

## 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  $\frac{1}{2}$  chance of being heads

- Probability of both being heads will be  $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$  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  $\frac{1}{2}$  chance of being heads

- Probability of one being heads and other being tails will be  $\frac{1}{4} + \frac{1}{4} = \frac{1}{2}$  or 50%

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

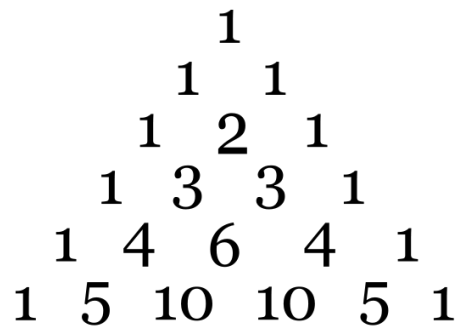
□ **Binominal Theorem:** Used when there are alternative ways to achieve a combination of events

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

Option 1

-  $(a + b)^n$                        $a = \text{male probability} = \frac{1}{2}$  and  $b = \text{female probability} = \frac{1}{2}$

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



- 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

$$6\left(\frac{1}{2}\right)^2\left(\frac{1}{2}\right)^2 = \frac{3}{8}$$

### 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%