

Human Reproduction

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Humans reproduce by the coming together of two cells (gametes) – an ovum, or egg, which is produced by the woman, and a sperm, which is produced by the man. Each gamete contributes half of the genetic material in the resulting individual. For normal conception to take place, therefore, the man must be able to produce a sufficient number of normal, actively-moving sperm, and the woman must be able to produce a healthy egg. Additionally, the parts of the woman's body which carry the egg and sustain a fertilised egg must all be in good working order.

The hormones which control the production of sperm and eggs are called gonadotrophins – they are termed Follicle-Stimulating Hormone (FSH) and Luteinizing Hormone (LH). They are produced in a tiny, pea-size gland at the base of the brain called the pituitary gland. In men, they stimulate the testicles to produce sperm and testosterone; and in women they act on the ovaries, which produce eggs, oestrogen and progesterone.

The Man's Role

Sperm are produced in the testes (or testicles). The testes also produce the male sex hormone testosterone.

Boys start producing sperm at puberty (around 15 years), and most men continue to produce sperm well into old age. Sperm are made at the rate of about 300 million per day, but take about 80 days to mature. They do so along a journey inside the seminiferous tubules (inside the testes) and the epididymis which then runs into the vas deferens. During ejaculation, the two vas deferens contract to propel sperm

and fluid into the ejaculatory duct, where they mix with fluids and nutrients from the seminal vesicles and prostate gland to form semen. The average volume of semen for each ejaculation is 2.5 to 6 mls, and the average number of sperm ejaculated is 50 to 100 million per ml. A proportion of these sperm are usually of abnormal shapes. Each sperm has a head, which contains its genetic material, and a tail, which propels it up through the woman's vagina, uterus and fallopian tubes, to reach and penetrate the ovum (egg).

The Woman's Role

Ova, or eggs, are produced in the woman's ovaries. The ovaries also produce the female sex hormones, oestrogen and progesterone.

At birth, the ovaries contain over a million egg follicles (sacs). Unlike the man, the woman does not continually produce gametes. Only about 350 eggs from these follicles mature and are released (ovulated) in her lifetime. The ovaries mature at puberty (around 12 years) and from then on, one egg will develop to maturity and be ovulated approximately every four weeks.

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The production of sex hormones and the release of an egg is known as the menstrual cycle, and is counted from the first day of the woman's menstruation. An "average" cycle is 28 days, but it can vary.

Ovulation occurs on approximately day 14 of a 28 day cycle, but it may occur earlier in a short cycle, and later in a long cycle.

The hormones LH and FSH regulate a woman's menstrual cycle by acting on the ovaries. Inside the ovaries, the developing egg produces oestrogen. At ovulation, the egg is released from the ovary and picked up by the fringed end of the fallopian tube (fimbria) and deposited in the fallopian tube. After ovulation, the empty follicle produces the hormone progesterone which, along with oestrogen, helps to "prime" the lining of the uterus (endometrium) and make it receptive for an embryo. If an embryo does not implant, the progesterone level drops, and menstruation begins. The cycle begins again.

Conception

The mature egg can survive for only 24 to 48 hours. The sperm remains healthy for a little longer. In a normal conception, sexual intercourse occurs and sperm is placed inside the woman's vagina. The mucus in the woman's cervix (neck of her uterus) at

around ovulation time is slippery and "traps" the sperm. The sperm then swim, guided by the mucus, into the uterus. The uterus, in turn contracts in such a way as to help move the sperm up into the fallopian tubes to reach the egg. However, so many sperm are lost along the way, that only a few hundred get this far.

Around the egg is a shell called the zona pellucida. Once a single sperm has penetrated it, it sets up a barrier which further sperm are unable to penetrate. The head of this single sperm releases its contents inside the egg, and the egg is said to have been fertilised. It starts to divide and grow, and is initially called a blastocyst before becoming an embryo.

Over about three days, the fallopian tube moves the embryo, via muscular action and the movement of fine hairs called cilia, along into the uterus. After about another three days, the embryo implants in the endometrium. Once it has implanted, it starts to produce a hormone called Human Chorionic Gonadotrophin (hCG), and we can detect the pregnancy. Pregnancy tests on blood or urine all test for the presence of HCG. A pregnancy can also be detected by ultrasound. The pregnancy sac can usually be seen via ultrasound at four weeks after conception (six weeks of pregnancy).

Summary

When you understand all the components necessary for normal conception to occur, it is easier to understand how the process works, or at which points problems might occur that lead to infertility.

In short, for a couple to conceive normally: the pituitary gland needs to be functioning properly in both man and woman, in order to produce the necessary hormones in the right quantities; the man must have a sufficient number of viable sperm; the woman's ovaries must be able to release eggs, and to produce the hormones which sustain the fertilised egg; her cervical mucus should be of the right quality; her fallopian tubes need to be open and healthy enough to sustain the egg and push it into the uterus, where it should be able to implant in her endometrium.