

Investigation 1: Multiple alleles

Chickens are not able to sweat so they control their body temperature with the help of their wattles and comb. In warm seasons, the wattles and comb will help reduce the temperature of the bird by diffusing some of the heat back into the air. In cooler seasons, a smaller wattles and comb help to conserve body heat and prevent loss of heat back into the air compared to a large wattles and comb.

How can farmers around the world help their poultry regulate their temperature? Artificial selection in poultry is a process by which humans choose traits that they wish to develop within the flock. These traits are genetic, determined by genes located in the bird's DNA. These traits are passed on from parents to offspring as alleles during sexual reproduction. Chicken combs are multiple allele traits that may be expressed as dominant/recessive traits. This means that chicken combs are determined by more than one gene. It all depends on the combination of alleles that each chicken has in its genotype.

Part 1

Let's start by looking at 4 distinct multiple allele comb types that are expressed as a combination of two dominant/recessive gene combinations:



Rose

RRpp or Rrpp



Pea

rrPP or rrPp



Walnut

R_P_
(must have 1 dominant allele of each gene)



Single

rrpp

What could we produce if we selectively bred a chicken that is heterozygous (Rrpp) for rose comb and another chicken that is heterozygous (rrPp) for pea comb?

1. How many comb types of each type would we expect to see? Complete the Punnett square and write the correct percentage by each comb type below.

DATA TABLE 1

Rrpp × rrPp

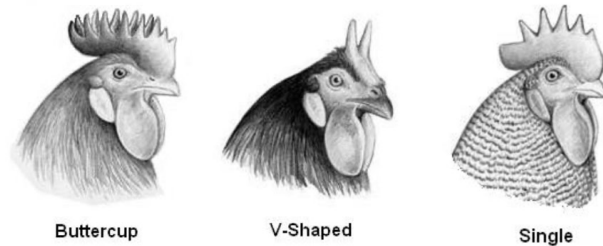
	Rp	Rp	rp	rp
rP				
rp				
rP				
rp				



2. How could a farmer breed more chickens that are suited for a hot climate? What genotype(s) would allow the farmer to produce chickens that could keep their temperature as cool as possible? Please show your Punnett square and explain your answer below.

Part 2

The duplex comb gene determines whether or not a chicken will have a divided or single comb. Take a look at the comb images to the right to see examples of the duplex gene compared to the single comb. In data table 2, please review the multiple allele pattern of inheritance for the duplex gene.



DATA TABLE 2

Phenotype	Allele	Pattern of inheritance
Duplex: V shape	D^v	Dominant to buttercup and single comb
Duplex: buttercup	D^b	Dominant to single comb
Single	d	Recessive

3. What type of comb is expressed with the following genotypes?

DATA TABLE 3

Genotype	Phenotype
D^vD^v	
D^vD^b	
D^vd	
D^bD^b	
D^bd	
dd	

4. Is it possible to breed a V-shaped comb chicken to a buttercup comb chicken and still receive a single comb chicken? Please show your Punnett square and explain your answer below.
5. Why would the duplex gene (double comb) be beneficial to some farmers? Which comb would be the most beneficial in a hot climate?