

4. Other factors that affect phenotype include: light, amount of water, type of soil, nutrients present or added, temperature, diseases, crowding or competition. Probability calculations are theoretical and will not always reflect what happens in reality.

**Activity 4.6.1** (pages 155–156)

(a) All are purple and smooth,  $PpAa$ .

(b) parents:  $PaAa \times PpAa$

$F_1$  generation

	$PA$	$Pa$	$pA$	$pa$
$PA$	$PPAA$	$PPAa$	$PpAA$	$PpAa$
$Pa$	$PPAa$	$PPaa$	$PpAa$	$Ppaa$
$pA$	$PpAA$	$PpAa$	$ppAA$	$ppAa$
$pa$	$PpAa$	$Ppaa$	$ppAa$	$ppaa$

9/16 purple, smooth  
 3/16 purple, wrinkled  
 3/16 yellow, smooth  
 1/16 yellow, wrinkled

The actual ratios may differ because the probabilities are only theoretical.

Environmental factors and chance could produce different ratios. Larger samples and averaging results would likely produce more accurate results.

(c) Answers will vary depending on the sample provided.

(d) Answers will vary depending on the sample provided.

**Sections 4.5–4.6 Questions** (page 156)

- Test crosses allow plant breeders to determine the genotypes of the plants. This knowledge facilitates prediction of the phenotypes of offspring.
- Generally, the larger the sample the more accurate the ratio. By using only 16 different kernels, there is a high probability that one of the gene combinations would not be represented.
- parents:  $SuSupp \times susuPp$

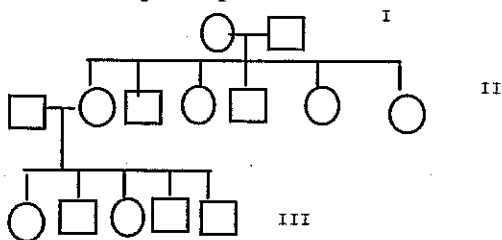
$F_1$  generation

	$Sup$	$Sup$
$suP$	$SusuPp$	$SusuPp$
$sup$	$Susupp$	$Susupp$

1/2 starchy, purple  
 1/2 starchy, yellow

### Chapter 4 Review (pages 158–159)

1. First, Mendel observed that garden peas have a number of different characteristics, each of which is expressed in one of two ways. For example, some garden peas produce green seed coats while others produce yellow seed coats. This makes it convenient to see which trait is expressed in offspring. A second reason for using garden peas is that they are both self-fertilizing and cross-fertilizing. Mendel could determine if a plant was pure-breeding by self-fertilizing, and then he could cross-fertilize two plants to determine the effects of combining sex cells.
2. Each allele is located on a homologous chromosome. Chromosomes are paired.
3. Incomplete dominance is the interaction of two genes to produce a new phenotype. For codominance, both genes exist together without masking the effect of either allele.
4. (a) Test crosses are performed to identify the genotype of a dominant phenotype. A cattle rancher that identifies an individual that is homozygous for a dominant allele knows that all of the offspring will express that trait.  
(b) One bull can impregnate an entire herd of cows. This reduces the number of genetic screens that need to be performed.
5. If each parent is heterozygous, they will not show the phenotype, but there is a one in four chance that a child will have two recessive genes.
6. A sample is provided below. Other combinations are possible.



7. (a) Possible genotypes for corn with dotted pigmentation are  $BBDD$  and  $BBDd$ .  
(b) Kernels with a genotype  $BBdd$  would appear solid black.
8. This is a problem of codominance, because in heterozygous individuals both red and white alleles express together.
9. parents:  $Ll \times ll$

F<sub>1</sub> generation

	L	l	
l	Ll	ll	1/2 long stem
l	Ll	ll	1/2 short stem

10. The male horse has genotype  $Tt$ ; female #1 and female #2 have genotype  $tt$ ; female #3 has genotype  $Tt$ , foal #1 and foal #3 have genotype  $tt$ ; foal #2 has genotype  $Tt$ .
11. A man with blood type O and a woman with blood type AB can only have children with blood types A or B (about 1/2 each). A woman with blood type AB could have children with AB blood, depending on the blood type of the father. However, she could never have children with blood type O, because all of her gametes have either an  $I^A$  or  $I^B$  allele, both of which are dominant over  $I^O$ .
12. (a) The mother has genotype  $I^A I^O$ , the father has genotype  $I^B I^O$ .

- (b) No, because individual 3 does not have an  $I^O$  allele.  
 (c) Individual 6 has genotype  $I^B I^O$ , individual 7 has genotype  $I^O I^O$ .  
 parents:  $I^B I^O \times I^O I^O$

F<sub>1</sub> generation

	$I^B$	$I^O$	
$I^O$	$I^B I^O$	$I^O I^O$	1/2 type B 1/2 type O
$I^O$	$I^B I^O$	$I^O I^O$	

13. parents:  $T^m T^n \times T^m T^n$   
 F<sub>1</sub> generation

	$T^m$	$T^n$	
$T^m$	$T^m T^m$	$T^m T^n$	1/2 less serious thalassemia 1/4 serious thalassemia
$T^n$	$T^m T^n$	$T^n T^n$	

14. All members of the F<sub>1</sub> generation are  $BbSs$ .

parents:  $BbSs \times BbSs$   
 F<sub>2</sub> generation

	$BS$	$Bs$	$bS$	$bs$	
$BS$	$BBSS$	$BBsS$	$BbSS$	$BbSs$	9/16 black, short
$Bs$	$BBsS$	$BBss$	$BbSs$	$Bbss$	3/16 black, long
$bS$	$BbSS$	$BbSs$	$bbSS$	$bbSs$	3/16 white, short
$bs$	$BbSs$	$Bbss$	$bbSs$	$bbss$	1/16 white, long

15. (a) Parents A and B have 4 children.  
 (b) Both parents have genotype  $Dd$ .  
 (c) Both individuals M and N have genotype  $dd$ .  
 16. Students should indicate why it is more likely to receive a recessive allele for a mutation from close relatives.  
 17. (a) No, amniocentesis is not necessary. Woman O is not genetically linked to person D, and her husband, K, has three siblings, all of whom appear normal.  
 (b) Yes, amniocentesis should be recommended. The risk is higher because woman J is genetically linked to person D.  
 (c) No, amniocentesis should not be performed unless there is strong evidence of genetic problems. There is some risk and it costs money.  
 (d) One pro associated with making pedigrees public is that the more data that is made available, the faster scientists can find cures and treatments.  
 One con associated with making pedigrees public is that health information may place people at a disadvantage at work and in other situations.

18. (a) Defective genes can be eliminated from a population via genetic screening, gene therapy, and selective breeding.
- (b) Some possible issues include: who decides what is best?; where should we draw the line about what is considered defective?.

## Chapter 5

# The Source of Heredity

### Reflect on Your Learning (page 160)

1. Genes are located in the nucleus.
2. X and Y chromosomes have a different appearance, however, the structure of the DNA is identical for all living things.
3. Many possible answers. Genes are arranged along the chromosomes. An understanding of the movement and replication of chromosomes helps explain how genes are inherited.
4. Many possible answers. Do humans have the right to engineer animals for their purposes? Could the smarter animal be used for destructive purposes? (Dolphins have been trained to assist in warfare). Could this technology be applied to humans? If it were applied to humans, who would decide how smart to make a baby?
5. The modification and insertion of a single gene, NR2B, into a chromosome of the mice improves the functioning of nerve receptors that play a key role in memory and learning. Patients with Alzheimer's disease have reduced memory, linked to nerve degeneration. Research with the mice might lead to new treatments for those with Alzheimer's disease.

### Try This Activity (page 161)

- (a) Al, Betty, David and Fred have genotype  $Rr$ ; Christina, Eileen and Gina have genotype  $rr$ .

### 5.3 Practice (page 167)

1. Sutton and Boveri observed that chromosomes come in pairs which segregate during meiosis. The chromosomes form new pairs when the egg and sperm unite. The paired chromosomes, or homologous chromosomes, supported Mendel's two factor explanation of inheritance. Sutton and Boveri knew that the expression of a trait was not tied to whether it was located in a male or female sex cell. Therefore, some structure in both sperm and egg cells must determine heredity. They deduced that Mendel's factors (genes) must be located on the chromosomes. The fact that humans have 46 chromosomes, but thousands of different traits, led Sutton to hypothesize that each chromosome contains many different genes.
2. Sex cells are haploid cells, somatic cells are diploid.
3. Thomas Hunt Morgan discovered that some genes are located on sex chromosomes. From experiments on *Drosophila*, he discovered that females have an XX chromosome pair and males have an XY chromosome pair. Morgan also discovered various mutations in *Drosophila*. He noted that some of the mutations seemed to be linked to other traits. Morgan concluded that the two genes responsible for the traits must be located on the same chromosome. This added support to the theory that the genes were located on chromosomes.
4. Hemophilia, hereditary nearsightedness (myopia), colour-blindness, and night blindness all affect males more often than females.