Ascaris
1. Why don’t people give birth to chickens or cats?
2. How many kids could your parents have before two were exactly the same?
Both mitosis and meiosis are initiated in cells that are diploid or “2n,” meaning cells that contain paired sets of chromosomes. The members of each pair are homologous—the same in size and function. Two pairs of homologous chromosomes are shown within the cells in both the mitosis and meiosis figures. In each homologous pair, one chromosome (in red) comes from the mother of the person whose cell is undergoing meiosis, while the other chromosome (in blue) comes from the father of this person.

Prior to the initiation of both mitosis and meiosis, the chromosomes duplicate. In both processes, each chromosome is now composed of two sister chromatids.

In mitosis, the chromosomes line up on the metaphase plate, one sister chromatid on each side of the plate. In meiosis, homologous chromosomes—not sister chromatids—line up on opposite sides of the metaphase plate.

In mitosis, the sister chromatids separate. In meiosis, the homologous pairs of chromosomes separate.

In mitosis, cell division takes place, and each of the sister chromatids from step 4 is now a full-fledged chromosome. Mitosis is finished. In meiosis, one member of each homologous pair has gone to one cell, the other member to the other cell. Because each of these cells now has only a single set of chromosomes, each is in the haploid or “n” state. Next, these single chromosomes line up on the metaphase plate, with their sister chromatids on opposite sides of the plate.

The sister chromatids of each chromosome then separate.

The cells divide again, yielding four haploid cells.
The Steps of Meiosis

Prior to meiosis

Diploid

End of interphase
DNA has already duplicated

Meiosis I

Prophase I
Homologous chromosomes link as they condense, forming tetrads.

Metaphase I
Microtubules move homologous chromosomes to metaphase plate.

Anaphase I
Microtubules separate homologous chromosomes (sister chromatids remain together).

Crossing over occurs (see Figure 10.3)

Independent assortment occurs (see Figure 10.4)

Figure 10.2
Telophase I
Two haploid daughter cells result from cytokinesis.

Prophase II (Brief)

Metaphase II
Sister chromatids line up at new metaphase plate.

Anaphase II
Sister chromatids separate.

Telophase II
Four haploid cells result.
The X and the Y
**Spermatogenesis**

1. The diploid spermatogonium cell produces a primary spermatocyte.

2. The primary spermatocyte goes through meiosis I, yielding two haploid secondary spermatocytes.

3. The secondary spermatocytes go through meiosis II, yielding four haploid spermatids, which will develop into mature sperm cells.

**Oogenesis**

1. Before the birth of the female, a cell called an oogonium develops into a primary oocyte; this cell enters meiosis I, but remains there until it matures in the female ovary, beginning at puberty.

2. On average, one primary oocyte per month will complete meiosis I. In this process, an unequal meiotic division of cellular material leads to the production of one polar body and one secondary oocyte, which enters into meiosis II.

3. Only secondary oocytes that are fertilized by sperm will complete meiosis II and develop into an egg. The three polar bodies that are produced by meiosis I and II will be degraded.

---

Figure 10.8
Down Syndrome

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Percentage</th>
<th>Characteristics</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mental impairment</td>
<td>99%</td>
<td>Abnormal teeth</td>
<td>60%</td>
</tr>
<tr>
<td>Stunted growth</td>
<td>90%</td>
<td>Slanted eyes</td>
<td>60%</td>
</tr>
<tr>
<td>Umbilical hernia</td>
<td>90%</td>
<td>Shortened hands</td>
<td>60%</td>
</tr>
<tr>
<td>Increased skin back of neck</td>
<td>80%</td>
<td>Short neck</td>
<td>60%</td>
</tr>
<tr>
<td>Low muscle tone</td>
<td>80%</td>
<td>Obstructive sleep apnea</td>
<td>60%</td>
</tr>
<tr>
<td>Narrow roof of mouth</td>
<td>76%</td>
<td>Bent fifth finger tip</td>
<td>57%</td>
</tr>
<tr>
<td>Flat head</td>
<td>75%</td>
<td>Brushfield spots in the iris</td>
<td>56%</td>
</tr>
<tr>
<td>Flexible ligaments</td>
<td>75%</td>
<td>Single transverse palmar crease</td>
<td>53%</td>
</tr>
<tr>
<td>Proportionally large tongue</td>
<td>75%</td>
<td>Protruding tongue</td>
<td>47%</td>
</tr>
<tr>
<td>Abnormal outer ears</td>
<td>70%</td>
<td>Congenital heart disease</td>
<td>40%</td>
</tr>
<tr>
<td>Flattened nose</td>
<td>68%</td>
<td>Strabismus</td>
<td>~35%</td>
</tr>
<tr>
<td>Separation of first and second toes</td>
<td>68%</td>
<td>Undescended testicles</td>
<td>20%</td>
</tr>
</tbody>
</table>

Eyes of newborn, showing Brushfield spots in iris

Feet of boy with Down syndrome

8-year-old boy with Down syndrome

Eyes of newborn, showing Brushfield spots in iris
Nondisjunction

Nondisjunction of homologous chromosomes in meiosis I

Nondisjunction of sister chromatids in meiosis II

Number of chromosomes:
- (a) $n + 1$, $n - 1$
- (b) $n + 1$, $n - 1$
Regeneration

Figure 10.11