1. In the 1940s and 1950s, scientists did experiments to determine the molecule responsible for heredity. Their experiments demonstrated that the molecule that encodes and transmits information in organisms is
   A. DNA   B. glucosamine   C. insulin   D. vitamin D

2. In guinea pigs, the allele for black hair (B) is dominant to the allele for brown hair (b). The allele for short hair (S) is dominant to the allele for long hair (s). The genes for hair color and hair length are located on different chromosomes. Guinea pigs with black, short hair (BbSs) are crossed with guinea pigs with brown, long hair (bbss). Some offspring have black, short hair or brown, long hair like the parents. Additionally, some offspring have black, long hair or brown, short hair. Which of the following explains the different phenotypes in the offspring?
   A. The expression of the alleles for hair color is influenced by the alleles for hair length.
   B. The alleles for hair color and hair length assort independently during gamete formation.
   C. The alleles for hair color and hair length mutate during the first cell divisions of the offspring.
   D. The interaction between the alleles for hair color and hair length is incomplete dominance.

3. A particular genetic disorder leads to very high levels of blood cholesterol. The gene linked to this trait has two alleles, N and n. The table below shows how the three different combinations of these alleles are expressed.

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Expressed Phenotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>NN</td>
<td>normal cholesterol levels</td>
</tr>
<tr>
<td>Nn</td>
<td>slightly elevated cholesterol levels</td>
</tr>
<tr>
<td>nn</td>
<td>greatly elevated cholesterol levels</td>
</tr>
</tbody>
</table>

Which of the following statements describes the interaction of the N and n alleles for the gene?
   A. The N allele is recessive to the n allele.
   B. The N allele is incompletely dominant to the n allele.
   C. The N allele assorts independently from the n allele.
   D. The N allele completely masks the phenotype of the n allele.

4. In garden pea plants, the tall allele (T) is dominant to the short allele (t), and the round seed allele (R) is dominant to the wrinkled seed allele (r). Which of the following crosses could produce short pea plants with wrinkled seeds?
   A. TtRr x TTRR  B. TTRr x TTRr  C. TtRr x Ttrr  D. TtRR x ttRR
5. In pea plants, the allele for purple flowers (P) is dominant to the allele for white flowers (p). A plant that is heterozygous for purple flowers is crossed with a plant with white flowers. What percentage of the offspring plants are expected to have purple flowers?
   A. 25%     B. 50%     C. 75%     D. 100%

6. Hemophilia is an X-linked recessive condition in which blood does not clot properly. Queen Victoria of England had one allele for hemophilia. Which of the following statements describes the most likely pattern for the occurrence of hemophilia in Queen Victoria’s descendants?
   A. All of Queen Victoria’s children had hemophilia.
   B. All of Queen Victoria’s children were carriers for hemophilia.
   C. Female descendants of Queen Victoria could not pass on the gene for hemophilia.
   D. More male descendants than female descendants of Queen Victoria had hemophilia.

7. In mussels, brown (B) coloring is dominant, and blue (b) coloring is recessive. If a blue mussel has two brown parents, what percentage of the total offspring of these brown parents are expected to be blue?
   A. 100%     B. 75%     C. 50%     D. 25%

8. In rabbits, a single gene controlling coat color has four alleles. The inheritance pattern for coat color in rabbits is therefore best described as which of the following?
   A. multiple allele     B. polygenic     C. recessive     D. sex-linked

9. A gene in horses controls whether the horse has a white coat or a colored coat. A white female horse and a white male horse are the parents of a total of five female offspring. Three of these offspring have white coats. The other two offspring have colored coats. The phenotypes of the horses suggest which of the following as the most likely pattern of inheritance for coat color?
   A. The allele for a white coat is dominant.
   B. The allele for a white coat is recessive.
   C. The allele for a white coat is sex-linked.
   D. The allele for a white coat is codominant.

10. Garden pea plants can have green or yellow pods. The green pod allele (G) is dominant to the yellow pod allele (g).
   a. Draw a Punnett square for the cross of a heterozygous plant with green pods and a plant with yellow pods.
   b. Give the expected phenotype ratio of the offspring for the cross in part (a).
11. SpongeBob loves growing flowers for his pal Sandy! Her favorite flowers, Poofkins, are found in red, blue, and purple. Use the information provided and your knowledge of incomplete dominance to complete each section below.

a. Write the correct genotype for each color if R represents a red gene and B represents a blue gene.

   Red - **RR**      Blue - **BB**      Purple - **RB**

b. What would happen if SpongeBob crossed a Poofkin with red flowers with a Poofkin with blue flowers. Complete a Punnett square to determine the chances of each flower color.

   ![Punnett Square]

   How many plants would be red? __________%
   How many plants would be blue? __________%
   How many plants would be purple? __________%

c. What would happen if SpongeBob crossed two Poofkins with purple flowers? Complete a Punnett square to show the probability for each flower color.

   ![Punnett Square]

   How many plants would be red? __________%
   How many plants would be blue? __________%
   How many plants would be purple? __________%

12. In sheep, the allele for white color (B) is dominant to the allele for black color (b). Give the F2 pheno-types and genotypes resulting from the cross of a true-breeding white sheep with a true-breeding black sheep.

   **Hint:** You are given the P generation, so you must cross them to find the F1 generation, and then cross two F1 offspring to find the F2 generation!

   ![Punnett Square]

   75% white (BB/Bb)
   25% black (bb)
13. A man has hemophilia, an X-linked recessive trait, as his genotype is X<sup>h</sup>Y. He marries a woman who is a carrier of the disease, X<sup>h</sup>X<sup>h</sup>. What is the probability that their children will have the disease? Determine the percentage for each sex (males kids and female kids).

\[ \text{Females: } X^h X^h \rightarrow X^h X^h \quad \text{Males: } X^h Y \rightarrow X^h Y \]

\[ \frac{50}{100} \]

14. Squash may be either white or yellow. However, for squash to be white, at least one of its parents must also be white. Which color is dominant? (Draw punnett squares to help!)

\[ \text{white} \]

\[ \text{yellow} \]

\[ \text{both yellow} \]

15. There are four different blood types possible in humans: type A, type B, type AB, and type O. Blood type in humans is controlled by a single gene with three alleles: I<sup>A</sup>, I<sup>B</sup>, and i.

The alleles I<sup>A</sup> and I<sup>B</sup> are codominant:
- I<sup>AI</sup> = type A
- I<sup>iI</sup> = type B
- I<sup>iI</sup> = type AB

The alleles IA and IB are dominant over i (the i allele is recessive):
- I<sup>AI</sup> = type A
- I<sup>iI</sup> = type B
- ii = type O

a) A man with type AB blood is married to a woman also with type AB blood. What percentage of their children will have:

- A blood? 25%
- B blood? 25%
- O blood? 6%
- AB blood? 56%
b) A man has type B blood (genotype $I^B I^B$) is married to a woman with type O blood.

What blood type will all their children have? ____________

What is the **genotype** of the children? ____________

c) A man with type AB blood is married to a woman with type O blood. They have two natural children and one adopted child. Jane has type A blood, Bobby has type B blood, and Grace has type O blood. Which child was adopted? ____________

16. The pedigree below is showing a family with a recessive disorder. Use the letter “A” to represent the disorder and write each person’s genotype:

```
    1      2
   /\      /\  
  3   4   5   6
   A   aa  A   A
```

17. According to the Law of Segregation, in an organism with the genotype Aa:

a. ¾ of the gametes will have A, ¼ will have a

b. ½ of the gametes will have A, ½ will have a

c. ¼ of the gametes will have A, ¾ will have a

d. none of the above

An individual who is a carrier for a sex-linked trait:

a. Is always female. **✓**

b. Is heterozygous for recessive condition. **✓**

c. Shows the dominant phenotype **✓**

d. All the above **✓**
18. A cross produced 915 offspring with normal pigment and 310 with albinism. What can you conclude based on this data?
   a. one of the parents was homozygous for albinism
   b. one parent was homozygous for normal pigment
   c. both parents were albinos
   d. both parents were heterozygous

19. Albinism results from a recessive allele. Which of the following is the expected offspring from a normal male that has an albino father and is mating an albino wife?
   a. 75% normal, 25% albino
   b. 75% albino, 25% normal
   c. 50% normal, 50% albino
   d. 100% albino

20. A man who carries a harmful sex-linked (on the X chromosome) gene will pass it on to:
   a. all of his daughters
   b. half of this daughters
   c. all of his sons
   d. half of his sons

21. You pollinate heterozygous purple/long pea plants with each other, and get mostly purple/short plants and white/long plants. There are very few purple/long or white/short plants. What is the most likely explanation?
   a. one of the genes is on a sex chromosome
   b. the genes are linked
   c. long is lethal, so few plants survive to adulthood
   d. this is a normal, random variation expected from independent assortment

22. An individual who is a carrier for a sex-linked trait:
   a. is always female
   b. is heterozygous for recessive condition
   c. shows the dominant phenotype
   d. all of the above

Incomplete Dominance \( \Rightarrow \) blending, mix (pink)
Codominance \( \Rightarrow \) both show up at same time (blood-AB)
Multiple Allele \( \Rightarrow \) more than 2 versions of gene (rabbits-\( c, c^-, c^+ \))
Polygenic traits \( \Rightarrow \) many genes, making 1 trait (height)