Name _____ Class _____

Date _____

HOLT BioSOURCES LAB PROGRAM
LABORATORY TECHNIQUES

C14 Karyotyping

Skills

- constructing a karyotype
- analyzing a karyotype

Objectives

- *Identify* pairs of homologous chromosomes by their length, centromere position, and banding pattern.
- *Determine* the sex of an individual from a karyotype.
- *Predict* whether an individual will be normal or have Down syndrome.

Materials

- chromosome spread
- scissors
- metric ruler
- WARD's Human Karyotyping Form
- transparent tape

Purpose

As a medical lab technician, one of your jobs is to assist with prenatal testing. Currently, you are working on the case of Mr. and Mrs. Smith. Mrs. Smith is pregnant, and her doctor has recommended amniocentesis, which is a type of prenatal testing. You have been given photomicrographs of the chromosomes in the unborn baby's cells, which were obtained through amniocentesis. Your job is to complete and analyze a karyotype of these cells to determine the sex of the Smiths' baby and whether the baby is normal or has Down syndrome.

Background

Humans have 46 chromosomes in every diploid (2*n*) body cell. The chromosomes of a diploid cell occur in **homologous pairs**, which are pairs of chromosomes that are similar in size, shape, and the position of their centromere. In humans, 22 homologous pairs of chromosomes are called autosomes. The twenty-third pair, which determines the individual's sex, make up the sex chromosomes. Females have only one type of sex chromosome, which is called an X chromosome. Males have two types of sex chromosomes, an X chromosome and a much smaller Y chromosome. The diagram at the top of the next page shows each of the 22 types of autosomes and the 2 types of sex chromosomes.

A karyotype is a diagram that shows a cell's chromosomes arranged in order from largest to smallest. A karyotype is made from a photomicrograph (photo taken through a microscope) of the chromosomes from a cell in metaphase. The photographic images of the chromosomes are cut out and arranged in homologous pairs by their size and shape. The karyotype can be analyzed to determine the sex of the individual and whether there are any chromosomal abnormalities. For example, the karyotype of a female shows two X chromosomes, and the karyotype of a male shows an a X chromosome and a Y chromosome.

Human Chromosomes

Chromosomal abnormalities often result from nondisjunction, the failure of chromosomes to separate properly during meiosis. Nondisjunction results in cells that have too many or too few chromosomes. Trisomy is an abnormality in which a cell has an extra chromosome, or section of a chromosome. This means that the cell contains 47 chromosomes instead of 46. Down syndrome, or Trisomy 21, is a chromosomal abnormality that results from having an extra number 21 chromosome.

Procedure

1. Carefully cut each chromosome from the chromosome spread. Be sure to leave a slight margin around each chromosome.
2. Arrange the chromosomes in homologous pairs. The members of each pair will be the same length and will have the centromere in the same location. Use the ruler to measure the length of the chromosome and the position of the centromere. Arrange the pairs according to their length, from largest to smallest. The banding patterns of the chromosomes may also help you to pair up the homologous chromosomes.
3. Tape each homologous pair to a Human Karyotyping Form, positioning the centromeres on the lines. Place the pairs in order, with the longest pair at position 1, the shortest pair at position 22, and the sex chromosomes at position 23.
4. The diagram you have made is a karyotype. Analyze the karyotype to determine the sex of the individual and whether or not the karyotype is normal.

Analysis

5. Dispose of your materials according to the directions from your teacher.
6. Examine your karyotype. Is the baby male or female? Will the baby have Down syndrome? How do you know?

7. The Y chromosome closely resembles many of the other chromosomes. What did you have to do to determine that it was the Y chromosome?

8. If the karyotype you constructed were for a female with Down syndrome, what chromosome changes would be evident?

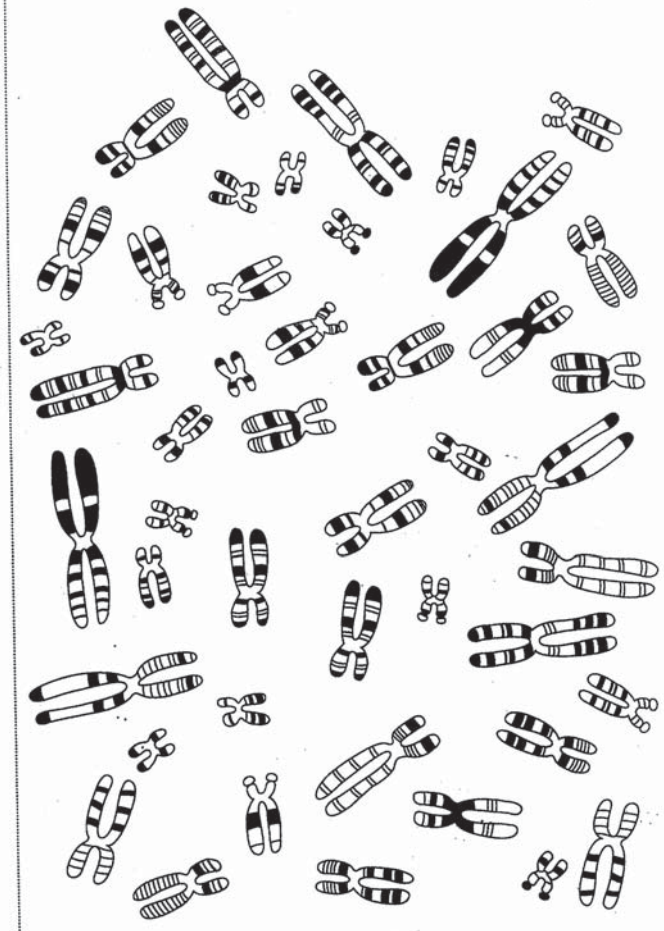
Conclusions

9. If your job were to inform the Smiths of their test results, what would you say?

10. Why are karyotypes important tools for geneticists?

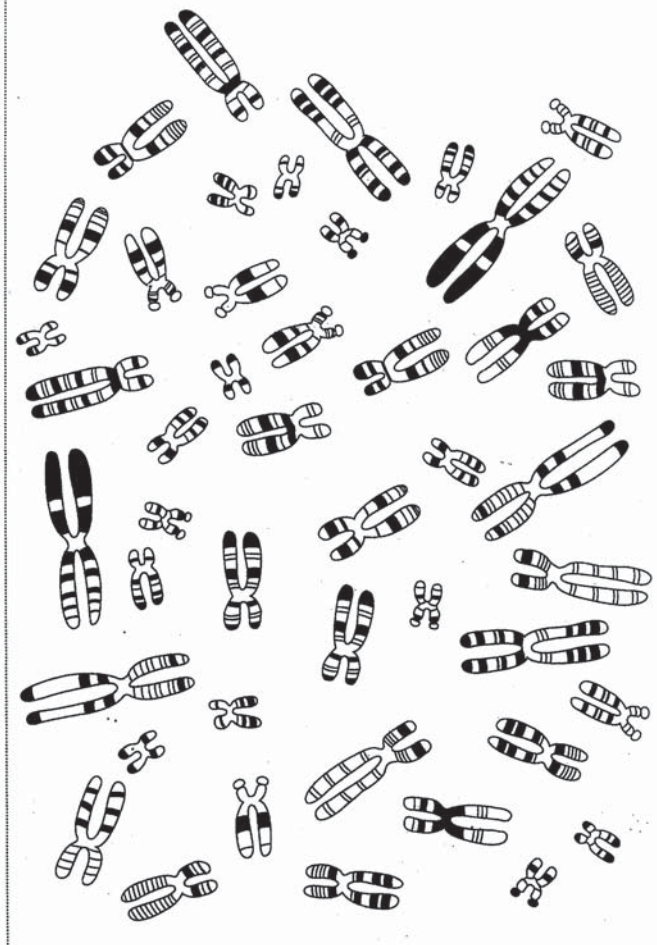
A

Chromosome Spread



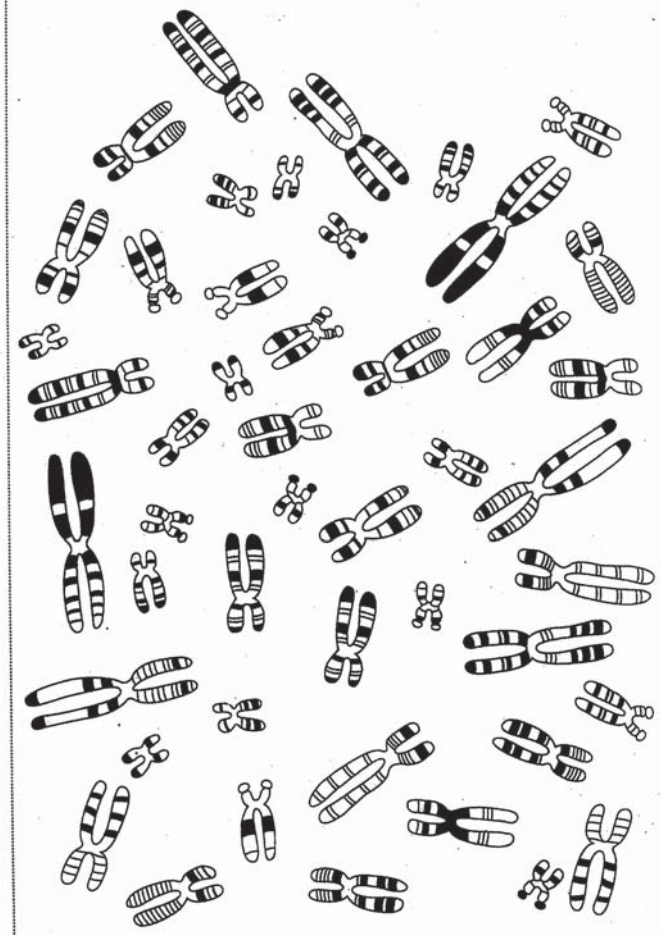
B

Chromosome Spread



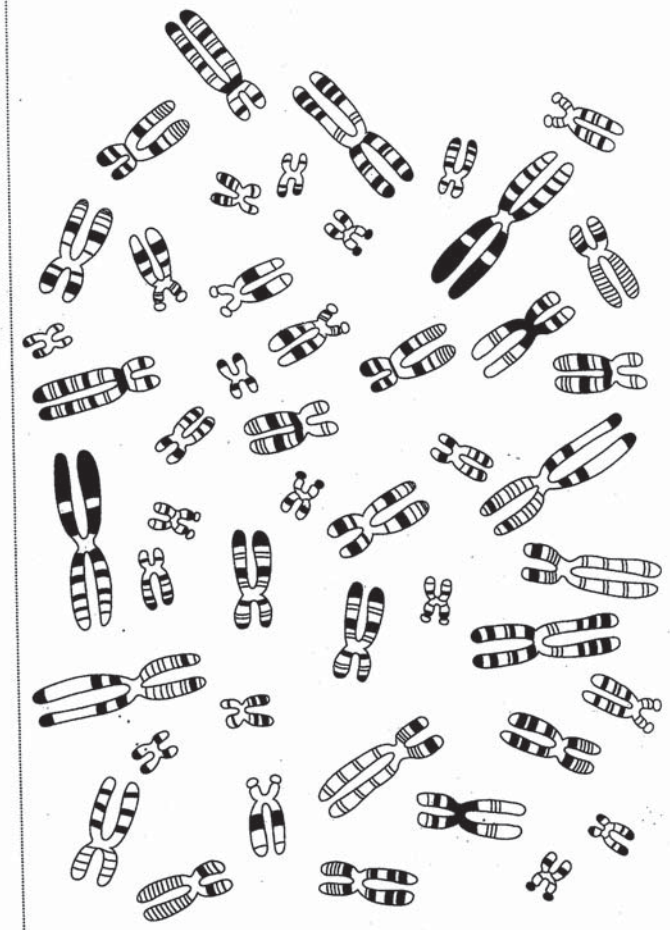
C

Chromosome Spread



D

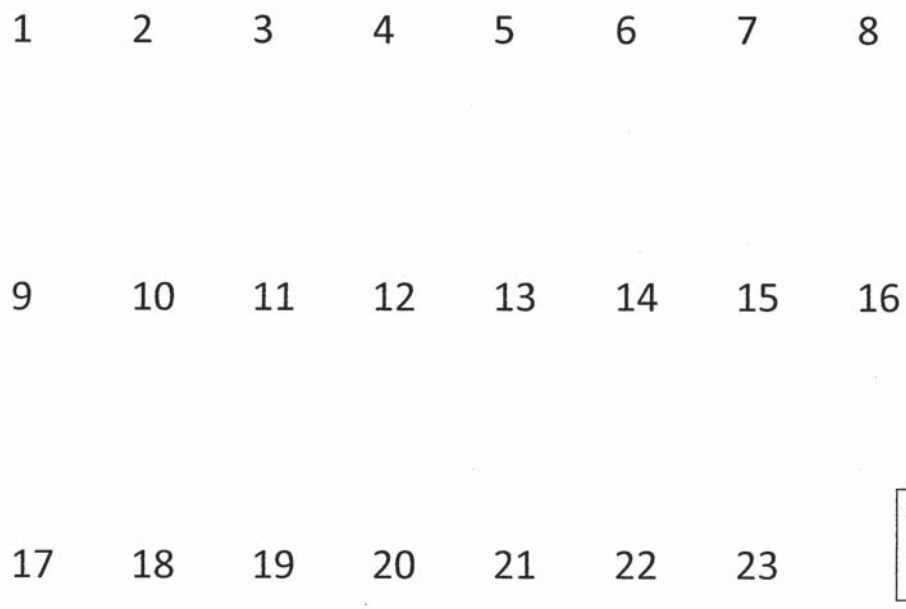
Chromosome Spread



Biology 1
Karyotyping Activity

Name:
Date:
Hour:

Chromosome Spread (Circle One)			
A	B	C	D



Is it a boy or girl?
Are there any other abnormalities?