(87)

SET 53

ANIMAL MITOSIS

FIRST CLEAVAGE IN ASCARIS

This is the story of the first hour of an animals life - of a man or dog or a fish or a worm. Each begins life as a single cell.

How does an animal begin to develop from a single cell?

In order to observe animal mitosis under the microscope, we have chosen the egg sac of the ascaris (AS-ca-ris), a parasitic worm.

Ascaris is a good subject for this study because the chromosomes are large and the characteristics number of chromosomes in this species is only four.

The female ascaris lays her eggs in small sacs. We can observe some of the eggs as they begin their development. Although the adult worm is very different from a human, the first hours – of a man and a worm – are quite similar.

These eight slides begin the story just after the egg has been fertilized. They show the activity within the cell from that moment until it divides to form the two-cell stage of the embryo.

The terms "equatorial plate" and "poles", as they are used in the study of mitosis, refer to certain locations in the cell. The equatorial plate in these slides runs from the top of the slide to the bottom; the poles are locations to the left and right of the plate.

The magnification given, for example, 75x for Slide 1 – The Zygote – means that the microscope was set at that power when the photograph was taken.

1 THE ZYGOTE (750x)

This is the zygote - the fertilized egg - of the ascaris. Two masses of chromatin can be seen in the cell. One mass was the nucleus of the egg. The other came from the sperm that fertilized the egg.

The sperm and the egg are very different in size and shape. The chromatin contributed by each is equal in amount. Each parent supplies an equal amount of hereditary material to the offspring.

The chromosomes are not seen distinctly because they are very thin. This cell is thick and round like a tiny ball, making it difficult to keep all the chromatin in focus.

2 PRO-METAPHASE (750x)

The chromosomes have become much shorter and thicker, so that they are now easily seen. Each parent supplied two chromosomes to form the zygote.

Notice how the chromosomes begin to pair up. Study their shapes carefully. One pair looks like two horseshoes. The other pair resembles bent rods. If you move ahead to slide 4, you can get a better idea of the peculiar shapes they have assumed. In these slide, we shall refer to these chromosomes as the "U-shaped" and the "bent."

The sperm supplied one U-shaped and one bent chromosome. The other U-shaped and bent chromosomes came from the egg cell. After fertilization, the two U-shaped ones pair up, as do the two bent chromosomes.

After a while, the two pairs begin to move towards the equatorial plate.

3 METAPHASE (750x)

In this slide the chromosomes have moved on to the equatorial plate. The equatorial plate is the imaginary line running from (E) to (E). At each pole is a centriole (P). A starlike structure, called an aster, radiates from each centriole.

Fine spindle fibers go from the centriole at (P) to each chromosome. Some of these can be seen in this slide.

At metaphase, chromosomes in most cells can be seen to be divided lengthwise; but the parts are held together by a structure called a CENTROMERE (Sent-ro-meer). This condition is not visible in these Ascaris slides. (The location of the centromeres can be seen in human chromosomes - see Microslide Set 62).

4 METAPHASE - POLAR VIEW (750x)

This is the same stage in the development of the egg as shown in slide 3, but we are now looking at the cell from the side, that is, from one pole, through the equatorial plate, to the other pole.

The four chromosomes are seen as they lie flat on the equatorial plate.

Look back at slide 3. You can see the chromosomes from the side. The centromeres (not visible) would be near the center of each chromosome.

5 EARLY ANAPHASE (750x)

Each chromosome has completed duplication. There are now four u-shaped and four bents.

In these eight chromosomes there is enough hereditary material for two cells.

At this stage you can also see that the duplicated chromosomes are beginning to form two groups. The groups are starting to move towards the poles and, as they progress, the separation between them will be clearly seen. Each chromosome is being pulled by a spindle fiber attached to each centromere.

6 ANAPHASE (750X)

The eight chromosomes are now separated into two groups, each with four chromosomes. The spindle fibers are pulling each group of chromosomes towards the aster and centriole at each pole. Electron microscopes show that the spindle fibers are made up of extremely small structures called microtubules.

Look closely at the chromosomes. Some of them appear to be beaded in places. Authorities on this subject believe that the long, thin chromosomes become short and thick by twisting into a tight coil. Sometimes the coil loosens up a bit, making the chromosome look beaded.

7 TELOPHASE (750X)

The two groups of chromosomes have drawn completely apart from each other. At the same time the rest of the cell is beginning to divide. The cell membrane pinches inward and the cytoplasm is dividing into two masses.

If you go back to slide 6 and examine the cell membrane carefully, you will actually see the beginning of this pinching process.

As the cell approaches its division into two cells, the individual chromosomes become less distinct.

8 LATE TELOPHASE (750x)

The separation is now complete. The original zygote of the ascaris has divided to form two daughter cells. Each of these two cells has four chromosomes.

The chromosomes in each cell will soon lose their clarity. They will become long and thin and not so distinct. Then the process of mitosis will start again in each of the two daughter cells. The result will be four cells, and these in turn will start the process of cell division or mitosis again.

You can thus see how mitosis in the ascaris achieved its function. One cell with two pairs of chromosomes formed two cells, each a duplicate of the original.

In the human being the process of mitosis is the same, but the number of chromosomes is forty-six as compared with the four in the ascaris. Until 1958, scientists believed that the characteristic number of chromosomes in humans was forty-eight. Improvements in instruments and techniques have since made an accurate count possible.