

Unit 7B Reproduction

About the unit

In this unit pupils:

- extend their earlier ideas about human reproduction and consider how offspring are protected and nurtured
- consider and compare reproductive patterns in other animals with those in humans
- relate what they know of the way their bodies change during adolescence to knowledge about human reproduction, growth and the menstrual cycle

In scientific enquiry pupils:

- consider sample size in biological investigations
- present data in bar charts and graphs
- interpret data they have collected and data from secondary sources

Teachers should make reference to their school's sex-education policy and personal, social and health education (PSHE) programme. They will also be aware of the need for sensitivity to the personal circumstances of pupils and their families.

This unit is expected to take approximately 8 hours.

Where the unit fits in

This unit draws on ideas developed in the key stage 2 programme of study. It builds on unit 5B 'Life cycles' in the key stage 2 scheme of work and on unit 7A 'Cells'.

This unit relates to:

- PSHE
- drugs education
- sex education

Expectations

At the end of this unit

in terms of scientific enquiry

most pupils will: select information about reproduction from secondary sources; present and interpret data about growth in bar charts and graphs, indicating whether increasing the sample they used would have improved the work

some pupils will not have made so much progress and will: with help, find information from selected secondary sources and present data in tables and bar charts

some pupils will have progressed further and will: explain whether the sample size in their investigation of growth was sufficient for comparisons to be made with national data and describe how reproduction was explained before the role of cells was understood

in terms of life processes and living things

most pupils will: identify and name the main reproductive organs and describe their functions; describe fertilisation as the fusion of two cell nuclei; describe egg and sperm cells; explain how the fetus obtains the materials it needs for growth; describe differences between the gestation periods and the independence of the young of humans and other mammals and describe the menstrual cycle

some pupils will not have made so much progress and will: identify and name the main reproductive organs; describe fertilisation as the fusion of egg and sperm and identify the importance of the placenta in supplying food for a developing fetus

some pupils will have progressed further and will: explain how egg and sperm cells are specialised, and describe how they carry the information for development of a new life

Prior learning

It is helpful if pupils:

- can describe the human life cycle in terms of infancy, childhood, adolescence, maturity and ageing
- know that organisms are made of cells which have a nucleus and that cells are adapted for their functions

Health and safety

Risk assessments are required for any hazardous activity. Model risk assessments used by most employers for normal science activities can be found in the publications listed in the *Teacher's guide*. Teachers need to follow these as indicated in the guidance notes for the activities, and consider what modifications are needed for individual classroom situations.

Language for learning

Through the activities in this unit pupils will be able to understand, use and spell correctly:

- names of reproductive organs, *eg ovary, testis, oviduct, uterus*
- specialised terms, *eg menstruation, ovulation, fertilisation, placenta, mammary glands, sperm, gestation*
- words with similar but distinct meanings, *eg hereditary and inherited, baby and fetus, puberty and adolescence*
- words with different meanings in scientific and everyday contexts, *eg cell, fuse*
- words relating to scientific enquiry, *eg reliability, sample size, national data*

Through the activities pupils could:

- make notes, summaries, etc to clarify ideas and thinking which can be used later
- plan and develop ideas and lines of thinking into continuous text
- join ideas within sentences including using links of time (then, later, meanwhile) and cause (so, because, since)
- collaborate with others to share information and ideas, and solve problems
- answer questions using relevant evidence or reasons

Resources

Resources include:

- secondary sources: video clips, photographs about reproduction in animals, *eg fish, frogs*, where fertilisation is external
- video clips, models, photographs, software simulations and ultrasound scans illustrating the human reproductive organs, fertilisation, gestation, birth, menstruation and the menstrual cycle
- secondary sources providing information about the effects of alcohol, tobacco and other drugs, and rubella on the developing fetus
- video clips showing responses of a newborn baby and other animals, *eg deer, birds, kittens*, immediately after birth/hatching
- data about egg production, gestation time, time to maturity, survival rates of humans and other species
- data, *eg height/weight charts*, showing expected ranges
- secondary sources providing information about height/weight/growth of human offspring in the past
- access to ICT data-handling package

Out-of-school learning

Pupils could:

- find out about reproduction of, and breeding in, domestic pets
- read newspaper and magazine articles about cloning
- find out about life-support systems for premature babies and children with prenatal developmental problems
- find out about social, ethical and technological issues when offspring are born as the result of assisted conception, such as 'test-tube' babies and fertility drugs
- find out whether height and weight charts from doctors and slimming organisations are the same or different

Pupils should learn:

Pupils:

How does a new life start?

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| <ul style="list-style-type: none"> • that animals have different patterns of reproduction and development • to make notes, summaries, etc to clarify ideas and thinking which can be used later | <ul style="list-style-type: none"> • Provide pupils with stimulus material, <i>eg pictures, video clips</i>, to review their knowledge of reproduction in animals. Ask pupils to find out about the reproduction and development of certain animals, <i>eg fish, frogs</i>, including information on fertilisation using texts, CD-ROMs and to make notes or summaries of their ideas. • Discuss how eggs are fertilised externally in some animals, <i>eg fish, frogs</i>, using video clips as illustrations and pointing out the numbers of eggs fertilised at one time. Ask pupils to suggest why this is. | <ul style="list-style-type: none"> • state that a new life starts when a sperm fertilises an egg • suggest reasons why large numbers of eggs, <i>eg of fish and frogs</i>, are fertilised at one time • note key points about the reproduction of a particular animal | <ul style="list-style-type: none"> • Extension: pupils could be asked to find out about theories of reproduction, <i>eg the homunculus theory</i>, held before cells were discovered. |
| <ul style="list-style-type: none"> • that animals have different patterns of reproduction and development • to draw conclusions from patterns in data • that newborn human babies are more dependent than offspring of some other species | <ul style="list-style-type: none"> • Remind pupils of the differences in the number of eggs produced by animals where fertilisation is external and those where it is internal. Provide pupils with stimulus material and secondary sources and ask them to identify patterns in the number of eggs, internal and external fertilisation or development, aftercare, growth pattern and chance of offspring surviving to maturity in the species used. • Discuss the advantages of retaining the young in the body and feeding the young on milk after birth, <i>eg continuous access to nutrients, protection from predators</i>. Show pupils video clips of other mammals' offspring immediately after birth and ask them about their experience of newly born pets. Establish that newborn humans are more dependent than some other species. Help pupils to agree some broad generalisations from the data considered. | <ul style="list-style-type: none"> • state that mammalian young are fertilised internally and develop in the uterus • explain that an advantage of internal development over external is that there is a greater chance of developing eggs surviving to become independent young • draw conclusions about mammalian reproduction, <i>eg some mammals have large numbers of offspring with a relatively small investment in aftercare, others have fewer offspring with a high degree of aftercare</i> | <ul style="list-style-type: none"> • Extension: pupils could be encouraged to comment on advertising campaigns aimed at getting parents to talk to their children, then to think about how parents provide for children's emotional as well as physical needs. • As an alternative, pupils could compare the advantages and disadvantages of internal versus external fertilisation. Pupils could follow this up with group discussion, before summarising their own viewpoints in writing. |
| <ul style="list-style-type: none"> • the structure and function of the human male and female reproductive organs • that fertilisation involves the fusion of the nuclei of sperm and egg • that the fertilised egg divides into 2, 4, 8, etc cells as it passes down the oviduct | <ul style="list-style-type: none"> • Using models, video clips or other illustrations, help pupils to identify, name and describe the functions of the mature human reproductive organs. Ask pupils to annotate diagrams of male and female reproductive organs. • Remind pupils of work on cells and establish that for fertilisation to occur, a male cell (sperm) fuses with a female cell (egg). Establish that sperm are produced in testes and eggs in ovaries. Talk with pupils about sperm being deposited in the vagina and having to move to where the eggs are and eggs being moved down the oviduct, illustrating, <i>eg with video and software simulations</i>. Explain fertilisation in terms of the fusion of nuclei of sperm and egg. • Discuss with pupils, illustrating with, <i>eg video clips, photographs, software simulations</i>, how the cells divide and increase in number. Ask pupils to draw, or label, and sequence pictures or diagrams illustrating ovulation, fertilisation, cell division and implantation. | <ul style="list-style-type: none"> • name, locate and describe the functions of the reproductive structures, <i>eg ovary, oviduct, uterus, vagina, penis, testis, sperm duct</i> • describe fertilisation in terms of the fusion of cells • sequence changes in sperm and eggs during and after ovulation | <ul style="list-style-type: none"> • This provides an opportunity to discuss how infertility may arise, <i>eg from low sperm counts, blocked oviducts or infrequent ovulation</i>, the technological solutions available and some ethical and social issues that may arise. • Teachers may wish to point out that an unfertilised egg will not survive more than three days, although sperm may remain alive for longer. |

Learning objectives

Pupils should learn:

- that sperm and egg cells are specially adapted for their functions

Possible teaching activities

- Show photographs or video clips of sperm and egg cells. Ask pupils to compare them and suggest how they are specially adapted for their functions. Ask pupils to draw and describe or annotate drawings of egg and sperm cells, identifying their main features.

Learning outcomes

Pupils:

- identify and describe how sperm cells are adapted to their functions, *eg a tail that pushes it along; streamlining, by reduction in size through having less cytoplasm; a specially strengthened head that contains chemicals to penetrate and break down the outer layers of the egg*
- identify and describe how egg cells are adapted to their functions, *eg an enlarged cell with food reserves*

Points to note

- This work draws on unit 7A 'Cells'.
- Extension: discussion of the adaptations of cells could be extended to the ciliated cells in the oviduct.

- that male and female nuclei contain the characteristics of male and female parents respectively

- Use quick questions to check pupils' recall of cell structure and making new cells. Review fertilisation in terms of the fusion of nuclei and discuss how this results in characteristics being passed from parents to offspring.
- Ask the pupils to speculate on how identical and non-identical twins occur, *eg by providing them with statements containing correct and incorrect explanations from which to select.*
- Establish with pupils that, whether fertilisation is internal or external, it involves the fusing of male and female nuclei and involves the combination of characteristics of both parents.

- explain that sperm and egg each contain half the inherited information needed and relate this to the concept of identical and non-identical twins

- This work provides opportunities for pupils to relate ideas about inheritance to themselves. Teachers will be aware of the need to be sensitive to the circumstances of individuals and of their families.
- Detail about mitosis is not required at key stage 3.

Pupils should learn:

Pupils:

When can human fertilisation take place?

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| <ul style="list-style-type: none"> • that egg cells are released from the ovaries at regular (approximately monthly) intervals • that menstruation is a monthly cycle which stops during pregnancy • that the stages in the menstrual cycle are controlled by hormones | <ul style="list-style-type: none"> • Remind pupils of the differences between external and internal fertilisation. Ask them about the numbers of eggs and sperm in each case and to suggest reasons for any differences. Find out what pupils know about human egg cells, <i>eg where they are produced, how often they are produced</i>, and how a woman might know if she is pregnant or not. Using pupils' suggestions and video or CD-ROM simulation introduce the stages of the monthly cycle. • Help the pupils to construct a diagram of the days in the cycle, marking when menstruation and ovulation might occur and when the uterus lining is thickening. Discuss with pupils the variation in cycle length and practise calculating when a woman might ovulate and when her period is due. Explain that the menstrual cycle also prepares the uterus for a fertilised egg and identify the time in the cycle when fertilisation is most likely. • Establish that, on the whole, humans have one offspring at a time and that the human reproductive system is designed to try to make sure that the one offspring survives. | <ul style="list-style-type: none"> • describe the changes of the menstrual cycle, <i>eg egg maturation, ovulation, menstruation</i> • recognise egg production as a cyclic activity • make calculations, <i>eg ovulation date and menstruation date</i>, for a regular cycle | <ul style="list-style-type: none"> • This work provides an opportunity to discuss other changes related to menstruation and to answer questions raised by both boys and girls. • At this stage pupils do not need to know about oestrogen or progesterone changes, or that egg development is stimulated by a hormone produced by the brain and changes in the uterus are controlled by hormones produced by the ovaries. • Personal-hygiene companies offer visits by health professionals to support girls in the early years of puberty. They can also provide support for boys and mixed groups. • These activities provide an opportunity to discuss with pupils the reasons for, and some outcomes of, multiple births. |
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How is the human fetus supported as it develops?

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| <ul style="list-style-type: none"> • that the fetus develops within a membranous bag and is supported and cushioned by amniotic fluid • that the placenta supplies nutrients and oxygen to the fetus via the umbilical cord, and removes carbon dioxide and other waste products | <ul style="list-style-type: none"> • Use quick questions to establish pupils' knowledge of pregnancy. Use photographs, models, diagrams, video clips, CD-ROMs or ultrasound scans to look at the changes in a developing fetus from implantation to birth and discuss the sequence with pupils. • Identify the structures within the pregnant uterus and explain the functions of the amnion and amniotic fluid. Discuss with pupils the fetus' need for nutrients and explain the role of the placenta in materials exchange. Ask pupils to label a diagram and use arrows to show movement of oxygen and nutrients from the mother to the fetus and the movement of carbon dioxide and other waste products from the fetus to the mother. | <ul style="list-style-type: none"> • identify the structures in a pregnant uterus and explain the function of amniotic fluid, <i>eg supporting the fetus, cushioning against shocks</i> • describe the general route taken by nutrients from the mother's digestive system to the fetus' brain • state that oxygen, water and digested food pass from the mother's blood to the fetus' blood and that carbon dioxide and other waste products pass in the opposite direction | <ul style="list-style-type: none"> • Several teaching schemes include photocopiable templates for making models of the fetus in the uterus. |
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Learning objectives

Pupils should learn:

- that harmful substances and viruses can cross the placenta into the fetus and affect development

Possible teaching activities

- Challenge pupils to explain why, at one time, teenage girls were offered the rubella vaccine, but boys were not. Using secondary sources, discuss with pupils the passage of alcohol, substances from cigarette smoke and drugs across the placenta. Ask pupils to make a poster or leaflet to explain, *eg why vaccination against rubella is important, how smoking can affect a developing fetus.*

Learning outcomes

Pupils:

- include in their poster or leaflet appropriate information about the effects of alcohol, smoking or drugs on a developing baby's growth
- recognise that pregnant women should avoid rubella

Points to note

- This work provides an opportunity to undertake a risk assessment on the effects of smoking on the unborn child.
- Other effects of harmful substances are covered in unit 9B 'Fit and healthy'.

What do newborn babies need?

- that uterine muscle contracts during birth, expelling the fetus and placenta through the vagina
- that the baby is nourished by milk from mammary glands, which provides nutrients and protects from infection

- Discuss with pupils the processes of birth, using video, photographs and diagrams as illustrations.
- Ask pupils how newborn babies obtain the nourishment they need. Describe the composition of breast milk. Review with pupils their knowledge of the care needed by babies.
- Use video clips to show that a baby is responsive to its world, *eg has reflex actions when born, such as head turning when its cheek is touched.*

- explain the process of birth as cervix muscles relaxing, uterus muscles contracting, and the fetus being pushed out, usually head first, with the placenta expelled afterwards
- describe how a newborn baby obtains the nutrients it needs for growth
- recognise that breast milk contains antibodies that protect against common micro-organisms

- Extension: premature babies receive technological support in countries where such facilities are available, *eg use of incubators and light treatment for jaundice*, and pupils could investigate what life-support systems are needed.
- Extension: pupils could examine data on the slight reduction in survival rate of both very small and very large babies and speculate on the factors that can lead to these conditions, *eg smoking linked with low birth weight.*

Checking progress

- to summarise and make connections between key ideas in the unit
- to plan and develop ideas and lines of thinking into continuous text

- Ask pupils to produce a short illustrated account of the growth of a fetus and birth, which could be used with a younger sibling when a new baby is about to arrive in the family. Ask them for their ideas of the main points to include and how to organise the material.

- produce an account identifying key points and linking them in an appropriate sequence, using links of time and cause

- A writing frame could profitably be used to give structure to this activity.

Pupils should learn:

Pupils:

How do humans change as they grow?

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| <ul style="list-style-type: none"> • that periods of rapid growth occur during the human life cycle • to decide what sort of graph is appropriate | <ul style="list-style-type: none"> • Use quick oral questions to elicit pupils' knowledge of the human life cycle, eg <i>babyhood, childhood, adolescence, puberty and adulthood</i>. • Ask pupils to recall times when they grew rapidly in primary school and identify the main ways in which they changed. Use secondary data of height at different ages to plot growth charts and identify the main periods of time when rapid growth takes place. | <ul style="list-style-type: none"> • recognise that rapid growth occurs at different times in the human life cycle and identify when this happens on a growth graph • recognise that there is a wide variation in the development of children • present data about height in an appropriate chart or graph | <ul style="list-style-type: none"> • Many pupils are sensitive about their weight. Sensitivity is needed with height because a small but significant number of children have growth problems. Height/weight charts used by health professionals illustrate the range of expected heights and weights. These can be used to reassure pupils at the extremes of the range. • Teachers will be aware of the need for sensitivity to pupils who may mature earlier or later than the majority of their peers. |
| <ul style="list-style-type: none"> • that cell division and increased cell size lead to growth of the body • about the importance of sample size in obtaining reliable evidence • to decide on an appropriate graph to display data • to interpret class data and compare with national data | <ul style="list-style-type: none"> • Remind pupils of their work on cell division. Discuss growth and how pupils should measure it, eg <i>weight gain, height changes, girth</i>. Pupils explore the range of heights in the class and present their data. Help pupils to think about how many individuals are needed for measurement to ensure reliable information, what other factors should be considered, eg <i>boys/girls</i>, and how they will present their data. • Discuss with the pupils trends in the data. Show charts and graphs to illustrate the range of expected heights and weights at this age. Help pupils compare the ranges shown by the charts with the data collected by the class and discuss reasons for similarities and differences in terms of sample size. | <ul style="list-style-type: none"> • explain that measurable changes in growth result from cell division and increased size • suggest reasons for differences between class and national data and explain in terms of sample size | <ul style="list-style-type: none"> • The focus is on collecting reliable information, but pupils may need support in constructing appropriate graphs and bar charts. The activity offers an opportunity to use ICT. • Extension: pupils could use secondary data, eg <i>evidence from great-grandma's height, Tudor beds, historical and literary evidence of people's diet, Saxon burial sites</i>, to compare growth of young people today with those in historical times when many children were not well nourished. In medieval times shortages in food supply contributed to smaller stature. However, many dark-age burial sites show that men and women had similar stature to people of today. • Extension: pupils could also explore present-day variations in stature between countries and within the UK. |

Learning objectives

Pupils should learn:

- that changes in hormone concentrations result in the development of secondary sexual characteristics and emotional changes at puberty
- to collaborate with others to share information and ideas, and solve problems
- to answer questions using relevant evidence or reasons

Possible teaching activities

- Discuss how external adult features change during puberty, *eg breasts, wider hips, facial and body hair, voice changes, stronger body smell*. Explain that circulating hormones cause the development of secondary sexual characteristics and reproductive organs.
- Challenge the pupils to provide evidence about whether emotional maturation during adolescence proceeds at the same rate as physical maturation in puberty, *eg by selecting or modifying personal problems from a teenage magazine or by creating stories about secondary sexual characteristics or emotional maturation*. Ask pupils to discuss scenarios in groups and then produce and present a reply to the rest of the class.

Learning outcomes

Pupils:

- recognise that reproductive organs mature during puberty as a consequence of growth and circulating hormones
- describe the observable changes of puberty in males and females, *eg breasts, more body hair, different body shape*
- provide examples of how physical and emotional development proceed at different rates
- share information and discuss ideas

Points to note

- Reassurance about the range of different secondary sexual characteristics can alleviate pupils' concerns and sensitivities about their stage of development.
- Extension: pupils could be given information about research into boys' and girls' views about parenting and discuss differences between the genders.

Reviewing work

- to bring together information about a particular aspect of reproduction
- to distinguish between the main ideas in the unit
- Provide pupils with a series of statements about the human life cycle, the processes of fertilisation, embryo development and birth, and about the specialisation of cells. Ask pupils to sort the statements into groups and use them to make summaries of the ideas encountered in the unit.
- produce summaries which are appropriately sequenced to show key ideas
- distinguish between aspects of reproduction, *eg fertilisation and gestation*
- It may be appropriate to give some pupils statements in one category first and then extend the work.