imagination some now and imagine the shoes going through the same steps of meiosis that the chromosomes do. Do you remember the first step of mitosis? It was interphase, during which the DNA ladders duplicated.

NOW LOOK AT SLIDE TWO

Here under the heading DUPLICATION our shoes have done the same thing as the DNA ladders do. Each has produced an exact replica of itself. We now have four sneakers and four heels. Each group of four remains together in the beginning of meiosis and is called a tetrad which means group of four. Do you remember how in mitosis the spindle fibers pulled the chromosomes to opposite sides of a cell? We can represent that here by separating our tetrads and placing the shoes in two shoe boxes to represent the two cells. Notice that the identical shoes remain together but are separate from their corresponding set - both left sneakers are in one box and both right sneakers in the other - both left heels are in one box and both right heels in the other. You would not get three heels in one box and one in another or a right and left heel together. The identical mates remain together in this first division since they are attached.

NOW LOOK AT SLIDE THREE

The shoe boxes you see at the top are the result of the first meiotic division and are merely redrawn here. Remember, however, that the purpose of meiosis is to cut the number in half. We have

not done this since we began with four shoes and we now have two boxes which each still have four shoes. Our purpose is to cut this number in half so that each new box will have two - one of each kind. This is accomplished through the process of reduction division as shown in the bottom row. One member of each pair is put into each box. We now have what we set out to get - one of each kind in each box.

If we ran through this again, it's possible that we could get both left sneakers and the right heels in one box and the right sneakers and left heels in the other. What is important is that the identical ones stay together and that the two pairs in the tetrads enter separate boxes.

NOW LOOK AT SLIDE FOUR

This is a picture of the human chromosomes as they appear in prophase. The DNA has already duplicated so you can see the 46 pairs. Each two identical chromatids formed when the DNA duplicated are joined together by a centromere so that they look like an "X". These pairs will be pulled apart in the final step of meiosis. If you looked very closely you would see that each "X" has a partner "X" that it pairs with in meiosis to form the tetrad I mentioned earlier.

NOW LOOK AT SLIDE FIVE

Here you see the stages in meiosis. It should look at lot like mitosis to you. In fact the stages you see here are the same as you observed before. In early prophase the chromosome "X"'s begin to appear. Remember that these are formed by the duplicated DNA strands held together. By late prophase they are quite evident and the nucleolus and nuclear membrane have broken down.

During meiosis in metaphase when the pairs line up they are in their tetrads. Notice that the red and orange long pairs are together here and the purple and blue short pairs are together. In anaphase just as in the shoe example the identical pairs remain together and are pulled to the opposite sides of the cell from their partner. Can you see this in the fourth picture? The red pair has been pulled to the opposite side of the cell from the orange pair.

NOW LOOK AT SLIDE SIX

In telophase as in mitosis the two new cells start to separate but we're not done yet. Remember that the whole purpose of

meiosis was to make cells with half the number of chromosomes and we don't have that yet. Instead there is a second metaphase in which the chromosomes again line up in the center. In anaphase these pairs are pulled apart by the spindle fibers and in telophase the process is completed. There are now four cells each with half the number of chromosomes. The sex cells are now formed and ready to combine to form a new individual.

Well! That's it! Did you understand it all? Make sure that you did since we will be referring to meiosis many times this year. If you didn't understand it, it is worthwhile to listen to the tape again to make sure you do. Read over the vocabulary and take the little self-quiz. Turn off the tape while you do this and then turn it back on for the answers.

MEIOSIS VOCABULARY

MITOSIS	**the process of cell duplication and division.**
MEIOSIS	**the process of reducing the number of chromosomes by one-half. The sex cells are formed in this manner.**
TETRAD	**a group of four chromosomes formed by each member of a chromosome pair duplicating itself.**
REDUCTION DIVISION	**the step in meiosis that cuts the number of chromosomes in half.**

MEIOSIS SELF-QUIZ

_____ 1. If a cell having eight chromosomes undergoes mitosis, how many chromosomes will the two new daughter cells have?

a. 4 b. 8 c. 16 d. 2

_____ 2. If a cell having eight chromosomes undergoes meiosis, how many chromosomes will the new cells have?

a. 2 b. 4 c. 8 d. 16

_____ 3. How many new cells will there be after meiosis has occurred?

a. 2 b. 1 c. 3 d. 4

_____ 4. Before either meiosis or mitosis can occur what must happen?

a. the cell must split in two
b. the DNA must duplicate itself
c. the mitochondria must double
d. the cell must eat a good meal and rest at least 5 hours

_____ 5. In meiosis how many times does anaphase occur?

a. 1 b. 2 c. 3 d. 4

_____ 6. What kind of cells are formed in meiosis?

a. liver cells
b. all cells
c. sex cells
d. skin cells

MUSIC

Here are the answers to the quiz. Number one reads: If a cell having eight chromosomes undergoes mitosis, how many chromosomes will the two new daughter cells have? The answer is: b - 8. The reason is that mitosis produces exact copies. Number two: If a cell having eight chromosomes undergoes meiosis, how many chromosomes will the new cells have? b - 4. The purpose of meiosis is to cut the number in half. Number three: How many new cells will there be after meiosis has occurred? The answer is: d - 4. Number four: Before either meiosis or mitosis can occur what must happen? The answer is: b - the DNA must duplicate. Number five: In meiosis how many times does anaphase occur? b - 2. The chromosomes are separated twice. Number six: What kind of cells are formed in meiosis? The answer is: c - sex cells. All other kinds of cells are formed by mitosis.

If you have understood the process to your satisfaction, rewind the tape and leave the carrel as you found it. That's all for now.

MUSIC