



**A PILOT DVD PROJECT**

***MEIOSIS MISHAPS***

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## Activity 1: Nondisjunction and Chromosomal Syndromes

**Time Frame:** 2 hours (Can be performed in a typical double block period or over two consecutive single class periods)

**Materials:** HHMI Lecture *The Meaning of Sex* (Nov. 2001), copies of student handouts, overhead projector with teacher overhead transparencies, pipe cleaners and beads (or Meiosis simulation pop-bead kit such as Ward's #36W-1602)

### Teacher Directions:

The lesson is an analysis of nondisjunction and the various syndromes that occur due to this mishap in the chromosomes, including Down syndrome, Turner syndrome, and Klinefelter syndrome.

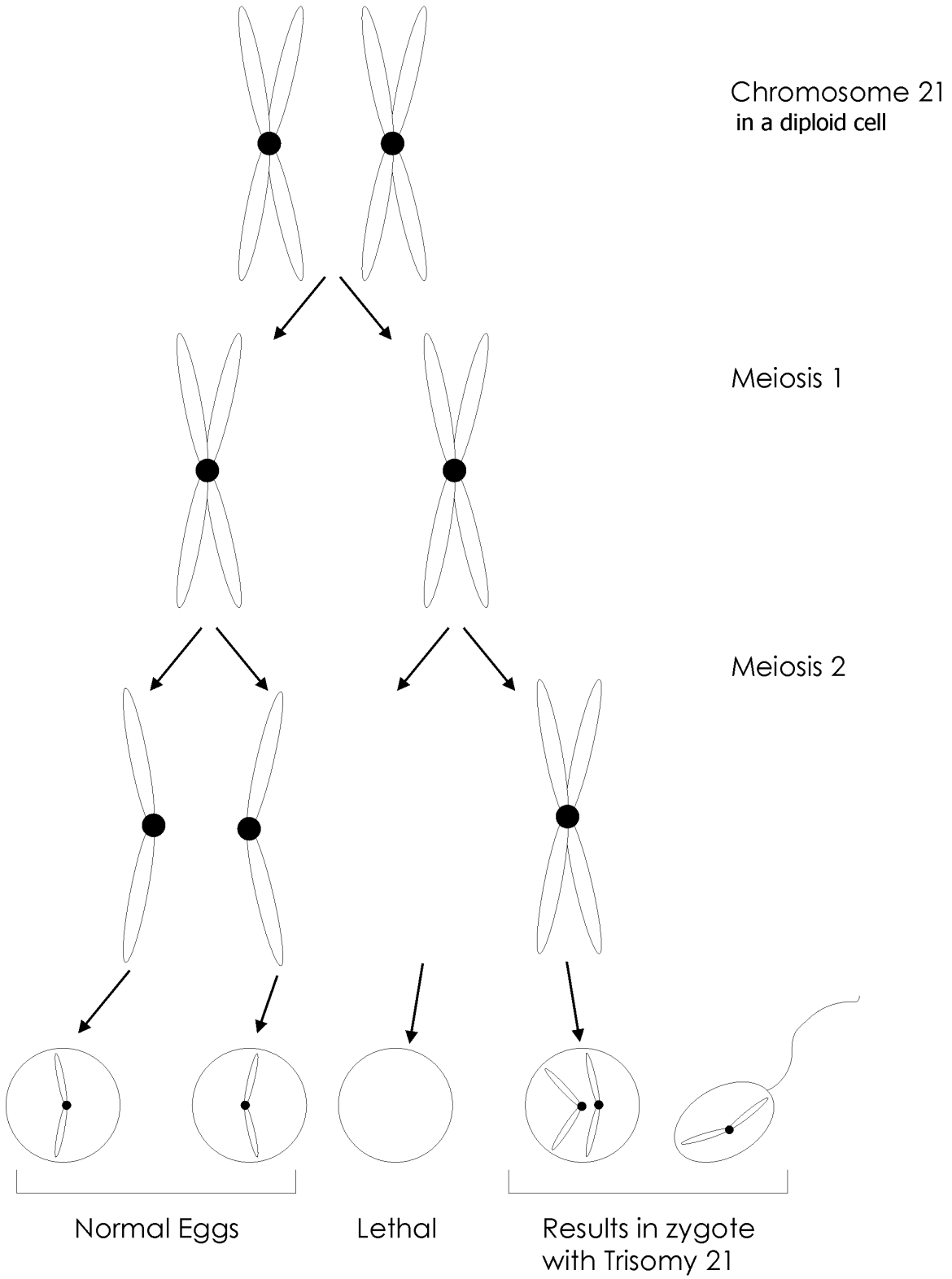
- Introduce the lesson with a review of meiosis
  - Ask the students to recall the various stages of meiosis
  - Ask what purpose is served by meiosis (reduction of chromosome number to haploid)
  - Show DVD Lecture 1, Chapters 26 and 31
- Begin a discussion of what might occur if chromosomes do not separate properly.
  - Define the concept of nondisjunction
  - Ask students to predict what might occur to gametes if nondisjunction occurs
- Tell students that while many chromosomal disorders are fatal, some are not.
  - Ask students if they have heard of Down syndrome
- Play DVD, Lecture 3, Chapter 4
- Using Blackline 1 *Nondisjunction Resulting in Down Syndrome* as an overhead transparency, the teacher should fill in the stages of nondisjunction of Trisomy 21, the autosomal disorder of Down Syndrome and identify it as an autosomal chromosomal disorder
- Discuss with students that nondisjunction can also occur on sex chromosomes
- Have students identify the concepts of spermatogenesis and oogenesis and the formation of gametes
- Using Blackline 2 *Gamete Formation* as an overhead, the teacher should discuss the correct stages of gamete formation as students watch and answer questions on the various stages
- Have students predict a variety of combinations that might be possible if nondisjunction occurs with sex chromosomes (XXX, X0, XXY, etc.)
- Define Klinefelter and Turner syndrome
- Explain to students that they are going to model chromosome separation and nondisjunction in a group activity.
- Demonstrate the proper construction of a pair of chromatids using a pair of pipe cleaners and a bead representing a centromere. (Place 2 pipe-cleaners together through 1 bead to represent each pair of sister chromatids) Students could also use a pop-bead kit, purchased from Wards or Carolina Supply that simulates meiosis.
- Place students in groups of 3-4 and distribute copies of Blackline 3 *Student Copy of Stages of Meiosis*, Blackline 4 *Student Copy of Nondisjunction for Down Syndrome*, and Blackline 5 *Student Copy of Klinefelter and Turner Syndrome*.

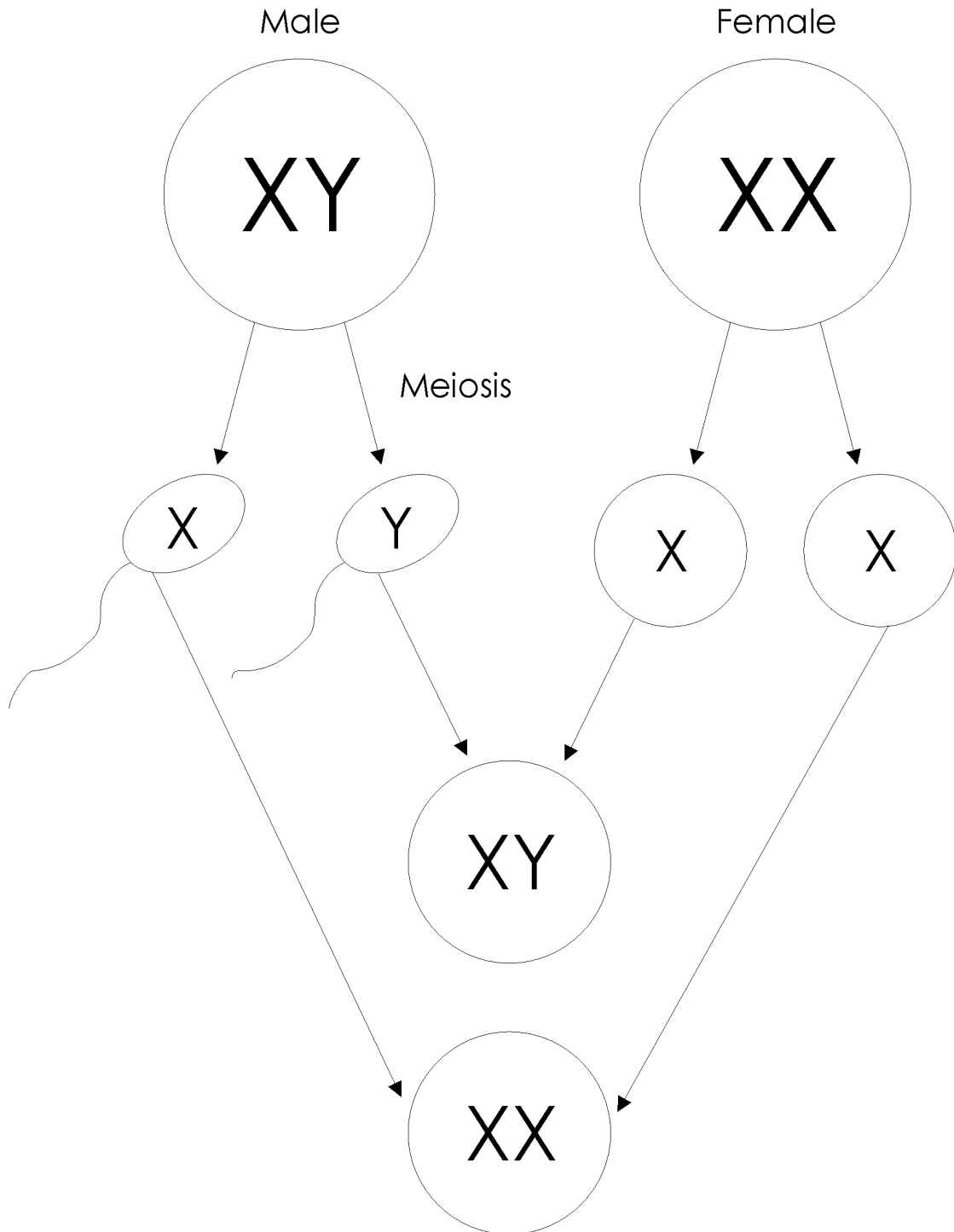
- Have students model proper chromosome separation using the pipe-cleaners or beads. They should complete Blackline 3 showing the correct number of chromosomes and descriptions. They should then model nondisjunction. (Students should see that sister chromatids that do not separate form abnormal gametes)
- Have students complete Blacklines 4 and 5 as worksheets to diagram how Down syndrome, Klinefelter syndrome, and Turner syndrome result from the nondisjunction of chromosomes.

**Evaluation:** Student groups turn in completed worksheets as assessment. (Use teacher copy of Blacklines for correct answers)

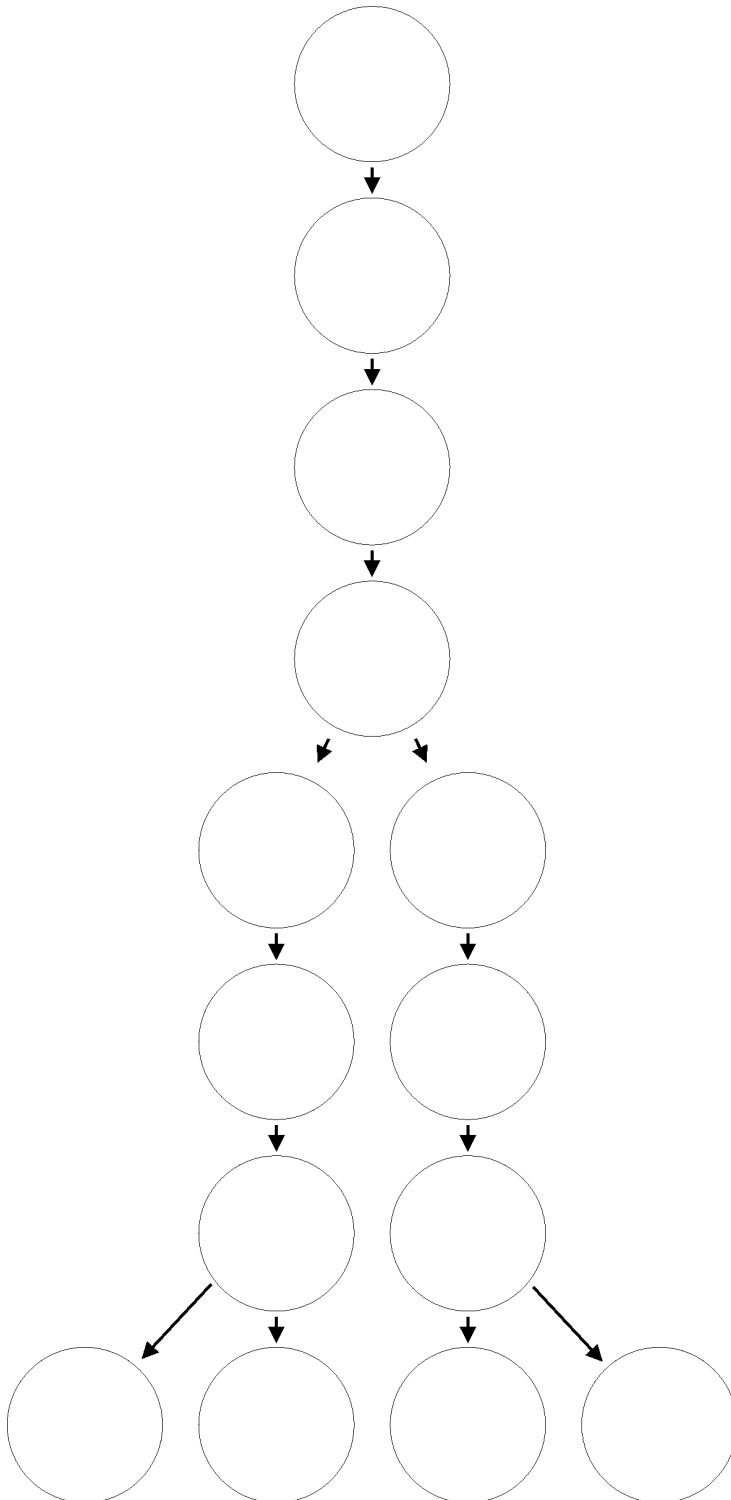
**Extensions:** Students can research and report on other disorders caused by nondisjunction such as Patau or Edwards syndrome.

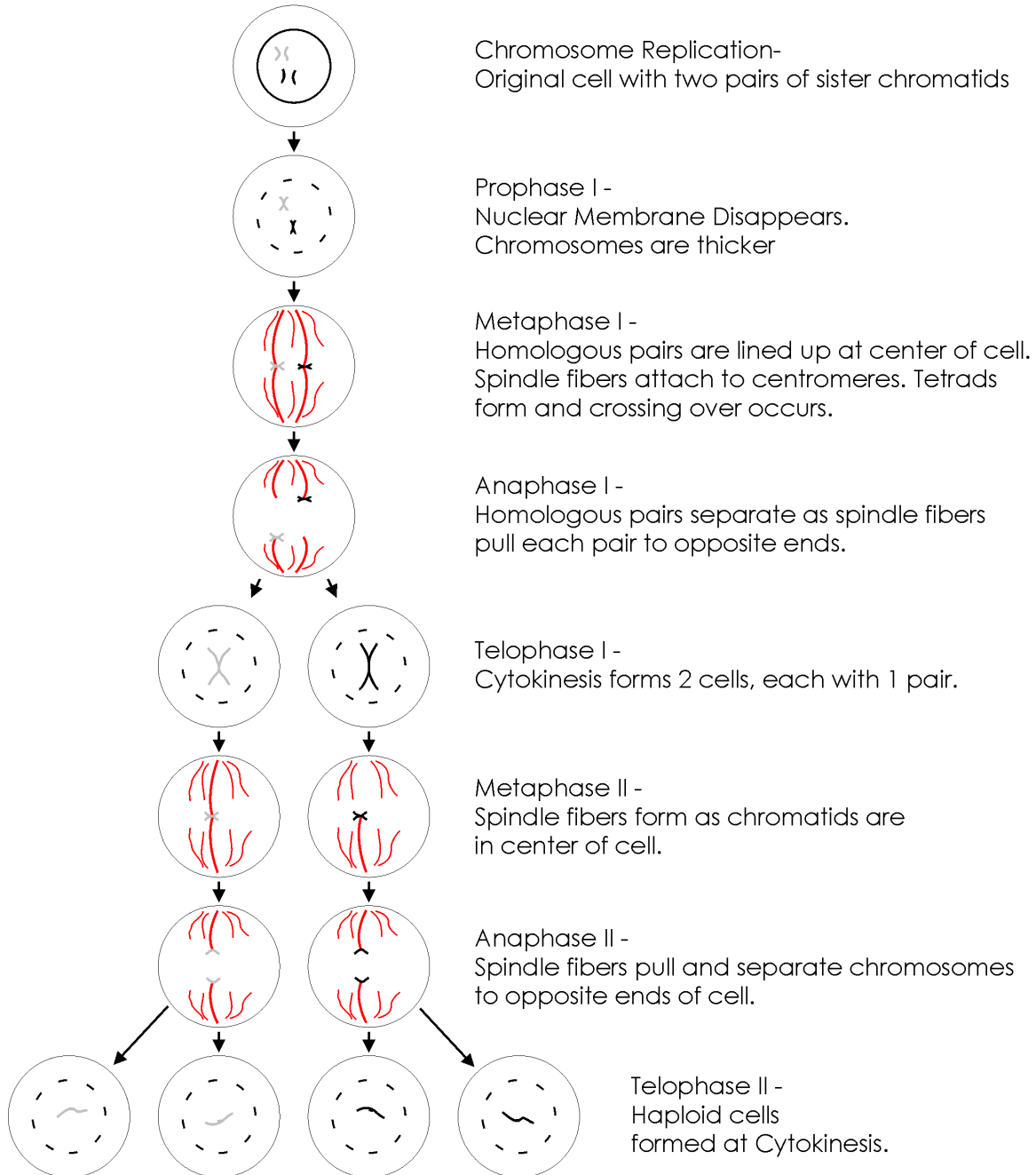
**Web Connections:** A variety of activities can be designed using the NIH site at <http://www.ncbi.nlm.nih.gov>. Students can search under “genes and disease” for chromosome maps and other information.

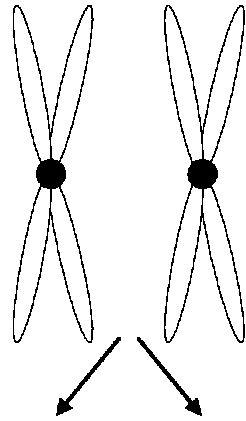




INSTRUCTIONS: Draw and describe each stage of meiosis using 2 pairs of chromosomes.





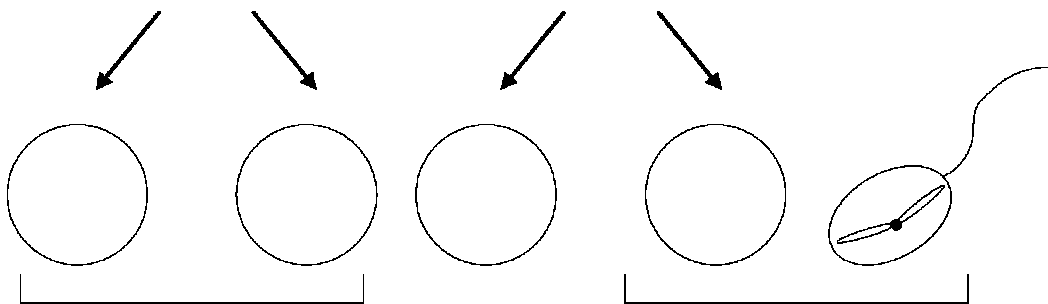


Chromosome 21

Meiosis 1



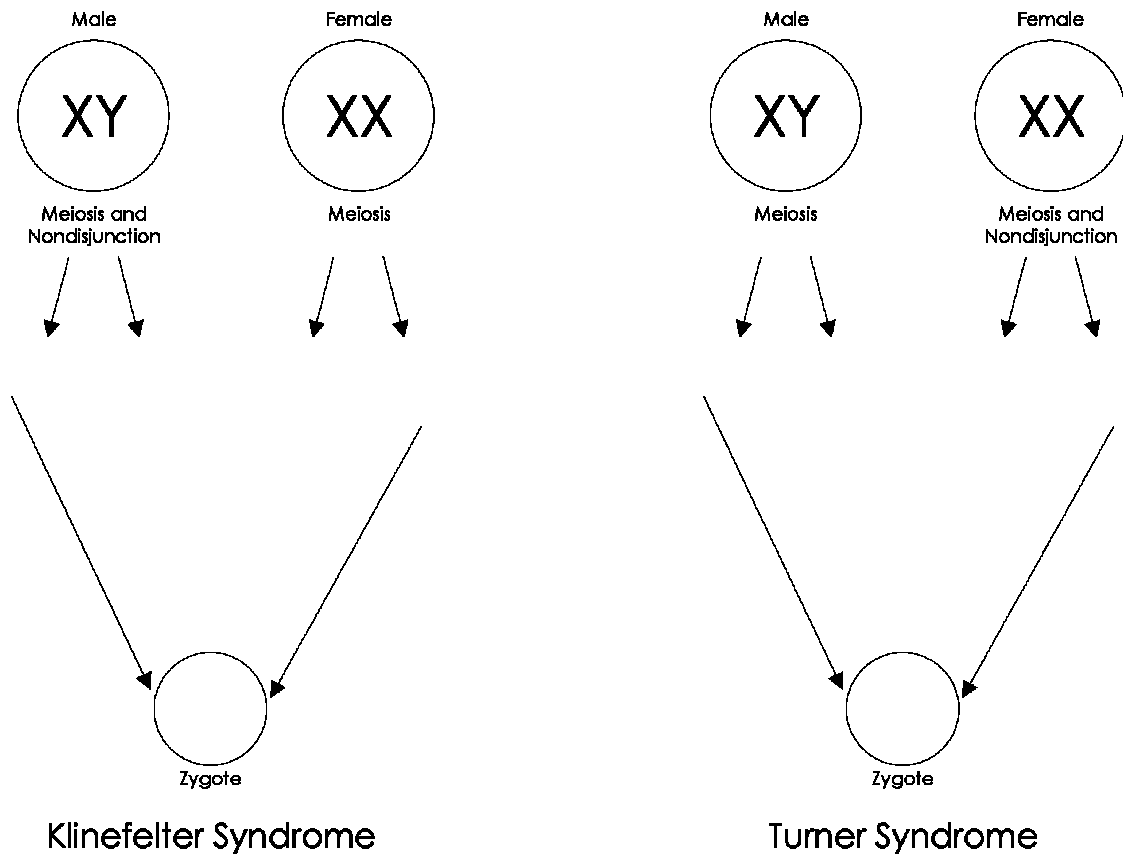
Meiosis 2

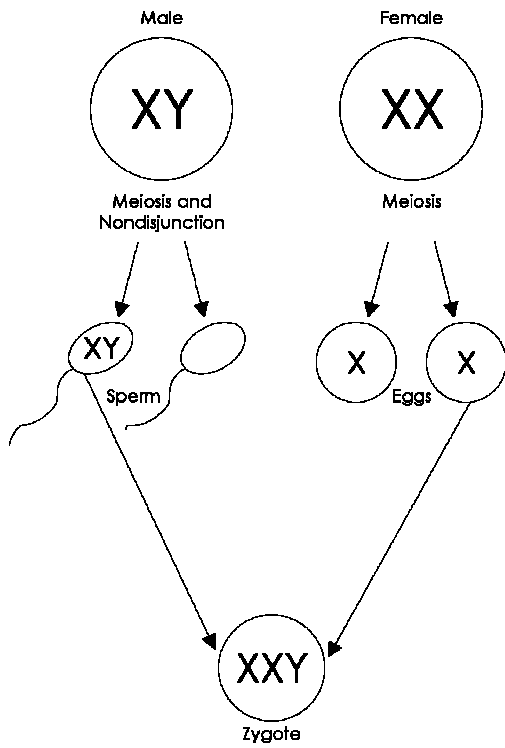


Normal Eggs

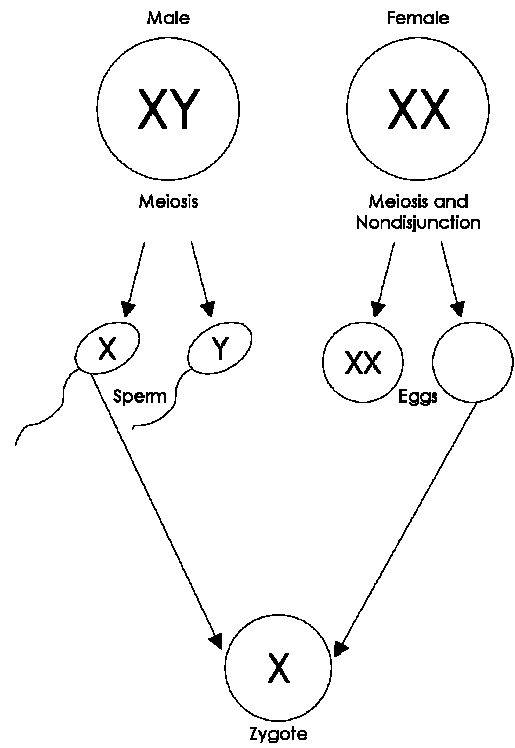
Lethal

Results in zygote with Trisomy 21





Klinefelter Syndrome



Turner Syndrome

