Finding Phenotypes and Genotypes For One Trait:

NAME: ______________________

<u>Background information:</u>
In genetics, it is possible to calculate the results that should appear in offspring if the **genotypes (SS, Ss, or ss)** of both parents are known. These are called expected results. **Expected results** can be calculated **by mathematics or use of Punnett squares**. Thus, expected results are specific numbers and <u>are not the result of random events</u>.
Observed results are those that appear in offspring in **actual crossings**. They <u>are due to chance combination of certain genes</u>. Thus, <u>observed results are always due to chance</u>.

Expected and observed results may not always agree exactly, but there should be some agreement. **Expected results are used to predict the results** of a cross before the cross is done. If the expected results indicate that a certain type of offspring is likely, the cross can be carried out with some certainty that the type of offspring will appear in the observed results.

In this investigation, you will:

1. Substitute properly marked coins for gamete cells
2. Toss the marked coins 100 times to represent 100 offspring (babies).
3. Determine the **expected numbers of genotypes** for 100 offspring and compare them with the **observed numbers of genotypes** obtained through 100 coin tosses.
4. Determine the **numbers of expected phenotypes** for a genetic cross, and compare them with the **numbers of observed phenotypes** obtained through coin tossing.

Materials:
- 2 pennies with an **S** and **s** marked on either side

PROCEDURE:
PART A: Determining numbers of expected genotypes
How many of each genotype combination are expected in the offspring if **<u>both parents</u> are Ss (heterozygous)** for a trait.

- Use the Punnett Square in **Figure 1** to determine the genotypes. Record the number of each expected genotype in *Column A* **Table 1**.
- How many of each genotype combination are expected if there are 100 offspring? Multiply each number in *Column A* by 25. Record this number in *Column B* of **Table 1**.

	S	**s**
S		
s		

Figure 1

PART B: Determining numbers of observed genotypes
- Place both coins in cupped hands, shake, and then toss the coins onto your desk. Read and record the letter combination in *Column C* (Toss Results) of **Table 1**.
- Make a slash (/) in the proper row of *Column C* to indicate the letter combinations for each toss in **Table 1**.
- Record in *Column D* the totals for each.

PART C: Determining numbers of expected phenotypes

- Assume that **S** represents the dominant gene for normal skin pigment.
- Assume that **s** represents a recessive condition called albinism, no skin pigment. From the Punnett square (Figure 1), list in *Column A* of **Table 2** the number of offspring expected to have **normal skin color (SS and Ss)** and those who are expected to be **albino (ss)**.
- Calculate the number expected to have each trait if there are 100 offspring. Do this by multiplying *Column A* numbers by 25. Record these numbers in *Column B* **Table 2**.

PART D: Determining numbers of observed phenotypes

- From your data in *Column D* **Table 1**, total and record in *Column C* of **Table 2** the number of offspring who will have normal skin pigment **(SS & Ss)** and those who will be albino **(ss)**.

Table 1: Expected and Observed **Genotypes**

Gene Combinations	**(A) Expected Genotypes for 4 Offspring**	**(B) Expected Genotypes for 100 Offspring**	**(C) Toss Results**	**(D) Observed Genotype For 100 Offspring**
SS				
Ss* or *sS				
ss				

Table 2: Expected and Observed **Phenotypes**

Possible Phenotype	**(A) Expected Phenotype For 4 Offspring**	**(B) Expected Phenotype For 100 Offspring**	**(C) Observed Phenotype For 100 Offspring**
Normal Skin ***(SS* or *Ss)***			
Albino ***(ss)***			

Analysis:

1. (a) What is meant by expected genotypes? ____

   (b) Are expected results due to chance or are they arrived at mathematically? ____________________

   ____

2. (a) What is meant by observed genotypes? ____

   (b) Are observed results due to chance or are they arrived mathematically? ____________________

3. What does <u>each side</u> of each coin represent? ____

4. How does the chance of a coin landing on each side compare to the chance that a gamete cell

   will receive a particular gene at meiosis? ____

5. (a) Why must two coins be used to determine the genotypes for the offspring? _______________

____

(b) What does the use of two coins compare to at fertilization? ___________________________

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6. Compare the **expected genotypes** of 100 offspring with the **observed genotypes** of 100 offspring.

(a) Do they agree or disagree? ____

(b) If they disagree, how much do they disagree (give % difference for **SS**, **Ss**, **ss**)? ____________

7. Are your results wrong if they do not agree? _________. Explain ___________________________

____

8. What is the advantage of comparing the 100 expected offspring rather than comparing only four expected offspring with four observed offspring? _______________________________________

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9. Compare the **expected phenotypes** for 100 offspring with the **observed phenotypes** for 100 offspring.

(a) Do they agree or disagree? ____

(b) If they disagree, how much do they disagree (give % difference for normal and albino skin)?

____

10. Are your results wrong if they do not agree? _________. Explain _____________________________

____

11. If expected and observed results are never in close agreement, then our understanding of the **law of dominance** and the **segregation of genes** cannot be correct.

(a) Are expected and observed results in close agreement after many offspring are counted? ___________

(b) Does your understanding of genetics seem to have been supported from this investigation? ________

(c) Would you have good evidence if only one or two offspring were examined instead of 100? _______

Explain ____

$$\% \text{ difference} = \frac{\text{absolute value between expected \& observed}}{\text{the larger number above}} (100)$$

12. Class totals also may be used to show that expected and observed results will agree more closely when large numbers of offspring (coin flips) are counted. Record the total number of students participating in this investigation at the top of **Table 3**. Using expected **phenotype data** for 100 offspring from **Table 2** *(Column B)*, record this same number in *Column A* of **Table 3**. Determine and record in **Table 3** the class total of expected phenotypes *(Column B)* by multiplying *Column A* by the number of "parents" groups in class. In *Column C*, record class totals from all students of observed phenotypes for 100 offspring from *Column C* of **Table 2**.

Table 3: CLASS TOTALS OF ___________ PARENTS (GROUPS)				Give % Differenc (show your work
	(A) EXPECTED PHENOTYPE FOR 100 OFFSPRING	**(B) EXPECTED PHENOTYPE FOR CLASS TOTALS**	**(C) OBSERVED PHENOTYPE FOR CLASS TOTALS**	
Normal Skin				→
Albino Skin				→

13. What is the advantage of <u>comparing</u> phenotypes for **expected** offspring with the **many hundreds of observed** offspring? In other words, what is the advantage of examining a large sample size? (compare your % difference for 100 offspring to the % difference for class totals).

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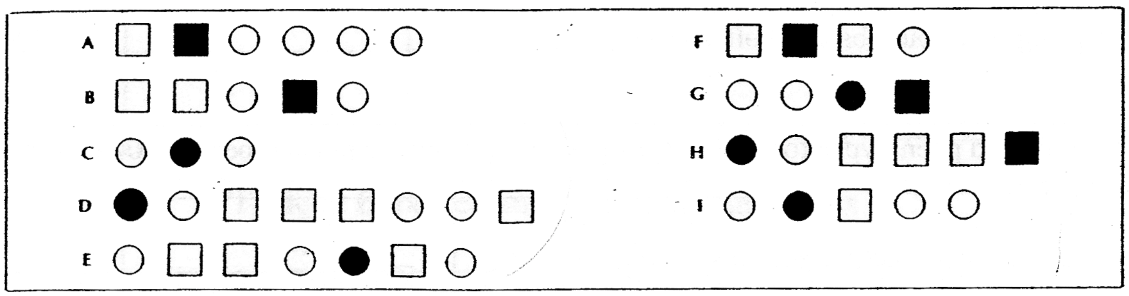
14. A number of actual families were observed that had albino children. All parents of the families had normal skin but were hybrid (Ss). The following *Pedigree* shows the offspring. **Note: A square represents a son. A circle represents a daughter, and shading indicates an albino. For example, Family A has six children, two boys and four girls. One son is albino and the other five children are normal.**



(a) What is the total number of children observed in all families? ______________________

(b) What is the total number of normal children observed in all families? ______________________

(c) How many children are expected to be normal in all families above? (multiply answer to question **(a)** by 0.75 or 3/4). ______________________

(d) Are your answers to questions (b) and (c) in close agreement? ______________________

(e) What is the total number of albino children observed in all families? ______________________

(f) How many children are expected to be albino in all families above? (multiply answer to question **(a)** by 0.25 or 1/4). ______________________

(g) Are your answers to questions (e) and (f) in close agreement? ______________________

(h) If only families D and E were used, would there be close agreement between observed and expected numbers of albinos? Explain.______________________

(i) Is our understanding of genetics supported when **observed results** from these families are <u>compared</u> to **expected results**? **Yes or NO**. ______________________