CHAPTER LEARNING OBJECTIVES

1. Explain the difference between a gene and a chromosome, and explain how a baby’s sex is determined.
2. Describe the processes of mitosis and meiosis and how twins are formed.
3. Describe the process of genetic transmission, how traits are passed from parents to children.
4. Discuss the causes and characteristics associated with chromosomal and genetic abnormalities.
5. Explain the techniques for prenatal testing for various genetic disorders.
6. Describe how studies of adopted children and identical (monozygotic) versus fraternal (dizygotic) twins are used to explore the relative influences of nature versus nurture – include in this discussion a description of genotype and phenotype and between reaction range and canalization.
7. Explain the formation of egg and sperm and where conception takes place.
8. Discuss causes of infertility and methods couples can use to conceive.

CHAPTER OVERVIEW

This chapter provides an overview of the biological processes of heredity and conception, including all of the basic structures (e.g., chromosomes, genes, DNA) and processes (e.g., mitosis, meiosis, fertilization, implantation) involved in the formation of a new human being. The relation between genotype and phenotype in developmental outcome is described, and the potential disorders resulting from various chromosomal and genetic abnormalities discussed. Research strategies for examining the contribution of genes and environment to development are introduced. The chapter concludes with a discussion of infertility and alternative pregnancy methods. Interesting features include a discussion of the gender imbalance in diverse countries and parental attempts to select the gender of their child.
CHAPTER OUTLINE

I. The Influence of Heredity on Development: The Nature of Nature
   A. Chromosomes and Genes
      1. Heredity is based on the biological transmission of traits from one generation to the next and defines one's nature. Genetics is the field within the science of biology that studies heredity.
      2. Normal human cells have 23 pairs (46 total) of chromosomes, containing genes that are composed of DNA and that determine traits. Most traits of interest to psychologists are polygenic.
   B. Mitosis and Meiosis
      1. During mitosis, all 23 pairs of chromosomes are exactly replicated (barring random mutations), resulting in cell division and growth or tissue replacement.
      2. Meiosis is reductive division, which leads to the production of sperm or ova containing 23 chromosomes, half of the DNA found in normal cells.
      3. 22 chromosomes in sperm and eggs are autosomes and the 23rd is a sex chromosome; mothers contribute an X and fathers contribute either an X (to create a female) or a Y (to create a male).
   C. Identical and Fraternal Twins
      1. Monozygotic twins (MZ) are derived from a single zygote that has split in two, resulting in two children that are genetically identical.
      2. Dizygotic twins (DZ) are derived from two zygotes, meaning they share about 50% of genetic material, the same as other siblings.
      3. DZ twins run in families, and the chances of twins increase with maternal age and the use of fertility drugs.
   D. Dominant and Recessive Traits
      1. Traits are determined by alleles, which are one member of a gene pair. Having matching alleles for a trait is known as being homozygous and non-matching alleles as heterozygous.
      2. Gregor Mendel discovered simple patterns of inheritance: Codominance, in which the effects of both alleles are expressed, and the Law of Dominance, in which the dominant allele will be expressed, masking the expression of the recessive allele. Most traits are more complex.
      3. A person having a recessive gene for a disease may not see the effects of the disease because the dominant copy of the gene cancels out the recessive effects, but they are known as carriers.

II. Chromosomal and Genetic Abnormalities
   A. Chromosomal Abnormalities
      1. Children who do not inherit the normal number (46) of chromosomes experience health and behavioral problems. The risk for chromosomal abnormalities increases with parental age.
      2. Down syndrome occurs when a child has an extra copy of the 21st chromosome and results in characteristic facial features, as well as cognitive and physical deficiencies.
      3. Most persons with sex-linked chromosomal abnormalities are infertile.
         a. XYY males have heightened male secondary characteristics
         b. XXY males (Klinefelter syndrome) usually have enlarged breasts and are mildly mentally retarded. They are often treated with testosterone replacement therapy.
         c. OX females (Turner syndrome) are typically short, do not develop breasts or menstruate, and have a specific pattern of cognitive deficits.
         d. XXX females (Triple X syndrome) are normal in appearance but typically have deficits in language skills and memory for recent events.
B. Genetic Abnormalities

1. Children with **phenylketonuria (PKU)** have two copies of the recessive gene causing the disorder and cannot metabolize a specific amino acid, thus cannot include it in their diets or there will be serious consequences (i.e., mental retardation).

2. **Huntington disease** is a rare neurodegenerative disease transmitted via a dominant gene.

3. **Sickle-cell anemia** is caused by a recessive gene and results in the altered shape of red blood cells, decreasing the oxygen supply. This can lead to both cognitive and physical problems.

4. **Tay-Sachs** disease is also caused by a recessive gene and causes degeneration of the central nervous system, and ultimately death.

5. **Cystic fibrosis**, caused by a recessive gene, results in excessive mucus production and increased risk of respiratory infections.

6. **Hemophilia** and **Duchenne muscular dystrophy** are caused by recessive genes on the X chromosome, and are thus known as **sex-linked genetic abnormalities**. Because females have two copies of the X chromosome, they are less likely to show these disorders.

C. Genetic Counseling and Prenatal Testing

1. Genetic Counselors address the probability of having children with genetic abnormalities based on the parents genetic make-up and family medical histories.

2. **Ammiocentesis**, examining fetal cells isolated from amniotic fluid, can detect the presence of over 100 chromosomal and genetic abnormalities in the developing fetus, but carries a small risk of miscarriage.

3. **Chorionic Villus Sampling (CVS)** can diagnosis abnormalities earlier in pregnancy than amniocentesis, but has a slightly greater risk of miscarriage.

4. An **ultrasound** creates a “picture” of fetus by using information about the reflection of sounds waves. It is beneficial in determining position of fetus, as well as the fetal age and sex.

5. A maternal blood tests, **Alpha-Fetoprotein (AFP) assay**, is used to detect spina bifida in the fetus.

III. Heredity and the Environment: Nature versus Nurture

A. **Reaction range** describes the possible variation in the expression of an inherited trait and is influenced by the environment. **Genotype** refers to the alleles that are inherited, while **phenotype** refers to the actual traits expressed from these alleles.

B. Some aspects of development, such as infant motor development, and strongly influenced by **canalization**, whereas the environment plays stronger roles in the development of personality and intelligence.

C. Scarr proposed three types of **genotype-environment correlations**: passive (child passively receives both genes and environment from parents), evocative (child’s characteristics evoke a certain response from others), and active (child’s characteristics influence the child’s selection of environments). The interaction of genes and environment in development is termed **epigenesis**.

D. **Kinship Studies**: Are the Traits of Relatives Related?

1. People who share more genetic material (i.e., close relatives) should be more alike on qualities affected by genes than those who share less genetic material (i.e., non-relatives).

E. **Twin Studies**: Looking in the Genetic Mirror

1. The logic behind twin studies is that if MZ twins show greater similarity on a trait that DZ twins, that trait is influenced by genetics. This is the case for many traits, such as intelligence and personality traits.

2. A confound of twin studies is that twins raised together share not only genetics, but environment. Thus, researchers often compare MZ twins that were reared apart to account for this.

F. **Adoption Studies**
1. If children are more like their adoptive parents on a trait, it is likely strongly influenced by nurture. If children are more like their biological parents on a trait, it is likely strongly influenced by genetics.

2. A Closer Look—Research: Adopted and Biological Children in the Study of the Impact of Genes on Delinquency Following Divorce. This section describes the methodology of a recent adoption study which concluded that it is divorce, and not possible genetic factors that accounts for delinquency in adolescent biological children.

IV. Conception: Against All Odds

A. Ova

1. All the ova a woman will ever have are present in an immature form at birth, and begin to mature during puberty.
2. There is a monthly release of a mature egg (which is much larger than a sperm) into the Fallopian tube, where the egg is propelled by cilia.
3. If the ovum is not fertilized, it is discharged in the menstrual flow.

B. Sperm Cells

1. Half the sperm a man’s body makes will carry a Y chromosome and swim more quickly than the other half, which contain an X chromosome.
2. Although 200 to 400 million in ejaculate, only 1 in 1,000 will arrive in the vicinity of ovum. Sperm cells are apparently attracted to the ova by the odor of a chemical secreted by the egg.
3. Sperm secrete an enzyme to allow penetration of the gelatinous layer that surrounds the ovum. Once one sperm enters, this layer thickens, locking out all other sperm.
4. Conception occurs when the chromosomes from a sperm cell and an ovum combine to form one cell with 23 chromosome pairs.

V. Infertility and Other Ways of Becoming Parents

A. A couple is considered infertile if they cannot conceive after trying for one year and 1 in 6 or 7 American couples will experience fertility problems. The man is the source of the problem in about 40% of the cases.

B. Causes of fertility problems may lie with the man or the woman.

1. Causes among men include low sperm count, deformed sperm, low sperm motility, infectious diseases, and direct trauma to testes. These can be caused by genetic factors, environmental poisons, diabetes, STI’s, overheating testes, pressure to testes, aging, and the effects of drugs.
2. Fertility problems among women include failure to ovulate, infections, and endometriosis which results in blocked fallopian tubes.

C. Helping People with Fertility Problems become Parents

1. Depending on the cause of infertility, various methods may be used to achieve pregnancy including artificial insemination, in vitro fertilization, and embryonic transplant.
2. Those desiring children may also obtain children from surrogate mothers or adoption. Today, greater numbers of adopted children are older, have spent some time in foster care, are of other races, have special needs, and were born in other countries.

D. A Closer Look—Real Life: Selecting the Sex of Your Child: Fantasy or Reality?

1. Many folklores and old wives tales suggest ways to conceive a child of a certain gender, but preimplantation genetic diagnosis (PGD) is a fool-proof way to select the sex of a child. In this method the sex of an embryo is determined in vitro, and only the ones that are the desired sex are implanted into a mother’s uterus. There are moral and ethical questions associated with this method.

E. A Closer Look--Diversity: Where Are the Missing Chinese Girls?
1. China’s one-child policy and cultural preference for male children have resulted in a skewed gender balance of children.
2. In the past, many girls were abandoned by their parents and subsequently adopted by foreigners. China has greatly tightened its restrictions on adoptions and claims there are not enough available babies. This may be to protect the image of the country.
3. It is also possible that sex-selective abortion is replacing female infanticide as China’s predominant method of sex-selection.

**ANSWER KEY: TRUTH OR FICTION?**

1. Your father determined whether you are female or male.
   **TRUE.** If we receive another X sex chromosome from our fathers, we develop into females. If we receive a Y sex chromosome (named after its Y shape) from our fathers, we develop into males.

2. Brown hair is dominant over blonde hair.
   **TRUE.** If one parent carried genes for only brown hair, and the other for only blonde hair, the children would invariably have brown hair. But brown-haired parents may also carry recessive genes for blonde hair.

3. You can carry the genes for a deadly illness and not become sick yourself.
   **TRUE.** This occurs when genes are recessive, and dominant genes cancel their effects.

4. Girls are born with all the egg cells they will ever have.
   **TRUE.** At birth, women have around 400,000 ova, but they are in immature form.

5. 120 to 150 boys are conceived for every 100 girls.
   **TRUE.** Sperm with Y sex chromosomes appear to swim faster than sperm with X sex chromosomes. This is one of the reasons why between 120 and 150 boys are conceived for every 100 girls.

6. Sperm travel about at random inside the woman’s reproductive tract, so that reaching the ovum is a matter of luck.
   **FALSE.** Although the journey of sperm is literally blind, it is apparently not random. Sperm cells are apparently attracted by the odor of a chemical secreted by ova.

7. Extensive athletic activity may contribute to infertility in the male.
   **TRUE.** Overheating of the testes, which happens now and then among athletes, such as long-distance runners, and pressure, which can be caused by certain bicycle seats, are two causes of male infertility.

8. “Test-tube” babies are grown in a laboratory dish throughout their nine-month gestation period.
   **FALSE.** “Test-tube” babies are conceived in a laboratory dish or vessel and then injected into the uterus, where they must become implanted to develop successfully.

9. You can select the sex of your child.
   **TRUE.** Preimplantation Genetic Diagnosis (PGD) is a fool-proof sex-selection method, but it is medically invasive and expensive, and successful implantation cannot be guaranteed.
IDEAS FOR INSTRUCTION

I. The Influence of Heredity on Development: The Nature of Nature

A. Key Terms

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<td>ovary</td>
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<td>ovum</td>
<td>ovulation</td>
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B. Lecture Expanders

What Kind of Twin- Monozygotic or Dizygotic?
Students often assume that if twins look alike, they are identical (monozygotic) twins. Although DNA testing is the only method that can determine the zygosity of twins with 100% accuracy, several questionnaires have also been developed that are highly accurate and less costly than DNA testing. Present one of these to your class (for instance, Price et al. (2000) has published a parental questionnaire that is 95% accurate. The questionnaire includes information about the similarity of twins’ hair color, texture, the timing of teething, etc.). However, these surveys are only effective after the twins have been born. If an ultrasound reveals that twins are sharing an amniotic sac and a placenta in utero, they must be identical. Yet separate amniotic sacs do not always indicate fraternal twins, although twin fetuses of different sexes always indicate fraternal twins.


C. Classroom Activities and Demonstrations

Video Suggestions

Cracking the Code of Life (2001, NOVA, 120 minutes). This video chronicles the race to capture the complete letter-by-letter sequence of genetic information—the human genome. Eric Lander, director of the Whitehead Institute/MIT Center for Genome Research presents a light-hearted look at genetic science. Also included is a segment about two brothers who both have children with Tay Sachs disease. This video may also be viewed on-line through the interactive companion website: http://www.pbs.org/wgbh/nova/genome/

After Darwin: Genetics, Eugenics, and Human Genome (1999, Films for the Humanities and Social Sciences, 2 parts, 49 and 46 minutes). Extensive presentation of genetic science using historical footage and interviews and including information on the Human Genome Project and cloning, and a discussion of the discriminatory practices of insurance companies in paying for prenatal testing and infertility treatments.

II. Chromosomal and Genetic Abnormalities

A. Key Terms

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<td>sex-linked chromosomal</td>
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<td>abnormalities</td>
<td>Tay-Sachs disease</td>
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<td>Klinefelter syndrome</td>
<td>cystic fibrosis</td>
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<td>testosterone</td>
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<td>muscular dystrophy</td>
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<td>phenylketonuria (PKU)</td>
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<td>Huntington's disease</td>
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<td>alpha-fetoprotein (AFP) assay</td>
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B. Lecture Expanders

Say “Cheese”: Prenatal Pictures

Although ultrasounds were developed for medical purposes, many companies now offer pregnant women 3-D and 4-D ultrasounds in order to see their babies before they are born. 3-D ultrasounds almost look like photographs (there are several examples on the web). 4-D (four dimensional) ultrasounds add the element of time to three-dimensional ultrasound images, so that women can purchase a video of their unborn child moving around. Thus, these ultrasounds do not provide any medical information about the health or gestational age of the baby, they just provide pretty pictures that cost a pretty penny! Many companies offering this service, including Prenatal Peek and Fetal Fotos, operate informative and slickly marketed websites. You can debate the pros and cons of this with your class.

C. Classroom Activities and Demonstrations

Video Suggestions


Genetic Translation (1996, Films for the Humanities and Social Sciences, 15 minutes). Covers the translation of genetic material into a living organism. Also includes a discussion of genetic testing and amniocentesis.


Gene Research: Promises and Dilemmas (Films for the Humanities and Social Sciences, 33 minutes). Covers difficulty of advising families about results of prenatal testing for diseases for which there is no cure.

D. Student Projects

Gene Testing of Newborn Infants

As a part of the Genetic Science Learning Center through the University of Utah, this activity challenges students to recommend policies to guide a program for genetic screening of newborns. You can register for free at this website and then the entire activity can be downloaded as a PDF from http://gslc.genetics.utah.edu/teachers/tindex/index.cfm.

In small groups, (the appointed Task Force) students will be assigned specific roles to play and given suggested questions for their consideration in the task. The activity includes the roles for the task force members; letter to task force; key issues for the task force to consider as well as extensive information on the specifics of newborn genetic screening; disorder information sheets; sample collection and storage; cost considerations; legislation and existing laws; demographics and disorder variability; a glossary and references.

Lessons in Observation: Prenatal Assessment

Ask students to visit WebTutor or the premium website (register/purchase access at www.cengage.com/login) to view the video “Prenatal Assessment”. This video is featured in Chapter 2 on page 56. Below are the video narration and the application questions with answers on Prenatal Assessment.

Video Narration: During a routine prenatal visit, ultrasound is used to estimate fetal age, determine the position and growth of the baby, and determine the health of the placenta. The ultrasound uses sound waves to produce an image of the unborn child for analysis. In high-risk pregnancies, the ultrasound is used to check for fetal abnormalities. Women approaching or beyond the age of 35 have a higher risk of having a baby with Down syndrome and other chromosomal abnormalities. Here, Dr. Cohen performs a detailed ultrasound to help rule out birth defects. While the ultrasound cannot diagnose chromosomal or other abnormalities, it is a useful screen for estimating risk and the need for additional diagnostic tests such as amniocentesis.
Chapter 2

Application Questions and Answers:
1. According to Dr. Cohen, what is the most common chromosomal abnormality seen in live-born babies?
   - Down Syndrome

   What is the prevalence of this disorder?
   - According to Dr. Cohen, 1/270 pregnancies in women over the age of 35

   What is the relationship between maternal age and the risk of having a baby with this disorder?
   - Positive correlation between maternal age and Down Syndrome

2. Dr. Cohen explains how multiple prenatal assessment measures can be used together to make decisions regarding whether further medical monitoring procedures, such as amniocentesis, are necessary. Does he recommend an amniocentesis for Eleanor? Why or why not?
   - Does not recommend an amniocentesis
   - States that there is more than a 99% chance that she will not have a baby with a chromosomal abnormality based on her age alone
   - Discusses 1/200 risk of losing the pregnancy due to amniocentesis
   - States that if the ultrasound is normal, the risk of losing the baby due to complications resulting from the amniocentesis is twice as high as Eleanor’s risk of having a baby with Down Syndrome

3. Describe the ultrasound procedure as performed by Dr. Cohen. What is the position of the baby?
   - Breach presentation, Dr. Cohen states that 95% of the time the baby will turn around by the time the pregnancy is full term

   What structures does Dr. Cohen identify?
   - Examines the placenta and describes it as the organ that feeds the baby nutrients and oxygen
   - Points out head and skull
   - Shows brain, paying close attention to the cerebellum
   - Moves down length of spine
   - Shows beating heart
   - Examines femur, thigh bone, and discusses the importance of measuring limb length

   What important health information is learned as a result of this ultrasound test?
   - Ultrasound results are normal, ruling out the need for additional diagnostic tests

4. Describe two structural abnormalities and/or markers of chromosomal abnormalities discussed by Dr. Cohen as he performs the ultrasound.
   - Cerebellum, if normal, chance that baby has spina bifida is very small
   - Femur, measurements of limb length are important, short femur length is associated with Down Syndrome

5. What risks are associated with various prenatal assessment measures?
   - Maternal blood analysis, AFP screening: high risk of false positive result
   - Amniocentesis: risk of losing the pregnancy to miscarriage
   - Chorionic villus sampling: some concern about fetal limb abnormalities, increased risk of miscarriage

How are decisions made regarding which measures to use?
- Maternal age
- Stage of pregnancy
- Abnormal ultrasound findings
- Previous child with a genetic or other disorder
- Family history of genetic or other disorder
- Ethnic origin
- Multiple miscarriages
- Risk of miscarriage and infection

What are some ethical considerations in the use of prenatal monitoring procedures?
- Selective abortion controversies, i.e., sex, disability status
- False negative/positive results and decision making
- Risk of miscarriage and infection
6. How prevalent are birth defects resulting from genetic factors?
   - *Prevalence rates vary depending on type of genetic abnormality and other factors, i.e., chromosomal, autosomal, and X-linked disorders*

   How can the family histories of prospective parents be used to determine the likelihood of a baby having a genetic disorder?
   - *Some genetic disorders are heritable, such as autosomal recessive disorders, while others, such as mutations, are not*
   - *Family history is used to assess risk of heritable genetic disorders*

7. What are some other, non-genetic factors that can affect prenatal development?
   - *Maternal disease, e.g., rubella, toxoplasmosis, sexually transmitted diseases*
   - *Drugs*
   - *Alcohol*
   - *Cigarette smoke*
   - *Environmental hazards, e.g., radiation, pollutants*
   - *Other maternal characteristics such as diet, depression, stress, age*

8. Eleanor began taking prenatal vitamins three months prior to conception, and she stopped consuming alcohol in the month prior to conception. What problems will her careful, planned approach likely rule out?
   - *Fetal alcohol syndrome, spina bifida (folic acid)*

   What other behaviors may affect the health of a child prior to, or very early in, pregnancy?
   - *Exercise*
   - *Diet*
   - *Drug use*
   - *Smoking*

### III. Heredity and the Environment: Nature versus Nurture

**A. Key Terms**

- reaction range
- genotype
- phenotype
- passive genetic – environmental correlation
- evocative genetic – environmental correlation
- active genetic – environmental correlation
- epigenesis
- autism

**B. Lecture Expanders**

**Genotype-Environment Effects**

The textbook briefly points out that expressed traits represent an interaction of heredity and environment. However, Sandra Scarr and Kathleen McCartney’s (1983) widely cited theory of genotype-environmental effects during development explains these interactions in much greater detail. These authors propose three genotype-environmental interactions: Passive, Evocative, and Active. (These interactions also tie in nicely with the active-passive controversy presented in chapter 1). Each of these interactions influences the expression of phenotypes in developing children.

In the passive genotype-environment effect, biological parents provide both their child’s DNA and their environment. For example, parents who are talented musicians may pass down genes that allow a child to develop perfect pitch and an environment with high levels of exposure to music. Thus, the child may express musical talent. This influence is most influential early in development when a child’s environment is most influenced by his or her parents.
The second influence is the evocative genotype-environment interaction. In this case, a child’s genotype will evoke certain responses from those around them, and hence influence his or her development. For instance, a child’s genotype may cause her to grow especially tall. This may evoke those around the child to encourage her to play basketball. Classmates may pick that child for teams first during gym class. This could influence the child to become quite athletic. Evocative genotype-environment effects operate throughout the lifespan.

Finally, the active genotype-environment effect is a type of niche-picking. People will seek out environments they are comfortable in and that are consistent with their traits. Consider the example above of the tall child. This child may choose to try out for the school basketball team and actively seek out opportunities to practice this sport. This influence becomes more prominent as a child matures and is able to make his or her own choices in life.


C. Classroom Activities and Demonstrations

Illustrating a Reaction Range
Gottman’s conceptualization of heredity-environment interactions is called range of reaction. The notion is that genetics sets upper and lower limits on environmental influences (e.g., nutrition, learning, accidents, illness, environmental toxins, schooling, and social class). One way to help your students grasp this concept is to have them generate examples of how multiple phenotypes are possible from one genotype in the areas of physical, cognitive, and social development. First have them propose traits that they think are very heavily influenced by heredity and traits they think have very little genetic influence. Next, have them think about what genetics might direct in the phenotype (e.g., two tall parents pass on genes for tall height to their children) and then have them place that genotype in a variety of environments (e.g., poor nutrition, adequate nutrition, excellent nutrition) and describe the multiple outcomes. You might even have students generate graphs of their examples as a way to highlight the way heredity and environment are said to interact in this model.

Video Suggestions

Nature and Nurture Interwoven (1992, Insight Media, 30 minutes). Overview of controversy, including discussion of behavior genetics, heritability, twin studies, and cross cultural research.

The Mystery of Twins (2000, Insight Media, 52 minutes). Looks at how research on twins informs the nature-nurture question.

D. Student Projects

Genes and Environment: Article Review
A fascinating and easy-to-read article recently published in Psychology Today may help students understand how genes and environmental influences affect complex personality traits. Have your students read this article, which can be found in a library or online: Sinha, G. (March/April 2004). The identity dance. Psychology Today, pp. 52, 57-58, 60-61, 63, 95. Students should then answer the following questions in a short discussion paper:

1. Describe what is meant by, “Susceptibility is not inevitability.”

2. How were ideas from behavioral genetics used to explain the failure of welfare programs? In light of the above statement (“Susceptibility is not inevitability”), how should these ideas be modified? What does this mean for welfare programs?

3. Although the monkeys Jim and George had the same transporter gene, they behaved quite differently. Why did researchers think these monkeys acted so differently? What could have been done to prevent George’s alcoholism?
4. According to a study by Moffit and Caspi, what made people carrying the short-versions of the transporter gene more likely to become depressed? If you knew you had this version of the gene, would you behave differently?

**IV. Conception: Against All Odds**

**A. Key Terms**

- conception
- endometrium
- fallopian tube
- spontaneous abortion

**B. Lecture Expanders**

*Microsort®: Sex-Selection by Sperm Sorting*

One new technology used for sex-selection not discussed in the text is Microsort® (Genetics & IVF Institute, 2009). This method, currently used in clinical trials, sorts sperm before conception to increase the proportion of either sperm containing either an X or Y chromosome, depending on the desired sex. The sperm is then used via intrauterine insemination or in vitro fertilization. Thus, the chances of having a girl or boy are also increased. The sorting is based on differences in the amount of DNA: sperm cells with an X chromosome contain approximately 2.8% more total DNA than sperm cells having a Y chromosome. This DNA difference can be measured and the X- and Y-bearing sperm cells individually separated using a modified flow cytometer instrument. However, this technology does not result in the complete exclusion of either X- or Y-bearing sperm from the final sperm preparation, meaning that this method is not 100% accurate like Preimplantation Genetic Diagnosis (PGD). In fact, Microsort® results in an average increase of X-bearing sperm to 88% and as of January 2008, 93% of the babies born via this method have been female. The accuracy rate is lower for males: sperm samples were on average 74% Y-bearing (male) and 82% of the babies have been male. Currently, to use this technology, couples must be married and seeking to avoid transmitting a sex-linked genetic disorder or seeking gender balance in their family. Furthermore, using this technology is quite expensive. This technology is the center of an ethical debate that you can discuss with your students. Some of the moral and ethical issues surrounding this technology have been articulated in the January 26, 2004 issue of *Newsweek* magazine.


**C. Classroom Activities and Demonstrations**

*Folk Wisdom*

Perhaps no other period of life generates as much fascination and misinformation as the gestation and delivery of a new baby. Folk wisdom, or old wives’ tales, concerning pregnancy and birth are still passed on today. Some are based on fact and observation; others are derived from fears or a cultural belief. Ask students to share some folk wisdom they have heard about determining the sex of the fetus. While relatives are a good source, you can also make this a cross cultural study and suggest that students do some research into the folk wisdom or specific cultures in regards to determining the sex of the fetus before this class discussion. Discuss how the folk wisdom presented relates (or does not relate) to the science of conception.

**D. Student Projects**

*Determining Ovulation*

When couples are trying to conceive, they may use many methods to determine when the woman is ovulating in order to appropriately time sexual intercourse to her most fertile time. Have students write a report presenting at least three methods that can be used to determine ovulation and a discussion of the pros and cons of each method. There are many web resources that will be helpful to students in completing this project including the American Pregnancy Association and FertilityFriend.com. You may expect students to include charting basal body temperature, the presence and consistency of cervical mucus, and ovulation prediction kits that indicate the presence of luteinizing hormone.
V. Infertility and Other Ways of Becoming Parents

A. Key Terms

motility  
endometriosis  
donor IVF
pelvic inflammatory disease  
artificial insemination  
embryonic transplant
in vitro fertilization  
surrogate mother

B. Lecture Expanders

Octomom and IVF

Some fertility treatments increase the risk of having multiples. For instance, the popular TV show *John & Kate plus 8* showcases a family that has twin daughters and sextuplets. In January 2009, Nadya Suleman, dubbed the “Octomom”, gave birth to octuplets after having 6 embryos implanted during an *in vitro fertilization* procedure. However, higher order multiple pregnancy is undesirable because of the many risks to both the mother and the fetuses. Many countries have laws that restrict the number of embryos that can be transferred. Currently the US has no laws governing embryo transfer, however the American Society for Reproductive Medicine has published a set of guidelines. They actually recommend that women under the age of 35 with a favorable prognosis should only have a single embryo transferred.


C. Classroom Activities and Demonstrations

You Be the Infertility Counselor

In conjunction with their hour long video *Test Tube Babies*, PBS offers a fun interactive web activity called “You Be the Counselor.” This activity presents the case files of several couples trying to conceive, and then asks what sort of fertility treatment you would recommend. Feedback is given on your selection. This activity can be done as a class, in small groups, or individually. You can access this activity at http://www.pbs.org/wgbh/amex/babies/sfeature/clinic.html.

Video Suggestions

*Making Babies* (1999, PBS, 60 minutes). Frontline program on reproductive medicine and the questions regarding safety, commercialization and the changing face of the family. This video has an interactive companion website, http://www.pbs.org/wgbh/pages/frontline/shows/fertility, and includes on-line videos on high tech procedures, information on human cloning and a short quiz.

*18 Ways to Make a Baby* (2001, NOVA, 60 minutes). Louise Brown, born in 1978, was the first baby conceived outside the womb and since that time reproductive science has moved forward in ways you may not have thought about. At least 18 ways are discussed including the baby with five parents and a report on Arceli Keh, who gave birth at 63 after she lied about her age to participate in an egg donation program. An interactive website provides tutorials and other activities: http://www.pbs.org/wgbh/nova/baby/


*Baby Making: The New Art of Life* (2000, Insight Media, 24 minutes). Assisted Reproductive Technology (ART) and ethical/social issues discussed, and including section on use of microscopic technology in infertility treatments.

*Gift of a Girl* (1998, Filmmakers Library, 24 minutes). Examines the practice of female infanticide in India (resulting from dowry rules) and the attempts to eradicate it.
Male Menopause. (2008, ABC Video: Lifespan Human Development, 7:47 minutes). One doctor believes there is a key to longevity through a controversial diet, exercise and hormone regimen that postpones “male menopause,” or the onset of old age in men.

D. Student Projects

The Cost of Infertility

Have students research their own health insurance policy (or, if they do not have health insurance, have them research their parent’s policy or a policy that they would be eligible to purchase from a local provider). Have them create a report showing the financial coverage that their health insurance provides for infertility treatments and/or adoption costs. Many policies will not pay for any of these treatments. Next, have students investigate the costs of these infertility treatments and the fees associated with private adoptions. This should be an eye-opening project for many students! Finally, have students discuss these findings in terms of social policy on health care. Do these costs make these treatments unattainable for lower-income families?