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## *Human Karyotyping Activity*

**Background:** Occasionally chromosomal material is lost or rearranged during the formation of gametes or during cell division of the early embryo. Such changes, primarily the result of nondisjunction or translocation, are so severe that the pregnancy ends in miscarriage – or fertilization does not occur at all. It is estimated that one in 156 live births have some kind of chromosomal abnormality.

Some of the abnormalities associated with chromosome structure and number can be detected by a test called a *karyotype*. A karyotype can show prospective parents whether they have certain abnormalities that could be passed on to their offspring, or it may be used to learn the cause of a child's disability. Karyotypes can also reveal the gender of a fetus or test for certain defects through examination of cells from uterine fluid – a procedure called amniocentesis – or through sampling of placental membranes. Over 400,000 karyotype analyses are performed each year in the U.S. and Canada.

To create a karyotype, chromosomes from a cell are stained and photographed. The photograph is enlarged and cut up into individual chromosomes. The homologous pairs are identified and arranged in order by size (with the exception of the sex chromosomes; these appear last). These tests are typically done on a sample of blood, although any body cell could be used. The cell must be undergoing mitosis – preferably in metaphase – so that the chromosomes are replicated, condensed, and visible under a microscope.

(adapted from: <http://www.slic.wsu.edu/bios/biol107/107Karyotypesp05.pdf>)

**Laboratory Safety Precautions:** The following symbols represent the precautions that are required for this lab:



**Purpose:** The purpose of this laboratory experience is:

- understand what a karyotype is and how it is performed.
- understand the reason for performing a karyotype, especially for those with a higher risk of genetic defect in their lineage.
- to determine what genetic defect is present in a chromosome sample.
- to investigate a variety of genetic disorders that commonly occur and are studied in biology classes.

**Materials:** The following materials are needed to perform this laboratory experience:

- Scissors
- ruler
- tape
- small envelope

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**Procedure:** The following procedure is utilized to perform this laboratory experience:

1. Using the attached sheets, complete four different karyotypes: One normal male, One normal female, two different disorders of your choice out of the four. Additional laboratory minutes may be granted for work above and beyond the four required karyotypes.
2. Working slowly and carefully, using scissors cut out the chromosome on one page labeled "1" and find its' EXACT match elsewhere on the page (it will not be numbered). Cut out this chromosome and tape BOTH chromosomes side by side on a "data page" that has the heading filled out.
3. Continue this procedure until you have matched all chromosomes and taped each of them in the corresponding place on the data page.
4. If you are caught short of time, use the coin envelope to store any chromosomes you may have clipped out and not matched. **DO NOT CUT OUT ALL CHROMOSOMES AND THEN ATTEMPT TO MATCH THEM!!!** Cut out only one at a time or you will lose chromosomes.
5. In the event that you have an extra chromosome, **DO NOT THROW IT OUT!** It is the chromosome that causes your mutation/disorder and you must match it correctly.
6. Once your chromosomes are all cut out and included in the karyotypes, answer the questions and complete the lab.

**Data:** The following data was collected during this experience:

-Data is included on the karyotype sheets attached.

**Conclusion:** The following can be concluded from this laboratory experience:

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**Questions:** Answer the following questions before turning in your lab.

Complete the following table:

<p style="text-align: center;"><b>Karyotype #1</b></p> <p>Individual is a _____</p> <p>Number of chromosomes: _____</p> <p>What is the sex? _____</p> <p>Normal or Mutated (circle one)</p> <p>If mutated, name the disorder below:</p> <hr/>	<p style="text-align: center;"><b>Karyotype #2</b></p> <p>Individual is a _____</p> <p>Number of chromosomes: _____</p> <p>What is the sex? _____</p> <p>Normal or Mutated (circle one)</p> <p>If mutated, name the disorder below:</p> <hr/>
<p style="text-align: center;"><b>Karyotype #3</b></p> <p>Individual is a _____</p> <p>Number of chromosomes: _____</p> <p>What is the sex? _____</p> <p>Normal or Mutated (circle one)</p> <p>If mutated, name the disorder below:</p> <hr/>	<p style="text-align: center;"><b>Karyotype #4</b></p> <p>Individual is a _____</p> <p>Number of chromosomes: _____</p> <p>What is the sex? _____</p> <p>Normal or Mutated (circle one)</p> <p>If mutated, name the disorder below:</p> <hr/>
<p style="text-align: center;"><b>Karyotype #5 (optional)</b></p> <p>Individual is a _____</p> <p>Number of chromosomes: _____</p> <p>What is the sex? _____</p> <p>Normal or Mutated (circle one)</p> <p>If mutated, name the disorder below:</p> <hr/>	<p style="text-align: center;"><b>Karyotype #6 (optional)</b></p> <p>Individual is a _____</p> <p>Number of chromosomes: _____</p> <p>What is the sex? _____</p> <p>Normal or Mutated (circle one)</p> <p>If mutated, name the disorder below:</p> <hr/>

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**Bibliography of Images used:**

Sharp Instrument Safety Symbol: <http://www.beckman.com/customersupport/images/sharpobj.gif>

Background Information: <http://www.slic.wsu.edu/bios/biol107/107Karyotypesp05.pdf>

Karyotype for Normal Male: <http://biologycorner.com/worksheets/karyotype/karyotype-male.gif>

Karyotype for Normal Female: <http://biologycorner.com/worksheets/karyotype/karyotype-female.gif>

Karyotype for Set A (Down's Syndrome): <http://biologycorner.com/worksheets/karyotype/A-karyotype-down.gif>

Karyotype for Set B (XXY): <http://biologycorner.com/worksheets/karyotype/B-karyotype-xyy.gif>

Karyotype for Set C (Trisomy 18): <http://biologycorner.com/worksheets/karyotype/C-karyotype-18.gif>

Karyotype for Set D (Trisomy 13): <http://biologycorner.com/worksheets/karyotype/D-karyotype-13.gif>

**“Cheat Sheet” for completing human karyotypes**

1. Clip out only ONE homologous pair at a time.
2. Locate and cut out/paste on the sex chromosomes FIRST!
3. Locate and cut out/paste the longest chromosomes in space 1, the next longest in space 2, etc... Chromosomes should get progressively smaller as you increase in chromosome number.
4. DO NOT lose any chromosomes. Students should try to find a large envelope to store their supplies in (these papers and some tape and perhaps some scissors).
5. CLEAN UP YOUR MESS!
6. Make sure that your name is on every sheet of this lab before you begin.
7. Work with a partner, but do not confuse your chromosomes with theirs. Once you have clipped out a chromosome, put your initials and the chromosome number of the back of it to avoid any confusion.

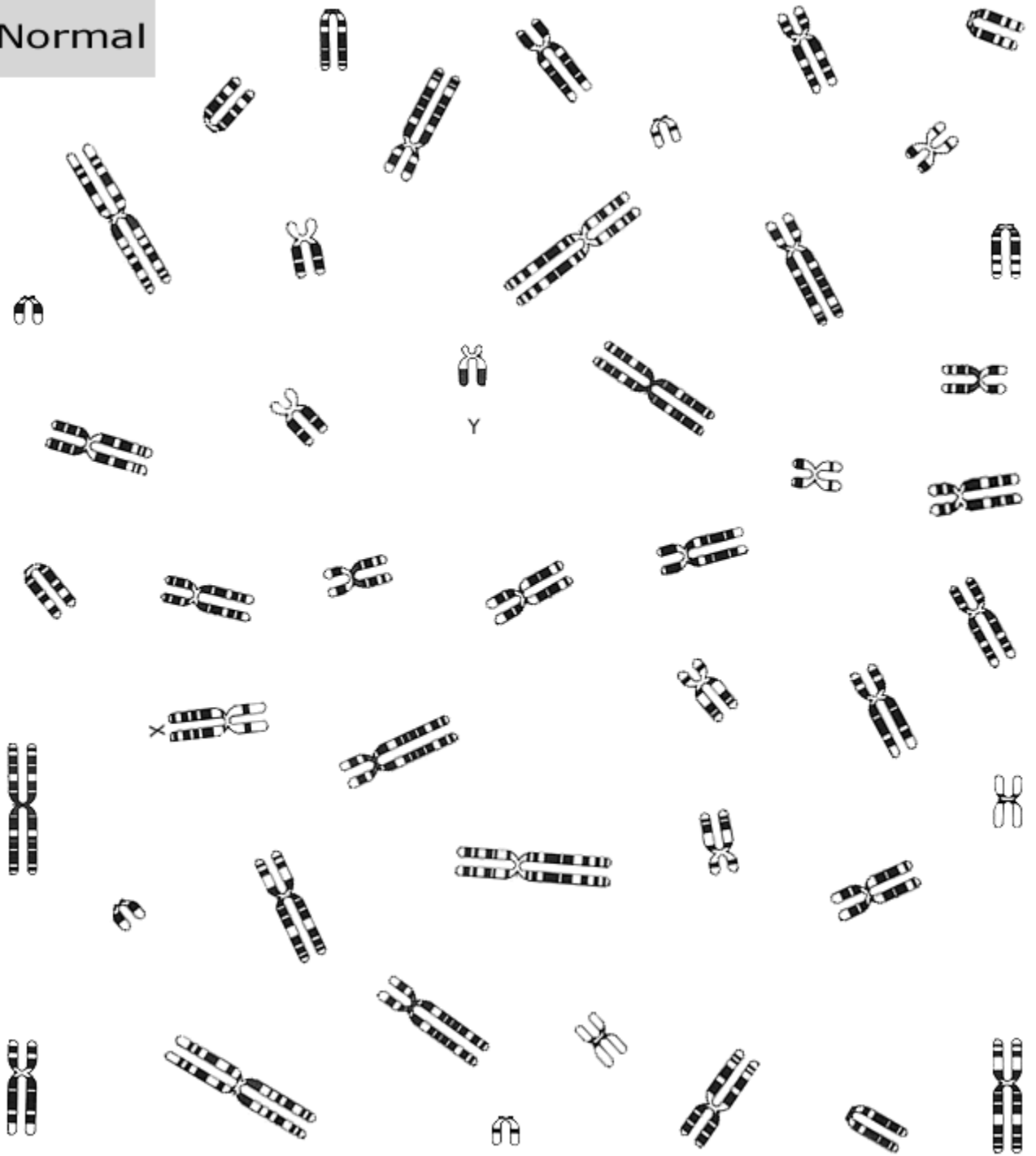
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Chromosome Picture #1

Normal

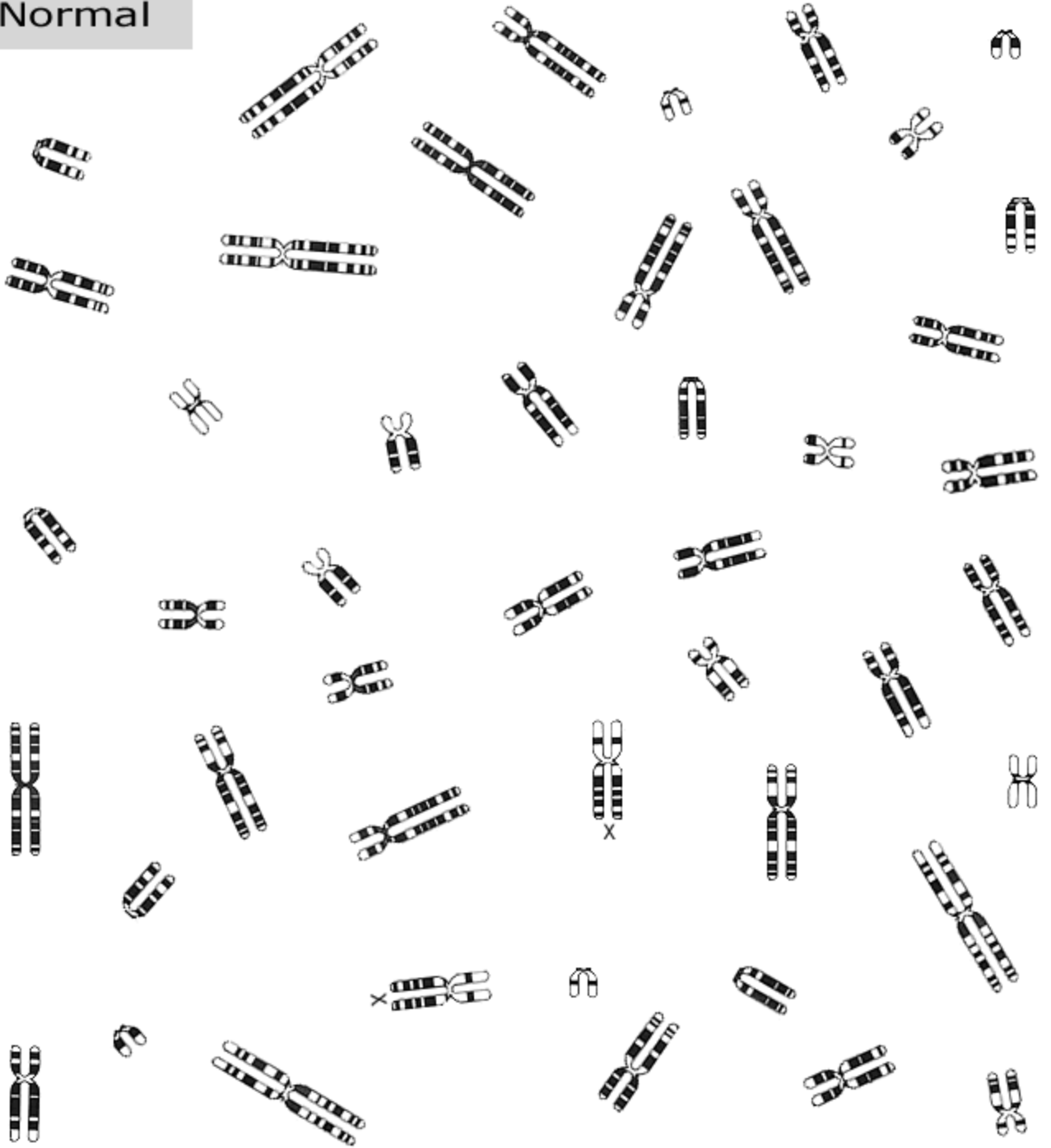


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Chromosome Picture #2

Normal

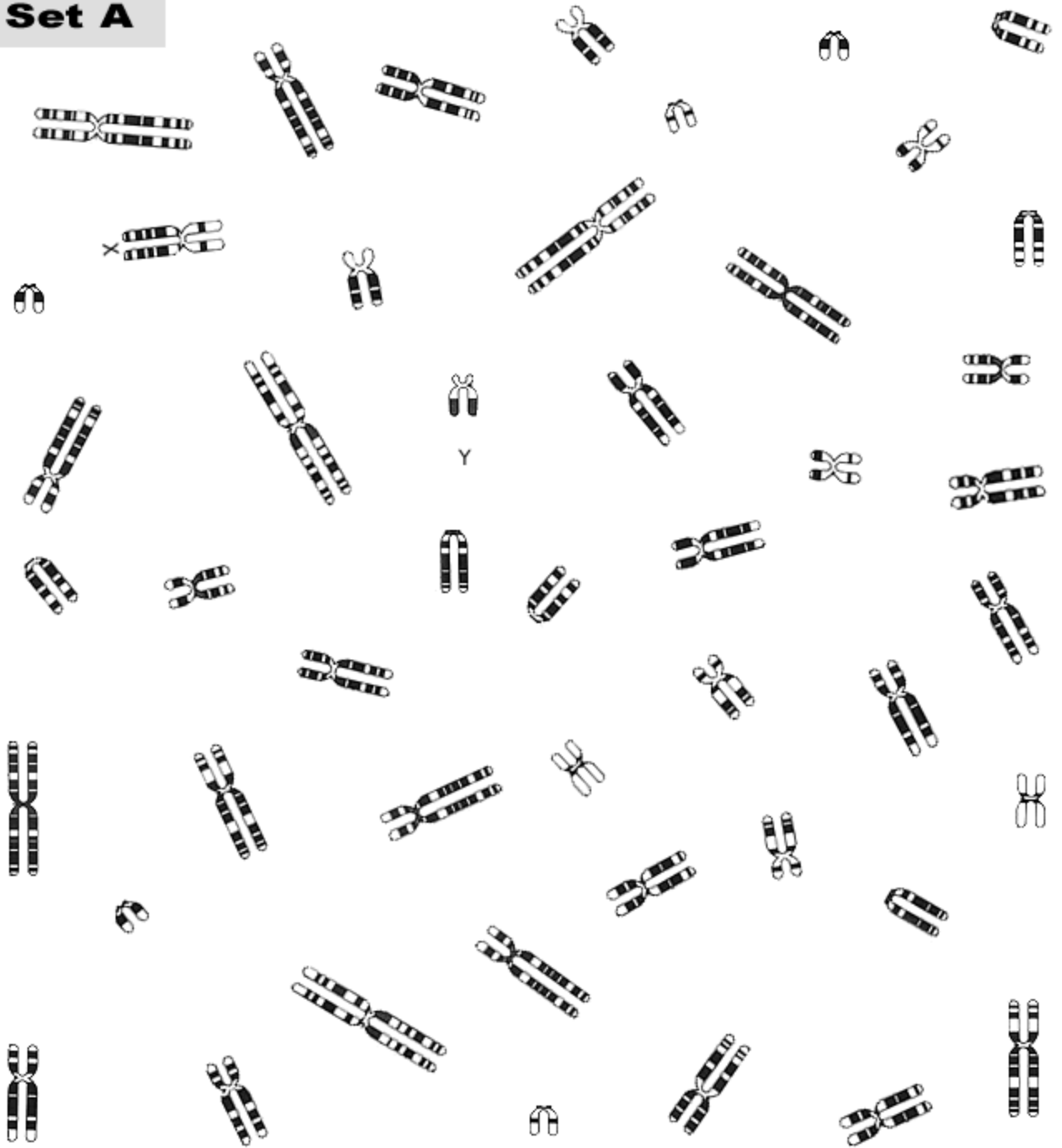


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Chromosome Picture #3

**Set A**

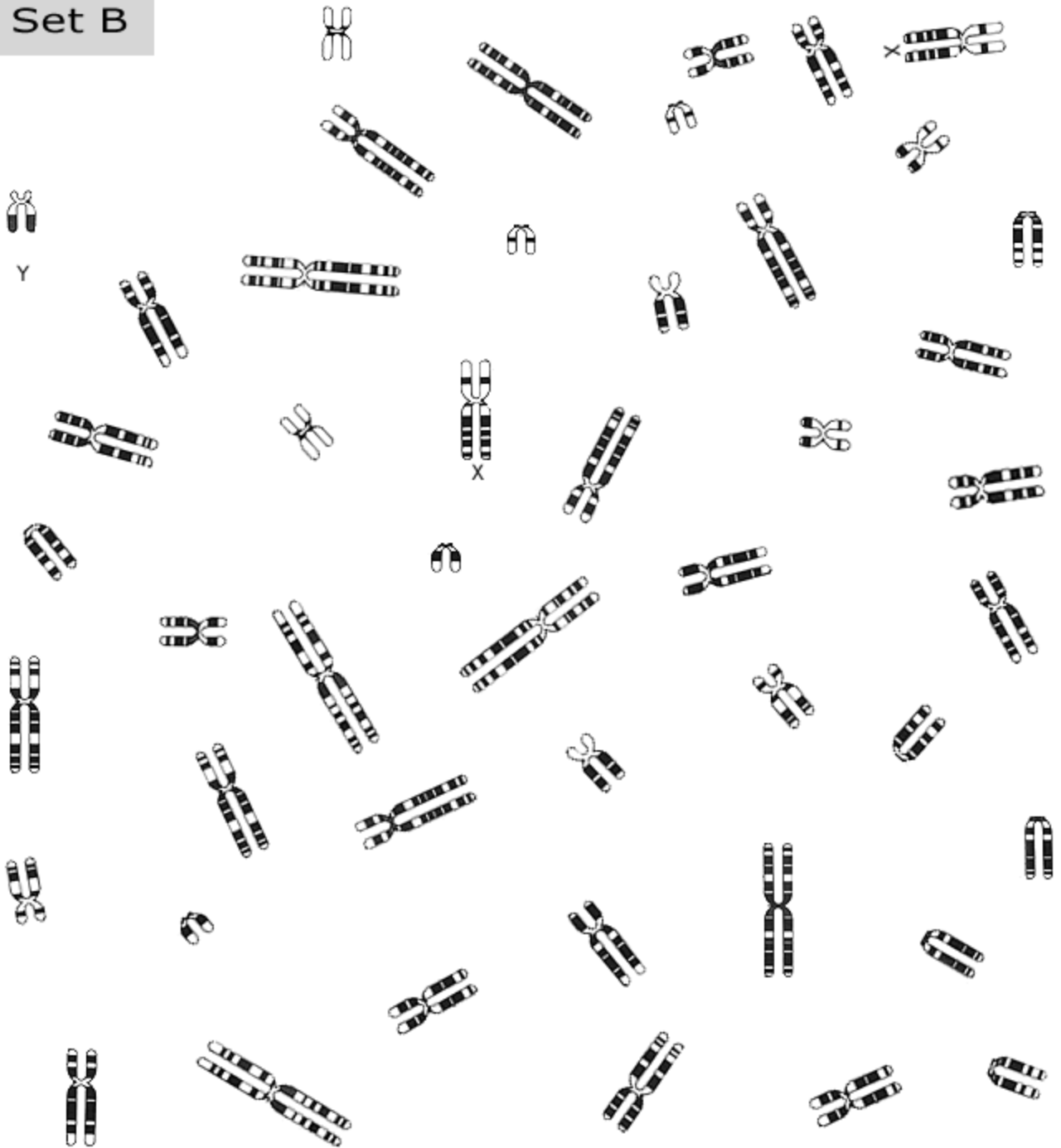


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Chromosome Picture #4

Set B



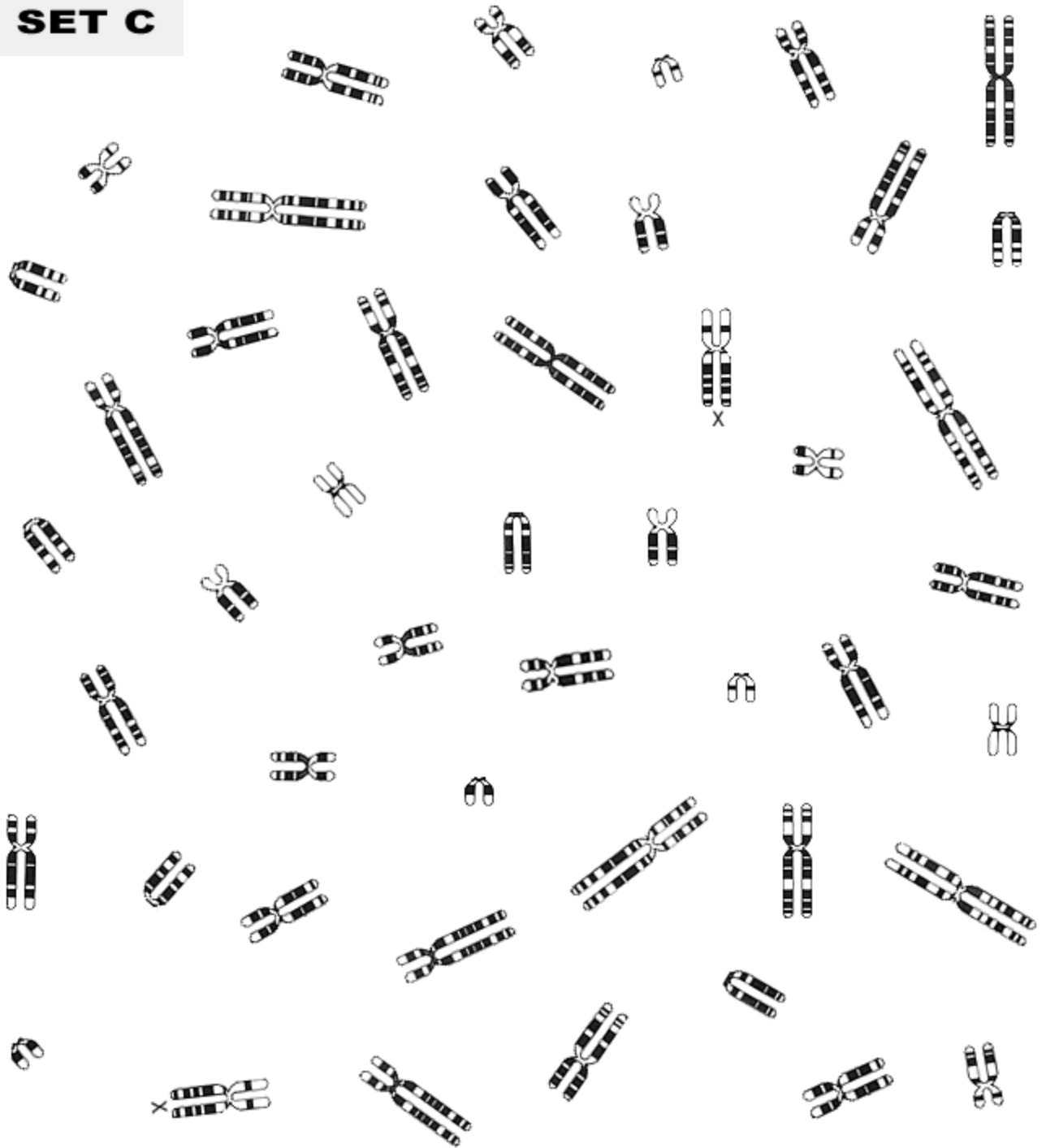


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Chromosome Picture #5

**SET C**

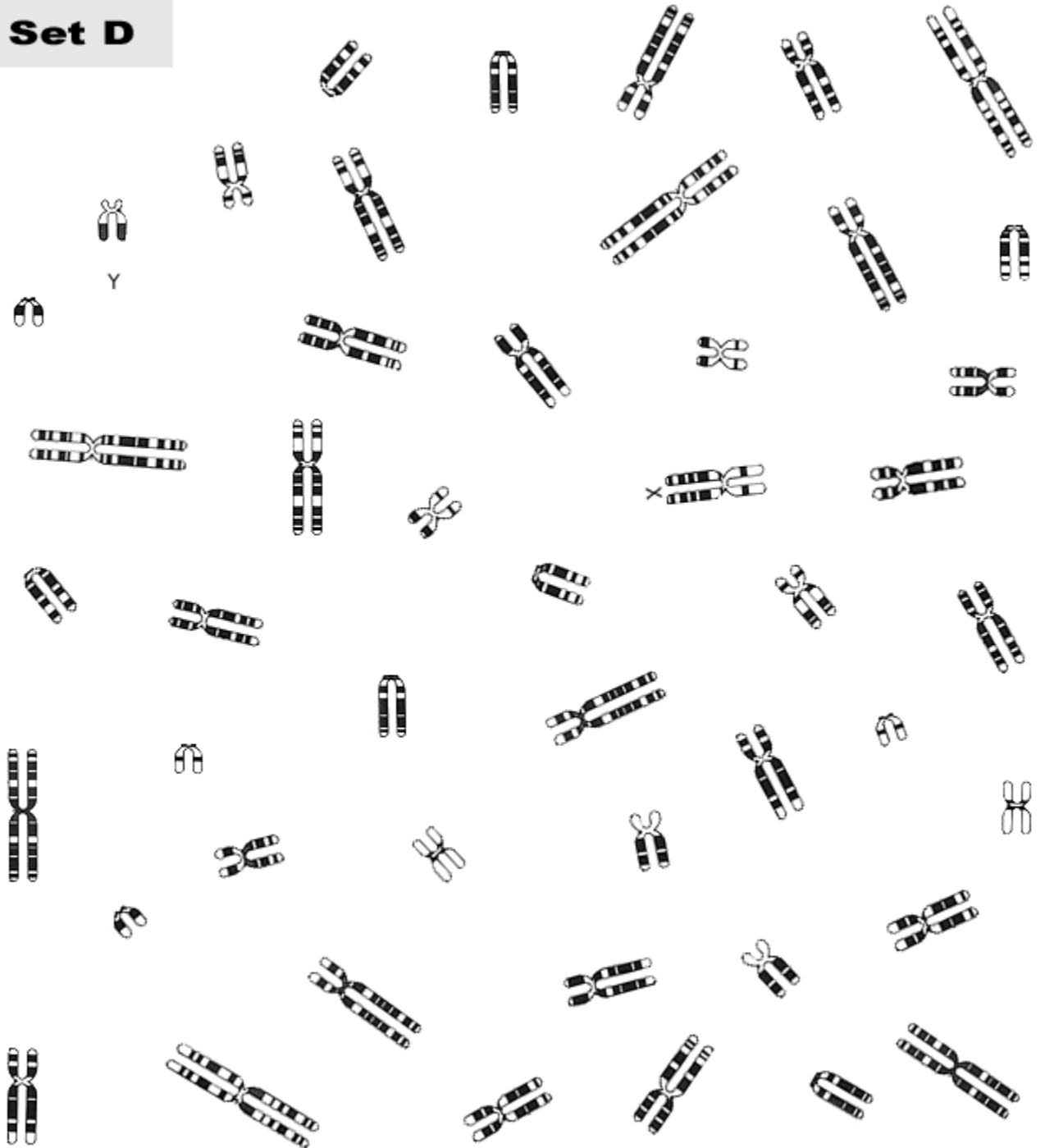


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Chromosome Picture #6

**Set D**



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**Research Component:** The following information can be found about the disorders that were chosen (You are REQUIRED to do at least 2 disorders. Additional lab minutes are awarded for doing each additional karyotype.)

Disorder Name	
Symptoms	
Physical Characteristics	
Disabilities	
Chromosome # affected?	

Disorder Name	
Symptoms	
Physical Characteristics	
Disabilities	
Chromosome # affected?	

Disorder Name	
Symptoms	
Physical Characteristics	
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Chromosome # affected?	

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Disorder Name		
Symptoms		
Physical Characteristics		
Disabilities		
Chromosome # affected?		

Disorder Name		
Symptoms		
Physical Characteristics		
Disabilities		
Chromosome # affected?		

Disorder Name		
Symptoms		
Physical Characteristics		
Disabilities		
Chromosome # affected?		

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<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>
<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>
<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>
<b>21</b>	<b>22</b>	<b>23</b>	Sex: _____ No. of Chr. _____ Normal / mutated (circle) Disorder: _____ Your Name: _____

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<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>
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