Like any other language, the language of genetics consists of symbols and rules for using these symbols. When a trait being studied shows dominance, it is observed in nature much more frequently than if it is a recessive form. The capitalized letter of the dominant form becomes its symbol (Ex. R stands for round seeds). For the recessive form of the same trait (the recessive allele); the symbol remains the same but not capitalized (Ex. r stands for wrinkled seeds). Complete the following chart using these rules of symbols.

<table>
<thead>
<tr>
<th>Dominant:</th>
<th>height</th>
<th>coats</th>
<th>pods</th>
<th>seed color</th>
<th>shape</th>
<th>flower</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recessive:</td>
<td></td>
<td></td>
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</tbody>
</table>

1. Using the symbols from the above chart, write the allele symbols that would be present in the following homozygotes. Next, indicate whether the are going to express the dominant or recessive trait.

- tall stemmed plants
- terminal flowers
- white seed coats
- yellow seeds
- yellow pods

2. Write the symbols for the following heterozygotes

- yellow seeded peas
- axial flowers
- green podded peas

3. The following letters represent pairs of alleles. Indicate whether each pair is a heterozygote or homozygote. Then indicate whether each pair would display a dominant or recessive phenotype.

- a. DD
- b. Dd
- c. ss
- d. Rr
- e. Tt
- f. yy
4. What percent of the alleles does each parent contribute to their offspring?

5. What are the phenotypes for the following dihybrids?

\[
\begin{align*}
\text{TtCc} & \quad \text{AaRr} \\
\text{GgYy} & \quad \text{TtAa}
\end{align*}
\]

**Single Trait Crosses (Monohybrid)**

6. Tall pea plants are dominant over short pea plants. If two homozygous tall parents are crossed, then:
   a. how many tall plants would be expected?
   b. how many dwarf plants would be expected?
   c. how many hybrid plants would be expected?
   d. Punnett Square:

7. If two heterozygous tall pea plants are crossed, then
   a. how many tall plants would be expected?
   b. how many dwarf plants would be expected?
   c. how many hybrid plants would be expected?
   d. Punnett Square:

8. If two homozygous recessive plants are crossed, then
   a. how many tall plants would be expected?
   b. how many dwarf plants would be expected?
   c. how many hybrid plants would be expected?
   d. Punnett Square:

9. If a hybrid tall plant is crossed with a dwarf plant, then
   a. how many tall plants would be expected?
   b. how many dwarf plants would be expected?
   c. how many hybrid plants would be expected?
   d. Punnett Square:

10. If a purebred tall plant is crossed with a dwarf plant, then
    a. how many tall plants would be expected?
b. how many dwarf plants would be expected?
c. how many hybrid plants would be expected?
d. Punnett Square:

In a certain species of rat, black color dominates white.

11. Cross two hybrid black rats

\[ P_1 = \]

F1 genotypes =

F1 phenotypes =

Punnett Square:

12. Cross a heterozygous black rat with a white one.

\[ P_1 = \]

F1 genotypes =

F1 phenotypes =

Punnett Square:

13. Short fur in rabbits is dominant to long fur. What phenotypic ratio would you expect from a heterozygous female and a male with long fur?

14. If black fur is dominant to white fur in rabbits, what would be the genotypic and phenotypic ratios resulting from the following crosses?
   a. homozygous black and white?
   b. two heterozygous blacks?
   c. a heterozygous black and white?

\.__Incomplete Dominance__

15. In Japanese four o'clock plants, the flowers may be red or white in the purebred form. But, in the hybrid form the flowers are pink and therefore show incomplete dominance. Write the correct genotype symbols for the following three plants.

   red flowered plants ________
   pink flowered plants ________
   white flowered plants ________

16. What would be the possible genotypes and phenotypes resulting from a cross between a pink parent and red parent four o'clock plant?

\[ P_1 = \]

Punnett Square:
F₁ genotypes =
F₁ phenotypes =

17. In radishes, when a plant homozygous for red radishes is crossed with a plant for homozygous white radishes, plants bearing purple radishes are produced.
   a. What would the offspring look like in a cross between a purple and a white?
   b. A red and a white?
   c. A red and a purple?

18. Radishes may be long, oval, or round: long is dominant, round recessive, and oval a mixture of the two. If a farmer has all oval plants in his garden, what will be the phenotypes of the F₁ generation? How many possible combinations of parent cross could occur using the offspring from the F₁ generation?

19. The polled (hornless) trait in cattle is dominant. The horned trait is recessive. A certain polled bull is mated to three cows. Cow A, which is horned gives birth to a polled calf. Cow B, also horned, produces a horned calf. Cow C, which is polled, produces a horned calf. Name the genotypes of all parents and show the Punnett squares and possible genotypes of each offspring resulting from the cross.

20. Persons with sickle-cell anemia have a problem with the blockage of capillaries due to a mutation in the hemoglobin gene. This usually causes death before reproductive age. This trait is produced by the homozygous recessive nn. The heterozygous condition of this trait produces people of generally good health, but some sickle shaped cells. These people are called carriers. Two heterozygous individuals are planning a family and have asked you to tell them their chances of having a sickle-cell child. What would you tell them?

21. In radishes, when a plant homozygous for red radishes is crossed with one homozygous for white radishes, plants bearing purple radishes are produced.
   A. What would the offspring look like in a cross between a purple and a white?
   B. A red and a white?
C. A red and a purple?

22. In short horned cattle, genes for red and white coats occur. Crosses between a red (RR) and a white (rr) produce an offspring whose coat appears a reddish-gray or roan color. A roan cow mates with a white bull. What will be the phenotypes of the offspring?

Two-Trait Crosses (Dihybrid)

23. Some dogs bark when trailing; others are silent. The barking trait is due to a dominant allele. Erect ears are dominant to drooping ears. What kind of pups would you expect from a heterozygous, erect-eared barker mated to a droop-eared silent trailer?

24. In snapdragons, if purple is dominant over yellow seed coat color, and smooth is dominant over a wrinkled seed coat, what would be the expected phenotypic ratio of the offspring of a cross between two parents that are heterozygous for both alleles?

25. In snapdragons tall stems are dominant to short stems. Red is incompletely dominant to white flower color, the heterozygous condition being pink. A tall pink plant is crossed with a short red plant. If tall is heterozygous in this case, what will be the phenotypes of the offspring?

Sex-Linked Problems

26. In Drosophila, the gene for red eyes, R is dominate for the gene for white eyes, r. This is sex-linked. Determine the possible genotype and phenotype ratios expected from a cross between, (a) heterozygous female and red-eyed male, (b) a heterozygous female and a white-eyed
male, (c) a homozygous dominant female and a red-eyed male, and (d) a homozygous dominant female with a white-eyed male.

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Genotype</th>
</tr>
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<tbody>
<tr>
<td>Ph phenotype</td>
<td>Ph phenotype</td>
</tr>
</tbody>
</table>

(c) Genotype                  (d) Genotype  
Phenotype                  Phenotype

27. In humans the gene from normal blood clotting, H, is dominant to the gene for hemophilia, h. This is a sex-linked trait found on the X chromosome. A woman with normal blood clotting has four children. They are a normal son, a hemophiliac son, and two normal daughters. The father has normal blood clotting. What is the probable genotype for each member of the family?

28. In humans the gene for normal color vision C, is dominant to the gene from red-green color blindness, c. This trait is sex-linked and found on the X chromosome. The gene for brown eyes, B, is dominant to the gene for blue eyes, b. Calculate the probable genotype and phenotype of the children born to a blue-eyed woman who is heterozygous for color vision and a heterozygous brown-eyed man who is colorblind.

29. In cats, black color is due to the gene, B, and yellow color its allele b. Yellow is incompletely dominant to black and with the heterozygous condition results in a color known as calico (black, yellow and white spotted). These genes are sex-linked. What kinds of offspring would you be expected from a cross between a black male and a calico female?