Reasons – Fraternal twins develop from two separate and different egg cells.

22. (a) No, cells without a nucleus cannot produce new cells.
    (b) Attempt to get one of the dead skin cells to divide, or measure the rate of oxygen uptake (i.e., rate of metabolism).
23. In irradiated produce, growth of roots and leaves will stop (e.g., eyes in potatoes will not sprout). Growth of microorganisms responsible for food spoilage will also stop. This is because cells produced by mitosis in which chromosomes have broken will die and thus microorganisms will be incapable of reproducing.
24. This is a true case study. Expect student answers to vary.
25. Factors that affect both male and female fertility include smoking, alcohol and drug use, over-exercise, and diet. Female fertility is also adversely affected by body weight (both abnormally high and abnormally low weight).
27. Males would no longer be needed for the continuation of the species.

# Chapter 4
# Genes and Heredity

**Reflect on Your Learning** (page 128)
All of these answers will vary.

**Try This Activity** (page 128)
All of these answers will vary.

**4.2 Practice** (pages 137–138)

1. Genotype: the genes an organism contains
   Phenotype: the observable traits of an organism that result from the interaction between genes and the environment
   Homozygous: a genotype in which both genes of a pair are identical
   Heterozygous: a genotype in which the genes of a pair are different
   Alleles: two or more alternate forms of a gene
   Monohybrid cross: a cross involving one gene pair of contrasting traits
   Punnett square: a chart used by geneticists to show the possible combinations of alleles in offspring
2. Purebred refers to parents that are homozygous for a trait. It was important for Mendel to use pure-breeding parents because that way he could ensure that no new alleles would be introduced.
3. (a) parents: $Tt \times Tt$
   $F_1$ generation

| | *T* | *t* |
|---|---|---|
| *T* | *TT* | *Tt* |
| *t* | *Tt* | *tt* |

3/4 tall
1/4 dwarf

   (b) parents: $Tt \times tt$
   $F_1$ generation

| | *T* | *t* |
|---|---|---|
| *t* | *Tt* | *tt* |
| *t* | *Tt* | *tt* |

1/2 tall
1/2 dwarf

   (c) parents: $Pp \times Pp$
   $F_1$ generation

| | *P* | *p* |
|---|---|---|
| *P* | *PP* | *Pp* |
| *p* | *Pp* | *pp* |

3/4 purple
1/4 white

(d) parents: $GG \times gg$

$F_1$ generation

| | *G* | *G* |
|---|---|---|
| *g* | *Gg* | *Gg* |
| *g* | *Gg* | *Gg* |

All have green pods.

(e) parents: $RR \times Rr$

$F_1$ generation

| | *R* | *R* |
|---|---|---|
| *R* | *RR* | *RR* |
| *r* | *Rr* | *Rr* |

All have round seeds.

4. (a) If the parent was heterozygous for black, some white individuals would appear in the $F_1$ generation. If all of the $F_1$ generation are black, the parent is most likely homozygous for black. The *B* allele can represent black and the *b* allele can represent white.

(b) parents: $Bb \times bb$

$F_1$ generation

| | *B* | *b* |
|---|---|---|
| *b* | *Bb* | *bb* |
| *b* | *Bb* | *bb* |

1/2 black
1/2 white

Expect 5 of 10 to be black.

**Sections 4.1–4.2 Questions** (pages 139–140)

1. (a) A homozygous black dog would have genotype *BB*; a heterozygous black dog would have genotype *Bb*.

(b) No. A yellow dog must have two yellow alleles. The heterozygous black dog has a yellow and black allele.

2. (a) $Rr \times rr$

(b) Round gametes are *R* and *r*. Wrinkled gametes are both *r*.

(c) parents: $Rr \times rr$

$F_1$ generation

| | *R* | *r* |
|---|---|---|
| *r* | *Rr* | *rr* |
| *r* | *Rr* | *rr* |

1/2 round
1/2 wrinkled

(d) parents (from $F_1$ generation): $Rr \times Rr$

$F_2$ generation

| | *R* | *r* |
|---|---|---|
| ***R*** | *RR* | *Rr* |
| ***r*** | *Rr* | *rr* |

3/4 round
1/4 wrinkled

3. (a) parents: $Ss \times Ss$

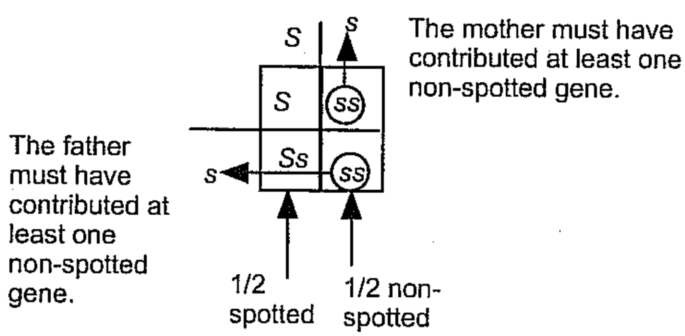
$F_1$ generation

| | *S* | *s* |
|---|---|---|
| ***S*** | *SS* | *Ss* |
| ***s*** | *Ss* | *ss* |

3/4 spotted
1/4 non-spotted

(b) The mother must have at least one spotted gene, *S*. The father's genotype is unknown. Begin by writing the known genotype of the offspring. The non-spotted offspring must be *ss*. This indicates that each parent must have contributed at least one non-spotted gene.

parents: Ss (spotted) × ??




Now determine the final gene. If the final gene for the male were an *S* gene, 3/4 of the offspring would be spotted. Since the ratio is 1/2 spotted and 1/2 non-spotted, the remaining gene must be *s*.

parents: *Ss* (spotted) × *ss* (non-spotted)

| | *S* | *s* |
|---|---|---|
| ***s*** | *S* | *ss* |
| ***s*** | *Ss* | *ss* |

1/2 spotted  1/2 non-spotted

4. The ratio is 3/4 hairless and 1/4 hairy. The 1/4 hairy indicates that each parent must contribute at least one hairy gene. Both parents are *Hh*.
5. (a) The woman who has developed Huntington's chorea has genotype *Hh*.
   (b) The probable genotype of the woman's husband is *hh*.
   (c) If the man and woman have 6 children, 3 are likely to develop Huntington's chorea.

**4.3 Practice** (pages 142–143)

1. *ss* = normal, *Ss* = shortsighted, *SS* = shortsighted

I-1: *ss*
I-2: *Ss*
II-1: *Ss*
II-2: *ss*
II-3: *ss*
II-4: *Ss*
II-5: *Ss*
III-1: *Ss* or *SS*
III-2: *Ss* or *SS*
III-3: *ss*
III-4: *Ss* or *ss* or *SS*

2. If the couple have another child, possible genotypes are *SS*, *Ss*, *ss*. The probability of shortsightedness is 3/4, the probability of normal vision is 1/4.

**4.4 Practice** (page 144)

1. (a) The homozygous condition is represented by $E^1E^1$, $E^2E^2$, $E^3E^3$ and $E^4E^4$; homozygous means a genotype in which both alleles of a pair are the same.
   (b) $E^2E^2$, $E^3E^3$ and $E^4E^4$ represent the homozygous recessive conditions, alleles from each of these genotypes is recessive to alleles of a higher order in the dominance hierarchy.
2. white eyes: $E^4E^4$, honey eyes: $E^3E^3$ or $E^3E^4$

parents: $E^3E^3 \times E^4E^4$
$F_1$ generation

| | $E^3$ | $E^3$ |
|---|---|---|
| $E^4$ | $E^3E^4$ | $E^3E^4$ |
| $E^4$ | $E^3E^4$ | $E^3E^4$ |

all honey