

Chapter 1: Biological Transitions

Learning Objectives

1. Describe the four chief physical manifestations of puberty.
2. Discuss the role of the hypothalamus and pituitary gland in the hormonal feedback loop.
3. List the normal sequence of events in puberty for males and females.
4. Discuss the factors, both biological and environmental, that influence individual variability in pubertal growth and development. Be sure to include a discussion of the secular trend.
5. Explain the adjustments that accompany puberty and comment on the advantages and disadvantages associated with early and late maturation.
6. Describe how physical maturation affects the adolescent's self-image, mood, and relationships with parents.
7. Describe the major changes in adolescent sleep patterns and how these changes relate to adolescent behavior.
8. Describe anorexia nervosa, bulimia, binge eating disorder, and obesity. How do they relate to pubertal development?

Key Terms

adolescent growth spurt	gonads
adrenarche	hormones
androgens	hypothalamus
anorexia nervosa	kisspeptin
basal metabolism rate	leptin
binge eating disorder	longitudinal study
body mass index (BMI)	melatonin
bulimia	menarche
cortisol	ovaries
cross-sectional study	pheromones

delayed phase preference	pituitary gland
disordered eating	plasticity
endocrine system	secondary sex characteristics
epiphysis	secular trend
estrogens	set point
feedback loop	Tanner stages
glands	testes
gonadotropin-releasing hormone (GnRH)	weathering
neurons	

Notable Changes from the Last Edition

- Thorough update of all content (more than 50 new citations and more than 40 removed)
- Five new figures in total (includes one dynamic figure)
- Three figures were removed
- New figure and information about the changes in mood over the course of preadolescence and adolescence, and their similarities and differences among males and females
- Expanded information on the problems that occur from poor quality sleep, and on the impact poor quality sleep has on self-control
- New figure and information about the interconnections between gut microbiome and the brain
- Figure on Black females and dieting and disordered eating was removed
- Figure on body dissatisfaction by BMI was removed
- New information about the sex difference in school achievement

Chapter Overview

I. PUBERTY: AN OVERVIEW

- A. The physical changes that accompany sexual maturation are called *puberty*. Although puberty is a universal feature of adolescence, individuals develop physically at different ages and at different rates. For example, today in the United States, girls reach menarche (the time of first menstruation) at an average age of 12, but at the dawn of the twentieth century, the average age was 14.5. Both genetic and environmental factors play a part in determining the onset and duration of puberty.
- B. The impact and meaning of pubertal maturation also vary considerably between societies. The timing of physical and sexual maturation influences both the self-image of the adolescent (e.g., self-definition) and the adolescent's integration into the world of adults (e.g., through its social stimulus value). This transformation to adulthood is influenced by a host of environmental factors including the adolescent's social environment.
- C. Puberty is marked by four major changes: rapid acceleration in growth, the development of primary sex characteristics (including the further development of the gonads), the development of secondary sex characteristics, and changes in the brain's anatomy and activity as a result of hormonal influences. These changes are part of a gradual process that actually begins at conception.
- D. *The Endocrine System:* The endocrine system produces, circulates, and regulates levels of hormones that have already been present since birth. Hormones are secreted by one or more endocrine glands and then enter the bloodstream. Glands stimulate parts of the body to respond in specific ways.

The Hormonal Feedback Loop:

- A. The endocrine system receives its instructions to increase or decrease circulating levels of particular hormones from the central nervous system, mainly through the firing of GnRH neurons. The system works like a thermostat. When hormone levels drop below the "set point," the hypothalamus stimulates the pituitary gland. The pituitary gland, in turn, stimulates the gonads, which produce more androgens and estrogens. When levels of androgens and estrogens in the bloodstream rise to a high enough level, the hypothalamus stops stimulating the pituitary gland, and the chain of events stops. At puberty, the hypothalamus becomes less sensitive, so that higher levels of androgens and estrogens must be circulating in the bloodstream before the hypothalamus stops hormone production.
- B. *Adrenarche:* Research indicates that early feelings of sexual attraction may be stimulated by maturation of the adrenal glands, called adrenarche. Changes in the system that regulates the adrenal gland also influence how individuals respond to

stress. Adolescence is a period of vulnerability to mental disorders because the hormonal changes make young people more responsive to stress.

- C. *What Triggers Puberty?* Although the HPG axis (involving the hypothalamus, the pituitary gland, and the gonads) is active before birth, during middle childhood, the HPG axis is reawakened and signals that the body is ready for puberty. The onset of puberty is stimulated by an increase in a brain chemical called kisspeptin. The production of kisspeptin in the brain is affected by other chemicals, most importantly leptin, which stimulates it, and melatonin, which suppresses it. Although leptin has a number of functions, one of leptin's main roles is to let your brain know you are "fat enough." Melatonin levels are lower when it is light and higher when it is dark. Your genes predispose you to go through puberty around a particular age, but the more fat cells you have, and the more light to which you have been exposed during childhood, the more likely it is that you will go through puberty on the early side of your inherited propensity. Exposure to artificial light, especially the kind of light emitted from electronic gadgets, can also suppress melatonin levels and hasten puberty.
- D. *How Hormones Influence Adolescent Development:* Hormones perform both an organizational role (i.e., change the way the brain will respond to stimuli) and an activational role (i.e., have a direct impact on physical development or behavior). The organization occurs prenatally, while the activation occurs at puberty. In addition, changes in behavior during adolescence could be due to changes in the *levels* of hormones that occur during puberty. There is also growing evidence that puberty affects the brain in ways that increase adolescents' emotional arousal and desire for highly rewarding, exciting activities, which may make some teenagers more prone to emotional and behavioral problems.

II. SOMATIC DEVELOPMENT

- A. *The Adolescent Growth Spurt:* Increases in hormone levels lead to the adolescent growth spurt, which occurs about 2 years earlier in girls than in boys. At the time when adolescents are growing most rapidly, they are growing at approximately the same rate as a toddler (about 4 in. per year for boys and 3.5 in. per year for girls). Puberty is also a time of significant increase in weight—nearly half of one's adult body weight is gained during adolescence. Different parts of the body do not all grow at the same rate or at the same time during puberty—extremities grow first (head, hands, and feet), followed by arms and legs, and lastly the torso and shoulders. The asynchronicity in growth of body parts during early adolescence often results in a clumsy or gawky appearance.
- B. *Body Dissatisfaction Among Adolescent Girls. Sex Differences in Muscle and Fat:* In addition to sheer changes in height and weight, there are changes in the relative proportion of body muscle and body fat. In both sexes, muscular development is rapid during puberty, but muscle tissue grows faster in boys than in girls. Body fat also

increases for both sexes during puberty, but more so for females than for males. These differences exaggerate physical differences between males and females. As a result, many girls tend to become overly concerned about their weight, and they respond to the increase in body fat by dieting unnecessarily. Adolescent girls who are most susceptible to feelings of body dissatisfaction are early maturers, those who begin dating at a young age, those who spend a great deal of time talking about physical appearances with their peers, and those who have been teased about their weight or are pressured to be thin. Adolescent girls' conversations about their looks are affected by the media images they are exposed to.

- C. *Sexual Maturation*: Another important aspect of somatic development at puberty is the emergence of reproductive capability and the development of secondary sex characteristics (changes related to physical appearance). The sequence of pubertal changes is described in the Tanner stages.
- D. *Sexual Maturation in Boys*: In boys, the changes in physical development occur in the following order: rapid growth of testes and scrotum and appearance of pubic hair; the beginning of the growth spurt (approximately 1 year after the first stage of puberty), enlargement of the penis, and thickening of pubic hair; growth of facial and body hair and deepening of the voice. The first ejaculation usually occurs about a year after the beginning of the accelerated growth of the penis. The skin also becomes rougher and there is an increase in sweat glands (which often gives rise to increases in acne, pimples, and oily skin).
- E. *Sexual Maturation in Girls*: Girls' development is in a less regular sequence but usually begins with either the development of the breast buds or growth of pubic hair. Later, breasts develop, the nipples and areola enlarge, and pubic hair thickens. Menarche, the first menstrual period, occurs later in puberty, and regular ovulation follows by about 2 years. The ability to carry a baby to full term usually follows menarche by several years.

III. THE TIMING AND TEMPO OF PUBERTY

- A. *Variations in the Timing and Tempo of Puberty*: There are tremendous variations among individuals in the timing (i.e., age at onset) and tempo (i.e., rate of change) of puberty. Some individuals will have completed pubertal maturation before their same-age peers will have even begun puberty. The range for puberty onset in developed countries is approximately 8–13 in girls and 9–14 in boys. There is no relation between the age at which puberty begins and the rate at which pubertal development proceeds. In the United States, there are ethnic differences in the timing and rate of pubertal maturation.
- B. *Genetic and Environmental Influences on Pubertal Timing*: Pubertal timing and tempo appear to be strongly (although not exclusively) influenced by genetic factors.

The environment (proper nutrition, health, etc.) influences whether an individual's genetic predisposition toward a particular timetable for maturation can be realized. In other words, the timing and tempo of pubertal maturation are the product of an interaction between nature and nurture.

- C. *Individual Differences in Pubertal Maturation:* The timing and tempo of pubertal maturation are largely inherited. A specific region on Chromosome 6 has been identified as one of the markers for pubertal timing in both boys and girls. By far the two most important environmental influences on pubertal maturation are nutrition and health. Puberty occurs earlier among individuals who are better nourished and grow more throughout their prenatal, infant, and childhood years.
- D. *Familial Influences on Pubertal Timing:* Studies suggest that aspects of the home environment may also influence the onset of maturation, particularly for girls. For example, puberty has been found to occur earlier among girls who have grown up without a father or with a stepfather (the presence of a stepfather may accelerate pubertal maturation by exposing the adolescent girl to pheromones). Additionally, pubertal maturation is likely to occur earlier among girls who are physically or sexually abused during childhood and in girls who grow up in high-conflict families (family conflict may accelerate maturation because tension may increase stress levels, which may affect hormonal levels). Although there is less evidence that family dynamics affect male puberty, it has been found that father absence in late childhood is correlated with earlier puberty. Puberty can be influenced by factors in the social environment, and scientists have long known that our social relationships affect our biological functioning.
- E. *Group Differences in Pubertal Maturation:* The age at which adolescents mature physically varies around the world. For example, menarche generally is earlier in industrialized countries where individuals are less likely to be malnourished or to suffer from chronic disease.
- F. *The Secular Trend:* The age at menarche has declined considerably over the past 150 years, a phenomenon known as the *secular trend*, which may be attributed to improved nutrition, better sanitation, and better control of infectious diseases. The secular trend is less well documented among boys, in part because there is no easily measured marker of puberty, such as menarche. There is, however, research that has suggested that one sign of male pubertal development—voice breaking—has indeed occurred earlier and earlier since the mid-1700s. The average age of puberty among American adolescents has continued to decline, probably because of increased rates of obesity (which affects leptin levels); exposure to certain synthetic chemicals in cosmetics, food, and the environment; and increased exposure to artificial light, which affects melatonin secretion. One reason scientists have expressed concern about the continuing decline in the age when puberty begins is that pubertal hormones make adolescents more inclined to engage in sensation seeking. The end result is that

the amount of time elapsed between the arousal of sensation seeking and the maturation of self-control has grown, creating a larger window of vulnerability to risky behavior.

IV. THE PSYCHOLOGICAL AND SOCIAL IMPACT OF PUBERTY

- A. Biological changes at puberty affect both an adolescent's behavior and self-image and may also elicit changes in how others react to the teenager. These changes in self-definition and in how the adolescent is treated may prompt further changes in behavior from the teenager. Thus, puberty may be said to have both direct and indirect effects on adolescents.
- B. Two approaches can be taken to studying the psychological and social consequences of puberty. One approach is to look at individuals who are at various stages of puberty, either in a cross-sectional study (in which groups of individuals are compared at different stages of puberty) or in a longitudinal study (in which the same individuals are tracked over time as they move through the different stages of puberty). A second approach compares the psychological development of early and late maturers.
- C. *The Immediate Impact of Puberty*: Regardless of whether puberty occurs early or late, physical maturation has been found to affect the adolescent's self-image, mood, and relationships with parents.
- D. *Is Puberty Stressful?* The connection between puberty and stress is complicated. Maturing early may be stressful, especially for girls, but going through puberty "on time" is generally not. Puberty affects the brain in ways that make people more vulnerable to stress. Heightened susceptibility to stress in adolescence is a specific example of puberty making the brain more malleable, or "plastic," which makes adolescence both a time of risk (because the brain's plasticity increases the chances that exposure to a stressful experience will cause harm) but also a window of opportunity for advancing adolescents' health and well-being (because the same brain plasticity makes adolescence a time when interventions to improve mental health may be more effective).
- E. *Puberty and Adolescent Moodiness*: Adolescents' moods fluctuate during the course of the day more than do the moods of adults. Research, however, that has monitored changes in adolescents' daily emotions by having them keep diaries about their activities and feelings has found that the majority of teenagers do not report large ups and downs in their moods. Moreover, teenagers become less moody as they get older. According to research on hormones and adolescent mood and behavior, the direct connection between hormones and mood is weak. When studies do find a connection between hormonal changes at puberty and adolescent mood or behavior, the effects are strongest early in puberty. Shifts in adolescents' moods appear to have more to do

with shifts in activities than with internal, biological changes. Over the course of preadolescence and adolescence, there are similarities and differences in patterns of mood among males and females.

- F. *Puberty and Changes in Patterns of Sleep:* A delayed phase preference (the tendency of adolescents to feel energetic in the evening, go to bed later, and sleep later in the morning) is driven by the biological changes of puberty, and changes in the way the brain regulates sleep are more dramatic in adolescence than any other stage of life. For example, the hormone melatonin (which is related to sleepiness) is secreted about 2 hours later among adolescents who have completed puberty than among those who have not yet begun. In conjunction with these physiological changes, the environment (doing homework, texting) encourages adolescents to stay up later, and exposure to light suppresses melatonin secretion, so that staying up late with the lights on or staring at computer, smartphone, tablet, or TV screens will delay the rise in melatonin even more. Unfortunately, most teenagers need to get up early on school days, and the combination of staying up late and getting up early leads to sleep deprivation and daytime sleepiness. Adolescents need approximately 9 hours of sleep a night; there is a consensus among scientists, however, that most teenagers are not getting enough sleep. Poor quality sleep among teens is associated with depression; poor self-control; delinquency; alcohol, tobacco, and drug use; obesity; worse or diminished relationships; cognitive impairment and mind wandering; greater reactivity to stress; and poor school performance and school burnout. An additional hour of sleep each night can significantly improve adolescents' well-being.
- G. *Puberty and Family Relationships:* The onset of puberty often leads to increased conflict within the family and may lead to a “distancing” between parents and adolescents, although this distancing effect is not seen consistently across ethnic minority families. The change that takes place is reflected in an increase in “negatives” (e.g., conflict, complaining, anger) and, to a lesser extent, a decrease in “positives” (e.g., support, smiling, laughter). This connection between pubertal maturation and parent-child distance is not affected by the age at which the adolescent goes through puberty—the pattern is seen among early as well as late maturers.
- H. *The Impact of Specific Pubertal Events:* Most adolescents respond positively to the bodily changes associated with puberty. Girls' attitudes, however, still vary, with those who view menarche negatively experiencing the most discomfort. Far less is known about males' reactions to first ejaculation. In contrast to girls, boys tend not to discuss this experience with either parents or friends.
- I. *The Impact of Early or Late Maturation:* Most adolescents react positively to the biological changes of puberty. Adolescents' behavior is related to how old they feel, rather than how physically mature they are. Nevertheless, early and late maturers are

often treated differently by others, view themselves differently, and therefore may result in different behaviors.

- J. *Early Versus Late Maturation Among Boys:* Boys and girls respond differently to early maturation. Research on the psychological impact of early maturation for boys has yielded mixed findings. For example, research has usually found that boys who mature earlier are likely to feel better about themselves and be more popular than later maturing peers. A few studies, however, have found higher rates of depression and anxiety among early-maturing boys. Early-maturing boys are also more likely to be involved in antisocial or deviant activities and are more likely to use drugs and alcohol. This could be due to early maturers being more likely to spend time unsupervised and to hang out with older adolescents. As young adults, later-maturing boys are more susceptible to depression, primarily because they perceive themselves as less masculine. On the other hand, late-maturing boys score higher on measures of intellectual curiosity and social initiative.
- K. *Early Versus Late Maturation in Girls:* Research with girls has been more consistent. Early-maturing girls tend to have more emotional difficulties (e.g., higher rates of depression, anxiety, eating disorders, panic attacks) than their peers who mature on time or a bit later. As with boys, early physical maturation in girls is associated with a greater likelihood of being involved with problem behavior, including drug and alcohol use, delinquency, early sexual activity, and problems in school. There are three explanations that may explain why early-maturing girls may be at a greater disadvantage than early-maturing boys: “maturation deviance” hypothesis, “developmental readiness,” and cultural desirability. It is important to keep in mind that the impact of early or late maturation (for males and females) depends on the broader social context in which maturation takes place. For instance, the impact of early maturation is accentuated when adolescents have stressful life events (harsh parents, disadvantaged urban neighborhoods).

V. OBESITY AND EATING DISORDERS

- A. Puberty results in dramatic changes to physical appearance, and a teen’s self-image is subject to constant reevaluation. During puberty, an adolescent’s basal metabolism drops, which may lead to weight gain.
- B. *Obesity:* The easiest way to determine whether someone is overweight is to calculate their body mass index (BMI). Individuals are considered overweight if their BMI is at or above the 85th percentile and obese if their BMI is at or above the 95th percentile. Based on these cutoffs, more than 20% of adolescents in the United States are obese. Obesity is especially prevalent among low-income areas and among Black, Latino, and indigenous adolescents.

- C. *Correlates and Consequences of Obesity*: Research on the psychological consequences of obesity has not led to consistent conclusions, partly because the consequences vary across ethnic groups, with more adverse correlates among White and Latino adolescents; females, however, may suffer more from the long-term psychological consequences of adolescent obesity. Nearly 80% of adolescents with obesity will have obesity as adults. This may predispose adolescents to a number of health problems in later life such as hypertension, high cholesterol, diabetes, and premature death. Interestingly, obese adolescents who do not become obese adults do not seem to suffer from these long-term health consequences. Research indicates that genetic and environmental factors (e.g., poor nutrition, insufficient exercise, and inadequate sleep) are related to an individual's likelihood of being obese. There is also an increase in sedentary behavior between childhood and adolescence, which continues throughout adolescence, especially among girls. Obesity affects the composition of the gut microbiome, which has a significant influence on the immune system, the brain, as well as cognitive and emotional functioning.
- D. *Preventing and Treating Obesity*: Preventing obesity will require multifaceted efforts involving parents, the mass media, food and beverage manufacturers, restaurants, schools, and communities. Obesity is less likely to develop among adolescents who have good relationships with their parents, probably because they are more likely to share family meals where healthy food is served. In addition, the availability of parks and recreational facilities is linked to lower rates of obesity, as is parental encouragement of exercise. Although there is evidence suggesting that some weight-loss programs work, there is wide variability in success rates depending on the nature of the program. Those that combine both behavior modification and weight-loss medication tend to be more effective for weight loss, whereas radical approaches to weight control—fad diets and the like—actually increase, rather than decrease, obesity. Adolescents who mistakenly believe that they are overweight often engage in unhealthy dieting behavior, which actually increases the likelihood that they will become obese.
- E. *Anorexia Nervosa, Bulimia, and Binge Eating Disorder*: In addition to obesity, health-care professionals are concerned about adolescents with unhealthy body images and attitudes toward eating. Only about one-fourth of American adolescents are highly satisfied with their body. More than half of all adolescent girls consider themselves overweight and have attempted to diet.
- F. *Disordered Eating*: Psychologists refer to unhealthy eating attitudes and behaviors as “disordered eating.” These can range from unnecessary dieting, to disordered eating that is unhealthy but does not require treatment, to clinical eating disorders. The emphasis on slimness in contemporary culture increases adolescent girls' dissatisfaction with their bodies. This dissatisfaction leads some adolescents to adopt disordered eating strategies to remain thin. Anorexia nervosa is characterized by extremely restrictive dieting, even to the point of starvation. Bulimia is an eating

disorder characterized by a cycle of bingeing and purging (vomiting or taking laxatives). Binge eating disorder is characterized by a pattern of binge eating (and feeling distressed about doing so) but is not followed by extreme weight-loss behaviors. Adolescents with eating disorders have extremely disturbed body images—they may see themselves as overweight when they are actually underweight. Research suggests that individuals from all social classes and ethnic groups develop eating disorders. Generally speaking, eating disorders decline between childhood and early adolescence but increase between mid-adolescence and young adulthood, although there are ethnic differences in the age of onset and progression.

- G. *Body Dissatisfaction*: Although the incidence of clinical eating disorders is low, it is far more common among females than males. While most do not exhibit disordered eating, many adolescent girls have significant feelings of body dissatisfaction. In one study, for example, more than 70% of the girls reported that they would like to be thinner than they are (as opposed to one-third of the boys), and more than 80% said that being thinner would make them happier, more successful, and more popular. Body dissatisfaction is associated with developing eating problems, as well as depression, smoking, and drinking. Research indicates that girls' perceptions that being slim will increase their popularity are based in reality—in one study, each one-point increase in a girl's BMI was associated with a 6% decrease in the likelihood of her being romantically involved. Body dissatisfaction among boys is less well studied, although many do aspire to an idealized, muscular body type. Dissatisfaction among boys can result from being either heavy or too thin. As is the case among girls, being teased by peers about one's body is a significant source of distress for boys.
- H. *Contributing Factors*: Although anorexia is observed all over the world, bulimia is reported mainly in Western cultures. Anorexia has increased in prevalence over time, whereas bulimia increased between 1970 and 1990 and has since declined somewhat, despite the fact that individuals' BMI has continued to increase. Bulimia is, therefore, much more culturally determined than anorexia, which is partly an inherited disorder. Eating disorders are now viewed as manifestations of more general "internalized distress." Studies have linked eating disorders to other mental health problems, such as depression, obsessive-compulsive disorder, and substance abuse. Broader social forces that factor in the development of eating disorders include early maturation and perceived pressure to be thin from the media, parents, and peers. Individual characteristics also play a role, such as genetic vulnerabilities, psychological proneness to depression, and strained relations with parents. Body dissatisfaction is predictive of disordered eating among males as well as females. A variety of therapeutic approaches have been successful in treating eating disorders, including individual psychotherapy, cognitive behavioral therapy, group therapy, family therapy, and antidepressant medications.

Lecture Topics and Supplementary Readings

I. Endocrinological and Physical Changes of Puberty

One or more lectures on the endocrinological and physical changes of puberty make an interesting supplement to the material presented in the text.

Do not overestimate students' knowledge of basic biology. Few students can clearly define what hormones are, and even fewer can identify the structure, function, or location of the hypothalamus or pituitary gland. It is an interesting exercise to use an anatomical chart and trace the physiological course of events that begin with changes in the hypothalamus and ends, for example, with the spurt in height and weight. Colleagues have suggested that they begin by giving their students a quick anatomy quiz—asking students to identify whether the areola, clitoris, labia majora, prostate, and so on, are found on males, females, or both. While you correct this in class, you can briefly define each term's function and location. This is a fun and silly exercise for students who are well versed in this vocabulary but is a much appreciated grounding for students who are less prepared.

After providing a common vocabulary, you may want to provide some additional information on the structure and function of the endocrine system, elaborating on the concept of the feedback loop discussed in the text and having students follow the relevant diagrams and figures included in the text during the lecture. It is one thing simply to list the various somatic changes that occur during puberty, but it is something else to actually explain why they occur when they do.

This chapter violates many students' expectations of what a course on adolescent development is going to be about. Because of this, try to place biological change within a broader sweep of development and to introduce many basic concepts that we return to again. For example, begin a lecture on puberty by describing how prenatal exposure to hormones causes male and female embryos, which had previously been physically identical, to diverge in their physical development. One component of this differentiation is how males and females will subsequently respond to hormones. This gives you an opportunity to define hormones, talk about organizational and activational roles, and so on. Then, you can discuss how changes in the hypothalamus's sensitivity trigger initiation of biological changes we associate with puberty. This is a recurring theme in development; early events can trigger different developmental trajectories that might not be expressed until years later. This same "sleeper" effect is later brought out in the family chapter discussing the effects of divorce.

Archibald, A. B., Graber, J. A., & Brooks-Gunn, J. (2003). Pubertal processes & physiological growth in adolescence. In G. R. Adams & M. D. Berzonsky (Eds.), *Blackwell handbook of adolescence* (pp. 24–47). Blackwell Publishing.

Brooks-Gunn, J., & Reiter, E. (1990). The role of pubertal processes. In S. Feldman & G. Elliott (Eds.), *At the threshold: The developing adolescent* (pp. 16–23). Harvard University Press.

Shalitin, S., & Phillip, M. (2003). Role of obesity and leptin in the pubertal process and pubertal growth—A review. *International Journal of Obesity*, 27, 869–874.

Sussman, E., & Dorn, L. (2009). Puberty: Its role in development. In R. M. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology* (3rd ed.). John Wiley & Sons.

Tanner, J. (1972). Sequence, tempo, and individual variation in growth and development of boys and girls aged twelve to sixteen. In J. Kagan & R. Coles (Eds.), *Twelve to sixteen: Early adolescence*. Norton.

II. The Role of Theory

Approaches to studying puberty make an excellent place to introduce the idea of how theories and paradigms shape what data we attend to, the questions we ask, and how we approach a problem. This lecture introduces three major ideas that are returned to many times in the course: normative versus individual difference approaches to studying development, the role of theory, and the development of alternative hypotheses. The latter idea can be very important for students in this course because many have previously studied science only as a collection of “facts” carefully collected by scientists and memorized by students.

Steinberg spends a lot of time describing sets of studies that detail the process through which we draw conclusions and emphasizes how different developmentalists have different interpretations of similar phenomena. For example, you could begin this lecture by asking students why no one has ever studied the relationship between thumb length and intelligence (an example borrowed directly from an introductory lecture by Urie Bronfenbrenner). Students will hem and haw, eventually coming to the idea that the notion is essentially “stupid”; in other words, we cannot think of a plausible causal process that would underlie such an association. This idea of underlying causal processes is both central to understanding what a theory is and also helps to introduce the idea of a “paradigm.” For example, although we now dismiss the study of phrenology as foolish, intelligent people pursued this idea for years because it was based on a very plausible metaphor to muscles: Larger muscles are stronger; it follows that larger brains work better. This idea now seems silly, however, because the way we understand the brain and intelligence—our paradigm—has shifted.

From this, you can discuss four different ways of thinking about the question of why puberty matters: pubertal status, pubertal tempo, pubertal timing, and pubertal deviance. For each, we develop a question a researcher might ask, draw a model of the approach on the board, and students generate a discussion of plausible causal mechanisms that might be invoked to answer the question (which is a nice review of key concepts in the chapter and the interaction of biological, cognitive, and social processes). Begin by discussing puberty as a normative event, followed by describing an individual difference approach to puberty, illustrated with pubertal tempo and pubertal timing. After generating plausible hypotheses and causal mechanisms with the class, discuss the fit of this model to the data by summarizing what the book says about the

differences in the consequences of early and late puberty for males and females. Finally, lay out two overlapping distributions on the board—one for the timing of males and one for females—and discuss a different hypothesis about causal processes: deviance or being on- or off-time. In addition to underscoring the main point, this also underscores the age difference between the onset of puberty for early-maturing girls and the completion of puberty for late-maturing boys.

Kuhn, T. S. (1996). *The structure of scientific revolutions* (3rd ed.). The University of Chicago Press.

III. Eating Disorders

On many college campuses, anorexia and bulimia are serious health problems, and lecturing on the etiology and treatment of these disorders can do some social as well as intellectual good. Anorexia nervosa typically has its onset around the time of puberty, although the connection between anorexia and puberty per se is open to debate. The conventional psychoanalytic view holds that the disorder represents a denial of sexuality and/or a refusal to become an adult. More contemporary theorists, such as those whose works are referenced below, focus instead on multiple determinants including the role that puberty plays in signifying the adolescent's passage into adulthood, the adolescent's attempt to establish autonomy and independence during this time period, the importance of physical appearance to the adolescent female's self-image, and the historical and cultural factors that shape our current fascination with thinness and no doubt influence the prevalence of anorexia and bulimia. Invite a mental health counselor from your college's health service program to make a presentation in your class on the treatment of eating disorders on college campuses.

Attie, I., & Brooks-Gunn, J. (1989). Development of eating problems in adolescent girls: A longitudinal study. *Developmental Psychology*, 25, 70–79.

Brumberg, J. (1988). *Fasting girls*. Harvard University Press.

Cauffman, E., & Steinberg, L. (1996). Interactive effects of menarcheal status and dating on dieting and disordered eating among adolescent girls. *Developmental Psychology*, 32, 631–635.

Jacobi, C., Hayward, C., & de Zwaan, M. (2004). Coming to terms with risk factors for eating disorders: Application of risk terminology and suggestions for a general taxonomy. *Psychological Bulletin*, 130(1), 19–65.

Polivy, J., & Herman, C. P. (1985). Dieting and bingeing. *American Psychologist*, 40, 193–201.

Ricciardelli, L. A., & McCabe, M. P. (2004). A biopsychosocial model of disordered eating and the pursuit of muscularity in adolescent boys. *Psychological Bulletin*, 130(2), 179–205.

Stice, E., & Shaw, H. (2004). Eating disorder prevention programs: A meta-analytic review. *Psychological Bulletin*, 130(2), 206–227.

Steinberg, Adolescence, 2025R

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Additional Readings to Draw From

Archibald, A. B., Graber, J. A., & Brooks-Gunn, J. (2003). Pubertal processes & physiological growth in adolescence. In G. R. Adams & M. D. Berzonsky (Eds.), *Blackwell handbook of adolescence* (pp. 24–47). Blackwell Publishing.

This accessible article provides a detailed overview of physical changes associated with puberty.

Blakemore, S.-J., Burnett, S., & Dahl, R. (2010). The role of puberty in the developing adolescent brain. *Human Brain Mapping*, 31(6), 926–933.

Buchanan, C. M., Eccles, J. S., & Becker, J. B. (1992). Are adolescents the victims of raging hormones? Evidence for activational effects of hormones on moods and behavior at adolescence. *Psychological Bulletin*, 111(1), 62–107.

A dense article discussing direct and indirect effects of hormones on adolescent behavior.

Dahl, R., & Lewin, D. (2002). Pathways to adolescent health: Sleep regulation and behavior. *Journal of Adolescent Health*, 31, 175–184.

A comprehensive summary of the research on adolescent sleep changes and its relation to behavior.

Ellis, B. J., & Essex, M. J. (2007). Family environments, adrenarche, and sexual maturation: A longitudinal test of a life history model. *Child Development*, 78(6), 1799–1817.

Classroom Activities

I. What You've Always Wanted to Ask Other Genders

It is a widespread belief that adolescents are incredibly naive and uninformed about sexuality and other genders, but this is not true *only* for adolescents. A large percentage of individuals retain myths about other genders and are not very knowledgeable. This exercise allows people to ask people of other genders any questions that they have always wanted to ask. The best way to conduct this activity is to divide the class into small groups with approximately equal numbers of males and females. Because many developmental psychology courses have more females than males, try to ensure that each group has at least two or three males. However, remind students that some individuals may identify as a nonbinary gender, so encourage them not to make assumptions about anyone in their group based on appearance or name. Students may ask questions about nonbinary genders, but if no one volunteers to answer those questions as a representative of the gender, the group should *not* speculate about what the answers to the questions might be. Once the class understands that, each group member should create a list of questions that they have always wanted to ask other genders. This will typically take about 15 min. Then, individuals should take turns asking their questions. After a short time, feelings of awkwardness will dissipate and everyone will begin having fun. (For some reason, most males want to know why women need to go to the restroom in pairs or groups!) This exercise is informative for the students and increases communication between the genders.

II. Menarche and All That Goes with It

The onset of menstruation is typically a vivid memory for most women. This memory may have related negative feelings or positive feelings, or a combination of both. The following simple exercise can be used to highlight a discussion of the subjective side of menarche in adolescence.

During the class period prior to the discussion of menarche, ask the women in your class to write on a piece of paper the age they were when they first began to menstruate and to write briefly (three or four sentences) about their experience. Both the mean age of menarche, and the range, can be tabulated for the class to reinforce the information provided in the text. In addition, several sample “stories” can be read to the class, which demonstrate both the negative and positive feelings attached to this significant event. (Let students know ahead of time that their responses may be shared with the class anonymously.)

This activity may also be conducted with the male students by asking them to recall the age of their first ejaculation.

III. Dear Son/Dear Daughter

Have students imagine that they are departing on a 10-year voyage, leaving behind their preadolescent child. Their task is to compose a letter to help the child cope with the changes that will soon occur. Both men and women are surprised at the details of how a person of another

gender prepares their child for puberty, including details of what types of clothes to wear and why. This letter can be written either as a homework assignment and brought to class or done in class either alone or in groups. You can either have students read these letters out loud or have them pass the letters around until each person has read five or six. At that point, ask students to either read aloud a letter they found interesting or bring out a point they had read and found interesting. Often, students who are unwilling to put their own work out before the group are willing to volunteer the work of another student. This exercise can be a useful starting point for discussing the social impact of puberty. This assignment could also be done as an online discussion in which students post their letters and then respond to each other.

IV. Early Versus Late Maturation

To begin the discussion of early versus late maturation, have students recount some of their own experiences. Students can be divided into small groups of three to five individuals and told to rate their development as early, average, or late. Alternatively, have them recall people from their elementary, middle, or high schools who fit into these categories. Students should then discuss the advantages and disadvantages of early, average, and late maturation. You may wish to have them focus on one sex and then on another. Some students may be uncomfortable with parts of this exercise. Their discomfort, however, can be used as an educational tool. Being able to share feelings about changes occurring during puberty will help an individual understand and support others undergoing puberty (Charlesworth & Slate, 1986). Parents and teachers who are comfortable with, and knowledgeable about, changes occurring during puberty will be better able to educate and help adolescents understand and adjust to changes they are undergoing.

Charlesworth, J. R., Jr., & Slate, J. R. (1986). Teaching about puberty: Learning to talk about sensitive topics. *Teaching Psychology*, 13, 215–217.

V. Bringing Puberty to Life

Oftentimes, students are reluctant or embarrassed to discuss their own pubertal experiences. To stimulate discussion on pubertal development, it often helps to use case studies to bring the event to life. Case studies also provide the student with the opportunity to apply what they have learned from the text. Below are several case studies that are both enjoyable and, at times, quite humorous.

Ephron, N. (1975). *Crazy salad: Some things about women*. Alfred A. Knopf. (See chapter on “A few words about breasts.”)

Frank, A. (1967). *Anne Frank: The diary of a young girl*. Translated from the Dutch by B. M. Mooyaart-Doubleday; with an introduction by Eleanor Roosevelt. Doubleday. (See pages 145–146 for Anne Frank’s description of her pubertal experience.)

VI. Importance of Sleep

The textbook includes basic information on pubertal change as well as detailed information about adolescent sleep needs and the consequences of lack of sleep. A discussion of this information might include a basic introduction to sleep physiology, social and biological factors that interfere with sleep, policy implications, and so on.

A brief survey of sleep patterns in the class or done outside of class by the students may provide an interesting point of departure. Because many college students work with a chronic sleep deficit, it can only be hoped that learning more about this topic may help them to think more carefully about their own sleep needs. In particular, a discussion of the drop in efficiency associated with exhaustion may be particularly helpful.

Example Student Sleep Survey

1. What time do you usually go to bed on weeknights? _____
2. What time do you usually go to bed on weekends? _____
3. On average, how many hours of sleep do you get per night? _____
4. Do you think you get enough sleep? Yes No
5. Is it easy for you to get up in the morning? Yes No
6. Do you often feel sleepy during the day? Yes No
7. Do you use caffeine to stay awake? Yes No

Wolfson, A. R., & Carskadon, M. A. (1998). Sleep schedules and daytime functioning in adolescents. *Child Development*, 69(4), 875–887.

Sleep for Science/Sleep Research Lab:

<http://www.sleepforscience.org/contentmgr/showdetails.php/id/93>

VII. Eating Attitudes Test (EAT)

To illustrate the importance of physical development and body image to psychological adjustment, distribute the following questionnaire created by Garner and Garfinkel (1979). The format requires subjects to respond on a 6-point scale (ranging from always to never) to how often they agree with a series of 26 statements. The most symptomatic response receives a score of 3, the second most symptomatic response receives a 2, the third a 1, and the rest are scored as 0. For the majority of the items below, the most symptomatic response is a 6, the second most symptomatic response is a 5, and the third most symptomatic response is a 4. Item 25 is the one reverse scored item, so the most symptomatic response is a 1, the second most symptomatic response is a 2, and the third most symptomatic response is a 3. The total EAT-26 score thus ranges from 0 to 78, with higher scores (>26) indicating more disturbed dieting behaviors.

After students have completed the questionnaire, have them write only their score and their sex on a piece of paper and pass it forward. Ask them to consider what they think the average score for males and females will be. Divide the piles by sex and then read the scores for the piles (you may wish to have a student calculate the means as you read out the scores). Students will probably be surprised, but relieved, at how high the average scores are (particularly among women). This activity often ignites a discussion of the sources of negative self-image. The prevalence of negative self-images about the body is especially interesting because, in most areas of self-assessment, people generally tend to view themselves as “above average” when compared to other people of their own age and sex.

Garner, D., & Garfinkel, P. (1979). The eating attitudes test: An index of the symptoms of anorexia nervosa. *Psychological Medicine*, 9(2), 273–279.

Eating Attitudes Test

1—*Always*

2—*Very often*

3—*Often*

4—*Sometimes*

5—*Rarely*

6—*Never*

1.	_____	Am terrified about being overweight
2.	_____	Avoid eating when I am hungry
3.	_____	Find myself preoccupied with food
4.	_____	Have gone on eating binges where I feel that I may not be able to stop
5.	_____	Cut my food into small pieces
6.	_____	Aware of the calorie content of foods that I eat
7.	_____	Particularly avoid foods with high carbohydrate content (e.g., bread, rice, potatoes)
8.	_____	Feel that others would prefer if I ate more
9.	_____	Vomit after I have eaten
10.	_____	Feel extremely guilty after eating

11.	_____	Am preoccupied with a desire to be thinner
12.	_____	Think about burning up calories when I exercise
13.	_____	Other people think that I am too thin
14.	_____	Am preoccupied with the thought of having fat on my body
15.	_____	Take longer than others to eat my meals
16.	_____	Avoid foods with sugar in them
17.	_____	Eat diet foods
18.	_____	Feel that food controls my life
19.	_____	Display self-control around food
20.	_____	Feel that others pressure me to eat
21.	_____	Give too much time and thought to food
22.	_____	Feel uncomfortable after eating sweets
23.	_____	Engage in dieting behavior
24.	_____	Like my stomach to be empty
25.	_____	Enjoy trying new, rich foods
26.	_____	Have the impulse to vomit after meals

VIII. High School Sports and Phys Ed

Students can be asked to design a gym program that would get kids moving, help them develop their coordination, and help them find forms of exercise that they like to do. Encourage them to think broadly. Why shouldn't aerobics be offered in place of basketball? How about kayaking, Frisbee, or skateboarding? What about those foot controls for video games that force you to do aerobics to win? This activity can lead to an interesting discussion of how activities are fun, but gym is not. Why do we structure physical education the way we do?

Link this activity to a discussion of obesity and ways of preventing and treating obesity.

Resources Available in Connect

The following are a selection of the videos and resources available for Steinberg, *Adolescence*, 13e in Connect.

Chapter	Resource Title	Type
1	Motor Development, Adolescence	Milestones Video
1	Puberty in Boys, Adolescence	Milestones Video
1	Puberty in Girls, Adolescence	Milestones Video

Web Resources

National Sleep Foundation: <https://www.thensf.org/>

Centers for Disease Control and Prevention (CDC): Division of Nutrition, Physical Activity, and Obesity: <https://www.cdc.gov/nccdphp/dnpao/index.html>

National Eating Disorders Association: <https://www.nationaleatingdisorders.org/>

Film and Video List

Adolescence—Physical Growth and Development (Magna Systems, 1995), 30 min

Panels of early and middle adolescents, supplemented by experts in physical development, review all aspects of pubertal development in adolescent males and females.

Boy to Man (Churchill Films; 1992), 20 min

Uses animation and live-action footage to present the primary and secondary sexual changes associated with the maturation process in the human male.

Bulimia—The Binge-Purge Obsession (Riverside Publishing, no date), 20 min

Explores the causes and effects of bulimia and the way that this type of behavior is routine for many high school and college students.

Dying to Be Thin (Nova, 2000), 55 min

Examines a disturbing increase in the prevalence of eating disorders, particularly anorexia and bulimia. Discusses how specialists are making advances in the diagnosis and treatment of these conditions.

Fear of Fat: Eight Stories of Eating and Weight (Films for the Humanities and Sciences, 2008), 60 min

Provides a look into adolescents' struggles with food, body weight, and self-image.

Steinberg, *Adolescence*, 2025R

IM-1 | 21

Girl to Woman (Churchill Films, 1992), 23 min

Uses animation and live-action footage to present the maturation process in the human female.

Menstruation—Understanding Your Body (Video Learning Library, 1993), 28 min

Part of an eight-part series that provides clear, concise answers to the health issues facing women of all ages. This program is hosted by Holly Atkinson, MD, NBC News *Today Show* Medical Correspondent.

Outside Activities

I. Secular Trend

To examine the secular trend in the age of pubertal onset, have students record the following information. (Some research will, of course, be necessary!) If older students have mature children, their information can be included as well.

Sex:
Date of Birth:
Race/Ethnicity:

Age of Maturity (i.e., menarche for females and spermatarche for males):	
Self	
Children	
Daughter ¹	
Daughter ²	
Son ¹	
Son ²	
Mother	
Father	
Maternal	
Grandmother	
Grandfather	
Paternal	
Grandmother	
Grandfather	

The following questions can then be addressed for individual students' data as well as for the data provided by the class as a whole. This also provides an opportunity to discuss simple

Steinberg, Adolescence, 2025R

IM-1 | 23

statistical concepts, such as means and correlations. In particular, you can have a perfect correlation between generations but still have a decline in mean age of puberty. This is an important concept that we return to many times in the class.

1. Does the age of onset differ as a function of generation? If so, how?
2. Does the age of onset differ as a function of gender? If so, how?
3. How do these findings on generational and gender differences relate to the trends described in the text? Why might they be similar or different from the findings described in the text?

II. A Visit to Middle School/Junior High

Have students visit a middle school or junior high school (after obtaining the school administrator's permission, of course) and observe groups of young adolescents in order to assess variability in pubertal maturation. As an exercise designed to teach the concept of inter-rater reliability, students might work with partners and try to classify adolescents as prepubertal, at the pubertal apex, or postpubertal.

III. Media Influences on Eating Disorders

To sensitize your students to the subtle and not-so-subtle ways in which the media contributes to the development of eating disorders, have your students engage in a survey of television and print media. Ask them to select a television program or magazine designed for a teen audience, then tally the number of underweight, average weight, and overweight (in their opinion) women they see in the show (and the commercials aired during the show) or in the magazine. The students should convert their frequency data to percentages so that the various programs and magazines can be easily compared. Your students should report back to the class the percentages of women viewed who were underweight, average weight, and overweight. Their data should confirm that the media reinforces an underweight “norm” for attractiveness. This exercise will prepare the students for a discussion of the media influence on the body ideals of adolescent females. Alternatively, soap operas or movies can be particularly useful for gathering information on how the media creates an association between weight and social class. Poorer or working-class individuals—especially middle-aged or above—are often portrayed as markedly heavier than doctors or lawyers.