

27.7 Sexual activity can transmit disease

Sexually transmitted diseases (STDs) are contagious diseases spread by sexual contact. Table 27.7 lists the most common STDs in the United States, organized by the type of infectious agent. Notice that bacteria, viruses, protists, and fungi can all cause STDs.

Bacterial STDs are generally curable, but treatment must be given early, before any permanent damage is done. The most common bacterial STD (with nearly a million new cases reported annually in the United States and over 90 million worldwide) is **chlamydia**. Chlamydia poses a public health challenge because it is frequently “silent,” producing no visible symptoms. Health officials estimate that for every reported case of chlamydia, two other cases go unreported. The primary symptom of chlamydia is a burning sensation and genital discharge during urination, but half of infected men and three-quarters of infected women do not notice any symptoms. Long-term complications are rare among men, but up to 40% of infected women develop pelvic inflammatory disease (PID). The inflammation associated with PID may block the oviducts or scar the uterus, causing infertility. Luckily, treatment for chlamydia is easy: A single dose of an antibiotic usually cures the disease completely. But early screening is required to catch the disease before any scarring occurs. Sexually active women are encouraged to be screened for chlamydia and other STDs annually.

In contrast to bacterial STDs, viral STDs are not curable. They can be controlled by medications, but symptoms and the ability to infect others remain a possibility through a person’s lifetime. One in five Americans is infected with **genital herpes**, caused by the herpes simplex virus type 2 (HSV-2), a variant of the virus that causes oral cold sores (see Module 10.18). Symptoms first appear about a week after exposure. Blisters form on

the external genitalia. After a few days, the blisters change to scabs that fall off. Most outbreaks heal within a few weeks without leaving a scar. But the virus is not gone: It lies dormant within nearby nerve cells. Months or years later, the virus can reemerge, causing fresh sores that allow the virus to be spread to sexual partners. Abstinence during outbreaks, the use of condoms, and the use of antiviral medications that minimize symptoms can reduce the spread of infection. However, there is no cure for genital herpes, so infection lasts a lifetime.

AIDS, caused by HIV (see Modules 10.20 and 24.13), poses one of the greatest health challenges in the world today, particularly among the developing nations of Africa and Asia. Yet even within the United States, there are 56,000 new infections each year, one-third of which result from heterosexual contact. Another sexually transmitted virus is the human papillomavirus (HPV). In 2006, a vaccine against HPV was approved that protects against genital warts and helps prevent infection by HPV strains that cause 70% of cervical cancers.

Many STDs can cause long-term problems or even death if left untreated. Anyone who is sexually active should have regular medical exams, be tested for STDs, and seek immediate help if any suspicious symptoms appear, even if they are mild. STDs are most prevalent among teenagers and young adults; nearly two-thirds of infections occur among people under 25. The best way to avoid the spread of STDs is, of course, abstinence. Alternatively, latex condoms provide the best protection for “safe sex.”

? How are bacterial STDs different from viral STDs in terms of their long-term prognosis?

Bacterial STDs can be cured; viral STDs can be controlled but not cured.

TABLE 27.7 | STDs COMMON IN THE UNITED STATES

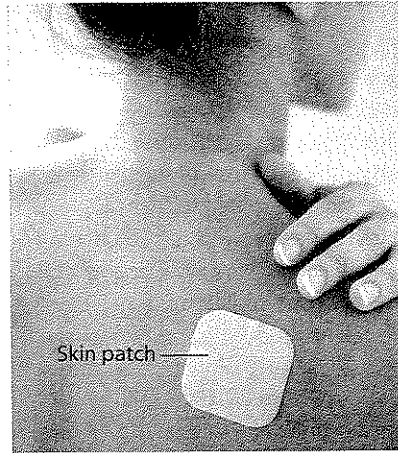
Disease	Microbial Agent	Major Symptoms and Effects	Treatment
Bacterial			
Chlamydia	<i>Chlamydia trachomatis</i>	Genital discharge, itching and/or painful urination; often no symptoms in women; pelvic inflammatory disease (PID)	Antibiotics
Gonorrhea	<i>Neisseria gonorrhoeae</i>	Genital discharge; painful urination; sometimes no symptoms in women; PID	Antibiotics
Syphilis	<i>Treponema pallidum</i>	Ulcer (chancre) on genitalia in early stages; spreads throughout body and can be fatal if not treated	Antibiotics can cure in early stages
Viral			
Genital herpes	Herpes simplex virus type 2, occasionally type 1	Recurring symptoms: small blisters on genitalia, painful urination, skin inflammation; linked to cervical cancer, miscarriage, birth defects	Valacyclovir can prevent recurrences
Genital warts	Papillomaviruses	Painless growths on genitalia; some of the viruses linked to cancer	Removal by freezing
AIDS and HIV infection	HIV	See Module 24.13	Combination of drugs
Protozoan			
Trichomoniasis	<i>Trichomonas vaginalis</i>	Vaginal irritation, itching, and discharge; usually no symptoms in men	Antiprotozoal drugs
Fungal			
Candidiasis (yeast infections)	<i>Candida albicans</i>	Similar to symptoms of trichomoniasis; frequently acquired nonsexually	Antifungal drugs

27.8 Contraception can prevent unwanted pregnancy

Contraception is the deliberate prevention of pregnancy. Complete abstinence (avoiding intercourse) is the only totally effective method of birth control, but other methods are effective to varying degrees. Sterilization, surgery that prevents sperm from reaching an egg, is very reliable. A woman may have a **tubal ligation** (“having her tubes tied”), in which a doctor removes a short section from each oviduct, often tying (ligating) the remaining ends. A man may undergo a **vasectomy**, in which a doctor cuts a section out of each vas deferens to prevent sperm from reaching the urethra. Both forms of sterilization are relatively safe and free from side effects. Sterilization procedures are generally considered permanent, but can sometimes be surgically reversed. Surgical reversals of tubal ligations or vasectomies are becoming increasingly successful, but these major surgeries carry some risk.

The effectiveness of other methods of contraception depends on how they are used. Temporary abstinence, also called the **rhythm method** or **natural family planning**, depends on refraining from intercourse during the days around ovulation, when fertilization is most likely. In theory, the time of ovulation can be determined by monitoring changes in body temperature and the composition of cervical mucus, but careful monitoring and record keeping are required. Additionally, the length of the reproductive cycle can vary from month to month, and sperm can survive for 3–5 days within the female reproductive tract, making natural family planning quite unreliable in actual practice. Withdrawal of the penis from the vagina before ejaculation is also ineffective because sperm may be released before climax.

If used correctly, barrier methods can be quite effective at physically preventing the union of sperm and egg. Condoms are sheaths, usually made of latex, that fit over the penis. A diaphragm is a dome-shaped rubber cap that covers the cervix; it requires a doctor’s visit for proper fitting. Barrier devices (including condoms) are more effective when used in combination with **spermicides**, sperm-killing cream, foam, or jelly; spermicides used alone are unreliable.



◀ **Figure 27.8** A contraceptive skin patch

Some of the most effective methods of contraception work by preventing the release of egg cells. **Oral contraceptives**, or **birth control pills**, come in several different forms that contain synthetic estrogen and/or progesterone (or a synthetic progesterone-like hormone called **progestin**). In addition to pills, various combinations of these hormones are also available as an injection (Depo-Provera), a ring inserted into the vagina, or a skin patch (**Figure 27.8**). Steady intake of these hormones simulates their constant levels during pregnancy. In response, the hypothalamus fails to send the signals that start development of an ovarian follicle. Ovulation ceases, preventing pregnancy.

Certain drugs can prevent fertilization or implantation even after intercourse has occurred. Combination birth control pills can be prescribed in high doses for emergency contraception, also called **morning after pills (MAPs)**. If taken within 3 days after unprotected intercourse, MAPs are about 75% effective at preventing pregnancy. Such treatments should only be used in emergencies because they have significant side effects.

If pregnancy has already occurred, the drug mifepristone, or RU486, can induce an abortion, the termination of a pregnancy in progress. If taken within the first 7 weeks, RU486 blocks progesterone receptors in the uterus, thus preventing progesterone from maintaining pregnancy. Mifepristone requires a doctor’s prescription and several visits to a medical facility and may cause significant side effects.

Table 27.8 lists common methods of contraception, along with their failure rates when used correctly and when used typically. Note that these two rates are often quite different, emphasizing the importance of learning to use contraception correctly. It is also important to note that condoms are the only means of “safe sex” that can prevent (but not eliminate the risk of) both unwanted pregnancy and sexually transmitted diseases (STDs); other contraceptive methods do not prevent STDs.

TABLE 27.8 | CONTRACEPTIVE METHODS

Method	Pregnancies per 100 Women per Year*	
	Used Correctly	Typically
Birth control pill (combination)	0.1	5
Vasectomy	0.1	0.15
Tubal ligation	0.2	0.5
Rhythm method	1–9	20
Withdrawal	4	19
Condom (male)	3	14
Diaphragm and spermicide	6	20
Spermicide alone	6	26

*Without contraception, about 85 pregnancies would occur.

? What is the fundamental difference between barrier methods (such as condoms) and oral contraceptives in terms of their means of preventing pregnancies?

◉ Barrier methods prevent sperm from reaching an egg, while birth control pills prevent the release of eggs altogether.

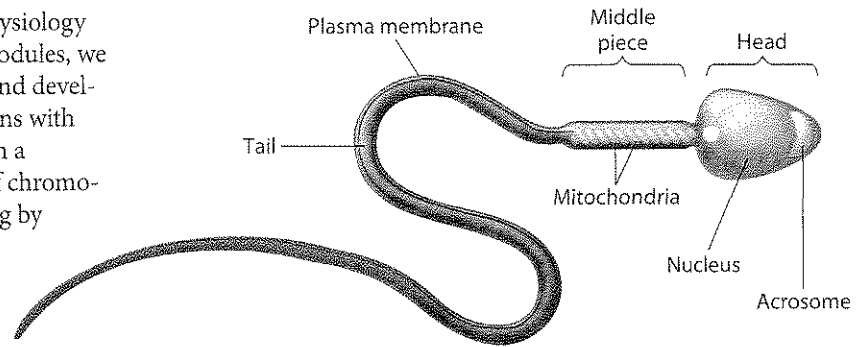
Principles of Embryonic Development

27.9 Fertilization results in a zygote and triggers embryonic development

The last six modules focused on the anatomy and physiology of the human reproductive system. In the next six modules, we examine the results of reproduction: the formation and development of an embryo. Embryonic development begins with fertilization, the union of a sperm and an egg to form a diploid zygote. Fertilization combines haploid sets of chromosomes from two individuals and also activates the egg by triggering metabolic changes that start embryonic development.

The Properties of Sperm Cells Figure 27.9A is a micrograph of an unfertilized human egg that is surrounded by sperm. Among all of these sperm, only one will enter and fertilize the egg. All the other sperm—the ones shown here and millions more that were ejaculated with them—will die. The one sperm that penetrates the egg adds its unique set of genes to those of the egg and contributes to the next generation.

Figure 27.9B illustrates the structure of a mature human sperm cell, a clear case of form fitting function. The sperm's streamlined shape is an adaptation for swimming through fluids in the vagina, uterus, and oviduct of the female. Its thick head contains a haploid nucleus and is tipped with a vesicle, the **acrosome**, which lies just inside the plasma membrane. The acrosome contains enzymes that help the sperm penetrate the egg. The middle piece of the sperm contains mitochondria. The sperm absorbs high-energy nutrients, especially the sugar fructose, from the semen. Thus fueled, its mitochondria provide ATP for movement of the tail, which is actually a flagellum. By the time a sperm has reached the egg, it has consumed much



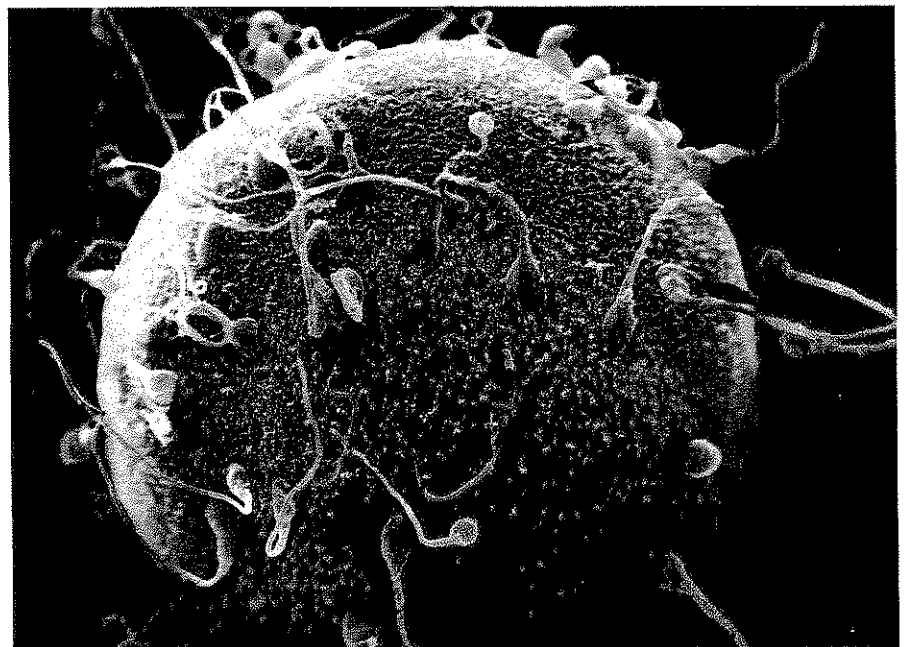
▲ Figure 27.9B The structure of a human sperm cell

of the energy available to it. But a successful sperm will have enough energy left to penetrate the egg and deposit its nucleus in the egg's cytoplasm.

The Process of Fertilization Figure 27.9C, on the facing page, illustrates the sequence of events in fertilization. This diagram is based on fertilization in sea urchins (phylum Echinodermata—see Module 18.13), on which a great deal of research has been done. Similar processes occur in other animals, including humans. The diagram traces one sperm through the successive activities of fertilization. Notice that to reach the egg nucleus, the sperm nucleus must pass through three barriers: the egg's jelly coat (yellow), a middle region of glycoproteins called the vitelline layer (pink), and the egg cell's plasma membrane.

Let's follow the steps shown in the figure. ① The contact of a sperm with the jelly coat of the egg triggers the release from

► Figure 27.9A A human egg cell surrounded by sperm



Colorized SEM 1,000X