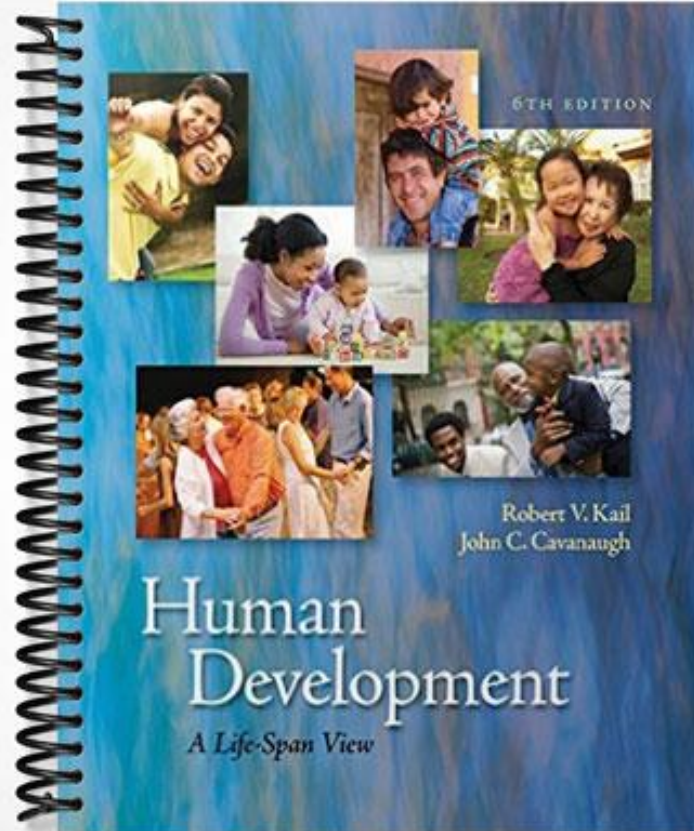


SOLUTIONS MANUAL



Chapter 2

Biological Foundations: Heredity, Prenatal Development, and Birth

CHAPTER OVERVIEW AND CONNECTIONS TO OTHER CHAPTERS

The focus of this chapter is the period before birth. This chapter provides the biological foundation for understanding all human development and consists of four sections covering heredity, prenatal development, influences on prenatal development, and labor and delivery. Understanding heredity and the exchange of hereditary information that takes place when egg and sperm cells unite is critical to understanding the process of human development. The second section focuses on the prenatal period, that period prior to the birth of the baby. This section is particularly important, as it traces the timetable that governs development before birth and highlights the stages of a normal, non-complicated pregnancy. The interplay between nature and nurture is introduced and elaborated on in each section, highlighting the importance of individual differences. Individual differences are also important as the authors examine the interaction between nature and nurture in prenatal development and birth experiences. The authors identify the many potential risks during prenatal development; however, the resilience of human development is apparent as the majority of pregnancies result in a healthy baby.

Two important themes in this chapter are the uniqueness of individuals and the interaction between the developing person and his/her environment. Both of these themes will be apparent in each of the subsequent chapters. The last part of the chapter offers a spotlight on research, where researchers discuss how cognitive functions are impaired in low birth weight babies.

CHAPTER OUTLINE

I. In the Beginning: 23 Pairs of Chromosomes

A. Mechanisms of Heredity

1. Humans have 23 pairs of chromosomes, 22 pairs of autosomes, plus the sex chromosomes (XY for a boy; XX for a girl).
2. Each chromosome consists of one molecule of DNA (deoxyribonucleic acid), which is composed of four nucleotide bases that are the biochemical basis of heredity.
3. Genotype refers to the actual set of genes a person inherits, and phenotype refers to the expressed genes that result from the interaction of the genotype and the environment.
4. Different forms of the same gene are called alleles. A person who inherits the same allele on a pair of chromosomes is homozygous; in this case, the biochemical instructions on the allele are followed. A person who inherits different alleles on a pair of chromosomes is heterozygous; in this case, the instructions of the dominant allele are followed, whereas those of the recessive allele are ignored.

B. Genetic Disorders

1. Genetic disorders can result from inheriting harmful genes. These genes are usually carried by recessive alleles (ex. Sickle-cell disease, PKU). Very few serious disorders are caused by dominant alleles; however, Huntington's disease is an exception, as it is caused by a dominant allele found on chromosome 4.

2. Genetic disorders can also be the result of extra, missing, or damaged chromosomes. Most fertilized eggs that do not have 46 chromosomes (44 autosomes and two sex chromosomes) are aborted spontaneously soon after conception. One exception is Down's syndrome, in which individuals usually have an extra 21st chromosome. Individuals with Down's syndrome have a distinctive physical appearance, and their mental and behavioral development usually lags behind the average child.
3. Abnormal sex chromosomes can also disrupt development. The most common examples include Klinefelter's syndrome, XYY complement, Turner's syndrome, and XXX syndrome. Table 2.2 in the text highlights these four frequent disorders associated with atypical numbers of X and Y chromosomes. Disorders of the sex chromosomes are more common because these chromosomes contain much less genetic material.

C. Heredity, Environment, and Development

1. Behavioral genetics is the branch that deals with the inheritance of behavioral and psychological traits. Many behavioral and psychological phenotypes, such as intelligence and extroversion, involve differences along an underlying continuum. These phenotypes often involve polygenic inheritance, in which the phenotype reflects the combined activity of a number of distinct genes.
2. Twins and adopted children provide important information about the role of heredity. Identical twins are called **monozygotic** because they come from a single fertilized egg that splits in two. Fraternal, or **dizygotic**, twins come from two separate eggs fertilized by two separate sperm. Genetically, fraternal twins are just like any other siblings.
3. The path from genes to behavior is mostly unknown, as the behavior consequences of genetic instructions depend on the environment in which those instructions occur. Research reveals that specific kinds of environments influence very particular aspects of development. However, a single genotype can lead to a range of phenotypes. In fact, behavioral geneticists often use correlations from twin and adoption studies to calculate the **heritability coefficient**, which estimates the extent to which differences between people reflect heredity.
4. Heredity and environment interact throughout development and constantly influence each other throughout a person's life. Genes can influence the types of experiences that children have. In other words, nature (genetics) can help determine the kind of "nurturing" that a child receives such that a person's genotype can lead others to respond to that person in a specific way. The opposite is also true. Children, as they grow and become more independent, actively seek out environments related to their genetic makeup. In other words, people seek environments that fit their genotype, a process known as niche-picking.
5. Environmental influences typically make children within a family different in both cognitive and social development due to non-shared environmental influences.

II. From Conception to Birth

- A. Prenatal development, which takes an average of 38 weeks, begins when a sperm successfully fertilizes an egg and describes the many changes that transform that fertilized egg into a newborn human.
- B. The Period of the Zygote (between weeks 1 and 2), begins with fertilization of the egg by the sperm and ends when the zygote becomes implanted in the wall of the uterus at about two weeks after conception.
 1. Conception can occur through natural means (i.e. sexual intercourse) or by artificial means (i.e. in vitro fertilization). These artificial means raise some controversial issues, including the idea of eugenics, availability, and affordability.

2. The implanted zygote is less than a millimeter in diameter. Once it is completely embedded in the uterine wall, it is called an embryo.
- C. The Period of the Embryo (weeks 3-8) is a period of rapid growth in which most of the major body structures are created.
1. Three layers begin to form in the embryo: **ectoderm, mesoderm, and endoderm**. Specialization of cells is under way when the embryo rests in a sac called the **amnion** that is filled with the **amniotic fluid**, which cushions and maintains temperature.
 2. The embryo is linked to the mother via two structures: the **umbilical cord**, which houses blood vessels that join the embryo to the placenta, and the **placenta**, in which blood vessels from the umbilical cord run close to the mother's blood vessels.
 3. Growth of the embryo follows two important principles: the **cephalocaudal principle**, where the head develops before the rest of the body, and the **proximodistal principle**, in which growth of parts near the center of the body occurs before those that are more distant.
- D. The Period of the Fetus (weeks 9 - 38) is the final and longest phase of prenatal development during which the fetus becomes much larger and many bodily systems begin to function.
1. All regions of the brain grow, particularly the **cerebral cortex**, which is the wrinkled surface of the brain that regulates many important human behaviors. Eyebrows, eyelashes, and scalp hair emerge, and the skin thickens. The skin is covered with a thick, greasy substance called the **vernix**, which protects the fetus during its long bath in amniotic fluid.
 2. The **age of viability** is the period between 22 to 28 weeks, when most systems function well enough that a fetus born at this time has a chance to survive.
- III. Influences on Prenatal Development
- A. Factors affecting prenatal development include a pregnant woman's age, her nutrition, her stress level, disease, drugs, and environmental hazards.
- B. General Risk Factors
1. Nutrition is one of three general risk factors that effect prenatal development.
 - a) The mother is the developing child's sole source of nutrition, so a pregnant woman should increase both her caloric and nutrient intake (proteins, vitamins, and minerals), which is essential for normal prenatal development.
 - b) Without adequate nourishment, the infant is likely to be born prematurely and underweight, and thus vulnerable to illness.
 2. Stress refers to a person's physical and psychological responses to threatening or challenging situations.
 - a) Stress causes greater harm when experienced early in pregnancy.
 - b) Increased stress in a pregnant woman can reduce the flow of oxygen to the fetus while increasing its heart rate and activity level.
 - c) Stress can weaken a pregnant woman's immune system, making her more susceptible to illness.
 - d) Pregnant women under stress are more likely to smoke or drink alcohol and less likely to rest, exercise, and eat properly.
 3. The mother's (and father's) age can have an impact on prenatal development.
 - a) Teenagers and older women experience pregnancy differently. Prenatal development is most likely to proceed normally when women are between 20 and 35 years of age, are healthy and eat right, get good health care, and lead lives free of chronic stress.
 - b) Compared to women in their 20s, teenage girls are more likely to have problems during pregnancy, labor, and delivery.
 - c) Women in their 20s are twice as fertile as those in their 30s.

- d) For women 35 years of age and older, the risks of miscarriage and stillbirth increase rapidly.
- e) Among 40- to 45-year olds, nearly half of all pregnancies result in miscarriage, with women in their 40s more liable to give birth to babies with Down's syndrome.

C. Teratogens: Drugs, Diseases, and Environmental Hazards

- 1. A teratogen is an agent that causes abnormal prenatal development. Most teratogens fall into one of three categories: drugs (alcohol, aspirin, caffeine, and nicotine), disease (AIDS, genital herpes, cytomegalovirus, rubella, and syphilis), or environmental hazards.
- 2. The use of alcohol carries serious risk. Pregnant women who consume large quantities of alcohol often give birth to babies with **fetal alcohol syndrome (FAS)**.
- 3. Environmental teratogens can be the most damaging because people are unaware of their presence in the environment.

D. How Teratogens Influence Prenatal Development

- 1. The impact of teratogens depends on the genotype of the organism, the period of prenatal development when the organism is exposed to the teratogen, and the amount of exposure.
- 2. The impact of teratogens changes throughout prenatal development, affects a specific aspect of prenatal development, and their impact may not be evident until later in life.

E. The Real World of Prenatal Risks

- 1. Many infants are exposed to general risks and multiple teratogens. It is often challenging for researchers to determine the harm associated with individual teratogens.
- 2. A good policy for pregnant women is to avoid diseases, drugs, and environmental hazards.

F. Prenatal Diagnosis and Treatment

- 1. Genetic counseling can help a couple determine if they are at risk of passing a disorder to their offspring.
- 2. Prenatal diagnosis is a tool to determine if prenatal development is progressing normally. Currently several techniques (ultrasound, amniocentesis, and chorionic villus sampling) are used to monitor prenatal growth and development.
- 3. Fetal medicine is a new field concerned with treating prenatal problems before birth. Fetal surgery is another way to correct prenatal problems. Genetic engineering is an additional approach used to replace defective genes with by-synthetic normal genes.

IV. Labor and Delivery

A. Stages of Labor

- 1. Labor is the most intense, prolonged physical effort associated with childbirth.
- 2. Labor consists of three stages: an initial phase in which the cervix enlarges and contractions begin; the crowning phase when the baby passes through the cervix and enters the vagina; and the phase in which the mother expels the placenta.

B. Approaches to Childbirth

- 1. The "natural" or prepared approach to childbirth views labor and delivery as a celebrated life event rather than a medical procedure to be endured. The "natural" or prepared approach to childbirth has four basic fundamental beliefs: going to classes to learn about pregnancy and childbirth; using natural methods to deal with pain rather than medication; involving a supportive "coach"; and giving birth in places other than a hospital.
- 2. In the U.S., approximately 99% of babies are born in hospitals, and only 1% is born at home. The assistance of a trained healthcare professional is the key factor for a safer birth.

C. Adjusting to Parenthood

- 1. A woman experiences many physical changes after birth.
- 2. Parents not only have to adjust physically but psychologically as well.

3. Some women experience postpartum depression after the birth of their child, which is a serious condition that can harm both the mother and the baby.

D. Birth Complications

1. Several birth complications can surface during labor and delivery.
2. Prolapsed umbilical cord is a complication that can disrupt the flow of blood through the umbilical cord causing hypoxia, which can lead to mental retardation or death.
3. A mother may be forced to deliver a baby via a Cesarean section (C-section) because the baby is in distress, in an irregular position, or too large to pass through the birth canal.
4. Other complications include babies born prematurely or with low birth weight. Premature babies lag behind full-term babies during the first year but soon catch up. Newborn babies with low birth weights can develop normally when they have excellent medical care and a supportive environment. Babies with very low or extremely low birth weight do not fare well.
5. Birth complications can have long-term effects. Babies who experience them are at risk for becoming aggressive or violent and for developing schizophrenia.

E. Infant Mortality

1. The infant mortality rate is defined as the percentage of infants who die before their first birthday.
2. Afghanistan has the highest infant mortality rate. In the U.S., infant mortality is quite high among developed nations. The high rate is the result of the high incidence of low birth weight babies. The U.S. has more babies with low birth weight than virtually all other developed countries.

LEARNING OBJECTIVES

In the Beginning: 23 Pairs of Chromosomes

- What are chromosomes and genes? How do they carry hereditary information from one generation to the next?
- What are common problems involving chromosomes and what are their consequences?
- How is children's heredity influenced by the environment in which they grow up?

From Conception to Birth

- What happens to a fertilized egg in the first two weeks after conception?
- When do body structures and internal organs emerge in prenatal development?
- When do body systems begin to function well enough to support life?

Influences on Prenatal Development

- How is prenatal development influenced by a pregnant woman's age, her nutrition, and the stress she experiences while pregnant?
- How do diseases, drugs, and environmental hazards sometimes affect prenatal development?
- What general principles affect the ways that prenatal development can be harmed?
- How can prenatal development be monitored? Can abnormal prenatal development be corrected?

Labor and Delivery

- What are the different phases of labor and delivery?
- What are "natural" ways of coping with the pain of childbirth? Is childbirth at home safe?
- What adjustments do parents face after a baby's birth?
- What are some complications that can occur during birth?

- What contributes to infant mortality in developed and least developed countries?

CRITICAL THINKING DISCUSSION QUESTIONS

Knowledge

- What are chromosomes and genes?
- What are common problems involving chromosomes, and what are their consequences?
- What are several prenatal risk factors?
- What are the events associated with each of the three stages of labor?

Comprehension

- What information is gained from each of the prenatal diagnostic techniques?
- Give an example of a polygenetic factor.
- Explain how the environment in which they grow up influences children's heredity.
- What is the difference between cephalocaudal and proximodistal growth?

Application

- If you were a physician advising a woman whether she should become pregnant, what advice would you give her if she were 15, 20, 30, 40, or 45 years of age?
- If you were a genetic counselor helping a couple determine if their unborn child is healthy, what techniques could you use to screen for birth defects during pregnancy, starting with the least invasive technique?
- Your friend, Shannon, is pregnant for the first time and asks you about smoking cigarettes and drinking a glass of wine to unwind during her pregnancy. Her husband is concerned, but cannot convince her that it is important to stop smoking and drinking, even though it is only a few cigarettes and one glass of wine per week. Offer your girlfriend a research-informed answer so that she can better understand why it is important not to smoke or drink during pregnancy.

Analysis

- What are the advantages and disadvantages of using twin and adoption studies to assess the relative effects of genetic and environmental factors?
- What are the advantages and disadvantages of advance knowledge of a child's birth defect for prospective parents?

Synthesis

- Design a study that would compare various childbirth preparation classes on the experience of labor and delivery.
- Design a study that would determine the influence of nature and nurture on behavior.
- Pregnancy is divided into three three-month trimesters. Explain how these three trimesters correspond to the three periods of prenatal development.

Evaluation

- Does the concept of niche-picking make sense?
- What ethical questions are raised by the new reproductive technologies, and how might those questions be resolved?

INSTRUCTIONAL GOALS AND TEACHING SUMMARIES

Breadth vs. Depth of Coverage. If you are going to spend two or more classes on this chapter, it is recommended that you supplement your class time with one of the excellent films on prenatal development and birth. For most of your students, this will be the first time they have witnessed these events. Many students may not be familiar with childbirth alternatives. A visit from a childbirth educator would enhance students' understanding of childbirth alternatives and the process of childbirth. Possibly inviting a midwife or an OB-GYN would be helpful. Additionally, a visit from new parents who have recently given birth would provide a more personal, qualitatively rich account of the birth experience.

Social Policy Implications. This chapter highlights many important social policy issues. Most notable are identifying and treating abnormal development during the prenatal period, the use of reproductive technologies, and the impact of poverty and drug use on pregnant women and their babies. You might choose to focus your lecture time on elaborating on some of these social policy issues, as provided in the lecture expander, *Conception in the 21st Century: Reproductive Technologies*.

Focus on Theory. The most important theoretical issue in this chapter is the nature vs. nurture issue. Use the lecture expander, *Heredity and Environment: Examining Nonshared Environment*, to introduce the behavior-genetics approach and elaborate on the concept of nonshared environment. This fits nicely with the chapter's coverage on niche-picking.

Clinical or Applied Perspectives. The clinical and applied issues in this chapter revolve around how to optimize the outcomes of at-risk pregnancies.

LECTURE EXPANDERS

Conception in the 21st Century: Reproductive Technologies

The “What Do You Think?” section of the text describes how conception can occur with the assistance of new reproductive technologies. The critical aspect of in vitro fertilization (IVF), the best-known technique, is explained along with some ethical dilemmas that arise from the use of such technologies. One important question that students may have about this new and fascinating area is whether there are any psychological consequences for children born using these new technologies. A study by Golombek, Cook, Bish, and Murry (1995) provides some preliminary answers. They compared families with children conceived through the assistance of IVF (where the child is genetically related to both parents) and donor insemination (where the child is genetically related to the mother but not the father) with families of normally conceived children and families of adopted children. They measured the quality of parenting, as well as the children's social and emotional development. Surprisingly, they found that the quality of parenting for families of children conceived through IVF and donor insemination (DI) was superior to that of families of children conceived naturally. Adoptive parents showed a similar pattern to IVF and DI parents. The children of the four different types of families did not differ on any of the measures of emotions, social behaviors, and parental relationships. The results of this study suggest that desire to become a parent may be more important to the quality of parenting than whether the parent has a genetic relationship to the child. In this study, almost all of the adoptive children knew they were adopted, whereas none of the children conceived through DI knew about their biological heritage. There is considerable debate about whether children conceived through DI should be informed about the condition of their conception (Daniels and Taylor, 1993) and how that knowledge might affect parent–child relationships (Snowden, 1990). Since there is a very small population of children with knowledge of the circumstances surrounding their conception through DI, the question of how family functioning

will be affected remains to be answered by future research, but may provide an interesting issue for class debate and discussion.

Daniels, K. and Taylor, K. (1993), "Secrecy and Openness in Donor Insemination," *Politics and Life Sciences*, vol. 12, pp. 155-170.

Golombek, S., Cook, R., Bish, A., and Murry, C. (1995), "Families Created by the New Reproductive Technologies: Quality of Parenting and Social and Emotional Development of the Children," *Child Development*, vol. 66, pp. 285-299.

Snowden, R. (1990), "The Family and Artificial Reproduction," in Bromhan et al. (eds.), *Philosophical Ethics in Reproductive Medicine*, Manchester University Press.

Heredity and Environment: Examining Nonshared Environment

Kail and Cavanaugh's *Real People* focuses on Kail's sons, Ben and Matt, and illustrates one of the most fascinating and complex issues in human behavioral genetics. Why are siblings different? As Kail and Cavanaugh explain, unique genetic factors may make some environments more interesting or rewarding for different individuals. This process, referred to as niche-picking, reflects the type of genotype–environment interaction known as *active*. Behavioral geneticists describe two other types of genotype–environment interactions. *Passive* interactions arise because of genetic similarity between individuals living together. Thus, parents provide both genes and environment for their biological children, and any resulting similarity between parent and child is due to the confounded genetic and environmental factors. *Evocative* genotype–environment interactions occur when the genotype of an individual elicits differential responses from the environment. According to Scarr and McCartney (1983), the relative salience of each type of interaction changes with development. For infants and young children, parents construct much of their experience, and therefore passive interactions are more typical. With increasing competence and accessibility to a wider range of experience, both *active* and *evocative* interactions come to predominate.

Behavioral geneticists argue that sibling dissimilarity arises because similarity within family environments, as measured in variables like discipline, childrearing patterns, divorce, intellectual environment, or socioeconomic status, have a different impact on different children, reflecting active and evocative genotype–environment interactions. Therefore, one would not expect siblings to be similar. This differential impact is known as *nonshared environment*. From this perspective, nonshared environment has far more explanatory power than the shared experiences of siblings typically measured by social developmental psychologists. According to Plomin, "shared environmental factors, the sort studied in the vast majority of environmental research, are not important in development" (pg. 123). What then are nonshared environmental factors? First, environmental factors must be measured as they relate to specific children; comparisons across families are meaningless. Likely candidates for such factors include differences between siblings, differential treatment of children by parents, birth order, gender differences, and nonoverlapping experiences outside the family (e.g., peer group, teachers).

In an excellent review of this behavioral genetic perspective, Lois Hoffman reconceptualizes environmental variables and provides a defense of the social environmental study of development (Hoffman, 1991). Acknowledging that research on siblings has shown them to be different, Hoffman argues that social developmentalists never based their research on the assumption that siblings would be similar. Nor would the failure to uncover similarity indicate the lack of influence of family-level variables. According to Hoffman, the approach of behavioral geneticists in examining similarities among genetically related individuals, adopted parents and children, and adopted siblings is flawed with regard to answering questions about environmental influence. For example, behavioral geneticists interpret low correlations between adopted children and their adopted parents on personality variables as evidence shows that shared environment explains very little about the child's behavior. As Hoffman argues, "environmental influences do not produce clones of the parent" (pg. 189). To apply the same reasoning,

shared environmental influences would not be expected to produce sibling clones. The absence of sibling similarity does not mean that family-level variables are not influential. Agreeing with the behavioral geneticists' argument that developmentalists should emphasize the interaction between individual children and environmental experiences, Hoffman offers as explanatory developmental variables the importance of children's cognitive development, subjective interpretation, and affective responses as ways to explain sibling differences. Thus, an event can be shared, e.g., divorce, while its interpretation and resulting impact may result in overt differences.

Clearly, both positions recognize the importance of genetic and environmental forces, while each conceptualizes their interactions differently. You might present these arguments to students so that they can begin to understand the complexity and subtlety of genetic and environmental influences.

Hoffman, L. W. (1991), "The Influence of the Family Environment on Personality: Accounting for Sibling Differences," *Psychological Bulletin*, vol. 110, pp. 187-203.

Plomin, R. (1990), *Nature and Nurture: An Introduction to Human Behavioral Genetics*. Brooks/Cole.

Scarr, S. and McCartney, K. (1983), "How People Make Their Own Environments," *Child Development*, vol. 54, pp. 425-435.

IN THE CLASSROOM

Demonstrations

1. *Invite a genetic counselor to class.* Ask him/her to discuss the types of cases he/she consults on, the methods of assessment, and issues of parental decision-making.
2. *Invite a childbirth educator or a midwife to class.* Have them discuss birthing options and the events of labor and delivery. A guest from a birthing center is interesting, as he/she may present a point of view that differs from the standard hospital experience.
3. *Invite a counselor from a drug and/or alcohol clinic to class.* Have him/her discuss the effects of substance abuse during pregnancy.
4. *Invite a public health official to class.* Ask him/her to discuss the impact of AIDS/HIV on pregnant women and their newborns. He/she may also be willing to discuss future public health issues, as they impact pregnant women and infants.
5. *Interview about childbirth alternatives.* Have the class prepare an interview to investigate people's preferences for home births, birthing centers, or hospital births. The interview could include perceptions of risks and benefits associated with each of these choices.
6. *Invite a group of mothers who have recently given birth (and their partners).* Have the mothers and their partners discuss their pregnancy and birthing experience. Try to invite at least three mothers to the class to provide a comparison of experiences, and if possible, invite mothers of varying ages who have had different birthing experiences, i.e., natural childbirth, Cesarean, midwife, etc. You might ask colleagues, current and/or former students, and friends to visit and share. Maybe students can invite their friends or relatives to come as well. Prior to the mothers' visit, have the students prepare a list of questions. Do not forget to have questions for the fathers as well. It is important to get perspectives from both mothers and fathers.

Small Group Activities/Role Plays/Simulations

1. *The ethics of new reproductive technologies.* Working in small groups, the class should identify all the ethical issues involved in the new reproductive technologies. Have each group identify their position on each issue.

2. *Debate the ethics of genetic screening for genetic abnormalities, sex selection, or personality characteristics.* Some of the relevant issues to discuss are the methods of screening, the time it occurs (pre-pregnancy or during pregnancy), the risks of the test, and the rate of false positive and false negative results.
3. *Folk wisdom.* Working in groups, have the students identify the folk wisdom and old wives' tales they have heard concerning pregnancy (e.g., pieces of advice related to the health or gender of the baby). As a class, discuss which folk tales are accurate and which are not.
4. *The role of fathers in childbirth and childcare.* Working in small groups, have students identify the role their own fathers played in their development. Ask students to consider the importance of fathers in childbirth and in childcare. How involved should fathers be? How much say should fathers have in the decision to have (or not have, i.e., abortion, adoption, etc.) a baby. Have students compare their experiences with their own fathers to each person in the group. Are there similarities/differences? How do their experiences vary?

OUTSIDE THE CLASSROOM

Short Writing Assignments

1. *Develop a pregnancy plan.* Students can design a plan for a woman who knows she is six weeks pregnant. Include diet, drugs to avoid, exercise, and lifestyle (see Handout 2-1).
2. *Develop an AIDS policy for pregnant women.* Include recommendations for HIV testing, informed consent, and rights of mother and fetus.
3. *Your best friend is having a baby.* Your best friend has shared with you that she is pregnant, but she is clueless about what to expect. She is also an emotional wreck, dealing with stress and concerned about factors that may affect her pregnancy. What would you tell her?
4. *Map the course of development during pregnancy.* Students can review and map the developmental milestones during pregnancy (see Handout 2-3).

Longer Writing Assignments

1. *Do some research on prenatal services.* Students can research the services available to poor mothers in your area. Find out what programs are available through public health services, local hospitals, or other clinics. How are these services supported with funding at the local, state, and federal levels? How many women take advantage of these services? Are there waiting lists? Try to find information about the percentage of local women who receive no prenatal care at all. What is the infant mortality rate for your state, and how does it compare to national statistics?

Projects/Collaborative Activities

1. *Have the class collect recent news stories (newspapers and news magazines) on reproductive technologies and child custody cases.* This project can be assigned in the first class of the term, so that the articles will be available during the class when you cover Chapter 2. Use these as a basis for small group or whole class discussions on the ethics of reproductive technologies.
2. *Have the class investigate the cost of childbirth.* Divide the class into groups. Have each group investigate the cost of childbirth in your local community, the state average, or the national average. Have them report the cost of a normal birth and a birth with complications.
3. *Have the class collect recent news stories or assign an article on gene therapy.* This project can be assigned in the first class of the term, so that the articles will be available during the

class when you cover Chapter 2. Use these as a basis for small group or whole class discussion on the ethics of gene therapy. You can use the questions on Handout 2-2 to guide the discussion. Students can complete the handout before the class discussion.

SUGGESTED WEBSITES

- The website of the American Association of Birth Centers, <http://www.birthcenters.org/>, provides information about birth centers and midwifery.
- The website of the American Society for Reproductive Medicine, <http://www.asrm.org/>, provides a series of factsheets on topics from adoption to infertility.
- To find out more about fetal alcohol syndrome, go to the site of the National Organization on Fetal Alcohol Syndrome, <http://www.nofas.org/>.
- The BBC World Service AIDS Project website, http://www.bbc.co.uk/worldservice/sci_tech/features/health/sexualhealth/aids/, provides information about AIDS and HIV, including how HIV can be passed from mother to child.

INTERNET ACTIVITIES

1. Give the students the following problem.
Proper exercise and nutrition play an important role in healthy prenatal development. A friend of yours has just found out she is pregnant and needs some advice. She asks you the following questions:
 - a. Is it safe to continue an exercise program while pregnant? How will body changes resulting from pregnancy affect my ability to exercise?
 - b. How much weight should I gain? What are the most important nutrients for my developing baby, and how can I get these nutrients? What should I avoid while I'm pregnant?

To answer these questions for your friend, search the internet for the answers, evaluating both the information and the reliability of the web source.

2. Raising a child with a serious genetic disorder such as Down's syndrome can be difficult. Go to the National Down's Syndrome Society website, <http://www.ndss.com>, to answer the following questions:
 - a. List a few local affiliate groups available, and describe the services they provide.
 - b. Read a few of the essays written by parents and siblings of children with Down's syndrome (see My Great Stories). Describe the impact of finding out your child has Down's syndrome. What impact does Down's syndrome have on the cognitive and social development of the child?
3. Go to the Human Genome Project's website, <http://www.ncbi.nlm.nih.gov/genemap98>, and answer the following questions:
 - a. What is the purpose of the Human Genome Project?
 - b. Browse three chromosomes, and describe the diseases associated with those chromosomes.

SPOTLIGHT ON RESEARCH

Have students read the section "Spotlight on Research" and answer the following questions:

1. *Who were the investigators, and what was the aim of the study?*

Susan Rose and her colleagues (2005) hoped to understand how impairments in basic cognitive skills among low birth weight babies contribute to delayed mental development during the preschool years.

2. *How did the investigators measure the topic of interest?*

One of the earliest cognitive skills to emerge is recognition memory, which refers to the ability to detect that an object or event is familiar—that it's been experienced previously. Rose and her colleagues measured visual recognition memory by showing infants a photograph of a face or a pattern for about 20 seconds. Then they showed the photograph again, paired with a novel face or pattern. Given the choice between novel and familiar stimuli, infants generally look longer at the novel stimulus. Rose and her colleagues recorded percentage of time spent looking at the novel stimulus as an index of recognition memory. They also measured mental development by administering the Bayley Scales of Infant Development.

3. *Who were the children in the study?*

The sample for this study included 144 full-term babies who weighed at least 2,500 grams at birth and 59 babies born prematurely who weighed, on average, about 1,100 grams at birth. The two groups of babies were matched by gender, race, and mother's education.

4. *What was the design of the study?*

The study used a correlational longitudinal design. It is correlational because the investigators were interested in the relation that existed naturally between two variables: birth weight and cognitive skill. The study was longitudinal because children were tested twice: at seven months of age, they were tested on the recognition memory task, and at three years of age, they were tested on the Bayley Scales.

5. *Were there ethical concerns with this study?*

No, there were no ethical concerns with this study. The tasks were commonly used with infants and preschool children; they posed no known risks to children. The investigators obtained permission from the parents for the children to participate.

6. *What were the results?*

The low birth weight babies had lower memory scores (they did not look as much at the novel stimuli, apparently because they were less likely to recognize the familiar stimulus as one they had seen previously) and lower mental developmental scores. The key result is a correlation of .44 between recognition memory and mental development scores: infants who showed greater recognition at seven months had larger mental development scores at three years.

7. *What did the investigators conclude?*

Low birth weight impairs basic cognitive processes—in this case, the ability to recognize photographs seen previously—and, over time, this impairment leads to delayed development of a broad array of mental skills.

8. *What converging evidence would strengthen these conclusions?*

The results of the study show that low birth weight affects children's basic skills, which, in turn, leads to delayed mental development. More convincing would be additional longitudinal results showing that impaired basic skills in low birth weight children makes them more likely to be

diagnosed with a learning disability, more likely to repeat a grade, or less likely to graduate from high school.

SEE FOR YOURSELF: APPLYING WHAT YOU'VE LEARNED

The Human Genome Project, launched in the late 1980s by U.S. scientists, aims to identify the exact location of all human genes. It is a vast undertaking that first requires determining the sequence of roughly three billion pairs of nucleotides. The project has produced maps of each chromosome showing the location of known genes. You can see these maps at <http://www.ncbi.nlm.nih.gov/science96>, a website maintained by the Human Genome Project. At this site, you can select a “favorite” chromosome and see which genes have been located on it. See for yourself!

Have students interview family members to see if there are diseases prevalent among them. Have students identify the genes that cause various diseases: high blood pressure, diabetes, Huntington’s disease, etc. Have students consider what it might mean to know what diseases or chromosomal abnormalities exist in their family line. Who should be privileged to this information? Should your employer or insurance company be made aware that you have a predisposition of contracting a particular disease? Debate the issue.

VIDEO RECOMMENDATIONS

- Ψ **ABC News Video on DVD: Lifespan Human Development**, Segment 1 - “Fathers & Autism,” Segment 2 - “Infant Mental Health,” and Segment 3 - “Childhood Eating.” 2008 Cengage Learning/Wadsworth
- Ψ **Birth: Eight Women’s Stories.** Films for the Humanities & Sciences, 70 minutes. (This video follows eight women giving birth in a variety of circumstances.)
- Ψ **Baby Love.** 2000, Films for the Humanities and Sciences, 57 minutes. (A look at unintended teen pregnancy. This film contains explicit language.)
- Ψ **Fetal Alcohol Syndrome: Life Sentence.** 1998, Films for the Humanities & Sciences, 24 minutes.
- Ψ **The Lily Videos: A Longitudinal View of Life with Down’s Syndrome.** 1997, Davidson Films, Inc., 3 volumes, 33 minutes. (Documentary of a child born with Down’s syndrome, from age 10 to 30.)
- Ψ **Blueprints for Life.** 1992, RMI Media Productions, Inc., 30 minutes. (This video provides an “inside look” at the developing fetus. Researchers explain how teratogens can endanger the growing fetus.)
- Ψ **Conception to Neonate: Reducing Risk Factors.** 1991, Concept Media, 34 minutes. (This film focuses on the environmental factors that can contribute to low birth weight and birth defects.)
- Ψ **Biological Growth: Nature’s Child.** 1991, Insight Media, 60 minutes. (Examines the nature vs. nurture debate. Explores the impact of genes and the prenatal environment on behavior.)
- Ψ **The Mind: Development.** 1988, PBS, 60 minutes. (Overview of development including reproduction prenatal factors and their effects. Also shows infants up to about two years of age.)
- Ψ **Miracle of Life.** 1982, Nova, 60 minutes.

SUGGESTED READINGS

Colapinto, J. (2001), *As Nature Made Him: The Boy Who Was Raised as a Girl*, HarperCollins Publisher.

DeSalle, R. and Yudell, M. (2004), *Welcome to the Genome: A User's Guide to the Genetic Past, Present, and Future*, Wiley.

Nilsson, L. and Hamberger, L. (2003), *A Child Is Born* (4th ed.), Delacorte.

Ridley, M. (2000), *Genome: The Autobiography of a Species in 23 Chapters*, HarperCollins.

Rutter, M. (2006), *Genes and Behavior: Nature–Nurture Interplay Explained*, Blackwell.

KEY TERMS

Below is a list of key terms in the order in which they appear in Chapter 2.

- Chromosomes
- Autosomes
- Sex chromosomes
- Deoxyribonucleic acid (DNA)
- Gene
- Genotype
- Phenotype
- Alleles
- Homozygous
- Heterozygous
- Dominant genes
- Recessive genes
- Incomplete dominance
- Sickle-cell trait
- Phenylketonuria
- Huntington's disease
- Behavioral genetics
- Polygenic inheritance
- Monozygotic twins
- Dizygotic twins
- Heritability coefficient
- Niche-picking
- Nonshared environmental influences
- Prenatal development
- In vitro fertilization
- Eugenics
- Zygote
- Implantation
- Germ disc
- Placenta
- Embryo
- Ectoderm
- Mesoderm
- Endoderm
- Amnion
- Amniotic fluid
- Umbilical cord
- Cephalocaudal principle
- Proximodistal principle
- Period of the fetus
- Vernix
- Cerebral cortex
- Age of viability
- Spina bifida
- Stress
- Teratogen
- Fetal alcohol syndrome
- Ultrasound
- Amniocentesis
- Chorionic villus sampling
- Fetal medicine
- Crowning
- Doula
- Hypoxia
- Cesarean section (C-section)
- Preterm (premature)
- Low birth weight
- Very low birth weight
- Extremely low birth weight
- Infant mortality

Name: _____

Date: _____

HANDOUT 2-1: PREGNANCY PLAN

Develop a pregnancy plan for a woman who knows she is six weeks pregnant. Include diet, drugs to avoid, exercise, and lifestyle. Use the table provided or make your own. Outline the percentage increase in calories and important supplements; list drugs that should be avoided, thinking also about the importance of timing. Outline the type of exercise appropriate for each stage of pregnancy. List any other lifestyle factors that can affect pregnancy.

Month	Diet	Drugs to Avoid	Exercise	Lifestyle
2	Calories			
	Supplements			
3	Calories			
	Supplements			
4	Calories			
	Supplements			
5	Calories			
	Supplements			
6	Calories			
	Supplements			
7	Calories			
	Supplements			
8	Calories			
	Supplements			
9	Calories			
	Supplements			

Name: _____ Date: _____

HANDOUT 2-2: GENE THERAPY

1. What is gene therapy?
2. What is the purpose of gene therapy, and how does it work?
3. What are the pros and cons of gene therapy?
4. How might informed consent be a problem with gene therapy?
5. How can scientists prevent implanted genes from being passed on to the next generation?
6. What do you think about gene therapy? Is it ethical? If not, what are the possible problems?
7. Do you think in the future people will “design” their babies? Why or why not?

Name: _____

Date: _____

HANDOUT 2-3: IDENTIFYING THE THREE PHASES OF PRENATAL DEVELOPMENT

Students can complete this assignment individually or as a group. Indicate in which period of prenatal development the items listed in the left column occur.

	Period of the Zygote	Period of the Embryo	Period of the Fetus
Differentiation of cells marks the end of this period.			
The mother feels movement.			
Specialization of cells occurs.			
Three layers begin to form.			
Implantation occurs.			
The skin thickens and is covered with a thick, greasy substance called the vernix.			
The final and longest phase of prenatal development.			
All regions of the brain grow, particularly the cerebral cortex.			
The developing baby has reached the age of viability.			
The nuclei of the egg and sperm fuse, and the two independent sets of 23 chromosomes are interchanged.			
Fertilization takes place.			
Body structures and internal organs develop.			
Cartilage begins to turn into bone.			