

Investigation 3: Sex-linked

Organisms have two sets of chromosomes: autosomes and sex chromosomes. The autosomes are all of the chromosomes that are not sex chromosomes. The sex chromosomes carry the genetic information that determines the sex of the offspring. In humans, the sex chromosomes are referred to as X and Y. A human with the sex chromosomes of XX is female and one with the sex chromosomes of XY is male. However, in poultry, the sex chromosomes are referred to as Z and W. A turkey or chicken with the sex chromosomes of ZW is female and the sex chromosomes of ZZ is male. The Z chromosome in poultry is larger and has more genes, similar to the X chromosome in humans. See the sex chromosomes of mammals and birds illustrated below.

Figure 1: gender determination

Organism	Male	Female	Determine the sex of offspring
Mammals	XY	XX	male
Birds	ZZ	ZW	female

In poultry, it is very difficult to determine the sex of newly-hatched chicks. Poultry do not have any external way to prove gender identification. However, some breeds of chickens are referred to as “autosexing” because when they hatch, their sex can be determined based on a “barred” feather pattern due to its location on the Z chromosome.

The barring gene is an absence of coloration in the feather, causing white stripes (bars) on the feathers. As chicks, the down feathers of a barred chicken will be light in color, whereas chicks without the barred gene will be solid.

Males can have zero, one, or two barred genes ($Z^B Z^B$, $Z^B Z^b$, $Z^b Z^b$); two copies intensifies the barring pattern. Females can either have one or no barred genes ($Z^B W$ or $Z^b W$).

- Identify the coloration of the chickens as either solid or barred in the chart below.

Male poultry	Solid or barred?	Female poultry	Solid or barred?
$Z^B Z^B$		$Z^B W$	
$Z^B Z^b$		$Z^b W$	
$Z^b Z^b$			

- What will be the outcome of a cross between a barred male ($Z^B Z^b$) and solid female ($Z^b W$)? Complete the Punnett square:

- How many chicks will have barred feathers?

	Z^B	Z^b
Z^B		
Z^b		

- Could you tell the difference between the male and females of these offspring when they hatch?

4. What will be the outcome of a cross between a solid male (Z^bZ^b) and barred female (Z^BW)? Complete the Punnett square:

	Z^b	Z^b
Z^B		
W		

- How many chicks will have solid feathers?
 - What is their sex?
 - How many chicks will have barred feathers?
 - What is their sex?
 - Could you tell the difference between the male and females of these offspring when they hatch?
5. How can breeders use these sex-linked traits to help them identify the gender of newly-hatched chicks? Why would this be helpful to commercial breeders?