D.N.A.
1. T or F: Xy is the genotype for a Woman.
2. __________ hold information for things like eye color and hair color
   a. Sex Chromosomes b. Autosomes c. Karyotype
3. What is the sex of the person who’s karyotype is shown here?

Summary: Today I learned...

Learning Objectives
1. Describe some sex-linked disorders and why they are more common in men.
2. Summarize nondisjunction and the problems it causes.

Sex-linked genes
- Genes located on the sex chromosomes (x and y) are considered sex-linked.
- Examples: Duchene Muscular Dystrophy, Colorblindness, Hemophilia
- Males only have one X chromosome, while females have 2. **Thus, all x-linked alleles are expressed in males, even the recessive ones.**
  - “This means males are more likely to get a sex-linked disorder.”
- When creating Punnett Squares the sex chromosomes are used, and the alleles are placed as exponents:
  - $\text{Ex}\| X^R X^r : X^R Y$
- When put in pedigrees you will see more males with the disorder & no half-shaded males.

Chromosomal Disorders
- Nondisjunction is when chromosomes fail to separate during the production of egg and sperm cells in meiosis.
  - “Abnormal numbers of chromosomes result in a number of disorders.”

Chromosomal Disorders Examples:
**Edwards Trisomy Syndrome**
- Extra chromosome at #18. 1/4400 births
  - Small head, Mentally retarded, Internal organ abnormalities, 90% die before 5 months of age

**Sex-Linke**
- Sex chromosome disorders occur when there are additional or missing X and Y chromosomes.
  - Examples: Klinefelter’s 47 (XXY)
    - Scarce beard, Longer fingers and arms, Sterile, Delicate skin, Low mental ability, Normal lifespan, ~1/500
  - Examples: Turner’s 45 + 1X occurs in about 1/2,000 live births.
    - Swollen hands and feet, Wide and webbed neck, absent or incomplete development at puberty, Drooping eyelids/Dry eyes, Infertility, No periods (absent menstruation), Short height.
The Secrets of Springfield
Sex-linked Traits with Homer & Marge

Background
After many years of studying, geneticists have sequenced the genes on the sex chromosomes of Springfield’s, Marge & Homer Simpson. Shocking discoveries have been made—can you figure them out?

Part I: Simpson Family Secret Analysis:
Use the data for Marge & Homer’s sex chromosome in the tables below to answer questions 1-10 in the spaces provided.

Traits on the X chromosome (in the order they appear from top to bottom)
(Disclaimer, most of these traits are made up. For example, there is no indication that clumsiness or impulsivity are sex-linked traits)

<table>
<thead>
<tr>
<th>Dominant Trait</th>
<th>X-linked Traits</th>
<th>Recessive Trait</th>
</tr>
</thead>
<tbody>
<tr>
<td>O – predisposed to obesity</td>
<td>X^O^+Y</td>
<td>o – not predisposed to obesity</td>
</tr>
<tr>
<td>N – Normal vision (can see red and green)</td>
<td>X^n^+Y</td>
<td>n – red-green colorblindness</td>
</tr>
<tr>
<td>B – Normal hair growth</td>
<td>X^b^+Y</td>
<td>b – baldness</td>
</tr>
<tr>
<td>D – Normal hearing</td>
<td>X^d^+Y</td>
<td>d – deafness</td>
</tr>
<tr>
<td>R – Immunity to radioactivity</td>
<td>X^R^+Y</td>
<td>r – not immune to radioactivity</td>
</tr>
<tr>
<td>S – Sweat glands present</td>
<td>X^S^+Y</td>
<td>s – sweat glands absent</td>
</tr>
<tr>
<td>M – Not Clumsy</td>
<td>X^M^+Y</td>
<td>m – Clumsy</td>
</tr>
<tr>
<td>T – Impulsive (Doh)</td>
<td>X^T^+Y</td>
<td>t – not impulsive</td>
</tr>
</tbody>
</table>

1. Use the genotype for Marge & Homer to figure out their phenotype. Write each phenotype in the space provided in the table.

<table>
<thead>
<tr>
<th>Trait</th>
<th>Homer’s Genotype</th>
<th>Homer’s Phenotype</th>
<th>Marge’s Genotype</th>
<th>Marge’s Phenotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obesity</td>
<td>X^O^+Y</td>
<td>Obesity</td>
<td>X^o^+O</td>
<td>No obesity</td>
</tr>
<tr>
<td>Color Vision</td>
<td>X^n^+Y</td>
<td></td>
<td>X^n^+n</td>
<td></td>
</tr>
<tr>
<td>Hair Growth</td>
<td>X^b^+Y</td>
<td></td>
<td>X^b^+b</td>
<td></td>
</tr>
<tr>
<td>Hearing</td>
<td>X^d^+Y</td>
<td></td>
<td>X^d^+d</td>
<td></td>
</tr>
<tr>
<td>Immunity to radioactivity</td>
<td>X^R^+Y</td>
<td></td>
<td>X^R^+r</td>
<td></td>
</tr>
<tr>
<td>Sweat Glands</td>
<td>X^S^+Y</td>
<td></td>
<td>X^S^+s</td>
<td></td>
</tr>
<tr>
<td>Clumsy</td>
<td>X^M^+Y</td>
<td></td>
<td>X^M^+m</td>
<td></td>
</tr>
<tr>
<td>Impulsive</td>
<td>X^T^+Y</td>
<td></td>
<td>X^T^+t</td>
<td></td>
</tr>
</tbody>
</table>

2. Is Marge Immune to radioactivity? (YES or NO). Explain.
3. Is Homer lying when he tells Marge that he thinks her hair is a beautiful shade of blue? (YES or NO). Explain.
4. Homer fondly remembers a full head of hair and blames his hair loss on Bart. Would Homer have lost his hair if all his children were like Lisa? (YES or NO). Explain.
5. Marge often invites Homer to exercise. Homer says that he just gets way too hot, and that he has a very hard time cooling down. Explain why this is true? (Hint: what feature helps people lose heat when they are exercising).
6. Does Bart need to worry about becoming bald like his father? Set up a Punnett square to show your answer. Explain your answer & circle the genotypes that could belong to Bart.
7. What is the chance (percentage) that Lisa will have to be predisposed to obesity? Construct a Punnett square and explain.
8. What is the probability of Bart having normal vision? Show work.
9. Use a Punnett square to explain why Bart is very athletic (not clumsy) while Lisa is not (clumsy).
10. What is the probability that Maggie’s first word will be “Doh”? Explain.

Concluding Questions:
2. Why are males affected by recessive sex-linked diseases more often than females?
3. If a male has a disease that is Y-linked, what percentage of his sons will inherit the disease?
4. If a male has a disease that is Y-linked, what percentage of his daughters will inherit the disease? What percentage will be carriers?