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CHAPTER 2: BIOLOGICAL BEGINNINGS

Total Teaching Package Outline

	Resources
WHAT IS THE EVOLUTIONARY PERSPECTIVE? How did the minds and behaviors of our early ancestors change when they left the forest to feed in the savannahs, and then form hunting societies to finally establish humans as the dominant species?	LG #1
Natural Selection and Adaptive Behavior—The evolutionary process by which those individuals of a species that are best adapted are those that survive and reproduce; Darwin's *On the Origin of Species.* Adaptive behavior is that which promotes an organism's survival in its habitat (e.g., eagle's claws, attachment in humans).	LM #1
Evolutionary Psychology—Emphasizes the importance of adaptation, reproduction, and "survival of the fittest" in shaping behavior. Behaviors that promote survival are conserved and carried on to subsequent generations. • **Evolutionary developmental psychology**—Uses the concepts of evolutionary psychology to understand human development. Ideas include that an extended childhood period in humans facilitates brain development, an extended childhood functions serve as preparation for adulthood in a complex society, evolved psychological mechanisms are domain-specific, and that evolved mechanisms are not always adaptive in contemporary society. • **Evaluating evolutionary psychology**—One alternative is the *bidirectional view,* in which environmental and biological conditions influence each other.	ESS #1 WS #9, 10, 11
WHAT ARE THE GENETIC FOUNDATIONS OF DEVELOPMENT? **The Collaborative Gene** **Genes and chromosomes** • **Chromosomes** are the threadlike structures of DNA; humans have 23 pairs. Each **gene** is a short segment composed of DNA which acts as a blueprint for cell reproduction and, production and assembly of proteins. Proteins are the building blocks of cells. Genes collaborate with genetic and non-genetic factors to produce a wide range of proteins. • **Mitosis, meiosis, and fertilization—Mitosis** is the process in which each chromosome in the cell's nucleus duplicates itself and the cell divides. **Meiosis** is where each pair of chromosomes	LG #2 CA #1 ESS #3

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separates—one member going to each gamete (egg or sperm). In the process of **fertilization,** a sperm **fertilizes** an egg to form a **zygote.** • **Sources of variability—** Each gamete produced is unique. A person's genetic material comprises her or his **genotype.** A **phenotype** consists of observable characteristics such as height and eye color.	
Genetic Principles • **Dominant-recessive genes principle**—The dominant gene of a pair always exerts its effects; examples include hair color, eyesight, and freckles. • **Sex-linked genes**—When a mutated gene is carried on the X chromosome, the result is X-linked inheritance. Since males have only one X chromosome, they are more vulnerable to X-linked disorders such as hemophilia and fragile-X syndrome. • **Genetic imprinting—**When genes have differing effects depending on whether they are inherited from the mother or the father; a chemical process "silences" one member of the gene pair. • **Polygenic inheritance**—Most characteristics are determined by the interaction of many genes**.**	CA #2 HO #1

Chromosome and Gene-Linked Abnormalities
• **Down syndrome**—Caused an extra copy of chromosome 21; associated specific physical characteristics and mental limitations.
• **Sex-linked chromosomal abnormalities**—Some abnormalities involve chromosomes that do not separate properly during meiosis, while others are produced by harmful genes.
  • **Klinefelter syndrome**—A sex-linked abnormality found in males who have an extra X chromosome; affects primary and secondary sexual characteristics.
  • **Fragile X syndrome—**An abnormality in the X chromosome; associated with mental retardation and learning disabilities.
  • **Turner syndrome—**A disorder in which females are missing either an X chromosome or part of one X chromosome; associated with possible infertility and some learning disabilities.
  • **XYY syndrome—**A disorder in which a male has an extra Y chromosome.
• **Gene-linked abnormalities**—Abnormalities may be produced by harmful genes.
  • **Phenylketonuria**—An individual cannot metabolize phenylalanine, an amino acid. If left untreated, PKU can
	LM #2
	
	LM #3
	WS #6
	
	CA #8
	HO #5

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result in mental retardation and hyperactivity. • **Sickle-cell anemia**—A genetic disorder that impairs the body's red blood cells so that the body's cells do not receive enough oxygen. Most often found in African Americans, sickle-cell anemia causes anemia and possibly early death. • **Dealing with genetic abnormalities** – Identifying genetic flaws could enable doctors to predict an individual's risks, recommend healthy practices, and prescribe safe and effective drugs. **WHAT ARE SOME REPRODUCTIVE CHALLENGES AND CHOICES?** **Prenatal Diagnostic Tests** • **Ultrasound sonography**—A procedure in which high-frequency sound waves are directed into the pregnant woman's abdomen; echoes from the sounds are transformed into visual representations of the fetus. • **Fetal MRI**— uses a powerful magnet and radio images to generate detailed images of the body's organs and structure. Fetal MRI can provide more detailed images than ultrasound in the identification of fetal malformations. • **Chorionic villus sampling**—A sample of the placenta is removed and tested for birth defects; considered to be more dangerous than amniocentesis. • **Amniocentesis—**A test by which amniotic fluid is withdrawn and tested for chromosomal or metabolic disorders. • **Maternal blood screening**—Identifies pregnancies that have an elevated risk for birth defects such as spina bifida and Down syndrome. • **Noninvasive Prenatal Diagnosis (NIPD)**—NIPD is used to isolate and examine fetal cells circulating in maternal blood and is being used to identify diseases such as cystic fibrosis and Huntington disease. • **Fetal Sex Determination**—Chorionic villi sampling and some other non-invasive methods can be used to determine the sex of a fetus as early as 7 weeks into pregnancy. **Infertility and Reproduction Technology**—Infertility, the inability to conceive a child after 12 months of intercourse without contraception, affects approximately 10–15% of couples in the United States The most common technique of reproductive technology is in vitro fertilization The risk factors associated with IVF are low birth weight and multiple births. **Adoption**—The effects of adoption on children and the challenges to adoptive parents are discussed.	LG #3 WS #1 ESS #8, 9, 10 CA #4 ESS #2 LG #4

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HOW DO HEREDITY AND ENVIRONMENT INTERACT? THE NATURE-NURTURE DEBATE **Behavior Genetics**—Seeks to discover the influence of heredity and environment on individual differences in human traits and development. • **Twin study**—The behavioral similarity of identical twins is compared with the behavioral similarity of fraternal twins. • **Adoption study**—Investigators seek to discover whether the behavior and psychological characteristics of adopted children are more like those of their adoptive parents who have provided a home environment, or more like those of their biological parents who have contributed their heredity. **Heredity-Environment Correlations** • **Passive genotype-environment correlations—**Biological parents provide a rearing environment for child. • **Evocative genotype-environment correlations**—Genetic foundations elicit social and physical influences from the environment. (Agreeable children get more positive attention.) • **Active (niche-picking) genotype-environment correlations**—Seeking environments that are found compatible to the individual. **Shared and Nonshared Environmental Experiences—**Children's common genetic inheritances versus their unique experiences in and outside the family. **Shared environmental experiences** are siblings' common experiences, while **nonshared environmental experiences** are a child's unique experiences not shared with a sibling. **The Epigenetic View and Gene × Environment (G × E) Interaction—**The epigenetic view emphasizes that development is the result of an ongoing, bidirectional interchange between heredity and the environment. **Gene × Environment (G × E) Interaction—** the interaction of a specific measured variation in DNA and a specific measured aspect of the environment **Conclusions about Heredity-Environment Interaction—** Heredity and environment operate together. Both environment and heredity are complex in their own way, and both are influenced by the other.	LM #4 CA #3 RP #2 PA #1 ESS #7, 9, 11 HO #2 CA #9 ESS #6 HO #6 CA # 7 PA #2 ESS #5 HO #4 CA #6 HO #3

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Resource Key

LG – Learning Goal
LM – Lecture Material
CA – Classroom Activity
HO – Handout
ESS – Essay
WS – Web Site Suggestions
RP – Research Project
PA – Personal Application

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Learning Goals

2.1 Discuss the evolutionary perspective on development.

Natural Selection and Adaptive Behavior

Evolutionary Psychology

2.2 Describe what genes are and how they influence human development.

The Collaborative Gene

Genes and Chromosomes

Genetic Principles

Chromosomal and Gene-Linked Abnormalities

2.3 Identify some important reproductive challenges and choices.

Prenatal Diagnostic Tests

Infertility and Reproductive Technology Adoption

2.4 Characterize some of the ways that heredity and environment interact to produce individual differences in development.

Behavior Genetics

Heredity-Environment Correlations

Shared and Nonshared Environmental Experiences

The Epigenetic View and Gene 3 Environment (G 3 E) Interaction

Conclusions About Hereditary-Environment Interaction

Key Terms

evolutionary psychology
chromosomes
DNA
genes
mitosis
meiosis
fertilization
zygote
genotype
phenotype
Down syndrome
Klinefelter syndrome
fragile X syndrome
Turner syndrome
XYY syndrome
phenylketonuria (PKU)
sickle-cell anemia
behavior genetics
twin study
adoption study
passive genotype-environment correlations
evocative genotype-environment correlations
active (niche-picking) genotype-environment correlations
shared environmental experiences
non-shared environmental experiences
epigenetic view
gene ×environment (G × E) interaction

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Biography Highlights

Thomas J. Bouchard Jr. is a Professor of Psychology at the University of Minnesota and the director of the Minnesota Center for Twin and Adoption Research. The primary research project being carried out under the auspices of the center is the Minnesota Study of Twins Reared Apart. Professor Bouchard is also a principal investigator on the Minnesota Twin Registry, from which data on large samples of twins reared together are gathered by mail. The data from twins reared apart are generally combined with data from the twins reared together for various scientific publications. More than 129 scientific papers have been published by center investigators in the last 20 years.

Charles Darwin (1809-1882) was born in Shrewsbury, England. He was a naturalist who some believe to be the father of evolutionary psychology. From 1831 to 1836, Darwin sailed aboard the H.M.S. *Beagle* on a British science expedition around the world and found fossils of extinct animals that were similar to modern species. On the Galapagos Islands in the Pacific Ocean, he noticed many variations among plants and animals of the same general type as those in South America. Out of this study grew several related theories: (1) evolution did occur; (2) evolutionary change was gradual, requiring thousands to millions of years; (3) the primary mechanism for evolution was a process called *natural selection;* and (4) the millions of species alive today arose from a single original life form through a branching process called *specialization*. Darwin's theory of evolutionary selection holds that variation within species occurs randomly and that the survival or extinction of each organism is determined by that organism's ability to adapt to its environment. He set these theories forth in his book called *On the Origin of the Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* (1859), or *The Origin of the Species* for short. After publication of this work, Darwin continued to write on botany, geology, and zoology until his death. He is buried in Westminster Abbey, England.

David Buss is a professor in the Department of Psychology at the University of Texas. His current research includes sexual strategies; conflict between the sexes; the psychology of status, prestige, and reputation; and the psychology of homicide. The research is guided by the conceptual toolkit provided by evolutionary psychology. Dr. Buss was awarded the APA Distinguished Scientific Award for Early Career Contribution to Psychology and the APA G. Stanley Hall Award. He is the author of *Evolutionary Psychology: The New Science of the Mind.*

Albert Bandura was born December 4, 1925, in the small town of Mundare in northern Alberta, Canada. He was educated in a small elementary and high school, with minimal resources, yet a remarkable success rate. After high school, he worked for one summer filling holes on the Alaska Highway in the Yukon. He received his bachelor's degree in Psychology from the University of British Columbia in 1949. He went on to the University of Iowa, where he received his Ph.D. in 1952. It was there that he came under the influence of the behaviorist tradition and learning theory. In 1953, he started teaching at Stanford University. While there, he collaborated with his first graduate student, Richard Walters, resulting in their first book, *Adolescent Aggression,* in 1959. Bandura was president of the APA in 1973 and received the APA's Award for Distinguished Scientific Contributions in 1980. He continues to work at Stanford.

Stephen Jay Gould is a prominent American paleontologist, evolutionary biologist, and historian of science. He graduated from Antioch College, Ohio, received his Ph.D. from Columbia University in 1967, and was a Professor of Geology and Zoology at Harvard University. A frequent and popular speaker on the sciences, his published work includes *Ontogeny and Phylogeny,* a scholarly study of the

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theory of recapitulation; *The Mismeasure of Man* (Penguin, 1983), winner of the National Book Critics' Circle Award for 1982; the popular collections of essays *Ever Since Darwin: Reflections in Natural History* (Penguin, 1980), which received great acclaim; and many other works.

David Moore completed his undergraduate studies at Tufts University and received his Ph.D. from Harvard University. Since 1989, he has been a professor of psychology at Pitzer College, one of the Claremont Colleges in Southern California. He is also the director of The Claremont Infant Study Center, where he oversees a variety of studies on cognition and perception in infancy, including research on categorization, number perception, and infant-directed speech. His published works include *The Dependent Gene* (2002). http://bernard.pitzer.edu/~dmoore/

Sandra Scarr was born in Maryland. She earned her Ph.D. in Psychology in 1965 from Harvard University, where she majored in behavior genetics. She taught at the University of Maryland, the University of Pennsylvania, the University of Minnesota, and Yale University. In 1983, she accepted a position as chair of the psychology department at the University of Virginia, where she remains. Scarr's research interests have focused on how heredity and environment interact to produce human development. She is especially well known for her study of transracially adopted African American children. She has written several books, including *Race, Social Class, and Individual Differences in IQ* (1981) and *Mother Care/Other Care* (1985), which earned her the National Book Award from the APA. http://www.psychologicalscience.org/observer/getArticle.cfm?id=2202

Robert Plomin is a research professor of behavioral genetics at the Institute of Psychiatry in London, England, and deputy director of the Institute's Social, Genetic and Developmental Psychiatry Research Center. He is known for merging genetic and environmental research strategies to investigate the development of behavior and temperament. For more than 30 years, he has conducted studies, many involving twins raised apart and adopted children, to increase understanding of the roles played by genetics and environment as a person develops. Several of his studies, including the widely known Colorado Adoption Project, have involved long-term follow-up of participants.

Judith Rich Harris is a graduate of Brandeis University, where she received the Lila Pearlman Prize in psychology and later received her master's degree in Psychology from Harvard University. Married with two daughters, she is most famous for her book entitled *The Nurture Assumption,* in which she contends that peers, not parents, have the greatest effect on a child's life. Her views are strongly allied with behavioral geneticists and social evolutionists, who claim that nature plays a far stronger role in child development than previously believed. Harris is a member of the Society for Research in Child Development, the American Psychological Society, and Phi Beta Kappa. In 1998, she received the George A. Miller Award from Division 1 of the American Psychological Association.

Gilbert Gottlieb (1929-2006) was a Research Professor of Psychology in the Center for Developmental Science at the University of North Carolina at Chapel Hill. Professor Gottlieb explored genetic correlations in longitudinal studies of human development, one study beginning in infancy and two others in adolescence. He was particularly interested in furthering the synthesis of developmental biological and developmental psychological thinking (developmental-psychobiological systems theory). This involves the concept of equifinality (the existence of different developmental pathways to the same endpoint), an understanding of structure-function bidirectionality, and delineating the various ways that experience or function operates at the genetic, neural, and behavioral levels of analysis.

Highlights of Research

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(These highlights are given here in the order that they appear in the chapter.)

1. Schmitt, D. P., & Pilcher, J. J. (2004). *Evaluating evidence of psychological adaptation: How do we know one when we see one?* The authors present a review of the evidentiary forms that evolutionary psychologists commonly use to document the existence of human adaptations. Pregnancy sickness, incest avoidance, men's desires for multiple sex partners, and an easily learned fear of snakes are evaluated as possible human adaptations using this framework.
2. Bjorklund, D. F. (2006). *Mother knows best: Epigenetic inheritance, maternal effects, and the evolution of human intelligence*. Research with great apes is presented to suggest that our last common ancestor with chimpanzees likely had the behavioral plasticity and sociocognitive precursors to modify their behavior and cognition via maternal effects toward a more human-like social intelligence.
3. Buss, D. M., & Duntley, J. D. (2008). *Adaptations for exploitation.* The authors advance a conceptual framework for the study of 2 classes of adaptations that have been virtually unexplored: (a) adaptations for exploitation designed to expropriate the resources of others through deception, manipulation, coercion, intimidation, terrorization, and force, and (b) antiexploitation adaptations that evolved to prevent one from becoming a victim of exploitation.
4. Gottlieb, G., Wahlsten, D., & Lickliter, R. (2006). *The significance of biology for human development: A developmental psychobiological systems view*. Describes the history and current status of a psychobiological systems view of development, its implications for a developmentally oriented conception of behavior genetics, its application to a research area such as intersensory development, and the broader implications of a developmental psychobiological systems view of human development.
5. Murphy, M. M., & Mazzocco, M. M. M. (2008). *Rote numeric skills may mask underlying mathematical disabilities in girls with Fragile X syndrome* .Children from a normative sample outperformed girls with fragile X on conceptual, but not rote, skills. However, their performance resembled that of children with mathematical learning disabilities on conceptual skills, such as identifying equal quantities with different symbols.
6. Golombok, S., MacCallum, F., & Goodman, E. (2001). *The "test-tube" generation.* "Test-tube" babies function well and typically do not differ from naturally conceived children in various behaviors and psychological characteristics.
7. Brodzinsky, D., & Pinderhughes, E. (2002). *Parenting and child development in adoptive families.* The authors review research on two different perspectives on adoption—one focusing on adoption as a risk factor in the life of the child, and the other focusing on the benefits associated with growing up in an adoptive home.
8. Matthews, J. D., & Cramer, E. P. (2006). *Envisaging the adoption process to strengthen gay- and lesbian-headed families: Recommendations for adoption professionals*. This article explores the unique characteristics and strengths of prospective gay and lesbian adoptive parents throughout each of the three phases of the adoption process—preplacement, placement, and postplacement—as well as provides suggestions for adoption professionals working with gays and lesbians.
9. Sharma, A., McGue, M., & Benson, P. (1996). *The emotional and behavioral adjustment of*

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United States adopted adolescents. A large-scale study of 4,682 adopted adolescents and the same number of nonadopted adolescents; the adoptees showed slightly lower levels of adjustment but higher levels of prosocial behavior.

10. Scourfield, J., Martin, N., Eley, T. C., McGuffin, P., & Cherny, S. (2004). *The genetic relationship between social cognition and conduct problems.* Conduct problems and social cognition were found to be highly correlated and to share common genetic influences that accounted for about half the covariation in scores. Each phenotype was subject to its own environmental influences that were not shared.
11. Gelhorn, H., Stallings, M., Young, S., Corley, R., Rhee, S. H., Hopfer, C., & Hewitt, J. (2008). *Common and specific genetic influences on aggressive and nonaggressive conduct disorder domains.* The authors investigated the genetic and environmental influences on *DSM-IV* conduct disorder (CD) aggressive and nonaggressive subscales, taking into account age and sex differences.
12. Butcher, L. M., & Plomin, R. (2008). *The nature of nurture: A genomewide association scan for family chaos.* Most of the heritable variation in environmental measures, such as family chaos, is likely due to many genes of very small effect size.

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Lecture Material

1. Darwinism Revival

The resurgence of Darwin's theories regarding evolution and adaptive behavior have cast his work in a modern light and rekindled the debate over evolution and creationism. The recent decision by an Iowa school board to ban teaching of evolution over creation not only caused a backlash, but stimulated a national debate on evolution. An excellent source for stimulating discussion in your class relating to adaptive behavior is Richard Dawkin's seminal text *The Selfish Gene*. He believes that a gene reproduces itself and protects itself to survive regardless of social motivations. He explains this concept by describing the fox that pursues the rabbit. The fox is running for his dinner while the rabbit is running for his life. The result is a rabbit that can outrun the fox and live to reproduce.

Darwin's current popularity may stem from postmodern thought, where an explanation of causes rest within themselves. As learning becomes more of a positivist activity, where children's achievement is measured using technological paradigms such as the alignment of standards with test results, the more objective becomes the evaluation of a child's potential. If, however, we too clinically subscribe to Darwinism, we might find ourselves blaming the child's genotype for a lack of motivation and relegate them to a role of an "average" student.

A lecture on Darwin can contain references to some of the evolutionists of the day: Edward O. Wilson, Robert Wright, William Wright, Thomas Bouchard, Richard Dawkins, and Joseph LeDoux. It would be an overstatement to say that all of these individuals agree totally with the presumption of behavior as gene-motivated, but each contributes evidence of the complexity of genetic and environmental interactions that ultimately formulate the motives and lives of human beings. "The Tyranny of the Natural," by David P. Barash, is an excellent article that could stimulate discussion on this topic.

References

Barash, D. P. (2001). The tyranny of the natural. *The Chronicle of Higher Education, 48*(10), B16–B17.
Dawkins, R. (1989). *The selfish gene*. New York: Oxford.

2. Designer Genes

A lecture on this topic might focus on the many advances in genetic engineering, a subject that has encouraged debate on the ethical and practical value of genotypic scripting. In his book *The Moral Animal,* Robert Wright (1994) explores the concept of evolutionary imperatives and provides some provoking ideas concerning man as an obedient servant to his genetic heritage. In a more scientific study of evolutionary psychology, William Wright (1998) traces the history of behavioral geneticism and demonstrates a compelling argument for inherited behavioral traits. Many instructors invoke the theme of Aldous Huxley's *Brave New World* in a discussion of genetic engineering utilized to propagate the utopian society.

A topic for discussion could be the $3 billion federally funded Human Genome Project, which is charged with mapping and sequencing all human DNA by 2005. Many researchers are working on privately funded projects and are filing patents with the U.S. Patent and Trademark Office for genes and gene fragments that they have identified. See **Classroom Activity #3** for class participation on this topic.

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A modern confirmation has recently been established by two biologists who used an ingenious method of determining the DNA mutations found in chimpanzees and humans and then matching them with a third DNA from a gorilla. Their findings strengthen the belief that sexual intercourse is the method used by our species to eliminate harmful mutations.

Your lecture should focus on the strength of Darwin's conclusions regarding natural selection, and how this concept is related to human survival. Most interesting to today's student would be the fact that human beings affect adaptation and longevity through advanced medical technology.

The concept of parents choosing the characteristics of their children, from intelligence to hair color, is rapidly becoming a reality as the federally backed $3 billion Human Genome Project works to reach its goal of mapping the 100,000 genes in the human body; however, the most practical use of such knowledge is its application to genetic disorders. Consider this quote:

> I have suggested that there should be tattooed on the forehead of every young person a symbol showing possession of the sickle-cell gene or whatever other similar gene, such as the gene for phenylketonuria . . . If this were done, two young people carrying the same seriously defective gene . . . would recognize this situation at first sight, and would refrain from falling in love with one another. It is my opinion that legislation along this line, compulsory testing for defective genes before marriage, and some form of semipublic display of this possession, should be adopted.
>
> —Linus Pauling (Appleyard, 1998, 67.)

This quote will help give your class an extreme view of what genetic databasing could do. Your lecture should focus on both the advantages and disadvantages of having such a database for each individual.

Also germane to this topic is the marketing of genes by young women who donate their eggs to infertile couples and/or brokers. There are approximately 200 clinics in the United States where women can donate eggs and receive compensation as high as $50,000. Young women who have attended Ivy League schools are especially sought after because of the strength of their genetic heritage. **Classroom Activity #3** is geared to stimulate the class into a moral and ethical discussion of the issue and possibly help them to formulate their own thoughts on how the database could be managed.

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Appleyard, B. (1998). *Brave new worlds: Staying human in the genetic future*. Viking Press.
Wright, R. (1994). *The moral animal*. New York: Random House.
Wright, W. (1998). *Born that way*. New York: Alfred A. Knopf.

3. Gender Identity and Sex Assignment

To expand on the topics of sex-linked abnormalities and the epigenetic view of development, you may wish to discuss the development of gender identity and the sex assignment of intersex individuals. The term "intersex" refers to a series of medical conditions (including Klinefelter, fragile X, and Turner syndromes), in which a child's genetic sex and phenotypic sex, or genital appearance, are somehow different from the "standard" male or female definitions (*Intersex Initiative*, 2005). According to some estimates, up to 1% of live births exhibit some degree of sexual ambiguity and between 0.1% and 0.2% of live births are ambiguous enough to become the subject of specialized medical attention, including surgery to disguise their sexual ambiguity

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(Blackless et al., 2000).

While the biological *sex* of a child is defined by the gonads, *gender* is defined by one's own identification as male, female, or intersex (Ghosh & Walker, 2005). Environmental influences on gender identity are significant from the moment a child is born in that parents usually rear the child as either male of female, and other adults and children interact with the child accordingly. For intersex individuals, for whom the usual cue of external genitalia may not clearly indicate one sex or another, one sex is often assigned with the intention of making social interactions and rearing simpler.

The idea that gender identity is malleable during the first years of life and at a certain point becomes irreversible, a notion fostered by John Money of Johns Hopkins University, has in recent years been challenged. The case of David Reimer, also known in the literature as "John/Joan," sadly illustrates this point. David Reimer, who was named Bruce at birth, was born in 1965, one of a pair of identical twin boys (*Who was David Reimer?,* 2005). At the age of 8 months, Bruce and his brother each underwent a circumcision procedure; most of Bruce's penis was destroyed by the surgery. At the advice of Dr. Money, Bruce's parents agreed to reassign his sex via surgical, hormonal, and psychological treatments, and raise him as a girl they called Brenda.

Dressing him in skirts and dresses and teaching him to apply make-up, Janet Reimer did her best to socialize Bruce as a girl (*David Reimer: The boy who lived as a girl,* 2004). Bruce, however, didn't move like a girl and didn't like playing with other girls. "I tried really, really hard to rear her as a gentle lady," Janet Reimer said. "But it didn't happen." By the time Bruce reached puberty, he started developing thick shoulders and a thick neck, and as an adolescent, Bruce threatened to commit suicide if his parents forced him to endure more surgery. By adulthood, Bruce changed his name from Brenda to David, cut his hair, started dressing as a man, and underwent reconstructive surgery to make him physically a man again. David's life ended in tragedy when he committed suicide on May 4, 2004, at the age of 38.

The subject of gender assignment or the need for gender reassignment continues to be a controversial topic among experts. Whether particular gender identity is truly an inborn characteristic, or if it remains unchangeable through the course of an individual's lifetime, has not yet been determined. For the moment, a number of theories appear to have some validity, but much more research is needed to assess the relative contributions of genes and environment on gender identity.

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Who was David Reimer? (2005). Intersex Society of North America. Retrieved June 22, 2005, from http://www.isna.org/faq/reimer.

4. Origins of Intelligence Testing in the United States

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Your students may be interested in discussing in further detail the controversial history of the belief in the genetic basis of intelligence and the origins of intelligence testing in the United States. Many consider American psychologist Henry Goddard a father of intelligence testing in the United States. In the years between 1908 and 1918, Goddard translated the Binet-Simon Intelligence Scale into English, distributed 22,000 copies of the test throughout the United States, and advocated for its use in the public schools (Plucker, 2003).

Influenced by Mendelian genetics, Goddard believed that "feeble-mindedness," or low intelligence, was the result of a single recessive gene. Goddard defined "morons" as "high grade defectives" who possess low intelligence but appear normal to casual observers. In addition to their learning difficulties, Goddard characterized morons as lacking self-control, which meant that they were also susceptible to sexual immorality and easily manipulated by others. A eugenicist, Goddard believed that forced sterilization of the feeble-minded would increase the overall intelligence of the American population. In the absence of this option, he suggested that mentally deficient individuals could alternatively be kept in institutions to prevent them from reproducing (Goddard, 1912).

In 1882, the U.S. Congress passed a law prohibiting mentally defective immigrants from entering the country at Ellis Island. In 1910, Goddard was invited by the U.S. Public Health Service to establish an intelligence testing program for European immigrants there. Over the next few years, Goddard developed a testing process by which an assistant would first visually inspect suspected mentally defective immigrants at the checkpoint. These individuals would then proceed to another location where another assistant would test them with a variety of performance measures including a version of the Binet scales—given in English. The number of immigrants who were deported increased exponentially as a result of these screening measures (Zenderland, 1998).

Lewis Terman, a Stanford professor responsible for revising the Binet-Simon scale for American populations (the "Stanford-Binet"), furthered the idea that those identified as "feeble-minded" were a menace to society. Having found low IQ scores for Mexican and Indian children that he tested, Terman concluded that "their dullness seems to be racial … they cannot master abstractions, but the can often be made into efficient workers" (Terman, 1916, pp. 91–92).
By the late 1920s, Goddard had reversed many of his early opinions, declaring in multiple public forums that he had been gravely mistaken in many of his most famous conclusions, that his former belief that morons could not be educated satisfactorily was wrong, that feeble-minded people should be allowed to have children if they so chose, and that the concept of segregation colonies had been a bad idea (Plucker, 2003). A translation of Goddard's (1912) *The Kallikak Family,* however, a powerful earlier work on the inherited basis of low intelligence and moral degeneracy, was printed in Germany in 1914 and reprinted in 1933, shortly after the Nazis came to power.

See **Classroom Activity #6** for a classroom exercise related to the heritability of intelligence.

References

Goddard, H. H. (1912). *The Kallikak Family: A study in the heredity of feeble-mindedness*. New York: Macmillan.
Plucker, J. A. (Ed.). (2003). Human intelligence: Historical influences, current controversies, teaching resources. Retrieved December 26, 2003 from http://www.indiana.edu/~intell.

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Terman, L. M., & Merrill, M. A. (1916). *The Measurement of Intelligence*.
Zenderland, L. (1998). *Measuring minds: Henry Herbert Goddard and the origins of American intelligence testing*. Cambridge, MA: Cambridge University Press.

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Classroom Activities

1. For an excellent demonstration of the process of genetic transmission, direct students to the Web site for CELLS Alive! (http://www.cellsalive.com/toc.htm), where they will find a complete tutorial on reproduction and specifically on cell division. The tutorial presents the entire process with graphics and animation and also features a self-testing application that allows students to examine their understanding of the process.

2. This chapter discusses the dominant and recessive gene principle. **Handout #1** is a diagram of a Punnett Square, which is designed to help your students understand this principle. Have the class complete the handout and then discuss the concept of natural selection and its application to maintenance of the species.

3. Have your students brainstorm the possibilities of genetic engineering both now and for the future. Divide the class into three or four groups and ask them to compile a list of possible uses and abuses in genetic technology. Using **Handout #2,** have them debate these issues after they have come up with lists of possible conflicts or problems.

4. For each of the common laboratory techniques listed in the text that are used to help infertile couples have babies, offer at least two reasons why that particular method would be sought by a couple. When the list is completed, have the class discuss the possible implications for these procedures on the development of the child and the family.

5. Ask the class for a definition of stereotypes. Once students have agreed upon a definition, have students work in small groups to catalog stereotypical characteristics of groups. You may wish to prompt them by asking them to think of their own stereotypical classifications for cliques or crowds from high school days. Once the list is complete, enjoin them in a discussion about the genetic and environmental origins of these traits and whether the use of stereotypes to characterize members of groups is justified. In conclusion, have them discuss ways in which to reduce racism through education.

6. See **Handout #3** which lists several assertions made by Murray and Herrnstein's *The Bell Curve*. Have your class complete the form which calls for their analysis of each assertion. You can then have the class discuss each one or generate the list as an essay assignment. (Note: It would help if you could acquire a copy of the book to provide further explication of the authors' assertions.)

7. To encourage students to think about heritable characteristics within their own families, distribute **Handout #4** which lists a number of traits that are genetically influenced. Have students consider how each characteristic varies among individual family members. Next, ask them to identify potential environmental influences acting on the expression of each characteristic by family members. Students will enjoy this opportunity to discuss their families in small groups, and you can invite them to share their thoughts in a large group class discussion.

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8. Your discussion of gene-linked abnormalities can provide an excellent opportunity to illustrate the role of the environment in the phenotypic expression of genetic traits. Have students complete **Handout #5** in which they will first review the characteristics of three gene-linked abnormalities. Then ask them to consider how the environment can be manipulated in such a way as to minimize the complications associated with each disorder. Review their responses as a class discussion.

9. Use **Handout #6,** which outlines Sandra Scarr's three phenotype-genotype interactions, to further examine the relationship between heredity and the environment. When completed, have the class compare their results and generate discussion that concludes with the weight of influence relative to heredity and environment.

10. See **Handout #7** for students' personal reflections on two topics covered in this chapter. Students may choose the topics related to evolution, genetics, reproductive choices, and/or heredity's influence on intelligence. Stress to the students that personal reflections are necessary but may be hypothetical if they are uncomfortable writing about themselves. The reflection should be no less than 1-1/2 pages double-spaced.

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Critique a Child Development Article

Choose one article from any periodical or journal on one of the following topics:

- Genetics and their influence on child development
- The issue of test-tube babies
- Parents choosing traits for their children before conception
- Parenting styles

Using the questions listed as follows, write a critique of the article from the viewpoint of a scientist seeking the truth. This paper should be 3 to 6 pages long, double-spaced.

- Who is the audience for the article (e.g., parents, teachers, adolescents)?
- What is the topic of the article? What are some examples of information provided?
- Does the article emphasize heredity (nature) or environment (nurture)?
- To which domain of child development does it refer (physical, socioemotional, cognitive)?
- Does the article rely on scientific findings, expert opinion, or case example?
- Do the conclusions of the article seem valid?
- In a concluding paragraph(s), give your personal evaluation of what was covered in the article and whether it advances our knowledge and understanding of child development.

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Research Projects

1. While stem cell researchers claim that stem cells offer the greatest potential for the alleviation of human suffering since the development of antibiotics, others are vehemently opposed to the extraction of stem cells from human embryos. Locate articles in journals, magazines, and Web sites that contain information on the methods and applications of stem cell research. Be sure to include sources that present the arguments of both sides of the debate on whether the use of human embryos for stem cells is ethical. Prepare a written report of your findings in which you also consider your own position on the debate.

2. As the Human Genome Project nears completion, there is much discussion about the weight of nature versus nurture on development. Considering the vast influence our genes have on our phenotypes, the influence of environment needs to be reevaluated. Research articles in journals and popular magazines concerning the Human Genome Project. Present summaries of the progress and impact of the project, and give your analysis about the future implications of the work being done on genetic blueprinting. Conclude with your evaluation about the extent of influence that nurturing might have in light of growing genetic intelligence.

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Personal Applications

1. The Same But Different

This exercise enables students to realize that a combination of factors contributes to one's environmental experiences. We automatically assume that because we live in the same house and have the same parents, we share the same environment with our siblings. But few siblings would admit that they share similar life experiences. The older siblings will swear that the younger ones always get their way and that their parents aren't nearly as hard on their younger brother or sister as they were on them. The younger ones believe the older siblings get to do everything, and they are treated like babies with all their restrictions. Then there are the middle children! Developmental psychologists know that being an older brother is different from having an older brother, and that despite living under the same roof, siblings' environments are not the same.

- *Instructions for Students:* Consider how your environment growing up was different from those of your siblings, given you were raised in the same household.

- *Use in the Classroom:* This can be a fun way to get students talking and sharing childhood (and even current) stories. Feel free to share some of your own, and encourage students to compare their experiences with those of their siblings. How many believed they had an overall easier time of it than their siblings? A harder time? Were their parents' reactions to them stricter, harsher, more unfair? Conclude by emphasizing the varying circumstantial influences experienced by people functioning in close proximity, and how that contributes to differences in behavior.

2. But *Everybody's* Doing It!

This exercise gets students to consider the various individual influences on the person they've become. Judith Harris presented a shocking and controversial theory stating that parents have little to no influence on the development of their children. She believes that genes and one's peer group determine the path our lives will take. This theory contrasts directly with numerous existing notions about human development and the irreplaceable role that parents play; however, much data exist illustrating the profound influence of peers over parents, particularly during the adolescent years.

- *Instructions for Students:* Discuss the evidence from your life that supports or refutes Judith Harris's provocative contention that what parents do does not make a difference in their children's and adolescents' behavior—that genes and peers are the primary influence.

- *Use in the Classroom:* Given the controversial nature of this theory, it makes a great topic for class discussion! If you can read Harris' book before class, come prepared with some specific quotes from the book to prompt discussion and debate. Make sure that students back up their arguments for or against with specific reasoning and examples. You could also plan a more formal debate on the topic, giving students a week or two to prepare and research the material.

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Reference

Harris, J. R. (1998). *The nurture assumption: Why children turn out the way they do: Parents matter less than you think and peers matter more.* New York: Free Press.

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Essays

1. Discuss how an evolutionary psychologist would describe the nature and function of the developmental period of childhood in humans.

2. Explain the reasons for the high rate of spontaneous abortion of the male at every stage of prenatal development. Discuss the implications of this on the practice and criticisms of artificial means of conception.

3. Explain why the zygotes' chromosomes are not exact copies of either parent's chromosomes. What are some sources of variability in genetic transmission?

4. Discuss the role of the environment in the phenotypic expression of physical and psychological characteristics.

5. Explain the premise of Judith Harris' arguments in her book, *The Nurture Assumption*. According to Harris, to what extent do parents influence children's development?

6. Review the definitions of passive, evocative, active-genotype environments, and shared/nonshared environmental experiences, and give an example of each.

7. The study of fraternal and identical twins has provided a great deal of research material regarding heredity versus environmental influences on human development. Find at least one journal article that discusses such a study and give your analysis about how this study advances our knowledge of development.

8. Discuss the evidence concerning the psychological outcomes of adopted children later in life.

9. Describe the special challenges that adopted children and parents of adopted children face during infancy, early childhood, middle and late childhood, and adolescence.

10. Explain how characteristics of both adopted children and adoptive parents have changed in recent decades.

11. Summarize the controversy over testing for intelligence and provide an analysis of the implications of such testing.

12. Discuss potential ethical issues regarding genetics and development that might arise in the future.

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Web Site Suggestions

1. http://www.obgyn.net/women/pregnancy/pb-cvs.htm
Relates concerns and answers about amniocentesis and chorionic villus testing, as well as other prenatal tests.

2. http://www.personalityresearch.org/bg.html
Information and links about research in behavior genetics.

3. http://www.psych.umn.edu/psylabs/mtfs/default.htm
Contains information on the Minnesota Twins Reared Apart Study, and its goal to identify the genetic and environmental influences on the development of psychological traits.

4. http://www.apa.org/monitor/apr04/second.html
American Psychological Association article about the relevance and controversy regarding the use of twin studies.

5. http://www.genecards.org/
The site of Gene Cards, which is a database of human genes, their products, and their involvement in diseases.

6. http://www.psych.ucsb.edu/research/cep
Information on evolutionary psychology.

7. http://homepage.psy.utexas.edu/homepage/Group/BussLAB/
Site for the research lab of David Buss and links to other evolutionary psychology sites.

8. http://hbes.com/
Site for the Human Behavior and Evolution Society.

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HANDOUT #1

THE PUNNETT SQUARE

The Punnett square is an easy way to demonstrate the possibilities of a single inheritable trait being present in an offspring.

In the Punnett square below, it is evident that there is equal opportunity for the fertilized egg to develop into either a boy or girl.

	X	**Y**
X	**XX**	**XY**
X	**XX**	**XY**

Try two examples for yourself. Brown hair is dominant over blond hair. Use the letters "B" and "b" to represent brown and blond hair, respectively, to determine the probability of having a child with blond hair.

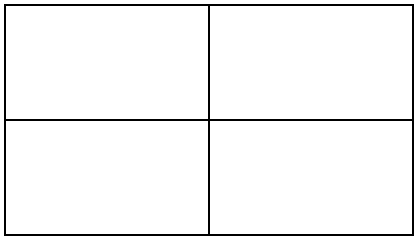
	B	**b**
B		
b		

	B	**B**
b		
b		

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Devise a Punnett square where the recessive trait has a 50% chance of appearing in an offspring. Use “T” and “t” to represent tall and short genes, respectively.



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HANDOUT #2

THE MANIPULATION OF GENES

Consider the growing practice of infertile couples paying for a donor's egg or sperm to be placed in the womb or in another womb in order to have a child. There are many ethical—and some would say, moral—problems that might arise from this practice. In your groups, brainstorm some of the problems and conflicts that might arise from this practice. The following are possible ways in which women can now conceive.

- A woman's egg can be fertilized by a donor's sperm.
- A woman may have an egg donated and then fertilized by her partner's sperm.
- A woman can actually carry an embryo that is a donor's egg fertilized by a donor's sperm (a case in Iowa where a grandmother carried her daughter's baby).
- A woman can receive donated embryos of an in vitro fertilization through adoption.
- A woman may have another woman carry her baby fertilized by her partner's sperm.
- A woman can give her egg, have it inseminated with her partner's sperm, and have it placed into the uterus of another woman—a surrogate mother.
- A couple can pay to have someone else's eggs and sperm fertilized, placed in a gestational surrogate, and then "adopt" the child.
- A woman could take two different eggs from two different donors, be inseminated, and thereby have twins from two different genetic mothers.

Answer the following questions to stimulate your discussion. Arrive at some conclusion following your discussion.

- Will parents be able to choose desired characteristics of their children?
- May couples visit databanks of genetic material to shop for the best characteristics?
- What concerns should we have about the privacy of our DNA?
- What commercial uses could be made of information about our DNA?
- What ethical questions are raised about the patenting of genes?
- What future problems can you foresee on the patenting of genes?
- What would happen if HMOs had access to your DNA? To your family's DNA?

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HANDOUT #3

A CRITIQUE OF *THE BELL CURVE*

Authors' Assertions	Page #s	Your Analysis
Statistically it is not good for children to be born either to a single mother or a married couple of low cognitive ability.	519	
America will become a custodial state; therefore, child care in the inner city will become the responsibility of the state, homelessness will vanish, the underclass will become more concentrated, the underclass will grow.	523–525	
White women with above-average cognitive ability or socioeconomic background rarely become chronic welfare recipients.	197	
Men who are out of the labor force, because of self-described physical disability, tend toward low cognitive ability.	163	

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HANDOUT #4

Heritable Characteristics of Family Members

Characteristic	Differences among family members	Environmental influences
Height		
Hair color		
Athleticism		
Reading ability		
Extraversion		
Agreeableness		
Open-mindedness		

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HANDOUT #5

Gene-Environment Interactions in Gene-Linked Abnormalities

Disorder	Characteristics	Role of the Environment
Phenylketonuria (PKU)		
Sickle-cell anemia		
Diabetes		

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HANDOUT #6

HEREDITY-ENVIRONMENT INTERACTION

In the boxes provided, articulate on Scarr's focus regarding genotype-environment interactions.

Passive genotype-environment interaction

Examples _____

_____

Influence of the interaction on the child

Evocative genotype-environment interaction

Examples _____

_____

Influence of the interaction on the child

Active (niche-picking) genotype interaction

Examples _____

_____

Influence of the interaction on the child

Conclusions of the Group:

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HANDOUT #7

PERSONAL REFLECTIONS
on the themes presented in this chapter

Review the learning goals and the summaries following each as presented throughout the chapter. From these, glean what you consider to be the two major themes of this chapter. (You may choose more than two.)

1. _____

_____

2. _____

_____

On a separate sheet of paper, write your personal reflections of child development relative to **ONE** of these themes. You will be writing about impressions of what has been discussed in class and presenting your own views using personal experiences or those of people you have known. (Note: Writing about your personal experiences is voluntary and not required for this assignment. You may use hypothetical situations or write about the experiences of people you know or have known).

Be sure to conclude by writing a general statement regarding child development that would summarize one of the themes of this chapter.

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