Chapter 9 Notes
"Disease"

Humans are very poor example of the ideal way to prevent the spread of disease. Through a simple thing such as not covering your cough, you are aiding to the spread of germs.

This chapter will tell us how lifestyle, diet and environmental factors play a role in the spread of disease.

Section 9.1 (Cause of Human Disease)

- Disease very simply prevents the body from working as it is intended to.
- As a result of the invention of microscopes it was determined that disease was caused by pathogens (germs).

- Some diseases are caused by poor environments. For example air pollution contributes to lung disease.

- Other diseases are caused by genetics (Muscular Dystrophy) which weakens muscles.

- Diseases may also arise from a combination of factors that include the environment, diet, lifestyle, genetics, pathogens and stress.

- If things such as household areas are not cleaned regularly pathogens will increase.

"Pathogens"
- Disease causing microbes, most of which are microscopic.
- There are 4 types of pathogens
    1. Bacteria
    2. Viruses
    3. Fungi
    4. Protists

Bacteria:
- Bacteria are microscopic
- Some are helpful(yogurt), which some are harmful(spoiling of food)
- Both reproduce quickly and form colonies when conditions are good.
- Bacteria likes warm temperatures, damp areas(moisture), and food such as sugar, protein or fats.

Viruses:
- Smaller than bacteria
- Can be found anywhere there are cells to infect.
- They reproduce by taking over cells.
- Viruses usually attack the reproduction area of the cell. This allows fast multiplication and invasion.

Protists:

- Single cell organisms that share some characteristics with both animals and plants
- Amoeba and paramecium are two common typles
- Giardia is a common protist that lives in the intestine of infected people. Drinking contaminated water will cause a condition that is known as "beaver fever"

Fungi:

- Includes molds, yeasts and mushrooms.
- Some fungi are parasites and can only live on host organisms. Athletes foot and ring worm are two examples that live on the body.

Check your understanding pg 162 #1-4

Section 9.2 (Communicable and Non Communicable Diseases)

- Communicable diseases are caused by pathogens that are spread from one organism to another. Examples include, the flu, HIV, and the common cold.

- Non communicable diseases are not a result of them being passed from one organism to another. These are genetic. An example would be diabetes, muscular dystrophy.

- Read and analyze the chart on page 163 that looks at the effect that CD's and how they are spread.

The Importance of a Clean Environment

- Very simply, clean environments reduce the number of viruses and bacteria spread.
- Some places have to be exceptionally clean.
    1. Hospitals
    2. Restaurants
    3. Washrooms

How do you get a Non Communicable Disease?

- Many are a result of bad environments, poor diets, unhealthy lifestyles and genetics.

Check your understanding pg 165 #1-3

Section 9.3 (Who is most likely to get sick?)

Why does life expectancy vary so much between countries in North America vs. countries in Africa?

- Living conditions
- Wealth
- Diet
- Health Care

- Public Education
- Employment
- Clean Water

What are the major risk factors?

- Table 9.2 on page 167. This table supports the statement that socioeconomic affects health.

Check your understanding pg 167 #1-4

Section 9.4 (Stop disease in its tracks)

- The staph bacterium that causes food poisoning enter food when you cough, sneeze or handling food without washing your hands properly.

Some ways to prevent the spread of such bacteria is to use gloves, change towels, carefully clean and cook food properly.

Food preservation assignment (Book Computer lab)

- The discovery of steam and its effect on killing germs was important in providing cleaner materials and preventing the spread of disease.

Aseptic Methods:

- Methods include using sterile bandages, instruments, lines and masks
- Scrubbing all exposed skin
- Having all surgical staff wear rubber gloves
- Use iodine and alcohol

Check your understanding pg 171 #1-3

Chapter Review page 172 and 173 # 1-13, 15-16.

Chapter 10 Notes
"Society's Response to Disease"

Section 10.1 (How Diseases Affect Society)

- When the Europeans came, they also brought small pox, tuberculosis, flu, etc.

- The effects on the aboriginal Groups was immense.
    1. Fewer hunters, resulted in more starving
    2. Many young women died, so birth rate went down
    3. Many elders died before traditions could be passed on.

Pandemic Disease:

- Diseases that are difficult to control are referred to as pandemics. AIDS, is one of the great pandemics of our times. Africa is seeing the effects of such a large death toll.

** AIDS and the Law**

Pandemic and Epidemic Diseases:

Bubonic Plague (1346-1350)
TB (1500-1700)
Spanish Flu (1918)
AIDS (1980-Present)

The Beginning of Public Health:

- Once the link between disease and sanitation was made, the development of public health was born. Governments eventually contributed to this cause. The Great Stink of England, where the Thames River became a dumping ground contributed to the end of dumping in water.

Check Your Understanding page 180 #1-4 (Book Computer Lab)

Section 10.2(Improving Human Health)

Chapter 11 Notes
"Protecting from disease"

Section 11.1 (Defenses against Pathogens)

- Millions and millions of harmful pathogens surround us daily.
- So why aren't we sick all the time? Why are people with illness more susceptible?

- We have several **Physical defenses**: They include, nose, sinus, tonsils, eyelids, tears, eyelashes, hair, ear, skin and stomach.

What happens once pathogens get past that, what is the next response? The answer is the **inflammatory response.**

1. White blood cells sent to the area and engulf the infection. This could result from a sliver(splinter), tonsillitis, appendicitis, etc.

Once the physical and inflammatory responses fail the **immune system** kicks in.

Check Your Understanding page 180 #1-4 (Book Computer Lab)

Section 11.3 (Immunity)

Science Background
Meningitis Immunizations — Alberta provides free immunizations to people at risk when there is an outbreak of a communicable disease such as meningitis.

The original vaccine against meningitis was effective in older children and adults. New vaccines against the major strains of meningitis exist for infants and young children. These include: meningococcal group C conjugate vaccine, haemophilus influenzae type b conjugate vaccine (HIB), and pneumococcal conjugate vaccines. The vaccines are made of complex sugars extracted and purified from the outer coat of a specific bacteria that is chemically combined with a protein such as tetanus toxoid. The combined protein–polysaccharide vaccine is called a conjugate vaccine.

Conjugate vaccines are effective in infants; however, it is necessary to get all three vaccines because each vaccine protects against a specific strain of meningitis.

Meningococcal group C conjugate vaccine was approved for use in Canada in May 2001. It was added to the infant immunization program in Alberta later that year. For more information about vaccines against meningitis, go to **www.mcgrawhill.ca/links/science.connect2**, then to **Teacher Resources**, **Web Resources**, **Unit C**, **Chapter 11**, and **Meningitis Vaccines**.
Why Get Immunized? — People should get immunized against disease to:
• protect themselves — disease can infect those who are not immunized
• protect others — some individuals cannot be vaccinated because they have severe allergies

Alberta provides free immunizations for infants and children because research shows that immunization saves lives. There is a direct link between the number of infants immunized for communicable diseases and the number of deaths from them. Failing to provide immunization

programs, or letting immunization levels drop, can have severe consequences. For example, in Britain, a drop in vaccinations against whooping cough in the 1970s resulted in an epidemic of more than 100 000 cases, and several deaths.

Some parents decide not to immunize their children because they think vaccines are not safe. For example, some researchers think there is a link between the measles, mumps, and rubella (MMR) vaccine and the incidence of autism.

There are some failures, but vaccines are usually very safe. Minor side effects can be treated. More serious side effects occur in from one per thousand to one per million doses of vaccine.

According to Health Canada, immunization is not mandatory in Canada. Only three provinces require some proof of immunization for school entrance. Ontario and New Brunswick require proof for diphtheria, tetanus, polio, measles, mumps, and rubella immunization. In Manitoba, only proof of measles vaccination is required. In these three provinces, exceptions are permitted for medical reasons, religious reasons, and reasons of conscience. The public school system in Alberta encourages immunization.

For more information about the importance of immunization, go to **www.mcgrawhill.ca/links/science.connect2**, then to **Teacher Resources**, **Web Resources**, **Unit C**, **Chapter 11**, and **Immunizations**.

Common Allergies — People develop allergies to a wide variety of allergens (substances that trigger allergic reactions). Allergens can be inhaled, eaten, injected, or contacted by the skin. They include non-food allergens such as dust, moulds, wood smoke, gases, smog, pesticides, chemicals, and bacteria; and food allergens such as wheat, strawberries, peanut butter/nuts, eggs, milk, chocolate, and shellfish.

Allergy Symptoms — Allergens cause body cells to release a substance called histamine, which causes an allergic reaction. Allergic reactions most commonly affect the respiratory tract or the skin.

The response to an allergy can range from mild discomfort to more serious physiological effects that are life threatening. For example, in hay fever, pollen allergens can cause continuous sneezing, itching, swollen tissues, and blocked nasal passages. Food allergies often result in cramps, diarrhea, or eczema.

When many cells all over the body react at the same time to an allergen such as bee venom, the body goes into anaphylactic shock. Symptoms may include hives, itching all over the body, lung spasms, a sudden drop in blood pressure, and swelling in the airways which, if not immediately treated, can cause death.

Someone suffering from anaphylactic shock must be treated quickly — usually with a shot of adrenaline (also called epinephrine) and an antihistamine. Adrenaline, a hormone found in the body, causes blood pressure to rise. The antihistamine neutralizes or slows down the effects of histamine.

Because an allergic reaction might occur when no hospital or clinic is close, an emergency injection of epinephrine (EpiPen™) is often prescribed for individuals who have had severe or life-threatening allergic reactions to specific foods (e.g., nuts, shellfish); drugs (e.g., penicillin); or stinging insects (e.g., bees, wasps, hornets, yellow jackets).

Allergy Treatment — Depending on the severity of the allergy, treatments may vary and include:

- avoidance — staying away from allergens;
- medicines — antihistamines, decongestants, and nasal sprays; and

• immunotherapy — injections of the weakened allergen to build antibodies against the allergen.

During spring and fall, someone sensitive to pollen (e.g., trees, weeds such as ragweed, grasses) might stay indoors and keep windows closed. During the winter, when air movement in homes and buildings is minimal, someone allergic to pets, dust, or moulds may need to rid the space of the allergen, take medications, or do a combination of both.

Who Gets Allergies? — Some people are born with a greater chance of getting allergies. For example, children have a greater chance of having allergies if one parent has allergies. Some children outgrow these allergies, but scientists do not yet know how.

Some people develop allergies over time. Coming in contact with certain allergens over many years may build up an allergic reaction in an individual.

Hypoallergenic Products — A hypoallergenic product implies that it is less likely to cause allergic reactions than competing products. However, manufacturers can label and advertise their products as hypoallergenic without any supporting evidence.

Health Canada states that no scientific studies have proven that hypoallergenic products produce fewer allergic reactions than products that do not make such claims. The same is true for products labelled dermatologist-tested, allergy tested, and non-irritating. Almost any cosmetic could cause an allergic reaction in some individuals.

In Canada, ingredient listings are not yet mandatory on cosmetic labels. Such information may help consumers who know they are allergic to certain ingredients to protect themselves.

Section 11.4 (Treating disease)

Antiviral Medications — Since antibiotics do not kill viruses, they are ineffective against the flu. For this purpose, antiviral medications are used. The following antiviral medications are available by prescription only: zanamivir (Relenza™), oseltamivir (Tamiflu™), amantadine (Symmetrel™). Although flu shots are the main way to prevent getting the flu, some antiviral drugs can also prevent flu. Symmetrel™ has been approved to prevent influenza A.

Factors Contributing to Antibiotic-resistant Bacteria — At the moment, people are more concerned about antibiotics than antiviral medications. That is because bacteria have been developing resistance to antibiotics. For example, until the late 1970s, penicillin was effective in killing the bacterium *Streptococcus pneumonia*, which is the most common cause of bacterial pneumonia, meningitis, and ear infections. According to studies done by the Centers for Disease Control and Prevention (CDC), up to 30 percent of these infections in the 1990s were penicillin resistant. Many other infections, including those that cause tuberculosis, gonorrhea, and salmonellosis, are also becoming resistant.

Antibiotic-resistant bacteria are of particular concern in hospitals. For example, the bacterium *Staphylococcus aureus* causes skin sores and abscesses. These bacteria have become resistant to an antibiotic called methicillin, which means that the infections can spread from the skin to the blood, lungs, brain, bones, or heart. In many cases, such infections picked up in the hospital have led to the death of patients.

What contributes to antibiotic resistance in bacteria? There are two main factors:

• Humans overuse and inappropriately use antibiotics. Most antibiotics are prescribed for respiratory tract infections (e.g., colds, sore throats, ear infections, sinusitis, bronchitis, pneumonia). However, many respiratory tract infections are due to viruses, and antibiotics do

not work against viruses. Researchers estimate that at least 50 percent of antibiotic use is inappropriate because antibiotics are prescribed for viral infections.

- Agricultural producers use antibiotics to prevent or treat diseases in animals and plants or to promote growth. Harvard Medical School researchers found that antibiotic-resistant bacteria infecting humans were identical to some bacteria infecting animals. The Centers for Disease Control and Prevention linked an outbreak of resistant salmonellosis in humans to beef cattle that had been fed an antibiotic called chlortetracycline. The antibiotic improved growth rates.

There is concern that antibiotics may no longer be useful to treat infections unless the problem is adequately addressed. Several studies have shown that decreasing antibiotic use can reverse resistance in bacteria. In 1997, the Canadian Committee on Antibiotic Resistance issued a mandate to decrease the use of antibiotics in respiratory tract infections by 25 percent.

An Edmonton company, Cytovax Biotechnologies Inc., has developed an experimental technology to block bacteria from establishing itself in the body. If the bacteria could not find a willing host, there would be no infection. If successful, the technology will help reduce resistant bacteria because people will use antibiotics less often.

For more information about antibiotic resistance and how to prevent it, go to www.mcgrawhill.ca/links/science.connect2, then to Teacher Resources, Web Resources, Unit C, Chapter 11, and Antibiotic Resistance.

Addiction to Prescription Drugs — Although it is difficult to determine how many Canadians are abusing prescription drugs, addiction to prescription drugs is a serious problem. Addiction may occur when people self-medicate with antibiotics, antidepressants, pain relievers, and sedatives that they may not need.

Some people regularly request and receive medications, which some doctors dispense without conclusive evidence of an illness. Others may not know that their medication contains addictive components. This is a concern because addiction to some medications can begin in as little as two weeks.

The following three classes of drugs are most commonly abused:

- Opioids treat pain. These include morphine, codeine, and meperidine (Demerol™).
- Central nervous system depressants treat anxiety and sleep disorders. These include barbiturates such as mephobarbital (Mebaral™) and benzodiazepines such as diazepam (Valium™), alprazolam (Xanax™), and Rohypnol™, (pronounced row-hip-nole and also known as the "date rape drug"). Rohypnol™ is not legally available in Canada, even for medicinal purposes.
- Stimulants treat narcolepsy and attention deficit/hyperactivity disorders. These include dextroamphetamine (Dexedrine™) and methylphenidate (Ritalin™). People with attention deficit/hyperactivity disorder (ADHD) do not become addicted to Ritalin™ if the medication is taken properly.

Drug Information — For information about specific prescription and over-the-counter medications, go to **www.mcgrawhill.ca/links/science.connect2**, then to **Teacher Resources**, **Web Resources**, **Unit C**, **Chapter 11**, and **Drug Information**.

Doctors, pharmacists, and consumers need to keep up to date on the safety of medical products. To find safety alerts about medical products, go to **www.mcgrawhill.ca/links/science.connect2**, then to **Teacher Resources**, **Web Resources**, **Unit C**, **Chapter 11**, and **Medical Product Safety Alerts**.

Over-the-Counter Drugs — When choosing an over-the-counter drug to treat symptoms, look for the following information on the label.

• Active ingredients — Choose products based on a single active ingredient or medicinal substance. This will help avoid overdose and multi-drug interactions.
• Expiration date or storage period — Do not buy any medicines past their expiration date.

Traditional Medicine — There is considerable interest in alternative or complementary medicine, and some students may mention alternative therapies they have tried. The World Health Organization defines traditional medicine as ways of preventing, diagnosing, and treating physical and mental illness that existed before the development of modern medicine. Traditional medicine practices developed from the traditions of the culture they came from and have met the needs of communities for centuries. For example, China and India have developed extensive systems such as acupuncture and ayurvedic medicine respectively. Traditional medicine also includes homeopathy and herbal therapy.

Chapter 12 Notes
"Genetics and Health"

Section 12.1 (Structure of DNA)

Science Background

James Watson, an American scientist, and David Crick, an English scientist, shared the 1962 Nobel Prize for Physiology and Medicine for their discovery of the structure of DNA. Even though Watson and Crick are credited with the discovery of the DNA molecule in 1952, there is an ongoing debate about the amount of credit due to an English scientist named Rosalind Franklin. She was responsible for much of the DNA research and many discoveries. For more information about Rosalind Franklin, go to **www.mcgrawhill.ca/links/science.connect2**, then to **Teacher Resources**, **Web Resources**, **Unit C**, **Chapter 12**, and **Rosalind Franklin**.

Watson and Crick described DNA as a double helix, a term still used today. The DNA molecule is often described as a twisted ladder. Tell students that the ladder is very long. If you stretched out the DNA from a single human cell, it would measure 1.7 metres. If you stretched out the entire DNA from a human being, it would be long enough to stretch to the moon 6000 times!

The main components of DNA are phosphates, sugars, and four nitrogenous bases: adenine, thymine, cytosine, and guanine. The rungs of the ladder are made up of pairs of these bases that can be arranged in an infinite number of sequences. The sides of the ladder are composed of a nuclear membrane made up of phosphate and deoxyribose sugars.

Chromosomes — Each species has its own number, type, and organization of chromosome pairs. For instance, potatoes and gorillas each have 24 pairs of chromosomes; humans have 23 pairs. Feel free to make an overhead of **Figure 12.1**, which lists the number of chromosome pairs of familiar organisms, and use it as a discussion tool.

Ask students what they have in common with gorillas and potatoes. People have similar numbers of chromosomes as gorillas and potatoes but the type and organization of the genes makes someone human and neither a potato nor a gorilla.

There is an important difference between the number of chromosomes contained in a sex cell and in a body cell. Every cell of the body has 46 chromosomes *except* the sex cells, which have exactly half the usual number of chromosomes. There are 23 chromosomes in a human egg cell or sperm cell.

Karyotypes — For more information about human karyotypes, go to **www.mcgrawhill.ca/links/science.connect2**, then to **Teacher Resources**, **Web Resources**, **Unit C**, **Chapter 12**, and **Human Karyotype**.

Sex determination — Information on sex inheritance in many organisms, including humans, came from a study of fruit flies. Fruit flies have eight chromosomes. Among these chromosomes are either two X chromosomes or an X chromosome and a Y chromosome. Scientists have concluded that X and Y chromosomes contain genes that determine the sex of an individual.

SRY (for **s**ex-determining **r**egion **Y**) is a gene located on the short arm of the Y chromosome. The presence of the Y chromosome is decisive in unleashing development that leads to a baby boy.

Each human egg or sperm cell contains one sex-determining chromosome. Females have two X chromosomes in their cells, while males have one X chromosome and one Y

chromosome. Females normally produce eggs that have only an X chromosome. Males, on the other hand, produce both X-containing sperm and Y-containing sperm.

When an egg is fertilized by an X-containing sperm, the offspring is XX, a female. When an egg is fertilized by a Y-containing sperm, the offspring is XY, a male. There is a 50 percent probability of producing either a male or female offspring.

a. Your body consists of about 10 trillion cells
b. Each cell contains a nucleus with chromosomes
c. Each chromosome contains a double helix shaped DNA
d. DNA is divided into segments called genes

- DNA is liked a twisted ladder, where the bases make up the rungs. A pair of bases makes up each rung.
- Different bases pairs result in different genes

"chromosomes"

- Human body cells contain 23 pairs (46 total). One chromosome of each pair comes from the mother and the other from the father.
- The sex chromosome is the last pair. Y chromosomes are found in males, and X chromosomes are found in females.

Figure 12.2

Check Your Understanding page 215 #1-4

Section 12.2 (Inheritance and Genetics)

Science Background

Genetics — During the mid-1800s, Gregor Mendel's work with pea plants became the foundation for modern genetics. Mendel tested over 28 000 pea plants as he analyzed seven pairs of seed and plant characteristics: plant height, pod colour, pod shape, flower colour, flower position, seed colour, and seed shape. From these investigations, he made important generalizations that he called the Laws of Heredity. He also reasoned that things called "factors" controlled the traits he studied. He discovered that some of these factors, such as the ones for tall stem and yellow pea colour, were always expressed if they were present, whereas the contrasting factors for short stem and green pea colour were not. He coined the terms "dominant" and "recessive" for each type of factor.

Today we know that Mendel was working with genes, the part of the chromosome that governs the expression of a particular trait. A gene can occur in alternative forms called alleles. When two alleles are present, a dominant allele usually prevents the expression of a recessive allele.

Genotype is the term used to describe the genetic make-up of an individual. Phenotype is the term used to describe the physical expression of the trait in an organism. For example, the

genotype of a tall pea plant could be described as Tt (one dominant allele and one recessive allele). The phenotype of this particular plant would be tall.

Alleles — Mendel determined that each organism contains two alleles, or factors, for each trait. An allele is one form of a given allelic pair. For instance, tall and dwarf are the alleles for the height of a pea plant. More than two alleles may exist for any specific trait, but each individual has only two of them.

Geneticists tend to use capital and lower-case letters to name the alleles for any trait. The actual letter can change, depending on what is being recorded, but the use of capital and lower-case letters is consistent. For any trait, an individual likely has one of the following pairs:

- DD — two dominant factors or alleles. This is called homozygous dominant.
- dd — two recessive factors or alleles. This is called homozygous recessive.
- Dd — one dominant gene and one recessive gene for a trait. This is called heterozygous or hybrid.

Inheritance of Alleles — When gametes form during reproduction, the alleles segregate so that each gamete carries only one member of the gene pair. During fertilization, the new organism inherits two alleles — one from each parent.

Mendel published his work in 1866, but his work was not widely accepted until after 1900. Today Mendelian genetics is studied worldwide. **Note:** It is not necessary for students to know or use the terms "allele," "homozygous," or "heterozygous."

Tools — Scientists use Punnett squares to calculate the probabilities that offspring will have particular phenotypes and genotypes.

To learn more about how to use Punnett squares, go to **www.mcgrawhill.ca/links/science.connect2**, then to **Teacher Resources**, **Web Resources**, **Unit C**, **Chapter 12**, and **Punnett Squares**.

Pedigrees are often used to help figure out someone's genotype. This can help if someone may have inherited a specific disease. Analyzing the genotype of a couple can determine the chances of the pair producing offspring with a specific disease.

A pedigree shows the physical expression, or phenotype, of a trait. It does not show the genotype. For example, a pedigree may indicate that a man has dimples, which is a dominant trait, but it does not show whether he is heterozygous (Dd) or homozygous (DD) for the trait.

Sex-linked Pedigrees — A sex-linked pedigree follows the inheritance of a trait that is controlled by genes found on the X chromosome. The gene is carried on the sex chromosome present in both sexes. There is only one copy in males (since males are XY), but two copies in females (since females are XX). Most sex-linked defects are recessive.

Women may have a recessive allele on one X chromosome and a dominant allele on the other. This explains why women are frequently carriers of X-linked traits but rarely express the trait in their own phenotypes. On the other hand, a female carrier can pass the recessive allele to her sons, who will express the recessive phenotype of the sex-linked trait. **Figure 12.2** shows the Punnett square that results from a normal male and a female carrier of colourblindness. When students work with such Punnett squares, you may wish to have them draw sperm around one set of chromosomes and ova around the other set. This will reinforce the fact that one chromosome from the male and one from the female make up the genotype of the offspring.

Inheritance of Colourblindness — Colour-blind people have fewer cones and rods at the back of their eyes to pick up different wavelengths of light. As a result, they have difficulty discriminating between colours such as red and green. Some people are more colour-blind than others.

Note that the Punnett square shows the presence of the X and Y chromosomes, and then uses a subscript to show the alleles on this chromosome. The woman is heterozygous for colourblindness. This is shown as Bb. Offspring who inherit the B will not be colour-blind. Only those who have the b by itself will be colour-blind.

Study the Punnett square to see how these alleles will affect offspring.

- Offspring 1 is a female with a BB combination = homozygous for not being colour-blind.
- Offspring 2 is a male with one B allele. This person will not be colour-blind.
- Offspring 3 has the Bb pair. This female will not be colour-blind, but may have offspring who are.
- Offspring 4 is a male with a b allele. Since this allele is not paired with a B allele, this offspring will be colour-blind. Also, if this male mated with a female with a Bb allelic pair (such as Offspring 3), female offspring from that coupling could be colour-blind.

Because males carry only one X chromosome, they inherit only one gene for colour vision. A defective allele for colour-blindness cannot be masked by an allele for normal colour vision, as in females; thus males have a much greater chance of being colour-blind than females do. To be colour-blind, a female must inherit two defective alleles.

Students are not expected to learn about sex-linked traits at this point but will be introduced to X-linked disorders in Section 12.3.

To learn more about the two types of pedigrees, autosomal pedigrees and sex-linked pedigrees, go to **www.mcgrawhill.ca/links/science.connect2**, then to **Teacher Resources**, **Web Resources**, **Unit C**, **Chapter 12**, and **Pedigrees**.

Albinos — People with albinism have inherited genes that do not make the usual amounts of the skin pigment called melanin. Albinism affects people from all races. Often people do not know they have albinism until they get an eye exam.

People with albinism have vision problems. Many are legally blind. The vision problems result from the abnormal development of the retina and abnormal patterns of nerve connections between the eye and the brain. It is the visual problems that define the diagnosis of albinism; therefore, the main test for albinism is an eye exam.

A common myth is that people with albinism have red eyes. In fact, there are different types of albinism and the amount of pigment in the eyes varies. Although some people with albinism have reddish or violet eyes, most have blue eyes.

- Your genetic makeup comes from your parents (half and half). The reason that all brother and sisters do not look alike is heredity

Figure 12.3 Purebreds vs. hybrids

"Recording Inherited traits"

- Just as chromosomes come in pairs, so do genes. We use letters to represent the genotype or combination of genes. Capital letters represent dominant genes, and lower case letter represent recessive genes.

"Punnett Squares"

- Used to predict the probability of offspring
- Pedigrees are diagrams that show the history of that trait from generation to generation

Check Your Understanding page 215 #1-4

Section 12.3 (Structure of DNA)

Science Background

Gene mutations can be inherited or acquired. Inherited mutations are mistakes in base pair sequences that are present in the DNA of virtually all body cells. Such mutations are passed from generation to generation. Inherited genetic disorders often result from a change in base-pair sequencing (mutation), missing genes, or from inheriting specific defective recessive genes.

Exposure to environmental factors called mutagens can also cause mutations in the DNA that develop throughout an individual's life. Most errors of this type do not pass from one generation to the next, unless they happen in the tissue that gives rise to egg or sperm cells.

Inherited Genetic Disorders — Some examples of genetic disorders caused by gene mutations or abnormal chromosome number include:

• Sickle-cell anemia: This affects people who inherit two recessive genes. It is one of a group of inherited blood disorders that results from an abnormal form of hemoglobin in the red blood cells. (Hemoglobin carries oxygen through the body.) Drugs help to manage the disease.

• Huntington's disease: This affects people who inherit a single dominant gene that is not sex-linked. Every child of an affected parent has a 50 percent risk of inheriting the gene that causes HD. It is a degenerative brain disease that usually begins in mid-life. Brain cells begin to die, causing deteriorating mental ability, emotional control, balance, and speech. Involuntary movements are often a symptom. There is no cure; treatment involves managing symptoms. For information about this disease, go to **www.mcgrawhill.ca/links/science.connect2**, then to **Teacher Resources**, **Web Resources**, **Unit C**, **Chapter 12**, and **Huntington's Disease**.

• Down syndrome: This is one of the most common genetic disorders. It affects people with an extra chromosome #2 — 47 in total. The abnormal complement of chromosomes results in physical features such as a short, stocky body; stubby fingers and toes; an enlarged tongue; and a round face with eyelid folds. Some people with Down syndrome have mental limitations. Early educational and social interventions are helpful.

• Turner syndrome: This condition is caused by the lack of one X chromosome in females. It results in features such as low-set ears, low hairline, pigmented moles, bending out of the elbows, and swollen hands and feet.

• Diabetes mellitus (Type 1): The specific gene mutation(s) that causes diabetes has not been found. Scientists *have* found a set of genes involved in the body's immune response that allow the immune system to attack foreign invaders. These genes are turned off in people with Type 1 diabetes. As a result, the immune system attacks the insulin-producing cells in the pancreas.

• Tay-Sachs: This condition is 100 times more common among Ashkenazic Jews (originating from France, Germany, and eastern Europe) than in the non-Jewish population. It is caused by a recessive allele.

The Trouble with Mutagens — Ultraviolet light, alcohol, both prescription and non-prescription drugs, and PCBs can harm the developing embryo in many ways.

Ultraviolet Light — Exposure to UV light can cause skin cancer, premature aging of the skin, cataracts, and other types of eye damage. Skin cancer is the most common cause of cancer in

Canada. Both the total amount of lifetime exposure and overexposure can cause skin cancer. Fair-skinned people who sunburn easily are at high risk.

Skin cancer is a disease in which malignant cancer cells are found in the outer layers of the skin. Ultraviolet radiation promotes chemical changes in the DNA, which show up as errors in the information encoded in a gene. The mutation can take many years to develop into skin cancer as the altered DNA is copied into more and more cells.

The most serious form of skin cancer is melanoma. To learn about three forms of skin cancer and how they are treated, go to **www.mcgrawhill.ca/links/science.connect2**, then to **Teacher Resources**, **Web Resources**, **Unit C**, **Chapter 12**, and **Skin Cancer**.

The Alberta Cancer Board recommends the following practices to reduce the risk of sunburn and skin cancer.

- Minimize exposure to the Sun between the hours of 11:00 A.M. and 4:00 P.M.
- Apply a broad spectrum sunscreen with at least an SPF 15 (Sun Protection Factor) to all exposed parts of the body. Re-apply sunscreen every two hours and after swimming or perspiring.
- Wear protective clothing to cover arms and legs, and a hat with a brim to shade the face and neck.
- Wear sunglasses that provide 100 percent UV ray protection.
- Avoid using tanning lamps.
- Protect children. Keep them out of the Sun when it is strongest. Use sunscreen generously. Do not use sunscreen on children under 6 months of age. Instead, severely limit their Sun exposure.

Fetal Alcohol Spectrum Disorder (FASD) — FASD is one of the most important causes of birth defects and developmental delays in children in Canada. FASD is present in approximately three in 1000 live births in Canada.

There is evidence that any amount of alcohol is damaging to a fetus. An individual with FASD has difficulties with learning, behaviour, mental health, and independent community living. This occurs because the condition:

- damages the nervous system, resulting in severe learning disabilities, a small head size, problems with fine and gross motor control, hyperactivity, and poor impulse control;
- slows down prenatal and postnatal growth, resulting in babies who are underweight at birth and fail to gain weight normally; and
- causes characteristic facial features such as widely spaced eyes, flattened cheekbones, a thin upper lip, misplaced teeth, and an indistinct groove between the upper lip and nose.

Suicide is the leading cause of death for FASD individuals. There is no cure.

Although FASD is found in all racial and economic groups, some populations may be more at risk. Research indicates that many more members of some populations lack or have lesser amounts of an enzyme necessary to break down alcohol and are therefore more likely to get this disease.

FASD is not inherited — it is linked to maternal drinking. To learn more about FASD, go to **www.mcgrawhill.ca/links/science.connect2**, then to **Teacher Resources**, **Web Resources**, **Unit C**, **Chapter 12**, and **Fetal Alcohol Spectrum Disorder**.

Prescription And Over-the-Counter Drugs — Drugs may be transmitted to a fetus *in utero* or through breast milk; some may cause harm. Some prescription drugs and over-the-counter drugs are more harmful to a fetus than others. These include drugs used to treat migraine headaches,

acne, blood clots, colds or flu, infection, epilepsy, and breast cancer. Pregnant or nursing women should never take these or any other drugs without a doctor's consent.

Few studies have assessed the safety of antibiotics during pregnancy. Generally, the penicillin group of antibiotics (e.g., penicillin G, ampicillin, amoxicillin, dicloxacillin, oxacillin), and a related group called the cephalosporins (e.g., Keflex™, Ceclor™, Suprax™), as well as erythromycin, are considered safe. Sulfonamides (e.g., Bactrim™, Septra™) should not be used during the last trimester of pregnancy or during nursing, because they can produce jaundice in the newborn. Tetracycline, streptomycin, and chloramphenicol should be avoided.

For more information about the effects of drugs, including tobacco, on pregnancy, go to **www.mcgrawhill.ca/links/science.connect2**, then to **Teacher Resources**, **Web Resources**, **Unit C**, **Chapter 12**, and **Effects of Drugs on Pregnancy**.

PCBs — PCBs were used as ingredients in a number of industrial materials, including sealing and caulking compounds, inks and paint additives, and coolants and lubricants for certain kinds of electric equipment. In 1977, a ban was placed on manufacturing and importing PCBs.

PCBs are a concern because they stay in the environment for many years — they do not break down easily. They are found worldwide in trace amounts, including in food. PCBs move up the food chain by getting into the body fat of animals.

According to Health Canada, most Canadians have limited exposure to PCBs. To limit exposure even further, people should limit the amount of sport fish and game eaten. They should also avoid storage sites that contain PCBs.

More research is needed before scientists can determine how exposure to low levels of PCBs affects health over time. Known effects on health include a severe form of acne called chloracne, swelling of the upper eyelids, numbness in the arms and/or legs, general overall weakness, discolouring of nails and skin, muscle spasms, chronic bronchitis, and problems with the nervous system.

Radiation— Radiation is a special kind of energy carried by waves or a stream of particles. It can come from special machines or from radioactive substances. Like X rays, this energy can cause cells to become cancerous with longer or frequent exposures. When radiation is used at doses many times those used for X-ray exams, it can be used to treat cancer and other illnesses.

For this purpose, special equipment is used to aim the radiation at tumours or areas of the body where there is disease. This form of radiation is called radiation therapy, radiotherapy, X-ray therapy, cobalt therapy, electron beam therapy, or irradiation.

High doses of radiation can kill cells or keep them from growing and dividing. This is a useful tool for treating cancer because cancer cells grow and divide more rapidly than many of the normal cells around them.

Although some normal cells may be affected by radiation, most normal cells appear to recover more fully from the effects of radiation than do cancer cells. Doctors carefully limit the intensity of treatments and the area being treated so that the cancer cells will be affected more than the cells of normal tissue.

Like many other treatments for disease, there are risks for patients who receive radiation therapy. The brief, high doses of radiation that damage or destroy cancer cells also destroy some normal cells. This is what causes side effects such as loss of hair and nausea. The risks associated with these side effects are usually less than the risk of allowing the cancer cells to proliferate.

- The majority of times when a chromosome copies itself during reproduction everything works well. When something does go off course, the body's cell recognizes this and fixes the mistake.
- However this does not happen all the time. As a result, changes in the genetic information can result in an abnormality or mutation.
- Environmental factors can also cause mutations. Some include, radiation, ultraviolet light, chemicals (PCB's and tobacco, alcohol.)

"Inherited Genetic Disorders"

- Usually mutations result in genetic disorders. For example sickle-cell anemia, which leads to high level of infection and lower contents of iron in the blood?

Table 12.1 (Mutagens and their effects on embryos)

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