

# Reproduction

- Reproduction means producing new living organisms. Animals and plants reproduce to make new individuals of the same species. There are two types of reproduction: asexual and sexual reproduction

## Asexual reproduction

- In asexual reproduction there is only one parent
- All the offspring are identical to the parent as they inherit exactly the same genetic information
- They are genetically identically identical to the parent, which means there is little variation amongst the offspring
- **Bacteria:** the bacterial cell divides into two making a new cell wall. This type of asexual reproduction is called binary fission, because the parent cells splits into two
- Pin mold is a **fungus** which grows on bread
- It reproduces asexually by making spores
- There are small and light, like specks of dusts and they float through the air
- When a spore lands on a damp surface it splits open and a thread grows out
- This thread or hypha, grows over the surface of the bread forming a dense network of threads called a mycelium
- Eventually short hyphae grow upwards and produce spore cases or sporangia at their tips.
- Inside each sporangium hundreds of new spores are formed asexually by division of the nuclei
- Each nucleus gains a small quantity of cytoplasm and protective spore case
- When ready, sporangia break open and the spores are dispersed
- **Potatoes** reproduce asexually by means of stem tubers, which are swollen underground stems that grow from the parent plant
- Sucrose is transported in the phloem from the leaves into these underground stems that swell as they convert the sucrose into starch
- The parent plant dies at the end of the growing season leaving the tubers in the ground to survive over the winter

## Sexual reproduction

- In sexual reproduction there are two parents
- The parents have sex organs
- The sex organs make sex cells or gametes
- In animals, the male gametes are sperm cells
- In flowering plants the male gametes are nuclei inside pollen grains
- In animals, the female gametes are egg cells
- In flowering plants the female gametes are inside structures called ovules
- The fertilized egg or zygote divides to form an embryo which may grow into a new individual plant
- At fertilization, half the genetic materials comes from the male gamete and half comes from the female gamete
- The nuclei in the gametes contain one set of chromosomes
- A zygote has a nucleus that contains two sets of chromosomes-one from each gamete
- Unlike asexual reproduction, the offspring produced are not genetically identical to the parents

- This means that sexual reproduction brings about variation in the offspring

### Advantages and disadvantages of asexual reproduction in plants

- Asexual reproduction is fast
- If left in the ground, potato tubers grow into new plants in the same place as the parent, but compete with each other for resources
- Seeds produced in sexual reproduction may be dispersed to new areas where there may not be as much competition
- However, many seeds land in unsuitable places for growth so many are wasted
- There is very little, if any, variation as a result of asexual reproduction
- This can be a disadvantage if these individuals are affected by a certain disease
- Disease could spread very quickly through crop monoculture, in which all the plants are genetically identical
- If environmental conditions change, it is unlikely that there will be individuals with features to adapt to these new conditions
- Sexual reproduction gives a rise to variation
- If there is plenty of variation, species are better able to survive and evolve

### Flower Structure

- Flowering plants carry out sexual reproduction by producing flowers, which have male and female parts
- The male parts make pollen grains to carry male gametes to the female parts
- The transfer of pollen grains is pollination
- Female gametes are deep inside the female part and pollen grain grow a tube to reach them
- Each pollen tube delivers a male gamete so it can fuse with the female gamete to form a zygote
- Fusion of male and female gametes is fertilization

Flowers vary in structure depending upon their method of pollination

### Insect pollinated flowers

Flower parts are often arranged in rings attached to the end of a swollen flower stalk. The sepals form the outer ring and the carpels form the inner ring.

- Sepals are leaf-like structures that protect the flower when it is a bud
- Petals are brightly colored and scented. Many have nectary at the base, which makes sugary nectar. Visiting insects land on the petals to feed on nectar
- Stamens are the male sex organs. Each one is made up of two parts: the anther, where the pollen is made, and the filament, a stalk which holds the anther,
- Carpels are the female sex organs. Each carpel is made up of a stigma, a style and an ovary
- The ovules are inside the ovary. Each ovule has a female gamete- the egg cell
- Pollen grains are often spiky and sticky
- The grains are adapted to attach to hairs in the surfaces of insect bodies
- The grains become dislodged onto a stigma when an insect enters another flower of the same species

## Wind pollinated flowers

- Grasses and cereals are all pollinated by the wind
- The flowers are small, green and inconspicuous compared to insect pollinated flowers
- They have no scent and no nectar
- The anthers produce pollen grains that are small, smooth and light so that they are easily carried on the wind
- These flowers make huge numbers of pollen grains as the chances of pollen grains landing on a stigma are very small
- The anthers hang outside the flower so the wind can blow away pollen
- The feathery stigmas are also positioned outside the flower
- They act like a net, providing a large surface area for catching pollen grains that get blown into them
- Wind pollination can waste a lot of pollen, which is why the anthers produce so much
- But the fact that plants such as grasses and cereals grow close to one another means that pollen is more likely to be transferred than if they are separated by large distances

## Pollination

- Pollination is the transfer of pollen grains from the anther of the male part of the flower to the stigma of the female part of the flower
- Self-pollination involves the transfer of pollen from the anthers to the stigma of the same flower or a different flower on the same plant
- Cross pollination involves the transfer of pollen from the anthers of one flower to the stigma of another flower on a different plant of the same species
- The benefit of cross pollination is that it results in greater variation in which natural selection can operate on

Feature	Insect Pollinated Flower	Wind Pollinated Flower
Petals	Present-colorful and scented to attract insects	Absent or very small and difficult to see
Nectararies	Present- make nectar which is a sugary liquid for pollinating insects	Absent
Stamens	Present-usually with short filaments; anthers attached firmly to filaments; inside the flower for insects to rub against	Long filaments so anthers hang outside the flower; anthers loosely attached to filaments so pollen is easily blown away
Pollen	Small quantities of sticky, spiky pollen grains that stick easily to insects' bodies	Large quantities of smooth, light pollen that can easily be carried by the wind
Carpels	Sticky, small stigmas usually inside the flower for insects to rub against	Large, feathery stigmas to catch pollen grains in the air

## Fertilization and seed formation

- If a pollen grain lands on a ripe stigma it starts to grow a pollen tube to take the male nucleus to the female nucleus
- Fertilization occurs when the male nucleus fuses with the female nucleus
- This occurs inside the ovule

- Each pollen grain grows a pollen tube to take the male nucleus to the ovule
- As it grows, the pollen tube gains nutrition from the tissues of the style and carries nutrition from the tissues of the style and carries the male gamete nucleus with it
- The first pollen tube reaches the ovary
- It enters the ovule through a small hole-the micropyle
- The male gamete and then fuses with the egg cell nucleus
- This is fertilization in which a zygote is formed by fusion of the two nuclei

### Seed Formation

- After fertilization, the zygote divides and grows into the embryo
- The ovule forms the seed with the embryo inside it
- The ovary forms the fruit with the seeds inside it
- Many of the parts of the flower are not needed when fertilization has occurred, so the sepals, petals and stamens, wither and fall off
- Each fertilized ovule grows to form a seed, each seed is made up of: an embryo, an energy store and a seed coat/testa
- The ovary forms the fruit

### Condition for germination

- Water is needed for the seeds to swell. This swelling breaks the seed coats of some seeds. Cells absorb water, develop vacuoles and expand. Cell expansion makes the radicle (embryonic root) grow out from the seed. Water is also needed to dissolve the soluble products made by enzymes from the food stores. Water also activated these enzymes.
- Oxygen is needed for aerobic respiration to provide the embryo with energy
- A suitably warm temperature is needed so that the enzymes can work efficiently

### The Male Reproductive System

- The testes are the male sex organs
- They produce the male gametes/spermatozoa/sperm
- The testes also make testosterone
- This stimulates changes in a boy's body as he develops into an adult during puberty
- This happens between about 10 and 16 years of age
- The testes are located inside a sac called the scrotum which hangs outside the body
- This keeps the testes at a cooler temperature as sperm cells need at temperature of lower than 37°C to develop properly and be stored
- After puberty, the testes constantly produce sperm cells which are stored in small tubules just outside the testes where they mature
- A much wider tube called the sperm duct connects these tubules to the urethra
- The prostate gland and other glands secrete fluids in which sperm cells can swim
- The prostate secretes mucus and other glands secrete sugars which sperm cells use as a source of energy for their respiration
- Sperm cells and the fluid together form semen, also known as seminal fluid
- The two sperm ducts join with the urethra, which runs down the center of the penis
- Urine and semen never pass down urethra at the same time

- A ring of muscle around the urethra contracts to prevent the loss of any urine from the bladder during sexual intercourse

### Male and Female gametes

- Gametes are sex cells
- The male gamete is called the sperm
- The female gamete is called the ovum or egg
- The sperm cell is a specialized cell that is adapted for swimming by having a flagellum that lashes from side to side
- Sperm cells carry genetic information from the male parent to the female parent
- The nucleus contains the father's chromosomes
- An egg is bigger than a sperm because it provides the food store that supports the embryo after fertilization
- An egg cell is fertilized by a sperm cell
- The head of the sperm contains enzymes to help it reach the surface of the egg cell
- The cell membrane of the sperm cell fuses with the egg cell membrane
- The sperm nucleus moves through the cytoplasm of the egg and the two nuclei fuse together to form a zygote (fertilized egg)
- After fertilization, the jelly coat changes, so that no more sperm can enter

### Comparing male and female gametes

Feature	Sperm Cell	Egg Cell
Size	Small	Much larger than sperm cell
Movement	Swims using flagellum that lashes from side to side	Does not move itself- is moved along the oviduct by cilia and peristalsis
Energy store	Has very little- uses sugar in seminal fluid for respiration	Protein and fat in cytoplasm-enough to last until implantation in uterus
Number of chromosomes	23	23
Number produced	Millions constantly produced after puberty, throughout life	Once a month after puberty until menopause, except when pregnant or taking a contraceptive pill

- Each sperm cell has mitochondria, which releases energy to power the swimming by the tail
- The acrosome contains enzyme that digest a pathway through the jelly coat surrounding the egg

### The Female Reproductive System

- Ovaries are female sex organs that produce the female gametes called ova or eggs
- The ovaries also make the female hormones estrogen and progesterone, which starts to happen with girls between 10 and 15 years of age during puberty
- Estrogen stimulates the development of the sex organs and secondary sexual characteristics in a girl's body as she starts to develop into an adult
- Progesterone prepares the uterus so that it is ready to receive an embryo in the case of pregnancy
- The ovaries are attached to the inside of the abdomen just below the kidneys

- After puberty, an egg is released from an ovary about every 28 days
- The ovaries tend to release an egg or eggs on alternate months
- The egg passes out of the ovary and into the funnel shaped opening of the oviduct in a process called ovulation
- The egg moves slowly down the oviduct towards the uterus (womb)
- If sperm cells are present in the oviduct the egg will be fertilized
- If the egg is not fertilized it will die after about a day
- If the egg is fertilized it will divide to form an embryo which may attach itself to the lining of the uterus where it develops into a fetus
- The lower end of the uterus has a ring of muscle called the cervix
- It leads to a muscular tube called the vagina that opens to the outside of the body
- Above the opening of the vagina is the opening of the urethra through which urine from the bladder passes out
- Above the urethra is the sensitive clitoris
- The outer opening of the vagina is called the vulva
- The vagina is sometimes known as the birth canal, as it is through here that a baby passes at birth

### Sexual Intercourse

- During sexual intercourse males and females stimulate each other
- Blood is pumped into special spongy tissue in the penis so that it becomes erect
- The erect penis is placed into the vagina during sexual intercourse
- Fluid made by the walls of the vagina lubricates movements of the penis within the vagina
- This movement stimulates the penis and contractions begin in the sperm ducts to move sperm cells from the tubules around the testes towards the penis
- As they flow, secretion from the glands including the prostate gland are added to form the semen or seminal fluid
- Contractions of the urethra move the seminal fluid through the penis into the vagina
- This is an ejaculation and the man experiences feelings of pleasure called an orgasm
- Repeated movements of the penis against the clitoris or against the vagina walls may also produce orgasms for the woman

### Fertilization and Implantation

#### Human fertilization

- Fertilization occurs when the nucleus of a sperm cell fuses with the nucleus of an egg cell
- After intercourse, sperm cells swim through the mucus in the cervix into the uterus and then all the way to the oviduct
- Many sperm cells do not survive this difficult journey which is why so many sperm cells are produced
- To increase the chance of some of them reaching the oviduct
- If there is an egg in the oviduct, a sperm cell may succeed in penetrating it
- Enzymes released by the acrosome on the head of the sperm digest a pathway through the jelly coat surrounding the egg
- After the sperm membrane has fused with the egg membrane the nucleus enters the egg cytoplasm and the flagellum is left outside
- The sperm nucleus fuses with the egg nucleus to form the zygote nucleus which is diploid as it contains two sets of chromosomes

- This stops other sperm cells from entering so only one sperm is able to fertilize the egg
- If there is no egg in the oviduct, no fertilization can take place
- However, the sperm can stay alive for 2 or 3 days
- So if intercourse happened just before ovulation, the sperm can fertilize an egg released during this time

### Implantation

- Fertilization takes place in the oviduct
- After this, the fertilized egg or zygote begins to divide
- It divides once to form a two-celled embryo
- Then it continues to divide to give four cells, then eight but after a while this cycle of divisions becomes less regular
- Some cells continue to divide while others stop or slow down the rate at which they divide
- After a few hours the embryo is a hollow ball of cell
- It moves down the oviduct, pushed along by peristaltic contraction of the oviduct and the beating of the ciliated epithelial cells lining the oviduct
- It may take a number of days for the embryo to reach the uterus
- The embryo embeds into the soft lining of the uterus
- This is called implantation
- The uterus lining has thickened in preparation and contains numerous blood vessels
- The embryo obtains nutrients and oxygen from these blood vessels by diffusion
- Carbon dioxide and chemical waste diffuse out in the opposite direction

### Pregnancy

- Pregnancy is the period of time between fertilization and birth, which in humans is 9 months
- This period of time is called the gestation period
- After the embryo has implanted into the lining of the uterus, it grows projection into the soft tissue to gain nutrients and oxygen to support its growth
- These projections continue to grow into the placenta
- An umbilical cord grows to attach the fetus to the placenta so it fills the amniotic sac which surrounds it
- The placenta is the site of oxygen and nutrients for carbon dioxide and other wastes; they diffuse between fetal blood and maternal blood
- The fetus obtains all its food from its mother. It produces some urea which diffuses into the mother's blood to be excreted through her kidneys
- The umbilical cord attaches the fetus to the placenta. The cord contains an artery that transports deoxygenated blood from the fetus to the placenta and a vein that returns oxygenated blood to the fetus
- The amniotic sac makes amniotic fluid to surround and protect the fetus against mechanical damage
- Amniotic fluid is formed from filtered blood and has a composition similar to plasma. Cells from the fetus' skin are shed into the amniotic sac and when the organs have developed the fetus carries out breathing movements taking fluid into the lungs. The fetus urinates the fluid and reabsorbs it, it does not provide any nutrients for the fetus

- The placenta acts as a barrier to toxins and pathogens. However, even though the womb is a sterile environment, the fetus is still susceptible to disease.
- Rubella can cause deafness and blindness in the fetus
- The HIV virus that causes AIDS may cross the placenta so a baby may be born HIV positive if the mother is affected
- However, with careful management the virus may not be transmitted to the fetus

#### Main stages in the development into a baby to be born

- One month after fertilization, a human embryo looks a bit like a fish embryo or tadpole. The embryo does not yet have arms or legs but it is clear where these will develop. The heart has started to beat
- Two months after fertilization the embryo has a face, limbs, fingers and toes and looks human. It is now called a fetus. Most of the organs are formed
- Three months after fertilization the nerves and the muscles of the fetus are developing rapidly
- Five months after fertilization, although only about 180 mm in length, the fetus has perfectly formed eyebrows, fingernails, fingerprints and body hair. Its movement may have been felt by the mother for the last month
- Seven months after fertilization development is almost complete

#### Ante-Natal Care and Birth

- Ante-natal care is the care before birth and it is vital for health of the fetus in the womb
- A pregnant woman will need to ensure that she gets adequate quantities of:
  - ✓ Calcium as the bones of the fetus are growing
  - ✓ Iron so her body can make the extra red blood cells needed to carry oxygen to the fetus
  - ✓ Carbohydrates so that the pregnant woman has enough energy to carry her heavier body around
  - ✓ Protein to provide amino acids for the making of tissue in the mother's uterus for birth and new tissues in the developing fetus
- The mother should not smoke since nicotine and carbon monoxide cross the placenta can result in premature or underweight
- She should not drink alcohol, as it can cause a variety of effects including birth defects and mental defects
- Drugs, such as heroin can diffuse across the placenta so the babies may be born addicted to heroin

#### Birth

- A normal pregnancy takes about 9 months
- Some babies can be born prematurely perhaps because there has been a problem during pregnancy
- An early breaking of amnion membrane around the fetus for the most common reason
- A few weeks before birth, the fetus usually turns over inside the uterus
- This positions its head above the cervix
- Hormones released by the fetus and the build-up of pressure in the uterus stimulate hormonal changes in the mother
- A hormone, oxytocin, is released from her pituitary gland that stimulates the muscles of the uterus to contract



- The mother starts to feel small contractions of the uterus wall. This is the beginning of labor
- These contractions become stronger and more frequent
- Stronger contractions become stronger and more frequent
- Stronger contractions slowly stretch the opening of the cervix and the amnion breaks, allowing the amniotic fluid to escape
- The muscles of the uterus wall now contract very strongly and start to push the baby towards the cervix
- The cervix widens or dilated and the baby's head is pushed through the vagina
- This part of birth takes place quite quickly
- As soon as it is born the baby breathes for the first time
- It is important that the baby has airways clear of mucus and can breathe easily
- The umbilical cord is tied and cut just above the point where it attached to the baby
- The remains of the cord heal to form the baby's navel
- After a few minutes the placenta comes away from the uterus wall. it is pushed out of the vagina as the afterbirth
- The process of labor with the muscular contractions of the uterus is painful for the mother
- Pain killing drugs can also be given to ease the pain during birth
- These may be given by an epidural
- This involves inserting a catheter (tube) into the space between the spine and the spinal cord
- The drugs prevents the transmission of impulses from pain receptors in the brain

### Breast Feeding

Advantages	Disadvantages
Contains antibodies aiding passive immunity	Can be embarrassing for the mother
The child is less likely to develop some cancers and diabetes	Mother may not be able to produce enough milk
The mother is less likely to develop womb, breast and ovarian cancer	Painful for mother
Promotes bonding with the mother	Father may feel secluded

### Breast milk vs formula

- Breast milk contains antibodies
- No sterilizing of equipment needed
- No mixing of powder or need for boiled water
- Cost nothing vs. expensive formula
- HIV positive mothers may not be able to breast feed so formula is the only alternative

### Sex Hormones

- You are born with a complete set of sex hormones but only become active later on in life, called puberty
- Girls usually develop earlier than boys
- The actual age of puberty varies from person to person
- The changes that take place are all controlled by the hormones

- At the beginning of puberty the pituitary gland at the base of the brain starts to make hormones that stimulate the testes and hormones
- These make the sex organs active
- The sex organs start to produce hormones which develop our secondary sexual characteristics

### Puberty in boys

The testes start making testosterone which stimulates:

- The growth of the male sex organs
- The testes to make sperm cells
- Growth of hair on the face
- The deepening of the voice
- Development of muscles in the body

### Puberty in girls

The ovaries start making estrogen which stimulates:

- The growth of the female sex organs
- The start of the first menstrual cycle and the first period
- Growth of hair on parts of the body
- Growth and the development of breasts
- Widening of the hips

### Menstrual Cycle

Hormone	Where it is produced	Function
FSH (Follicle Stimulating Hormone)	Pituitary gland	Stimulates the formation/maturation of an egg cell in the follicle Stimulates the formation of estrogen
LH (Luteinizing Hormone)	Pituitary gland	Stimulates the thickening of endothelium lining Triggers the release of a mature egg from follicle
Estrogen	Ovary- follicle cells	Inhibits the secretion of FSH Stimulates the secretion of LH
Progesterone	Ovary- corpus luteum	Helps to maintain thickened lining of the endothelium

### Day 1 -5

Ovary:

- FSH secreted by the pituitary gland to stimulate the maturation of one/more follicles in the ovary
- The egg is stored in the follicle

Uterus:

- The endothelium breaks down leading to menstruation

### Day 5-14

Ovary:

- Follicle keeps maturing

Uterus:

- FSH stimulates the secretion of estrogen by the follicle cells: the ovarian tissues starts to prepare the endometrium lining
- Estrogen inhibits the secretion of FSH and stimulates the secretion of LH
- Lining of the endothelium thickens

### Day 14/15

- Ovary: LH also secreted by the pituitary gland trigger the release of the egg from follicle into the fallopian tube

### Day 15-28

- Ovary: remains of follicle is called the yellow body (corpus luteum) which secretes progesterone
- Uterus: progesterone secreted by the yellow body and the presence of estrogen keeps the endometrium thick, waiting for possible embryo implant. Inhibits the secretion of LH and FSH
- Day 28: Scenario 1: The egg is not fertilized
- No implantation takes place, the corpus luteum degenerates, causing a lack of progesterone
- This means the endometrium lining is no longer thick
- Back to day 1
- Day 28: Scenario 2: Egg is fertilized
- Implantation occurs. Embryo stimulates the yellow body to keep on forming progesterone and estrogen. Maintains the endometrium and inhibits FSH and LH formation.

### Methods of birth control

- Birth control allows couples to decide when, and how many children they want to have
- To prevent pregnancy the birth control should either:
  - i. Stop the sperm from reaching the egg
  - ii. Stop the eggs from being made
  - iii. Stop the fertilized egg from implanting and developing in the uterus

### Barrier methods

- The **cap** or **diaphragm** is a rubber dome. The woman places it over her cervix before intercourse. It prevents the man's sperm from entering the uterus. It should be cleaned with sperm-killing cream or foam
- The **condom** is a thin rubber tube. It is rolled over a man's erect penis before intercourse. It stops sperm from entering the woman's body. It also gives protection against STIs.
- A **femidom** is the female equivalent of a condom and is inserted into the vagina.

### Chemical methods

- The **IUD (intra-Uterine Device)** is a small plastic device that is wrapped in copper or contains hormones. It is fitted inside the woman's uterus and it is thought to work by preventing sperm

passing through the uterus. It may also prevent an embryo from implanting in the uterus should conception occur

- **IUS (intra-uterine system)** is a small T-shaped device that is placed in the uterus. It contains progesterone that is released slowly and causes the mucus in the cervix to become thick and sticky, making it unlikely that sperm will swim through
- The **pill** is an oral contraceptive taken by mouth. They contain estrogen and progesterone in varying concentrations. There are also progesterone-only pills. These work by preventing the release of eggs. As a result, no eggs mature to be released by the ovaries and so pregnancy does not occur. This pill has to be taken every day
- It is a reliable and convenient form of contraception
- However, failure to take the pill regularly can result in pregnancy
- The side effects of the pill include: sore breasts, weight gain, depression and painful periods
- In a very small number of women, the pill can be the cause of heart and circulation problems
- A **contraceptive implant** is a small flexible rod that is placed just under the skin of the upper arm. It releases progesterone which prevents ovulation and works for up to 3 years
- **Contraceptive injections** also contain progesterone. There are different types that work between 8 and 13 weeks
- **Spermicides** are chemicals that kill sperm. They are sold as foam, cream or jelly. The woman puts the cream into her vagina before intercourse. Spermicides are not very effective on their own and should be used with another method

#### Natural methods

- **Abstinence**
- **Rhythm method**- this relies on determining when ovulation is most likely to occur and abstaining from sex in the days just before and after that date
- A woman keeps a record of when she has her periods and then predicts each month when ovulation should occur
- This is about 2 weeks after having her period
- This is not a very reliable method, especially in women who do not have very regular periods
- **Symptoms based method**-e.g. checking for an increase in body temperature and changes in cervical mucus that becomes wetter and less sticky just before ovulation.

#### Surgical methods

- **Vasectomy**- a man's sperm tubes are cut and tied. The operation is not usually reversible. The man can still ejaculate but there are no sperm in the semen, just fluid
- **Sterilization**- a woman's oviducts are cut and blocked.

#### Control of fertility

##### Fertility drugs

- Couples are regarded as being infertile if they have had regular, unprotected sexual intercourse for 12 months without the woman becoming pregnant
- The most common cause of infertility in women is that the woman does not release eggs
- This may be due to the lack of FSH
- Treatment for this type of infertility may involve regular injection of a fertility drug containing FSH

- Other treatments involve tablets that make the pituitary insensitive to estrogen
- Estrogen inhibits the production of FSH
- So if the effect of estrogen on the pituitary is blocked by the drug, the pituitary continues to release FSH and ovulation occurs
- Unfortunately, fertility treatment does not always work for a variety of reasons that may not be easy for doctors to discover
- Or it may work too well resulting, in twins, triplets or even quadruplets

### Artificial insemination

- Some couples cannot have kids because the male is infertile
- This may be because he does not produce enough sperm or there are problems with ejaculation
- It is possible that semen may be collected from the man and placed via a fine plastic tube into the woman's uterus. This process is called artificial insemination (AI).
- If the man does not produce enough sperm for this, or if the sperm is defective then a donor may provide a sample of semen for the AI.
- AI by a donor can lead to problems later in life because the child's father is not the biological father who probably remains unknown

### In vitro fertilization

- Egg and sperm are collected from potential parents and mixed together in a laboratory dish where fertilization occurs
- To increase the chances of success, the woman is often injected with FSH to stimulate the development of several follicles so that several eggs can be collected from her ovaries
- A small incision is made in the body wall and a fine plastic tube inserted to collect the eggs from the follicles on the surface of the ovaries
- The eggs are kept in a solution that contains nutrients and oxygen
- Semen is collected from the man/sperm donor and is mixed with the eggs and left for up to 24 hours for fertilization to occur
- A technician checks that fertilization has occurred and that the zygotes have started to divide into embryos
- These are kept in the solution for a few days and then the doctor places them into the woman's uterus
- If the procedure is successful, the embryo will develop into a fetus
- It is also possible to take the nucleus from a defective sperm cell and inject it into an egg
- The zygote is then cultured for several days so it grows into an embryo and is transferred into the woman in the hope that it implants in the uterus

### The social implication of contraception and fertility treatments

- IVF is an expensive procedure and is not available to all
- Success rates for IVF are often about 30% for women under 35 years of age
- In countries with a publicly funded NHS decisions have to be made about who receives IVF and how many repeats should be done if the first one is unsuccessful
- In many parts of the world, childless couples are unable to afford this treatment
- A problem is what to do with spare embryos that are implanted
- Some maintain that it is not acceptable to just dispose of them or use them for medical research

## Sexually transmitted infections (STIs)

- A sexually transmitted infection (STI) is a disease that is transmitted via body fluids during sexual contact.
- STIs include HIV, syphilis and gonorrhoea amongst the major infection that can be transmitted

## Human immunodeficiency virus (HIV)

- The main type of cell that it infects is a type of lymphocyte
- HIV may lead to the development of Acquired Immunodeficiency Syndrome (AIDS)
- If someone has been infected with HIV they are known as HIV+
- The virus weakens the body's immune system
- It is easier for the HIV+ person to be infected by other diseases such as TB and pneumonia
- People who do not have HIV are described as HIV negative

## HIV and lymphocytes

- HIV attacks and destroys an important type of lymphocyte that coordinated the immune system
- During an infection these lymphocytes stimulate other lymphocytes to produce antibodies
- During an HIV infection the number of these T lymphocytes decreases so fewer antibodies are produced every time there is another infection
- By reducing the number of T lymphocytes, HIV weakens the body's ability to fight disease
- Eventually the person infected with HIV will succumb to any number of other infections because of their weakened immune system
- AIDS is the name given to a collection of diseases brought on by the weakening of the body's immune system
- The early symptoms of AIDS are very much like flu, with swollen glands and a high temperature.
- Later the symptoms may include weight loss, various types of cancer and a decrease in brain function
- Not all HIV+ people develop AIDS
- Some remain HIV+ without any symptoms at all

## How is HIV transmitted?

- HIV is transmitted in the blood and semen
- The virus can pass from one person to another during unprotected sex
- The virus can also be passed via hypodermic needles contaminated with infected blood
- In this way, HIV is spread quickly amongst drug addicts who share needles
- Unborn babies are also at risk of HIV
- This is because the virus can pass across the placenta to the fetus
- Even more likely is its passage from the mother's blood at birth when the two bloodstreams come into close contact
- HIV can also be transmitted in breast milk
- Blood used for transfusions is another way which HIV has been transmitted

## How can HIV/AIDS be prevented?

- There is no cure for HIV/AIDS and no vaccine for HIV
- There are anti-viral drugs e.g. AZT, and some of these prevent the virus from multiplying inside the body cells

- Antibiotics do not work against viruses, but people with AIDS take them to treat the bacterial and fungal infections that they have
- Since HIV cannot be cured, it is important to prevent the transmission of the virus
- Contact tracing is used to identify people who may have been put at risk either as a result of sex or the sharing of needles
- These people are offered an HIV test which reveals the presence of HIV antibodies in their blood
- However, the antibodies only appear after several weeks of the person being infected
- Other methods to reduce the spread include:
  - ✓ The use of condoms to provide a physical barrier to transmission of the virus during sex
  - ✓ Setting up free needle exchange schemes for people who inject drugs
  - ✓ Screening donated blood for HIV antibodies and eliminating contaminated blood
  - ✓ Educational programs that make people aware of HIV and how it can be prevented