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Module 2.1

Prenatal Development

LEARNING OBJECTIVES

After reading Module 2.1, students will be able to answer the following questions:

Earliest Development

LO1 What is our basic genetic endowment?

LO2 How can human development go off track?

The Interaction of Heredity and Environment

LO3 How do environment and genetics work together to determine human characteristics?

LO4 Which human characteristics are significantly influenced by heredity?

KEY TERMS AND CONCEPTS

Amniocentesis
Behavioural genetics
Chorionic villus sampling (CVS)
Chromosomes
Dizygotic twins
DNA (deoxyribonucleic acid)
Dominant trait
Down's syndrome
Fragile X syndrome
Genes
Genetic counselling
Genotype
Heterozygous
Homozygous
Klinefelter syndrome
Monozygotic twins
Multifactorial transmission
Phenotype
Polygenic inheritance
Recessive trait
Sickle-cell anemia
Tay-Sachs disease
Temperament
Ultrasound sonography
X-linked genes
Zygote

MODULE OUTLINE

I. Earliest Development

A. Genes and Chromosomes: The Code of Life
   1. Humans begin life as a single cell, called a **ZYGOTE**.
   2. Our genetic code is stored and communicated in our **GENES**, the basic units of genetic information.

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a) Genes are composed of sequences of **DNA (deoxyribonucleic acid)**, the substance that determines the nature of every cell in the body and how it will function.
b) Humans have over 25 000 genes
c) Genes are arranged in specific locations and in a specific order along 46 **CHROMOSOMES**, rod-shaped portions of DNA that are organized in 23 pairs.
i. One pair chromosomes (via the gametes) is provided by the mother; one by the father at fertilization.

3. Meiosis and mitosis
a) Gametes (sperm and ova) are formed by a process called *meiosis*.
b) Zygote is one cell formed by fusion of the two gametes.
c) All other cells replicate the genetic code by a process called *mitosis*.
d) There are tens of trillions of possible genetic combinations.

B. Multiple Births: Two—or More—for the Genetic Price of One
1. Less than 3% of all pregnancies produce twins; the odds are slimmer for three or more children.
2. **MONOZYGOTIC TWINS** form when a cluster of cells in the ovum splits off within the first two weeks following fertilization.
3. **DIZYGOTIC TWINS**, who are produced when two separate ova are fertilized by two separate sperm, are no more genetically similar than two siblings.
4. Other kinds of multiple births (triplets, quadruplets, etc.) can form from either mechanism.
a) Using fertility drugs increases the chances of having a multiple birth.

b) Older women are more likely to have multiple births.

5. Boy or Girl? Establishing the Sex of the Child
a) The 23rd chromosome determines the sex of the child.
1) Females are XX.
2) Males are XY.
3) The father's sperm determines the sex of the child.
4) New techniques are being developed to help specify in advance the gender of the child.

C. The Basics of Genetics: The Mixing and Matching of Traits
1. An Austrian monk, Gregor Mendel (mid-1800s), working with peas, discovered that when two competing traits were present only one could be expressed.
a) The trait that is expressed when two competing traits are present is called the **DOMINANT TRAIT**.
b) The trait that is present in the organism but not expressed is called the **RECESSIVE TRAIT**.
c) **GENOTYPE** is the underlying combination of genetic material present (but not outwardly visible) in an organism.
d) **PHENOTYPE** is an observable trait, the trait that is actually seen.
e) *Alleles* are genes for traits that may take alternate forms.
1) **HOMOZYGOUS** is inheriting from parents similar genes for a given trait.
2) **HETEROZYGOUS** is inheriting from parents different forms of a gene for a given trait.
3) If a child receives a *recessive* allele from each parent, it will display the recessive characteristic.
4) However, few human traits are the result of single alleles and follow the simple laws of Mendelian inheritance.

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D. Transmission of Genetic Information
   1. Most traits are the result of **POLYGENIC INHERITANCE**, in which a combination of multiple gene pairs is responsible for the production of a particular trait.
   2. Some genes (such as those for blood type AB) are neither dominant nor recessive but are a combination.
   3. Some recessive genes are **X-LINKED GENES,** meaning they are located on the X chromosome.
      a) Males have a higher risk for a variety of X-linked disorders because they lack a second X chromosome to counteract the genetic information that produces the disorder.
      b) *Hemophilia* is a blood disorder produced by X-linked genes.
      c) Red-green colour blindness is another disorder produced by X-linked genes.
   4. The Human Genome and Behavioural Genetics: Cracking the Genetic Code
      a) In 2001, molecular biologists succeeded in mapping the human genome – the specific sequence of genes on each chromosome.
      b) The number of human genes, long thought to be 100 000, has been revised downward to 25 000.
      c) In humans 99.9% of the gene sequence is shared by all humans.
   5. The most recent approach to the study of the effects of heredity on behaviour and development is called **BEHAVIOURAL GENETICS**.
      a) This field merges psychology – the study of behaviour – with genetics – the study of transmission of characteristics through heredity.
      b) These are learning how behavioural difficulties (such as schizophrenia) may have a genetic basis.
      c) Researchers also seek to identify how genetic defects may be remedied.

E. Inherited and Genetic Disorders: When Development Deviates from the Norm
   1. Some disorders are inherited (e.g., PKU).
   2. Some genetic disorders are the result of genes that become physically damaged.
   3. Sometimes genes spontaneously change their form, a process called *spontaneous mutation*.
   4. Certain environmental factors, such as exposure to X-rays, can produce malformed genetic material.
   5. Some genetic disorders include
      a) **DOWN'S SYNDROME** is a disorder produced by the presence of an extra chromosome on the 21st chromosome pair, once referred to as mongolism.
      b) **FRAGILE X SYNDROME** is a disorder produced by injury to a gene on the X chromosome, producing mild to moderate intellectual impairment.
      c) **SICKLE-CELL ANEMIA** is a blood disorder that gets its name from the shape of the red blood cells in those who have it.
      d) **TAY-SACHS DISEASE** is an untreatable disorder that produces blindness and muscle degeneration prior to death.
      e) One male out of every 400 is born with **KLINEFELTER SYNDROME**, a disorder resulting from the presence of an extra X chromosome that produces underdeveloped genitals, extreme height, and enlarged breasts.

F. Genetic Counselling: Predicting the Future from the Genes of the Present
   1. **GENETIC COUNSELLING** is the discipline that focuses on helping people deal with issues related to inherited disorders.
      a) Genetic counsellors use a variety of data.
      b) They can take a thorough family history, seeking any familial incidence of birth defects.

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c) The age of mother and father will be taken into account.
d) Blood, skin, and urine may be used to isolate and examine specific chromosomes.
e) Possible genetic defects can be identified by assembling a *karyotype*: a chart containing enlarged photos of each of the chromosomes.

2. Prenatal Testing
   a) Other tests take place once the woman is already pregnant:
      (1) **ULTRASOUND SONOGRAPHY** is a process in which high-frequency sound waves scan the mother's womb to produce an image of the unborn baby whose size and shape can then be assessed.
      (2) **CHORIONIC VILLUS SAMPLING (CVS)** is a test used to find genetic defects that involves taking samples of hair-like material that surrounds the embryo.
      (3) **AMNIOCENTESIS** is the process of identifying genetic defects by examining a small sample of fetal cells drawn by a needle inserted into the amniotic fluid surrounding the unborn fetus.
   b) Screening for Future Problems
      (1) The newest role of genetic counsellors is to test people, rather than their children, for susceptibility to disorders due to genetic abnormalities.
         (a) *Huntington's disease* can be predicted based on genetic testing.
         (b) More than 1000 disorders can be predicted on the basis of genetic testing.
         (c) Other advances include *germ-line gene therapy*, a process where genetic modifications can correct problems not only for unborn individuals but for future generations.

II. The Interaction of Heredity and Environment

A. The Role of the Environment in Determining the Expression of Genes: From Genotypes to Phenotypes
   1. **TEMPERAMENT**, patterns of arousal and emotionality that represent consistent and enduring characteristics, may represent **MULTIFACTORIAL TRANSMISSION**, traits that are determined by a combination of both genetic and environmental factors in which a genotype provides a range within which a phenotype may be expressed.
   2. Some genotypes are not as sensitive to the environment as others.

B. Studying Development: How Much Is Nature? How Much Is Nurture?
   1. The question is not whether behaviour is caused by nature or nurture but *how much* by nature and *how much* by nurture.
   2. Nonhuman Animal Studies: Controlling Both Genetics and Environment.
      a) Scientists put laboratory animals bred to share genetic backgrounds in different environments to explore the effects of these environments.
      b) Conversely, they use genetically different animals in similar environments to determine the role of genetics.
      c) A drawback of animal studies is that we can't be sure how well the findings can be generalized to people.
   3. Contrasting Relatedness and Behaviour: Adoption, Twin, and Family Studies
      a) Scientists use human twins to study the effects of genes and the environment.
      b) Differences between monozygotic twins separated at birth are most likely but not always due to different environments.

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(1) If monozygotic twins are more similar than dizygotic twins on a particular trait then we can assume that genetics plays a role.
(2) People who are unrelated but share the same environment also tell us about environmental influences.

c) Researchers also study biological parents and their children versus adoptive parents and their children to see the effects of heredity versus environment.
d) Bottom line: Virtually all traits, characteristics, and behaviours are the joint result of the combination and interaction of nature and nurture.

C. Physical Traits: Family Resemblances
1. The more genetically similar two people are, the more likely they are to share physical characteristics (e.g., height, weight).

D. Intelligence: More Research, More Controversy
1. Genetics plays a significant role in intelligence; however, the environment is also a significant factor.

E. Genetic and Environmental Influences on Personality: Born to Be Outgoing?
1. There is increasing evidence that supports the conclusion that at least some personality traits have at least some genetic components.
2. Two of the "big five" personality traits have been linked to genetic stability.
a) *Neuroticism* refers to the degree of moodiness, touchiness, or sensitivity an individual characteristically displays.
b) *Extroversion* is the degree to which a person seeks to be with others, to behave in an outgoing manner, and generally to be sociable.
3. Certain traits reflect the contribution of genetics more than others.
a) Some evidence comes from direct examination of genes themselves.
b) Other evidence comes from studies of twins.
4. The environment also plays a role in determining personality.

F. **Cultural Dimensions: Cultural Differences in Physical Arousal: Might a Culture's Philosophical Outlook Be Determined by Genetics?**
1. Jerome Kagan and colleagues speculate that the underlying temperament of a given society, determined by genetics, may predispose people in that society toward a particular philosophy.

G. Psychological Disorders: The Role of Genetics and Environment
1. Several psychological disorders have been shown to be related, at least in part, to genetic factors.
a) Schizophrenia
b) Major depression
c) Alcoholism
d) Autism
e) Attention-deficit hyperactivity disorder
2. Genetics often produces a tendency toward a future course of development, but when and whether the characteristics will be displayed depends on the environment.

H. Can Genes Influence the Environment?
1. According developmental psychologist Sandra Scarr, the genetic endowment not only determines genetic characteristics, but also influences the environment.
a) Children tend to focus on aspects of their environment that are most in tune with their genetic abilities.
b) The gene–environment influence may be more passive and less direct.
c) The genetically-driven temperament of a child may evoke certain environmental influences.

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I. **Focus on Research: The Relationship between Parenting and Cancer**
   1. Meaney and Szyf's research at McGill University is credited for creating the field of *behavioural epigenetics*, the study of how molecular changes to genes brought about by the environment affect behaviour, from behavioural problems to psychiatric difficulties to the onset of neurological disease.

LECTURE SUGGESTIONS

The New Genetic Code

Begley's 1992 article discussed the discovered exceptions to Mendel's rules. For example, it is genetic dogma that children inherit 23 chromosomes from mom and 23 from dad. However, research shows that individuals can inherit both chromosomes from a pair from the same parent (that's how diseases like cystic fibrosis are inherited).

Reference:
Begley, S. (11-2-92). A new genetic code. *Newsweek*. pp. 77–78

Genetic Testing in Canada

Sullivan and Born (2011) discussed how direct-to-consumer genetic testing is now available to Canadians who want to pay for it. According to Sullivan and Born, people need to be properly educated about these tests so that they know what the results mean and what the implications of such testing are.

In addition, there are concerns regarding privacy when it comes to genetic testing. However, only half of the Canadians polled by Ekos Research Associates Inc. in a 2009 Public Opinion Survey expressed such privacy concerns.

References:
Sullivan, T., & Born, K. (March 23, 2011). Direct-to-Consumer Genetic Testing Comes to Canada. *Healthy Debate.* Accessed January 8, 2013 from http://healthydebate.ca/2011/03/topic/cost-of-care/the-ethics-cost-of-direct-to-consumer-genomewide-profiling.

Office of the Privacy Commissioner of Canada (March, 2009). Canadians and Privacy: Final Report. Accessed January 8, 2013 from http://www.priv.gc.ca/information/por-rop/2009/ekos_2009_01_e.asp#sec4_8.

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Genetic Discrimination in Canada

Carly Weeks discussed genetic discrimination in Canada, with a focus on Huntington's disease and one of its foremost researchers, Dr. Hayden. Dr. Hayden is Canada Research Chair in human genetics and molecular medicine at UBC. Dr. Hayden was quoted as saying that Canada is the only G8 country that doesn't have laws to protect its citizens against genetic discrimination.

Reference:

Weeks, C. (January 1, 2012). Health Insurance and 'genetic discrimination': Are rules needed? *The Globe and Mail*. Accessed January 8, 2013, from http://www.theglobeandmail.com/life/health-andfitness/health-insurance-and-genetic-discrimination-are-rules-needed/article4197442/.

SUPPLEMENTAL READING

Eisenberg, A., Murkoff, H. E., & Hathaway, S. E. (1991). *What to expect when you're expecting* (rev. 2nd ed.). New York: Workman.

- This is an excellent and comprehensive guide that covers conception, pregnancy month by month, and childbirth.

Freiberg, K. L. (Ed.). (1999). Annual editions: *Human development 99/00* (27th ed.). Sluice Dock, Guilford, CT: Dushkin/McGraw-Hill.

- This annually updated series presents articles published in magazine, newspapers, and journals on current issues in development. Editions now include annotated World Wide Web sites. A good source for keeping up to date.

Sullivan, T., & Born, K. (March 23, 2011). Direct-to-Consumer Genetic Testing Comes to Canada. *Healthy Debate.* Accessed January 8, 2013 from http://healthydebate.ca/2011/03/topic/cost-of-care/the-ethics-cost-of-direct-to-consumer-genomewide-profiling.

- This is an online article about the availability of genetic testing to Canadians.

MULTIMEDIA IDEAS

Note: These assets are not necessarily owned or distributed by Pearson Education. They may be available in your department or library or accessible online.

(See **Handout 1-4** for a way to have your students think about and evaluate any videos you show in class.)

Birth Defects (Films for the Humanities and Sciences, 1987, 19 minutes)

- Describes both genetic and environmental causes of birth defects.

Brave New Babies (Penn State Audio-Visual Services, 1982, 48 minutes)

- An introduction to genetic engineering. This program examines the development of the fetus in utero and the child during the first year.

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Canadian Association of Genetic Counsellors (website — https://cagc-accg.ca/)
- This website for the CAGC increases awareness of the genetic counselling profession in Canada.

Canadian Coalition for Genetic Fairness (website — http://www.ccgf-cceg.ca/en/home)
- This is the website for the CCGF, which is a coalition that is dedicated to preventing genetic discrimination in Canada.

Cracking the Code of Life (WGBH Educational Foundation and Clear Blue Sky Productions, 2001, 113 minutes)
- Available online at http://www.pbs.org/wgbh/nova/body/cracking-the-code-of-life.html
- An informative video about the race to uncover the complete letter-by-letter sequence of the human genome.

High Tech Babies (Coronet/MTI Film and Video, 1987, 58 minutes)
- Useful as a way of increasing students' awareness of the issues surrounding the new reproductive technology: in vitro fertilization.

Human Genome Project Information (website — http://www.ornl.gov/sci/techresources/Human_Genome/home.shtml)
- This website provides a great deal of information about the Human Genome Project

No One Quite Like Me . . . Or You (Sunburst Communications, 1992, 16 minutes)
- A video to help students understand that everyone is unique.

Online Education Kit: Understanding the Human Genome Project (website — http://www.genome.gov/25019879)
- A great resource for teaching students about the Human Genome Project

Prenatal Diagnosis (Filmmakers Library, 1982, 45 minutes)
- Explains amniocentesis, fetoscopy, and ultrasound. Discusses the ethical and practical aspects of making a decision about whether to abort or not abort an abnormal fetus.

Time to Grow: Part 2, Contexts of Development (Pennsylvania State University, 28 minutes)
- Discusses the interaction of genetic, social, economic, and cultural factors that contribute to child development.

HANDOUTS

Handout 2-1: Dominant and Recessive Characteristics
This handout shows various dominant and recessive traits and can be used when discussing heritability of traits.

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Handout 2-1

EXAMPLES OF DOMINANT AND RECESSIVE TRAITS

CHARACTERISTIC	DOMINANT TRAITS	RECESSIVE TRAITS
Eye colour	Brown	Grey, green, hazel, blue
Vision	Farsightedness	20/20 vision
	20/20 vision	Nearsightedness
	Ability to see all colours	Colour blindness
Hearing	Normal hearing	Congenital deafness
Blood type	Type “A”	Type “O”
Blood clotting	Blood able to clot properly	Hemophilia
Body hair	Plentiful body hair	Little body hair
Hair colour	Dark hair	Blonde, light, red hair
Hairline	Widow’s peak	Straight hairline
Facial features	No cleft in chin	Cleft in chin
	Dimples	No dimples
	Almond-shaped eyes	Round eyes
	Free earlobes	Attached earlobes
	Broad eyebrows	Slender eyebrows
	Long eyelashes	Short eyelashes
Manipulation of tongue	Tongue rolling	Inability to roll tongue
	Inability to fold tongue	Tongue folding
Fingers	Hair on fingers	Absence of hair on fingers
	Pinky finger bent	Straight pinky finger

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Module 2.2

Prenatal Growth and Change

LEARNING OBJECTIVES

After reading Module 2.2, students will be able to answer the following questions:

The Prenatal Period

LO5 What happens during the prenatal stages of development?

The Prenatal Environment: Threats to Development

LO6 What are the threats to the fetal environment and what can be done about them?

KEY TERMS AND CONCEPTS

Artificial insemination	Fetal alcohol syndrome (FAS)	In vitro fertilization (IVF)
Embryonic stage	Fetal stage	Infertility
Fertilization	Fetus	Placenta
Fetal alcohol effects (FAE)	Germinal stage	Teratogen

MODULE OUTLINE

I. Prenatal Growth and Change

A. Fertilization: The Moment of Conception
   1. **FERTILIZATION** is the process by which a sperm and an ovum—the male and female gametes—join to form a single new cell.

B. The Stages of the Prenatal Period: The Onset of Development
   1. The prenatal period consists of three phases:
      a) The Germinal Stage: Fertilization to Two Weeks
         (1) The **GERMINAL STAGE** is the first and shortest stage of prenatal development, which takes place during the first two weeks following conception.

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(a) It is characterized by methodical cell division and the attachment of the organism (*blastocyst*) to the wall of the *uterus*.
(b) The baby is called a *zygote* at this stage.
(c) The cells become specialized, with some forming a protective layer around the zygote, while others create the rudiments of a placenta and umbilical cord.
(d) The **PLACENTA** is the conduit between the mother and fetus, providing nourishment and oxygen via the umbilical cord.

b) The Embryonic Stage: Two Weeks to Eight Weeks
(1) The **EMBRYONIC STAGE** is the period from two to eight weeks following fertilization during which significant growth occurs in the major organs and body systems.
(a) In this stage the child is called an *embryo*.
(b) The developing baby is now composed of three layers:
(i) The *ectoderm* is the outer layer forming the skin, hair, teeth, sense organs, brain and spinal cord.
(ii) The *endoderm* is the inner layer producing the digestive system, liver, pancreas, and respiratory system.
(iii) The *mesoderm* is sandwiched between the inner and outer layers and forms the muscles, bones, blood, and circulatory system.

c) The Fetal Stage: Eight Weeks to Birth
(1) The **FETAL STAGE** begins about eight weeks after conception and continues until birth.
(2) The developing child from eight weeks after conception until birth is called a **FETUS**.
(3) The fetus dramatically increases in size and weight.
(4) Organs become more differentiated and operational.
(5) The brain becomes increasingly sophisticated.
(a) The symmetrical left and right halves of the brain, known as *hemispheres*, grow rapidly, and the interconnections between neurons become more complex.
(b) The neurons become coated with an insulating material called *myelin* that helps speed the transmission of messages from the brain to the rest of the body.
(6) By three months the fetus swallows and urinates.
(7) By four months the mother will be able to feel her fetus move.
(8) By the last 10 weeks of the fetal period, brain waves indicate that the fetus passes through different stages of sleep and wakefulness, including REM sleep, which is believed to be important for brain development.

C. Pregnancy Problems
1. Infertility
a) Some 15% of couples suffer from **INFERTILITY**, the inability to conceive after 12 to 18 months of trying to become pregnant.
b) Infertility has several causes:
(1) The age of the parents

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(2) Previous use of birth control pills, illicit drugs or cigarettes, sexually transmitted infections (STIs)
(3) Men who have an abnormally low sperm count
(4) The woman's *mother* taking certain drugs during pregnancy
(5) The most common cause of infertility is failure to release an egg through ovulation – possibly caused by hormonal imbalance, damage to fallopian tube or uterus, or stress, or abuse of alcohol or drugs.

c) Treatments for infertility include several approaches.
(1) **ARTIFICIAL INSEMINATION** is a process of fertilization in which a man's sperm is placed directly into a woman's vagina by a physician.
(2) **IN VITRO FERTILIZATION (IVF)** is a procedure in which a woman's ova are removed from her ovaries, and a man's sperm are used to fertilize the ova in a laboratory.
(a) *Gamete intrafallopian transfer (GIFT)* and *zygote intrafallopian transfer (ZIFT)* are procedures in which an egg and sperm or fertilized egg are implanted in a woman's fallopian tubes.
(3) A *surrogate mother* is a woman who agrees to carry the child to term; this method may be used in cases where the mother is unable to conceive.

2. Ethical issues
a) Ethical issues surround the use of surrogate mothers, in vitro fertilization, and sex selection techniques (sex selection techniques are illegal in Canada).

3. Miscarriage and Abortion
a) A *miscarriage*, known as spontaneous abortion, occurs when pregnancy ends before the developing child is able to survive outside the womb.
b) 15 to 20% of all pregnancies end in miscarriage, usually in first few months.
c) Many times, the mother is not even aware she is pregnant.
d) Typically, miscarriages are attributable to some sort of genetic abnormality.
e) *Abortion* is the voluntary termination of a pregnancy by the mother.

D. The Prenatal Environment: Threats to Development
1. Certain aspects of mothers' and fathers' behaviour, both before and after conception, can produce lifelong consequences for the child.
2. A **TERATOGEN** is an environmental agent such as a virus, chemical, or other factor that produces a birth defect.
a) At some phases of prenatal development, a teratogen might have minimal impact; at other periods, consequences can be severe.
b) Different organ systems are vulnerable to teratogens at different times.

E. Mothers' Diet
1. A mother's diet clearly plays an important role in bolstering the development of the fetus.
2. A mother who eats a varied diet high in nutrients is apt to have fewer complications during pregnancy, an easier labour, and a generally healthier baby than a mother whose diet is restricted in nutrients.

F. Mothers' Age
1. Mothers over 30 and adolescent mothers are at greater risk for a variety of pregnancy and birth complications:
a) Premature birth
b) Low birth weight
c) Down's syndrome
d) Higher infant mortality rates

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G. Mothers' Prenatal Support
    1. Mothers without sufficient money or social support are not able to get good prenatal care and parenting support after the baby is born, which can have negative consequences.

H. Mothers' Health
    1. Illness in a pregnant woman can have devastating consequences:
        a) *Rubella* (German measles) prior to the 11th week can cause blindness, deafness, heart defects, or brain damage.
        b) *Chicken pox* and *mumps* may cause birth defects and miscarriage, respectively.
        c) *Syphilis* and *gonorrhea* can be transmitted to the child.
        d) Babies born with AIDS (*acquired immune deficiency syndrome*) can have birth abnormalities including small, misshapen faces, protruding lips, and brain deterioration.

I. Mothers' Drug Use
    1. The use of many kinds of drugs, both legal and illegal, pose serious risks to the unborn child.
        a) Legal drugs
            (1) Aspirin can lead to fetal bleeding.
            (2) *DES (diethylstilbestrol)* later caused cervical and vaginal cancer in daughters.
        b) Illegal drugs
            (1) *Marijuana* restricts oxygen to the fetus.
            (2) *Cocaine* restricts blood flow and oxygen
                (a) Babies are born addicted and go through withdrawal
                (b) Babies are shorter and weigh less
                (c) Babies have serious respiratory problems and birth defects or seizures
                (d) Babies are often impossible to soothe.

J. Mothers' Use of Alcohol and Tobacco
    1. Pregnant women who take even small amounts of alcohol or nicotine can disrupt the development of the fetus.
    2. Alcohol Use
        a) **FETAL ALCOHOL SYNDROME (FAS)** is a disorder caused by the pregnant mother consuming substantial quantities of alcohol during pregnancy, potentially resulting in cognitive impairments, delayed growth, and facial deformities.
        b) Even smaller amounts of alcohol can produce **FETAL ALCOHOL EFFECTS (FAE)**, a condition in which children display some, although not all, of the problems of FAS due to their mother's consumption of alcohol during pregnancy.
        c) Just two drinks a day has been associated with lower intelligence in offspring.
    3. Tobacco Use
        a) Smoking reduces the oxygen content and increases carbon monoxide content in the mother's blood.
        b) Babies can miscarry or are born with abnormally low birth weight.
        c) Babies born to smokers are shorter and may have subtle brain damage contributing to later behavioural and cognitive problems.

K. Do Fathers Affect the Prenatal Environment?

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1. Second-hand smoke can affect the mother's health.
2. Alcohol and illegal drugs can lead to chromosomal damage at conception.
3. Stress may produce an unhealthy environment for the mother.
4. Sperm damage may result from father's exposure to environmental toxins in the workplace.

L. **From Research to Practice: Optimizing the Prenatal Environment**

1. There are things that women can do—before and during pregnancy—to optimize their chances for a smooth pregnancy.
   a) Planning for pregnancy
      (1) Schedule nonemergency x-rays only during the first 2 weeks after menstrual periods.
      (2) Get vaccinated against rubella at least 3 months before getting pregnant.
      (3) Discontinue birth control pills at least 3 months before getting pregnant.
   b) Eat well before and during pregnancy.
   c) Don't use alcohol or other drugs.
   d) Monitor caffeine intake.
   e) Don't smoke.
   f) Exercise regularly.

LECTURE SUGGESTIONS

Conception and Pregnancy

Handout 2-2 is a worksheet on the facts about Conception and Pregnancy.

Fertility

Traditionally, women's fertility ranged anywhere from two days to ten days a month. However, a study by the National Institute of Environmental Health Sciences in Research Park, NC, published in the *New England Journal of Medicine* (12-7-95) found that women are fertile for five days before ovulation as well as on the day of ovulation. Researchers were surprised to find that having sex just one day after ovulation will not result in a pregnancy. Kits are available which can tell when a woman is ovulating. (For couples wanting to avoid pregnancy, these researchers suggest abstaining from sex, or using birth control, during this six-day period.)

According to the study, the probability of conception ranges from 10% when intercourse occurs five days before ovulation to 33% when it happens on the day of ovulation. Daily intercourse results in the highest chance of pregnancy, 37%. The study had some other findings: there is no evidence that the timing of intercourse influences whether the baby will be a boy or a girl. Also, there is no sign that aging sperm is more likely to produce babies with defects, although the study was too small to prove this conclusively. On average, couples have a 20% chance of getting a viable pregnancy each month. However, according to Dr. Allen Wilcox, who conducted the study, "even couples who are very fertile are not fertile in every cycle. We don't understand why that is." Results from another study show that women who drink three or more cups of coffee a day reduce their

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chances of conception by 26%. It is believed that caffeine disrupts the menstrual cycle and may lead to early pregnancy loss.

Reference:
Fertility window placed at 6 days. *Arizona Republic* (12-7-95).

Infertility

"Infertility is defined as the inability to get pregnant after one year or more of regular sexual activity without the use of contraception, or the inability to carry a pregnancy to a live birth....Some specialists use two years as the cut-off point" (Jewelewicz, 1989, p. 170). According to Bushnik, Cook, Yuzpe, Tough, and Collins (2012), the prevalence of infertility is on the rise in Canada. Estimates are that one-sixth of all couples who try to conceive are sterile or infertile. Jewelewicz (1989) cites several reasons for this:

1. There are more couples trying to conceive because the post-WWII baby boomers are reaching the end of their reproductive years.
2. The rise in sexually transmitted infections, women entering the workforce and being exposed to occupational hazards that affect their fertility, and the possibility of being exposed to more environmental toxins are all reasons hypothesized for increased infertility.
3. Women are delaying childbirth and increased age is related to decreased fertility.
4. Oral contraceptives and use of an IUD may account for some cases of infertility.
5. Because of second marriages, some couples seek to reverse previous surgical sterilizations.
6. More techniques are available and written about in the media so couples are more aware of help for infertility.

It is estimated that over three million couples will seek reproductive help each year. The top five procedures include:

- in vitro fertilization (IVF)
- gamete intrafallopian transfers (GIFT)
- intrauterine insemination (IUI)
- zygote intrafallopian transfer (ZIFT)
- intracytoplasmic sperm injection (ICSI)

There are some pros and cons about the new reproductive technologies. For example, before the 1970s, only *donor insemination*—injection of sperm from an anonymous man into a woman—was available for infertile women. Today, *in vitro fertilization* is a common choice where hormones are used to stimulate the production of several ova, which are removed. The eggs are placed in a dish of nutrients, sperm are added, and then the fertilized eggs are injected into the mother. Ova can be screened for genetic defects and fertilized ova can also be frozen for use in the future. Sperm can also be frozen. Consequently, problems that might arise include:

- genetic defects
- sexually transmitted infections
- poor records of donor characteristics
- possibility that children from same donor may grow up together and marry
- use of genetic selection for the "perfect child"

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- use of "surrogate mothers"

Use **Handout 2-3** to review some of the reasons for infertility, and various solutions.

References:

Jewelewicz, R. (1989). Sexual and reproductive health. In Tapley, D. F., Morris, T. Q., Rowland, L. P., Weiss, R. J, Subak-Sharpe, G. J., & Goetz, D. M. (Eds.), *The Columbia University College of Physicians and Surgeons complete home medical guide* (rev. ed.). New York, NY: Crown.

Bushnik, T., Cook, J. L., Yuzpe, A. A., Tough, S., & Collins, J. (2012). Estimating the prevalence of infertility in Canada. *Human Reproduction, 27*(3), 738–746.

Teratogens

Teratogens (from the Greek *tera* meaning "monsters") are any agents that may pass from the mother through the placental barrier and affect the fetus. Teratogens are a major cause of birth defects. Use **Handout 2-4** to go with this lecture

CLASS ACTIVITIES

Conception and Pregnancy

Use **Handout 2-2** for this assignment. Pass out the handout before you discuss conception and pregnancy. Tell students that some of the answers are in Chapter 2 and some they will have to find on their own using other sources.

Reflective Journal Entry #2: Prenatal Development

See **Handout 2-5** for instructions on writing the second **Reflective Journal Entry.**

SUPPLEMENTAL READING

Dorris, M. (1990). *The broken cord.* New York, NY: HarperCollins.

- This is a moving account of the difficulty an adoptive father has raising his son born with fetal alcohol syndrome.

Eisenberg, A., Murkoff, H. E., & Hathaway, S. E. (1991). *What to expect when you're expecting* (rev. 2nd ed.). New York: Workman.

- This is an excellent and comprehensive guide that covers conception, pregnancy month by month, and childbirth.

Freiberg, K. L. (Ed.). (1999). Annual editions: *Human development 99/00* (27th ed.). Sluice Dock, Guilford, CT: Dushkin/McGraw-Hill.

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- This annually updated series presents articles published in magazine, newspapers, and journals on current issues in development. Editions now include annotated World Wide Web sites. A good source for keeping up to date.

Freiberg, K. L. (Ed.). (2002). *Annual editions: Human development 2002/2003* (30th ed.) Guilford, CT: Dushkin/McGraw-Hill.

- *A State of the Art Pregnancy* and *Fetal Psychology* provide additional information on the importance of a health prenatal environment.

Karr-Morse, R., Wiley, M., and Brazelton, T. (1999). *Ghosts from the nursery: Tracing the roots of violence.*

- This book details recent research about the importance of a healthy prenatal environment.

Levinson, D. L. (1996). *The seasons of a woman's life.* New York, NY: Alfred A. Knopf.

- Chapter 2 provides a nice overview of the history and current thinking on the entire lifespan and human development.

Murkoff, H, Hathaway, S., & Eisenberg, A. (2002). *What to expect when you're expecting.*

- This book covers important topics such as exercise, childbirth options, multiple births, choosing a caregiver, and common (and uncommon) problems. It's a comprehensive, straightforward guide to labour, delivery, postpartum care, breastfeeding, and more. There is a section for fathers-to-be also.

Public Health Agency of Canada (2007). *The Canada Prenatal Nutrition Program.* Accessed January 9th, 2013 from http://www.phac-aspc.gc.ca/hp-ps/dca-dea/publications/pdf/mb_e.pdf.

MULTIMEDIA IDEAS

Note: These assets are not necessarily owned or distributed by Pearson Education. They may be available in your department or library or accessible online.

(See **Handout 1-4** for a way to have your students think about and evaluate any videos you show in class.)

Canada Prenatal Nutrition Program (Website - http://www.phac-aspc.gc.ca/hp-ps/dca-dea/prog-ini/cpnp-pcnp/index-eng.php)

- Community-based program delivered by the Public Health Agency of Canada to help communities promote health and provide support to improve the health and well-being of pregnant women, new mothers and babies.

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Developmental Phases Before and After Birth (Films for the Humanities and Sciences, 28 minutes)
Fetal Alcohol Syndrome and Other Drug Use During Pregnancy (Films for the Humanities and Sciences, 19 minutes)

- This program profiles an 8-year-old boy born with FAS, showing how alcohol enters the bloodstream of the fetus; it describes common characteristics of children with FAS and the learning disabilities, mental handicaps, and behavioural problems that are common. Also shows how cocaine impairs the growing fetus.

The Endowment for Human Development (Website - http://www.ehd.org/educators_note.php)
- This website is free for registered educators and is a great resource for quizzes, timelines, DVD outlines, images, etc.

The Miracle of Life (Time-Life Films, 1983, 57 minutes)
- Shows development from conception to birth using Nilsson's microphotography techniques. Actually presents footage of the fetus moving *in utero.*

Psychological Development Before Birth (Films for the Humanities and Sciences, 22 minutes)
- The development of the individual can be followed *in utero*. This program shows how it is possible to determine the well-being of the fetus; when the fetus begins to react to sound; and how mothers-to-be deal with pregnancy and prepare themselves for the birth.

HANDOUTS

Handout 2-2: Facts About Conception and Pregnancy
This handout can be used as an assignment to be completed before your lectures on conception and pregnancy or as a review. The answers are:

Conception
1. Ovary → fallopian tube → uterus → uterine wall (fertilized) or vagina (unfertilized)
2. P → vagina → uterus → fallopian tube → egg (ovum)
3. Possible answers include blocked/damaged fallopian tubes, abnormal ovulation, pelvic inflammatory disease (PID), endometriosis, damaged ovaries, hostile cervical mucus, fibroid tumour
4. Possible answers include low sperm count, dilated veins around testicle, damaged sperm ducts, hormone deficiency, sperm antibodies
5. Possible answers include surgery, in vitro fertilization, hormone therapy, antibiotics, artificial insemination

Pregnancy
1. Possible answers include cessation of menses, breast tenderness, nausea
2. Stage 1: Germinal lasts two weeks (from conception till week 2), the cells divide and attach to the uterine wall, the baby is called a "zygote"

Stage 2: Embryonic stage lasts 6 weeks (from week 2 until week 8), the cell layers (endoderm, ectoderm, mesoderm) form, the baby is called an "embryo"

Stage 3: Fetal stage lasts 7 months (from week 8 until birth), all the child's systems are developing rapidly, the child is called a "fetus"

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3. Possible answers are see an obstetrician/midwife, eat a healthy diet including calcium and multivitamin and mineral supplements, abstain from caffeine, alcohol, nicotine, and unnecessary drugs, get plenty of rest, avoid X-rays, exercise moderately
4. Amniocentesis—fetal cells are taken via a needle from amniotic fluid chorionic villus sampling (CVS)—samples of hairlike material taken from embryo ultrasound sonography—high frequency sound waves produce an image of baby
5. Possible answers include alcohol, nicotine, X-rays, prescription drugs such as Thalidomide, illicit drugs such as cocaine and marijuana, illnesses of the mother such as rubella, influenza, and AIDS

Handout 2-3: Fertility Problems and Solutions
Use this handout with the class discussion on fertility and infertility.

Handout 2-4: Possible Teratogens
Use this handout to discuss possible teratogens. Straub suggests an activity where students decide which teratogens they are exposed to every day as an interesting way for students to see that it is difficult to avoid all teratogens in our present society. Have students notice if there is a gender difference. Is it important for expectant fathers to avoid teratogens also?

Handout 2-5: Reflective Journal Entry #2: Prenatal Development
Use this handout for the second **Reflective Journal** exercise.

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Handout 2-2

FACTS ABOUT CONCEPTION AND PREGNANCY

Review your knowledge of conception and pregnancy by answering the questions below.

Conception

1. Trace the journey of the egg in a woman's body:

__ovary_____ → _____ → _____

_____
fertilized

_____
unfertilized

2. Trace the journey of sperm cells from ejaculation to conception:

__penis_____ → _____ → _____ → _____ → _____

3. List three possible reasons for infertility in women.
   a. _____
   b. _____
   c. _____

4. List two possible reasons for infertility in men.
   a. _____
   b. _____

5. List and define three treatments for infertility.
   a. _____
   b. _____
   c. _____

Pregnancy

1. List three early signs and symptoms of pregnancy.
   a. _____
   b. _____
   c. _____

(continued)

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Handout 2.2 (continued)

2. Name the three stages of prenatal development. How long does each stage last? What systems have developed? What is the developing child called?

Name of Stage	Length of Stage	Systems Developed	Term for the Developing Child
1.			
2.			
3.			

3. List six important components of good prenatal care.

a. _____
b. _____
c. _____
d. _____
e. _____
f. _____

4. Name and describe three prenatal tests.

a. _____
b. _____
c. _____

5. Name six teratogens.

a. _____ b. _____
c. _____ d. _____
e. _____ f. _____

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Handout 2-3

FERTILITY PROBLEMS AND SOLUTIONS

FEMALES	
PROBLEM	**SOLUTION**
Damaged fallopian tubes	Surgery, in vitro fertilization
Abnormal ovulation	Hormone therapy, antibiotics, in vitro fertilization
Pelvic inflammatory disease (PID)	Antibiotics, surgery, change in birth control methods
Endometriosis	Antibiotics, hormone therapy, surgery, artificial insemination
Damaged ovaries	Surgery, antibiotics, hormone therapy
Hostile cervical mucus	Antibiotics, artificial insemination, hormone therapy
Fibroid tumour	Surgery, antibiotics
Stress	Relaxation techniques
Tipped uterus, fibroid tumours	Surgery
MALES	
PROBLEM	**SOLUTION**
Low sperm count	Antibiotics, hormone therapy, artificial insemination, lowered testicular temperature
Dilated veins around testicle	Surgery, lowered testicular temperature, antibiotics
Damaged sperm ducts	Surgery, antibiotics
Hormone deficiency	Hormone therapy
Sperm antibodies	Antibiotics, in vitro fertilization
Chronic illness, alcoholism, drug abuse, long-term use of marijuana	Artificial insemination
Pollutants	Artificial insemination
Stress	Relaxation techniques

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Handout 2-4

POSSIBLE TERATOGENS

This list contains some of the common teratogens. Because most babies are born without defects, the placenta appears to be an effective barrier. Exposure to these possible teratogens is more dangerous earlier in the pregnancy while the fetus' organs are developing.

CHEMICALS AND MEDICATIONS

Anti-cancer drugs (e.g., Aminopterin)	Tranquilizers (e.g., lithium)	Antibiotics
Anti-epileptic drugs (e.g., phenytoin)	Anti-anxiety drugs (e.g., diazepam)	Isotretinoin (used for acne)
Warfarin (used for thinning the blood)	SSRIs (used for depression, e.g., paroxetine)	Aspirin
Excess of vitamins	Diethylstilbestrol (form of estrogen)	ACE inhibitors (used for high blood pressure)

ALCOHOL, SMOKING, AND OTHER DRUGS

Alcohol	Cocaine	Alcohol
Cigarette smoking (nicotine)	Caffeine	Opioid drugs (e.g., heroin)
Marijuana	LSD	
Amphetamines (e.g., speed)	Hexachlorophene	

OTHER CHEMICALS

Mercury	Chemotherapy	Nickel
Lead	Radiation	PCBs
X-rays	Pesticides and herbicides	

INFECTIOUS DISEASES IN MOTHER

Chickenpox	Hepatitis E	Streptococcus
Shingles	Enteroviruses (e.g., poliovirus)	Listeria
Hepatitis B	AIDS	Candida
Hepatitis C	Fifth disease (Parvovirus B19)	Rubella
Hepatitis D	Toxoplasmosis	Cytomegalovirus
Herpes simplex virus	Syphilis	Other STIs (e.g., gonorrhea)

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Handout 2-5

REFLECTIVE JOURNAL ENTRY #2

Prenatal Development

If possible, interview your mother and father (if this is not possible, try an aunt, or uncle, or grandparent) about your own prenatal development. Use the following questions to get started.

- Was this a planned pregnancy?
- Was this your first baby?
- How did you find out you were pregnant?
- How did you feel?
- Were you working?
- When did you see a doctor?
- Did you take vitamins?
- When did you start feeling the baby?
- When did you begin wearing maternity clothes?
- What changes did your body go through?
- What are some of the strongest memories you have of this pregnancy?
- Did you have any prenatal tests?
- How did your lifestyle change?
- Did you smoke? Drink alcohol? Drink coffee or tea? Take any drugs?
- Did you know the sex of the baby before the birth? Did you have a preference for a boy or a girl? How did you feel when you found out the sex of your baby?
- When did you decide on a name for the baby?
- Did you attend any special classes or workshops about childbirth, nursing, etc.?
- Did you know of any pre-existing conditions?
- Where were you living?
- Were there any features/characteristics you were hoping the baby would have? Were there any you were hoping the baby would **not** have?
- How much of your spouse's medical history did you know? In retrospect, how important would that have been?
- What role/expectations did you have for this child?
- What influenced your decision to have a child at this time?
- Did you have any trouble conceiving? Did you expect to have any trouble getting pregnant?

Now, reflect on what you learned. How do you think your own pregnancy (or your wife's) will be (was) the same or different than your mother's?

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Module 2.3

Birth and the Newborn Infant

LEARNING OBJECTIVES

After reading Module 2.3, students will be able to answer the following questions:

Birth

LO7 What is the normal process of labour?

Birth Complications

LO8 What complications can occur at birth, and what are their causes, effects, and treatments?

The Competent Newborn

LO9 What capabilities does the newborn have?

KEY TERMS AND CONCEPTS

Anoxia
Apgar scale
Bonding
Caesarean delivery
Classical conditioning
Episiotomy
Fetal monitor
Habituation
Infant mortality
Low-birth-weight infants
Neonates
Operant conditioning
Postmature infants
Preterm infants
Reflexes
Small-for-gestational-age infants
Stillbirth
States of arousal
Very-low-birth-weight infants

MODULE OUTLINE

I. Birth

A. Labour: The Process of Birth Begins
   1. The term used for newborns is **NEONATES**.
   2. About 266 days after conception, a protein called *corticotropin-releasing hormone (CRH)* triggers the process of birth.
   3. The hormone oxytocin is released from mother's pituitary.
   4. *Braxton-Hicks contractions* have been occurring since the fourth month.
   5. Contractions force the head of the fetus against the *cervix*.
   6. Labour proceeds in three stages:

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a) The *first stage* is the longest.
   (1) Uterine contractions occur every 8–10 minutes and last about 30 seconds.
   (2) Contractions increase to their greatest intensity, a period known as *transition*.
   (3) The mother's cervix fully opens.
   (4) For first babies, this stage can last 16–24 hours (this varies widely).
   (5) Subsequent children involve shorter periods of labour.

b) During the *second stage of labour*, the baby's head moves through the birth canal.
   (1) This stage typically lasts 90 minutes.
   (2) After each contraction the baby's head emerges more and increases the vaginal opening.
   (3) An **EPISIOTOMY** is an incision sometimes made to increase the size of the opening of the vagina to allow the baby to pass.
   (4) This stage ends when the baby is born.

c) The *third stage of labour* occurs when the child's umbilical cord and placenta are expelled.
   (1) This is the shortest and easiest stage, and lasts only minutes.

d) Cultural perspectives colour the way that people in a given society view the experience of childbirth.

B. Birth: From Fetus to Neonate

1. Birth occurs when the fetus passes through the vagina and emerges from the mother's body.
2. As soon as they are born, most babies cry to clear their lungs and begin breathing on their own.
3. The Apgar Scale
   a) The **APGAR SCALE** is a standard measurement system that looks for a variety of indications of good health in newborns.
   b) The scale was developed by Virginia Apgar in 1953.
   c) The Apgar directs attention to five qualities:
      (1) **A**ppearance (colour)
      (2) **P**ulse (heart rate)
      (3) **G**rimace (reflex irritability)
      (4) **A**ctivity (muscle tone)
      (5) **R**espiration (respiratory effort)
   d) Each quality is scored 0–2, producing an overall scale score that ranges from 0 to 10.
      (1) Most babies score around 7.
      (2) Scores under 4 need immediate life-saving intervention.
   e) A restriction of oxygen, **ANOXIA,** lasting a few minutes can cause brain damage.
4. Physical Appearance and Initial Encounters
   a) Babies are often coated with *vernix*, a thick, greasy substance which smoothes the passage through the birth canal.
   b) Newborns are often covered with a fine, dark fuzz called *lanugo*.
   c) Baby's eyelids may be swollen and puffy from an accumulation of liquids during birth.
   d) A matter of considerable controversy is the subject of **BONDING**, the close physical and emotional contact between parent and child during the period

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immediately following birth, and argued by some to affect later relationship strength.

e) Although research does not support the existence of a critical period for bonding between parent and child, newborns do need touch and gentle massage soon after birth as it stimulates the production of chemicals in the brain that initiate growth.

C. Approaches to Childbirth: Where Medicine and Attitudes Meet

1. There are a variety of choices for how to give birth and no research proves that one method is more effective than another.
2. Childbirth Attendants: Who Delivers?
   a) *Obstetrician*, a physician who specializes in childbirth
   b) *Midwife*, a nurse specializing in childbirth
   c) *Doula*, an experienced person who provides emotional, psychological, and educational support but does not replace an obstetrician or midwife
3. Use of Anaesthesia and Pain-Reducing Drugs
   a) The use of medication during childbirth has benefits and disadvantages.
   b) It reduces pain.
      (1) One third of women who choose anaesthesia choose to receive *epidural anaesthesia*, which produces numbness from the waist down and can prevent them from helping to push the baby
      (2) A newer form is known as *walking epidural* or *dual spinal-epidural*, which use smaller needles and a system of delivering continuous doses of anaesthetic, allowing women to move about more freely during labour.
      (3) Anaesthetics might depress the flow of oxygen to the fetus, slow labour, and it might harm the fetus.
      (4) Not all studies suggest harmful effects for fetus.
      (5) Most research suggests that drugs currently used produce no significant effect on a child's later well-being.
4. Postdelivery Hospital Stay: Deliver, Then Depart?
   a) A generation or two ago, new mothers normally stayed in the hospital for five days after giving birth while today, the average stay is two days.
   b) A few studies support the claim that early discharge of baby and mother increases the number of newborns readmitted to the hospital, usually for jaundice or dehydration.
   c) Women in many parts of Canada are offered home visits by public health nurses after they are discharged.
5. Newborn Medical Screening
   a) Typically screens newborns for disorders via a small quantity of blood from infant's heel.
   b) The number of disorders screened varies from province to province, with some provinces having only three tests mandated and others as many as 29.
   c) An advantage of screening is early treatment of problems.
6. **Becoming an Informed Consumer of Development: Dealing With Labour**
   a) There is no right or wrong way to deal with labour; strategies can help make the process as positive as possible.
      (1) Be flexible.
      (2) Communicate with your health care providers.
      (3) Remember that labour is . . . laborious.
      (4) Accept your partner's support.

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(5) Be realistic and honest about your reactions to pain.
(6) Focus on the big picture.

II. Birth Complications

A. Preterm Infants: Too Soon, Too Small

1. **PRETERM INFANTS** are born prior to 37 weeks after conception (also known as premature infants) are at high risk for illness and death.
   a) The main factor in determining the extent of danger is the child's weight at birth.
      (1) The average newborn weighs 3400 grams (7½ pounds).
      (2) **LOW-BIRTH-WEIGHT INFANTS** weigh less than 2500 grams (5½ pounds).
      (3) Although fewer than 7% of newborns are in the low-birth-weight category, they account for the majority of newborn deaths.
      (4) **SMALL-FOR-GESTATIONAL-AGE INFANTS,** because of delayed fetal growth, are infants that weigh 90% or less than the average weight of infants of the same gestational age.
   b) Premature infants are susceptible to *respiratory distress syndrome (RDS)* because of poorly developed lungs.
   c) Low-birth-weight infants are put in *incubators*, enclosures in which oxygen and temperature are controlled.
      (1) They are easily chilled, susceptible to infection, and sensitive to their environment.
   d) Preterm infants develop more slowly than infants born full term.
      (1) 60% eventually develop normally.
      (2) 38% have mild problems (such as learning disabilities or low IQ).
2. Very-Low Birth-weight Infants: The Smallest of the Small
   a) **VERY-LOW-BIRTH-WEIGHT INFANTS** weigh less than 1250 grams (2¼ pounds) and, regardless of weight, have been in the womb less than 30 weeks and are in grave danger because of the immaturity of their organ systems.
   b) Medical advances have pushed the **AGE OF VIABILITY**, or point at which an infant can survive a premature birth, to about 22 weeks.
   c) Costs of keeping very-low-birth-weight infants alive are enormous.
   d) Research shows that children who receive more responsive, stimulating, and organized care are apt to show more positive outcomes than children whose care was not as good.
   e) "Kangaroo care" in which infants are held skin-to-skin against their parents' chests, and massaging preterm infants are two methods of care that appear to be beneficial.
3. What Causes Preterm and Low-Birth-Weight Deliveries?
   a) Multiple births
   b) Young mothers (under age 15)
   c) Subsequent births that are too closely spaced
   d) Older fathers (wives of older fathers are more likely to have preterm deliveries)
   e) General health and nutrition of mother

B. Postmature Babies: Too Late, Too Large

1. **POSTMATURE BABIES**, those still unborn two weeks after the mother's due date, face several risks.

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a) Blood supply to baby's brain may be decreased and cause brain damage.
b) Labour and delivery become more difficult.

C. Caesarean Delivery: Intervening in the Process of Birth
1. Approximately 25% of mothers in Canada today have a **CAESAREAN DELIVERY** where the baby is surgically removed from the uterus, rather than travelling through the birth canal.
a) Several types of difficulties can lead to Caesarean delivery.
(1) Fetal distress is most frequent.
(2) Used for *breech position*, where the baby is positioned feet first in the birth canal.
(3) Used for *transverse positio*n, in which the baby lies crosswise in the uterus.
(4) When the baby's head is large.
(5) Mothers over age 40 are more likely to have Caesarean deliveries than younger ones.
b) Routine use of **FETAL MONITORS**, devices that measure the baby's heartbeat during labour, have contributed to soaring rates of Caesarean deliveries, arguably by causing doctors to perceive greater risks than are present. Medical authorities now recommend that fetal monitors not be used routinely, because they may indicate fetal distress when there is none.
c) Frequency of Caesareans has several criticisms.
(1) There is no association between Caesarean delivery and successful birth consequences.
(2) It involves major surgery and a long recovery for the mother.
(3) There is a risk of infection to the mother.
(4) Easy birth may deter release of certain stress hormones, such as catecholamines, which help prepare the infant to deal with stress outside the womb.
(5) Babies born via Caesarean delivery are more prone to breathing problems at birth.
(6) Medical authorities currently recommend avoiding routine use of fetal monitors.

D. Mortality and Stillbirth: The Tragedy of Premature Death
1. **INFANT MORTALITY** is defined as death within the first year of life.
a) Overall rate in Canada continues to decline, but some provinces (e.g., Nunavut, Nova Scotia) have experienced increases.
b) Rate is generally declining since 1960s.
c) **STILLBIRTH** is the delivery of a child who is not alive; it occurs in less than 1 delivery in 100.
d) Parents grieve in the same manner as if an older loved one dies.
e) Depression is a common aftermath.

E. Postpartum Depression: Moving from the Heights of Joy to the Depths of Despair
1. *Postpartum depression* is a period of deep depression following childbirth.
2. This depression affects about 10% of all new mothers.
3. Symptoms such an enduring sleep, deep feelings of sadness and unhappiness may last for months or even years.
4. Postpartum depression may be triggered by changes in hormone production after giving birth.
5. Maternal depression may lead to emotional detachment and lack of responsiveness to infants that may affect an infant's social maturation and behaviour.

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III. The Competent Newborn

A. Physical Competence: Meeting the Demands of a New Environment
   1. **REFLEXES** are unlearned, organized, and involuntary responses that occur automatically in the presence of certain stimuli.
      a) *Sucking* and *swallowing reflexes* permit the neonate to ingest food.
      b) The *rooting reflex*, which involves the turning in the direction of a source of stimulation near the mouth, guides the infant to the breast and nipple.
   2. The newborn's digestive system produces *meconium*, a greenish-black material that is a remnant of the neonate's days as a fetus.
   3. Because their livers do not work efficiently, almost half of all newborns develop *neonatal jaundice*, a yellowish tint to their bodies and eyes.
   4. Jaundice is most likely to occur in preterm and low-weight babies.

B. Sensory Capabilities: Experiencing the World
   1. Infants' visual and auditory systems are not yet fully developed.
      a) They can see levels of contrast and brightness.
      b) They can tell size consistency and distinguish colours.
      c) They react to sudden sounds and recognize familiar sounds.
   2. They are sensitive to touch.
   3. Their senses of taste and smell are well developed.

C. Circumcision of Newborn Male Infants: The Unkindest Cut?
   1. *Circumcision* is the surgical removal or part or all of the foreskin from the penis; this procedure is most commonly performed shortly after birth.
   2. Much debated procedure that most Canadian physicians claim is not medically necessary
   3. Circumcision rates vary from province to province, ranging from 6.8% in Nova Scotia to 44.3% in Alberta.
   4. Emerging research, however, suggests that circumcision may provide protection against some sexually transmitted infections such as HIV infection [based on studies conducted in Africa] and may reduce the risk of urinary tract infections and penile cancer.

D. Early Learning Capabilities
   1. **CLASSICAL CONDITIONING**, a type of learning in which an organism responds in a particular way to a neutral stimulus that normally does not bring about that type of response, underlies the learning of both pleasurable and undesired responses in the newborn.
   2. **OPERANT CONDITIONING**, a form of learning in which a voluntary response is strengthened or weakened, depending on its association with positive or negative consequences, functions from the earliest days of life.
   3. **HABITUATION**, the decrease in the response to a stimulus that occurs after repeated presentations of the same stimulus, is probably the most primitive form of learning and occurs in every sensory system of the infant.
      a) Habituation produces an *orienting response*, in which infants become quiet and attentive to new stimuli.
      b) The development of habituation is linked to physical and cognitive maturation

E. Social Competence: Responding to Others
   1. Infants have the ability to imitate others.
   2. Researchers have shown that infants can differentiate between such basic facial expressions as happiness, sadness, and surprise. This finding has been questioned since, so the jury is still out.

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3. Newborns cycle through various **STATES OF AROUSAL**, different degrees of sleep and wakefulness ranging from deep sleep to great agitation.

LECTURE SUGGESTIONS

Childbirth Options

Methods of childbirth have changed dramatically in the last 50 years. Most current methods are based on the pioneering work of Grantly Dick-Read in England and Ferdinand Lamaze in France. In 1944 Dick-Read proposed that fear is the major cause of most of the pain of childbirth. He proposed the concept of *natural childbirth* and developed a method of teaching women about reproduction, pregnancy, delivery, and exercises in breathing, relaxation, and fitness. Lamaze, in the 1950s, developed a method called *prepared childbirth* where expectant mothers are taught to breathe and concentrate on sensations other than contractions. This is facilitated by a "coach," usually the father, who attends classes with her and helps time her breathing. Fathers then became a part of the childbirth process, and by the 1970s hospitals were beginning to allow them to go into the delivery room to assist. Now, most fathers elect to participate in the birth of their children.

Although almost 98 % of all babies born in the Canada are born in hospitals, some women elect to have their babies at home with the services of either a physician who specializes in home births or a midwife, a specially trained nurse. In 2008, midwives performed 2360 home births in Ontario, which represented an increase of 23% since 2003 (Bochove, 2011). These options should only be used by women whose pregnancies are low risk. Hospitals responded to the home-birth movement by offering birthing centres, rooming-in facilities so mothers and babies are together all day, and sibling visitations.

References:

Sullivan, D. A. & Weitz, R. (1988). *Labour pains: Modern midwives and home birth*. New Haven, CT: Yale University.

Bochove, D. (August 26, 2011). Are home births safe? *Macleans*. Accessed January 10, 2013, from http://www2.macleans.ca/2011/08/26/dont-try-this-at-home/.

Are There Too Many Caesarean Section Deliveries?

The World Health Organization recommends that the rate of Caesarean sections (C-sections) be no higher than 10–15% in any country. Canada's rate is significantly higher than this recommendation, with the reported rate in 2004–2005 at 25.6% (Chalmers et al., 2010). Reasons for Caesarean delivery include: labour is progressing poorly, the mother has had a previous C-section (although many women can successfully deliver vaginally after a previous C-section), the baby is in the breech or transverse position, the mother has an active case of genital herpes, and to avert potential malpractice suits. Some critics argue that the use of a fetal monitor has increased the incidence of C-sections. Babies born by C-section miss out on the stress hormones released during birth (*catecholamines*). These hormones are believed to help in the post-birth breathing process. The effects on mothers are a result of the major abdominal surgery involved, which is associated with a longer hospital stay, longer recovery, higher rates of postpartum depression, and a greater risk of infection. Despite the risks, the rate of C-sections in Canada has increased from 17% in 1993 to almost 26% in 2005 (Hall, 2009).

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References:
Chalmers, B., Kaczorowski, J., Darling, E., Heaman, M., Fell, D. B., O'Brien, B., & Lee, L. (2010). Cesearean and vaginal birth in Canadian women: A comparison of experiences. *Birth, 37,* 44–49.
Hall, J. (October 1, 2009). What's behind Canada's rising C-section rate? *University of Toronto Research & Innovation*. Accessed January 10, 2013, from http://www.research.utoronto.ca/behind_the_headlines/what%E2%80%99s-behind-canada%E2%80%99s-rising-c-section-rate/.
Stafford, R. S. (1990). Alternative strategies for controlling rising caesarean section rates. *Journal of the American Medical Association, 263*, 683–687.

Low-Birth-Weight Babies

The number one risk factor associated with death in infants in the first months of life is low birth-weight. Low birth-weight is defined as under five pounds for a full-term infant. Low-birth-weight babies also spend more time in intensive-care nurseries at an annual cost of over $2 billion. According to the Canadian Institute for Health Information (2012), 1 in 16 newborns in Canada are low-birth-weight babies.

Several conditions contribute to the possibility of low birth-weight:

- maternal hypertension
- rubella during the first 16 weeks of pregnancy
- urogenital infections
- diabetes
- more than four previous pregnancies
- teenage mother or mother over age 35
- mother underweight or malnourished
- cigarette or marijuana smoking
- having two or more abortions
- anemia
- exposure to teratogens
- maternal stress

References:
Canadian Institute for Health Information. (2012). *Highlights of 2010-2011 Selected Indicators Describing the Birthing Process in Canada*. Accessed January 10, 2013, from https://secure.cihi.ca/free_products/Childbirth_Highlights_2010-11_EN.pdf.
Cristafi, M. A., & Driscoll, J. M. (April, 1991). *Developmental outcome in very-low-birth-weight infants at three years of age.* Paper presented at the biennial meeting for the Society for Research in Child Development, Seattle.
Singer, L. T., Yamashita, T. S., & Baley, J. (March/April, 1995). Maternal distress and medical complications predict developmental outcome in very-low-birth-weight (VLBW) infants to 2 years. Paper presented at the biennial meeting for the Society for Research in Child Development, Indianapolis.

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CLASS ACTIVITIES

Critical Thinking Exercises

1. Get copies of Darcy Frey's article in the *New York Times Magazine* titled "Does Anyone Here Think This Baby Can Live?" (see **Supplemental Reading** for the complete reference). Have your class read the article and write an essay considering the following Rethink questions.

   What are some ethical considerations relating to the provision of intensive medical care to very-low-birth-weight babies?

   Do you think such interventions should be routine practice? Why or why not?

2. Have students investigate the cost of childbirth in their city. These costs should include prenatal care, the hospital/doctor or midwife charges, and costs of items for the baby, such as clothing, well-baby checkups, and furniture.

Reflective Journal Entry #3: Birth

Use **Handout 2-6** to guide the third **Reflective Journal Entry**.

Infant Reflexes

See **Handout 2-7** for information about survival and primitive reflexes.

SUPPLEMENTAL READING

American Baby Magazine (1995). *As your baby gr*ows*,* 4(2).

- This magazine is published for expectant mothers and fathers and uses some of Nilsson's photographs to describe how the fetus develops month by month. To obtain a copy write to Cahners Publishing Company, 249 West 17th Street, New York, NY 10011 or call (212) 645-0067.

Bean, C. (1990). *Methods of childbirth* (rev. ed.). New York, NY: Quill.

Bochove, D. (August 26, 2011). Are home births safe? *Macleans*. Accessed January 10, 2013, from http://www2.macleans.ca/2011/08/26/dont-try-this-at-home/.

Canadian Institute for Health Information. (2004). *Giving Birth in Canada: Providers of Maternity and Infant Care.* Accessed January 10, 2013, from https://secure.cihi.ca/free_products/GBC2004_report_ENG.pdf.

Canadian Institute for Health Information. (2006). *Giving Birth in Canada: The Costs.* Accessed January 10, 2013, from https://secure.cihi.ca/free_products/Costs_Report_06_Eng.pdf.

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Chalmers, B., Kaczorowski, J., Darling, E., Heaman, M., Fell, D. B., O'Brien, B., & Lee, L. (2010). Cesearean and Vaginal Birth in Canadian Women: A Comparison of Experiences. *Birth, 37,* 44–49.

Eisenberg, A., Murkoff, H. E., & Hathaway, S. E. (1991). *What to expect when you're expecting* (rev. 2nd ed.). New York, NY: Workman.

- This is an excellent and comprehensive guide that covers conception, pregnancy month by month, and childbirth.

Freiberg, K. L. (Ed.). (1999). Annual editions: *Human development 99/00* (27th ed.). Sluice Dock, Guilford, CT: Dushkin/McGraw-Hill.

- This annually updated series presents articles published in magazine, newspapers, and journals on current issues in development. Editions now include annotated World Wide Web sites. A good source for keeping up to date.

Freiberg, K. L. (Ed.). (2002). *Annual editions: Human development 2002/2003* (30th ed.) Guilford, CT: Dushkin/McGraw-Hill.

- *A State of the Art Pregnancy* and *Fetal Psychology* provide additional information on the importance of a health prenatal environment.

Frey, D. (July 9, 1995). Does anyone here think this baby can live? *The New York Times Magazine*. pp. 22–47.

- This article presents a true story of a 24-week-old fetus who is born prematurely and discusses the decisions involved in whether to use medical technology to keep the baby alive.

Leboyer, F. (1975). *Birth without violence*. New York, NY: Knopf.

Nilsson, L., Ingelman-Sundberg, A., & Wirsen, C. (1990). *A child is born* (2nd ed.). New York, NY: Delacorte Press.

- Lennart Nilsson is justly famous for his amazing photographs of babies *in utero*. Share these with your class. The film *The Miracle of Life* also uses some of his microphotography. As one student exclaimed, "He must be a very small photographer!"

Public Health Agency of Canada. (2009). *What Mothers Say: The Canadian Maternity Experiences Survey*. Accessed January 10, 2013, from http://www.phac-aspc.gc.ca/rhs-ssg/pdf/survey-eng.pdf.

Smith, R. (March, 1999). The timing of birth. *Scientific American*.

- Scientists have recently discovered a hormone in the human placenta that tells the pregnant woman's body to begin labour.

Warrick, P. (March 1, 1992). The fantastic voyage of Tanner Roberts. *The Los Angeles Times.* pp. E1, E12–13.

- This fascinating article relates a typical birth.

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MULTIMEDIA IDEAS

Note: These assets are not necessarily owned or distributed by Pearson Education. They may be available in your department or library or accessible online.

(See **Handout 1-4** for a way to have your students think about and evaluate any videos you show in class.)

After the Baby Comes Home (Films for the Humanities and Sciences, 19 minutes)
- This film shows how new parents can prepare for the stress of the new baby, including postpartum depression, marital stress, exhaustion, and the reactions of siblings.

The Amazing Newborn (Polymorph Films, 1975, 26 minutes)
- This film emphasizes the sensory capabilities of the newborn.

Birth and the Newborn (Concept Media, 27 minutes)
- A video describing various childbirth practices.

Birth at Home (Filmmakers Library, 14 minutes)
- A fascinating film about a home birth in Australia assisted by a midwife.

The Dad Film (Fanlite Productions, 1991, 28 minutes)
- This video assuages the anxieties of "expectant dads" and encourages the involvement of fathers in the birth experience.

Developmental Phases Before and After Birth (Films for the Humanities and Sciences, 28 minutes)
Easier to Bear (ABC News/Prentice Hall, 1994, 12 minutes)
- A *20/20* segment that deals with underwater birth as an alternative method to ease the pain of childbirth. Both pros and cons are discussed. Several underwater births are shown.

Five Women, Five Births (Davidson Films, 29 minutes)
- This film shows two home births and three hospital births.

It's Our Baby: *Parents Talk about Certified Nurse-Midwife Birth Care* (The Cinema Guild, 1992, 25 minutes)
- Dispels common misconceptions and shows what midwives do.

A Joyous Labour (Filmmakers Library, 1987, 30 minutes)
- Explores birth options: hospital, home births, birthing centers and the methods used in each setting.

Labour and Delivery (Injoy Productions, 35 minutes)
- This video details the labour and delivery process and includes interviews with mothers and fathers during the last weeks of pregnancy and after delivery.

The Miracle of Birth (AIMS Media, 1989, 30 minutes)
- This video presents current information on childbirth.

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The Miracle of Life (Time-Life Films, 1983, 57 minutes)

- Shows development from conception to birth using Nilsson's microphotography techniques. Actually presents footage of the fetus moving *in utero.*

The Newborn (Films for the Humanities and Sciences, 23 minutes)

- This program shows the reactions of newborns 10 days after birth and important functions of infancy such as sitting, standing, walking, and social contact.

The Process of Birth (Films for the Humanities and Sciences, 23 minutes)

- This program shows how different cultures and different individuals determine the best birth position, whether births should take place in a hospital, who should be in attendance at the birth, and whether mother should breastfeed the newborn.

HANDOUTS

Handout 2-6: Reflective Journal Entry #3: Birth
Use this handout for the third Reflective Journal Entry.

Handout 2-7: Infant Reflexes
This handout lists both the survival and primitive reflexes of infants.

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Handout 2-6

REFLECTIVE JOURNAL ENTRY #3

Birth

You may (a) consult with your parents about your own birth, (b) interview a new parent about her birth experience, or (c) consider the birth of your own child(ren). Please discuss the following in your journal:

1. Describe the events leading up to the delivery. Where did the delivery take place? Who was present? Was any medication used? Was the birth experience as you expected it to be?

2. What was your initial reaction to the newborn? How soon were you able to hold the baby? When did you name the child? If you stayed in a hospital, describe your experience after the birth.

3. What were the first weeks at home like? What problems did you experience? How was having a baby different than you expected? Describe a typical day at home during the first weeks after the baby was born.

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Handout 2-7

INFANT REFLEXES

SURVIVAL REFLEXES	
Breathing	Infants reflexively inhale to obtain oxygen and expel carbon dioxide.
Rooting	If you touch an infant's cheek, the infant will turn its head toward the stimulus and open its mouth as if expecting a nipple.
Sucking	If you touch or otherwise stimulate an infant's mouth, the infant will respond by sucking and making rhythmic movements with the mouth and tongue.
Pupillary	The pupils of infant's eyes narrow when in bright light and when going to sleep, and widen when in dim light and when waking up.
Eye-blink	Infants blink in response to an object that is moving quickly toward their eyes, or to a puff of air.
PRIMITIVE REFLEXES	
Moro (startle)	When infants are startled by loud sounds or by being suddenly dropped a few inches, they will first spread their arms and stretch out their fingers, then bring their arms back to their body and clench their fingers.
Palmar	When an infant's palm is stimulated, the infant will grasp tightly and increase the strength of the grasp as the object is pulled away.
Plantar	When an object or a finger is placed on the sole of an infant's foot near the toes, the infant responds by trying to flex the foot.
Babinski	If you stroke the sole of an infant's foot from heel to toes, the infant will spread the small toes and raise the large one.
Stepping	When infants are held upright with their feet against a flat surface and are moved forward, they appear to walk in a coordinated way.
Swimming	Infants will *attempt* to swim in a coordinated way if placed in water in a prone position.
Tonic neck	When infants' heads are turned to one side, they will extend the arm and leg on that side and flex the arm and leg on the opposite side, as if in a fencing position.

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