CONCEPT: PROBABILITY AND GENETICS

● To predict the genotypes and phenotypes of offspring, geneticists use probability _____

□ **Product Law** – multiply the probability of independent events occurring together

- Ex: Tossing a penny and a nickel – each has a ½ chance of being heads

- Probability of both being heads will be ½ x ½ = ¼ or 25%

- Use this when two independent events are occurring together

□ **Sum Law** – add the probability of independent occurring together

- Ex: Tossing a penny and a nickel – each has ½ chance of being heads

- Probability of one being heads and other being tails will be ¼ + ¼ = ½ or 50%

- Use this when the events could occur in more than one way

□ **Binominal Theorem:** Used when there are alternative ways to achieve a combination of events

1. What is the probability that in family with four children, two will be male and two will be female?

Option 1

- $(a + b)^n$ a = male probability = ½ and b = female probability = ½

- $(a + b)^4 = a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4$

$$
\begin{array}{ccccccc}
 & & & 1 & & & \\
 & & 1 & & 1 & & \\
 & 1 & & 2 & & 1 & \\
1 & & 3 & & 3 & & 1 \\
1 & 4 & & 6 & & 4 & 1 \\
1 & 5 & 10 & & 10 & 5 & 1
\end{array}
$$

- Each of these terms represents a different outcome

- a^4 = probability of having four males

- $6a^2b^2$ = probability of having two males, two females

$6(1/2)^2(1/2)^2 = 3/8$

Option 2

- N = s + t ; n=total number of events, S = # of times a occurs t = # of time b occurs
- 4 = 2 + 2

$$p = \frac{n!}{s!t!}a^s b^t$$

$$p = \frac{4!}{2!\ 2!}(1/2)^2\ (1/2)^2$$

$$p = 3/8$$

PRACTICE

1. Use the product law to calculate the probability that mating two organisms with the genotype of AaBbCcDd will produce offspring with the genotype of AA bb Cc Dd?
    a. 1/4
    b. 1/16
    c. 1/64
    d. 1/128

2. In a family of five children what is the probability that…
    I. Three are males and two are females
        a. 0.31, 31%
        b. 0.5, 50%
        c. 0.25, 25%
        d. 0.10, 10%

    II. All are females
        a. 0.031, 3.1%
        b. 0.31, 31%
        c. 0.25, 25%
        d. 0.10, 10%

    III. Two are males and three are females
        a. 0.31, 31%
        b. 0.5, 50%
        c. 0.25, 25%
        d. 0.10, 10%

3. In a family of six children, where both parents are heterozygous for albinism, what is the probability that four are normal and two are albinos?
    a. 0.50, 50%
    b. 0.25, 25%
    c. 0.30, 30%
    d. 0.10, 10%