

Sexual Development

by Richard H. Hall, 1998

Basics and Primary Sex Characteristics

Researchers who focus on developmental differences between males and females usually point to two fundamental stages in differentiation, organizational and activational. **Organizational** differences are sex differences that occur in the womb, while **activational** effects occur during adolescence. Sex differences between males and females at birth are referred to as **primary sex characteristics**. These include differences in internal and external organs between the two sexes. All of these structural differences result from a system of ducts, which release (or don't release) hormones, which in turn affect internal structures, which are stimulated to differentiate into characteristically male or female organs. Up until the third or fourth week of development, the fetus is **undifferentiated**. It has the potential to become either a male or a female. The differentiation begins with a specialized organ present in both males and females called the **gonads**. The gonads develop into testes in males and ovaries in females. They are the first structure to differentiate, they play the important role of producing sperm and ova, and they release hormones. If the fetus is a male, the male chromosomes will direct the release of an enzyme that directs the gonads to develop into testes. If this enzyme is not present, which is the case with females, the gonads will develop into ovaries.

The internal sex organs for males and females develop from two different systems of ducts, which release hormones and direct the development of, for example, the uterus in females and the prostate in males. This system in females is called the **Müllarian system**. In males it is called the **Wolffian system**. Both of these systems exist in males and females up until about the third month of pregnancy. At this point, one of them develops, while the other withers away. The male testes secrete two hormones, anti-Müllarian hormone, which represses the Müllarian system, and testosterone, which stimulates the Wolffian system. If these hormones are not present, the fetus will develop into a female. Interestingly enough, this will occur regardless of the genetic make up of the fetus. This is the reason that it is sometimes said that "God's tendency is to create a woman."

Brain Differentiation and Secondary Sex Characteristics

Differences in the development of internal and external sex organs are quite familiar to all of us, however, differences in brain development, between males and females, are more subtle. Nevertheless, there is evidence from experiments on various non-human animals that factors in early development result in the differentiation of not only sex organs, but of the brain as well. For example, the medial preoptic area is very important in male sexual behavior. Ironically, experiments with rats indicate that a crucial chemical in stimulating this structure is the female hormone estrogen. Although estrogen is produced by the females' ovaries in development, it never gets to the brain, because it binds with chemicals called **alpha-fetoproteins** and, as a result, cannot pass into the brain. On the other hand, testosterone does not bind with these chemicals so it readily passes into male brains, and once there, through a process called aromatization, it is converted to estrogen and, in turn, "activates" the medial preoptic area in males. (This process is illustrated in Figure 1.)

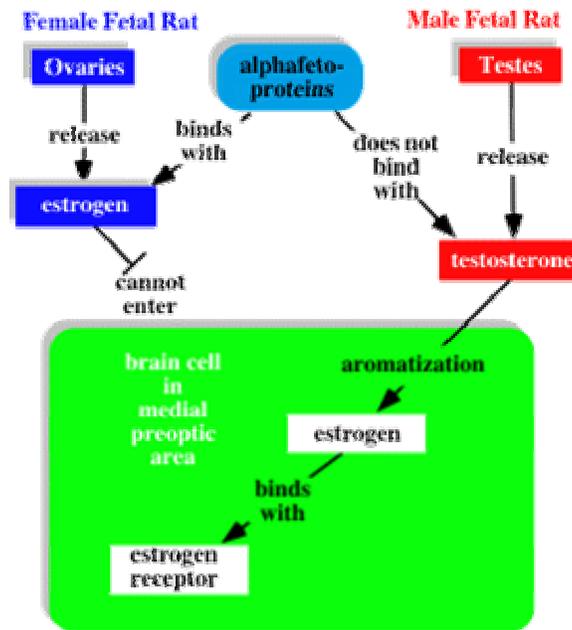


Figure 1. Process of “Masculinization” of Medial Preoptic area in Male Brain

As we all know, the physical differences between young boys and girls are not too great early in life, however, once they reach adolescence, many dramatic differences begin to appear, and the differentiation which allows for reproductive capacity begins to occur. In effect, this potential lays dormant for the first years of life, and at adolescence a series of events takes place referred to as the **activational effects** of hormones, which result in **secondary sex characteristics**. This process begins in the hypothalamus, which affects the pituitary gland, which affects the testes/ovaries, and then the organs. The basics of this final and dramatic process in sexual development are illustrated in Figure 2.

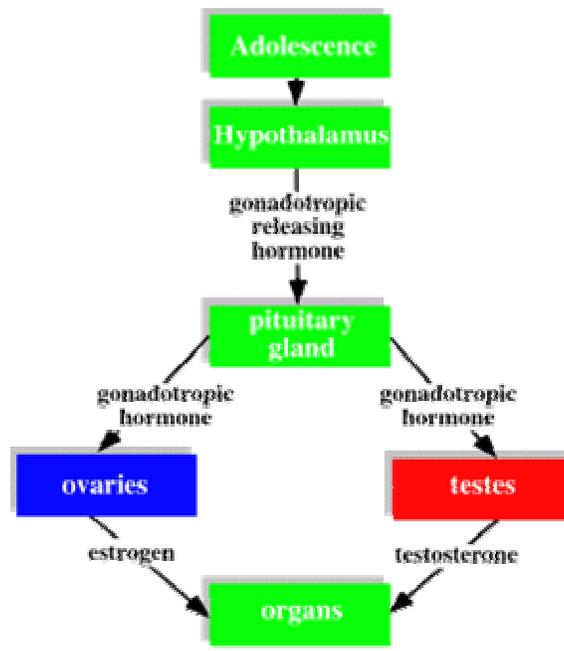


Figure 2. Development of Secondary Sex Characteristics