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Glossary of Terms Used In Developmental and Reproductive Toxicology

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INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

CHEMISTRY AND HUMAN HEALTH DIVISION†

GLOSSARY OF TERMS USED IN DEVELOPMENTAL AND REPRODUCTIVE TOXICOLOGY

(Provisional Recommendations)

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Membership of the Committee of the Chemistry and Human Health Division during the preparation of this report (2014-2015) was as follows:

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IUPAC GLOSSARY OF TERMS USED IN DEVELOPMENTAL AND REPRODUCTIVE TOXICOLOGY

(IUPAC Recommendations 2015)

Abstract: The primary objective of this *Glossary of Terms Used in Developmental and Reproductive Toxicology* is to give clear definitions for those who contribute to studies relevant to these disciplines in toxicology, or must interpret them, but are not themselves reproductive physiologists or physicians. This applies especially to chemists who need to understand the literature of reproductive and teratogenic effects of substances without recourse to a multiplicity of other glossaries or dictionaries. The Glossary includes terms related to basic and clinical reproductive biology and teratogenesis, insofar as they are necessary for a self-contained document, and particularly terms related to diagnosing, measuring, and understanding effects of substances on the embryo, fetus, and the male and female reproductive systems. The glossary consists of about 1200 terms as primary alphabetical entries, and includes Annexes of common abbreviations, and examples of chemicals with known effects on human reproduction and development. The authors hope that among the groups who will find this glossary helpful, in addition to chemists, are toxicologists, pharmacologists, medical practitioners, risk assessors, and regulatory authorities. In particular, it should facilitate the worldwide use of chemical terminology in relation to occupational and environmental risk assessment.

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PREFACE

A major goal of IUPAC is to promote "regulation, standardization, or codification" globally in relevant areas of chemistry. To this end, the Division of Chemistry and Human Health (Division VII), recognizing the importance of toxicology to chemists, produced the Glossary of Terms Used in Toxicology, 2nd ed., in 2007 [1]. That glossary was intended to provide clear and concise definitions for a range of terms in toxicology and toxicokinetics, primarily for chemists who find themselves working in toxicology or requiring a working knowledge of the subject. It was also recognized that other scientists, regulators, and managers must from time to time interpret toxicological information, and it was hoped that the Glossary would also provide them with ready access to internationally accepted definitions of relevant terms. A number of subspecialties have

broadened the scope of toxicology; in 2009 the Division expanded the collection of available definitions with publication of a Glossary of Terms Used in Ecotoxicology [2], and again in 2012 with a Glossary of Terms Used in Immunotoxicology [3]. A Glossary of Terms in Neurotoxicology [4] has special significance with respect to the present compilation insofar as the developing nervous system is particularly susceptible to toxic substances.

Scientific terminology continues to evolve and definitions need periodic refinement. A searchable, electronic database updating and combining entries from the previous glossaries is desirable, and achievable, and a project to realize this is underway, but at its inception we realized that some areas of toxicology had been under-represented, and addressing this deficit will enhance the usefulness of the database. One area that has been under-represented in previous IUPAC glossaries is reproductive and developmental toxicology, and the present document is an attempt to address this deficit. Intended to stand alone as an IUPAC Recommendation in the narrower field, it is also destined for integration into the revised, online Glossary of Terms Used in Toxicology, currently under construction.

In order to minimize the reader's time in consulting additional texts, terms from [1-4] are included in the present Glossary when it is felt that they are used with particular frequency in reproductive and developmental toxicology. By the nature of the subject, it has been necessary to include a number of clinical and anatomical terms. We have also exercised judgment in deciding which terms from basic developmental biology should be included for the reader's convenience. In the spirit of producing a document primarily useful for chemists and allied professionals, we have tried not to be over-inclusive in this regard, yet including terms that may be encountered with reasonable frequency in the literature of reproductive and developmental toxicology. When a medical term is defined, we have tried to provide a brief, useful definition that is nevertheless accurate in terms of current medical understanding. A number of syndromes caused by gene mutations have been included, although the list is necessarily selective and by no means exhaustive. In many instances there is no evidence of these being the direct result of toxic or teratogenic effects, and the guiding principle has been to include more commonly mentioned syndromes (even when their actual occurrence may be rare) as examples of potentially teratogenic outcomes.

In general, commonly preferred or American spelling has been adopted for the main entry terms; thus, for example, disc (not disk), fiber (not fibre), masculinization (not masculinisation), and tumor (not tumour). Further, somewhat arbitrary decisions must be made in listing alternative forms of terms as the main entry (e.g., haploid instead of monoploid, semen instead of seminal fluid, and undescended testis instead of cryptorchism). We have generally tried to use the form we find to be in most common usage, and cross-reference the lesser-used term if it seems also common; but if a desired entry is not found under one construction, it should be sought under another.

Some definitions have been compiled from earlier sources, with or without modification, as indicated in the citation. When no citation is given, the term is newly defined. When a citation is given, the definition is more or less a quotation from the original. With the qualification "After [ref.]", the general concept of the original has been retained with some rewording, often for consistency with IUPAC guidelines for glossaries. "Modified

from" implies that a concept specific to the source is retained but given revised wording. When a citation is indented following a *Note*, it refers only to the *Note*.

The document has been put together with invaluable input from many colleagues and expert reviewers. Where flaws remain, they are the responsibility of the authors.

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ALPHABETICAL ENTRIES

A/D ratio
Ratio of the *adult* toxic dose to the developmentally toxic dose.

abdominal cavity
Body cavity between the *diaphragm* and pelvis that contains the abdominal organs.

ablepharia (n)/**ablepharous** (adj)
Congenital absence of the eyelids.

abortion
Premature termination of *pregnancy* with the death of the *embryo* or *fetus*.

abortion, induced
Intentional termination of a *pregnancy* with death of the *embryo* or *fetus*.

abortion, spontaneous
miscarriage
Non-intentional termination of *pregnancy* before the embryo or *fetus* has developed to the stage of independent *viability*, or in humans before the 20th week of *gestation*.

accessory rib
Rib arising from a cervical *vertebra* (*cervical rib*), or *supernumerary* rib arising from a thoracic or lumbar vertebra.

accessory sex gland
Any gland, other than a *gonad*, associated with the genital tract, such as the *bulbourethral* gland and *prostate*.

accessory sex organ
secondary sex organ
Organ or structure other than the *gonads* that matures at puberty and assists indirectly in *sexual reproduction* by nurturing and transporting *gametes*.

Note 1: In the human female the accessory sex organs include the *uterus*, *vagina*, and the external genitalia.

Note 2: In the human male, the accessory sex organs include the *epididymis*, *vas deferens*, ejaculatory duct, *urethra*, *seminal vesicles*, *bulbourethral glands*, *prostate*, and penis.

achondroplasia (n)/**achondroplastic** (adj)
Inherited disorder where *ossification* of cartilage is retarded, especially affecting growth of long bones, resulting in very short limbs and a comparatively large head. Type of dwarfism.

Note: Achondroplasia results from a mutation in the fibroblast growth factor receptor FGFR3 gene, increasing its activity in suppressing *endochondral ossification*.

acidosis
Opposite term: *alkalosis*
Abnormal increase in hydrogen ion concentration (decrease in pH below the reference interval measured in the arterial blood) usually caused either by an accumulation of carbon dioxide or acidic metabolites, or by a depletion of alkaline reserve (i.e., bicarbonate).
Note: Acidosis may occur as a result of accumulation of ketones in uncontrolled diabetes mellitus (diabetic acidosis) or after calory deprivation (starvation acidosis), or with accumulation of keto-acids at the expense of bicarbonate (metabolic acidosis). Suppression of respiration can produce a respiratory acidosis.
Note 2: Some intoxications can produce metabolic and (or) respiratory acidosis.

acinus
1. Small sac-like cavity in a *gland*, surrounded by secretory cells.
2. Terminal region of the airways of the lung where gas exchange occurs.

acoustic meatus
Either of two passages in the ear, one leading to the *tympanic* membrane (external acoustic meatus), and one for passage of nerves and blood vessels (internal acoustic meatus).
[6]

acrania
Rare *congenital* disorder that occurs in the human *fetus* in which the flat bones in the *cranium* are either completely or partially absent.

acrocephaly
acrocephalia
oxycephaly
Type of *cephalic* disorder where the top of the skull is pointed or conical due to premature closure of the *coronal suture* plus any other suture.
Note: Acrocephaly should be differentiated from *Crouzon syndrome*, which involves the maxilla and mandible.

acromegaly
acromegalia
Abnormal enlargement of the hands, feet, and face in adults, caused by overproduction of *growth hormone* by the *pituitary* gland.
Note: Overproduction of *growth hormone* by the *pituitary* gland in children causes *gigantism*.

acrosome
Organelle that develops over the anterior half of the head in the *spermatozoon*.
Note: The acrosome is a cap-like structure derived from the Golgi apparatus.

acrosome reaction
Process that occurs in the *acrosome* of the *sperm* as it contacts the *egg*, leading to structural changes that facilitate fusion.

activin
Growth factor of the transforming growth factor β (TGF-β) superfamily, originally identified as a gonadal factor that stimulated secretion of *follicle stimulating hormone*, also involved in many aspects of development including *mesodermal* induction (see *mesenchyme*), *hematopoiesis*, and *neuronal* differentiation.

acyclicity
Irregular or absent *estrous cycles*.
Compare *anestrus*.

Ad4BP
See *adrenal 4 binding protein*.

adactyly
adactylia
adactylism
Congenital absence of fingers or toes.

adenocarcinoma
Malignant *tumor* formed from glandular *epithelial* tissue or formed in a glandular pattern.

adermia
Congenital absence of skin.

adhesion factor
Substance contributing to selective cell-cell and cell-matrix binding.

aditus
Entrance or opening to some interior space or cavity.

adolescen/ce n., **/t** adj.
Stage of human development beginning with *puberty* and ending with *adulthood*.

adrenal 4 binding protein (Ad4BP)
Transcription factor that regulates the *expression* of the enzymes of *steroid* synthesis and is expressed primarily in *steroidogenic* cells.

adrenal gland
paranephric gland
suprarenal gland
Either of two small *endocrine glands*, one located above each kidney, consisting of a cortex, which secretes several *steroid hormones*, and a medulla, which secretes

epinephrine and *norepinephrine*.

adrenaline
epinephrine
4-[(*1R*)-1-hydroxy-2-(methylamino)ethyl]benzene-1,2-diol
Catecholamine hormone secreted by the adrenal glands that increases heart rate, breathing rate, blood pressure, and carbohydrate metabolism.
See also *noradrenaline*.

adrenocortocotropic hormone (ACTH)
Hormone secreted by the *pituitary gland* and stimulating the adrenal cortex (see *adrenal gland*).

adrenogenital syndrome
See *congenital adrenal hyperplasia*.

adult
Person or animal that is fully grown, developed and sexually mature.

adulthood
State of being *adult*.

adult stem cell
Undifferentiated cell involved in tissue renewal.

aganglionic megacolon, congenital
See *Hirschsprung disease.*

agenesis
Absence or partial development of an organ or body part observed at *birth*.

age-specific birth rate
age-specific fecundity
age-specific fertility rate
Mean number of offspring born to a female in a specific age class in a given year, expressed per 1000 females in that age class.
[2]

aggregation chimera
Organism made by combining cells from two *embryos* of different *genotypes*.
After [7]

agnathia
Congenital absence or partial absence of the lower jaw.
See also *macrognathia, otocephaly, synotia*.

agonist
Opposite term: *antagonist*
Substance, naturally occurring or otherwise, that binds to cell *receptors* that normally respond to a naturally occurring substance, and producing an effect similar to the natural substance.
Note 1: A partial agonist activates a receptor but does not cause as much of a physiological change as does a full agonist.
Note 2: A co-agonist works together with other co-agonists to produce a desired effect.
After [1]

alar plate
Part of the *dorsal* side of *neural tube* in the *embryo*, involved in general *somatic* and *visceral* sensory communication.

albinism
achromasia
achromatosis
Congenital disorder characterized by the complete or partial absence of pigment in the skin, hair and eyes, due to an absence of or defect in tyrosinase, a copper-containing enzyme involved in the production of melanin.
Compare *leucism*.

alcohol-related neurodevelopmental disabilities (ARND)
Spectrum of functional neurologic (behavioral) defects resulting from exposure *in utero* to alcohol.
See also *fetal alcohol syndrome*.

alkalosis
Opposite term: *acidosis*
Abnormal decrease in hydrogen ion concentration (increase in pH above the reference interval measured in the arterial blood) caused by a decrease in CO_2, deficiency of chloride, decreased bicarbonate. etc.

allantois (n)/**allantoic** (adj)
Extra-*embryonic membrane* formed early in development as an outpouching of the *yolk sac* into the area of the future *umbilical cord*.
Note: Blood vessels of the allantois become the *umbilical artery* and *umbilical veins*.

allele
One of several alternate forms of a *gene* that occur at the same relative position (*locus*) on *homologous chromosome*s.
Note: Paired alleles become separated during *meiosis* and can be recombined following fusion of *gamete*s.
[1]

alopecia

Hairlessness; absence or thinning of hair from areas of skin where it is usually present. [1]

alopecia, neonatal
See *neonatal occipital alopecia*.

alpha-fetoprotein (AFP)
α-1-fetoprotein
Protein coded by the AFP gene and produced by *fetal* tissues, an abnormally high amount of which in the *amniotic fluid* or maternal serum may indicate a *neural tube defect*, or some other loss of structural integrity in the fetus.

alpha-reductase
See *5α-reductase*.

alveolar period
alveolar phase
Phase in lung development beginning *in utero* (about 32 to 36 weeks in the human fetus) and lasting until about 8 years of age.
Note: In this phase, the terminal alveolar saccules subdivide several more times, giving rise to the mature *alveoli*.

alveolus
Any of the many terminal air sacs of the airways in the lungs necessary for rapid gaseous exchange with the blood.

amastia
Congenital absence of one or both *mammary glands*.

ambisexual
bisexual.
1. Pertaining to or characterized by *hermaphroditism*.
2. Denoting sexual characteristics common to both sexes, e.g., *pubic* hair.

amelia
Lacking one or more limbs or having a shrunken or deformed limb as a *birth defect*.
See also *phocomelia*.

ameloblast
Epithelial cell that deposits enamel during tooth development.

amelogenesis imperfecta
hereditary yellow, brown or grey tooth enamel
Developmental disorder of the teeth in which they are covered with thin, abnormal enamel resulting from defective structure or processing of enamel proteins.

amenorrhea
menostasis
Absence or abnormal stoppage of *menstruation*.

Ames test
Method for assessing *mutagenicity* in vitro using mutant (see *mutation*) strains of the bacterium Salmonella typhimurium that cannot grow in a given histidine-deficient medium

Note 1: Mutagens cause reverse mutations that enable the bacterium to grow on the deficient medium.

Note 2: The test can be carried out in the presence of differentially centrifuged liver homogenates, providing enzymes that catalyze the metabolic transformation of mutagen precursors to active derivatives.

[1]

amniocentesis
Transabdominal procedure in which *amniotic fluid* is sampled by means of a needle inserted into the *amniotic sac*.

Note: This procedure is used to screen for infections and abnormalities in the developing *fetus*.

amniochorionic membrane
Composite *membrane*, formed by fusion of the *amnion* interiorly and the outer *chorion*, that surrounds the developing *fetus*.

amnion
Membrane that lines the *amniotic cavity* (*amniotic sac*) and encloses the *embryo* of a mammal, bird, or reptile.

amniote
Any *vertebrate* animal, such as a reptile, bird, or mammal, that possesses an *amnion*, *chorion*, and *allantois* during *embryonic* development.
Compare *anamniote*.

amniotic cavity
Fluid-filled space that surrounds the developing *embryo* of a mammal, bird, or reptile, bounded by the *amniotic sac*.

amniotic fluid
Fluid surrounding an *embryo* or *fetus* in the *amniotic cavity*.

amniotic sac
Membranous structure in *amniotes*, within which the *embryo* and *fetus* develop.

Note: It consists of a thin but tough, transparent pair of membranes, the *amnion* and *chorion*, that hold the developing *embryo* (and later *fetus*) until shortly before *birth*.

amphibian metamorphosis assay
Procedure in which a frog (often Xenopus laevis) is exposed to a substance starting at the tadpole stage, and the growth and development of the animals is studied.
See also *FETAX*.

ampulla
Flask-like dilatation of a *canal* or *duct*.

anal canal
Terminal part of the large intestine between the rectum and anus.

anal membrane
In the *embryo*, *dorsal* part of the *cloacal membrane* after its division of the urorectal septum.
[6]

anal pit
See *proctodeum***.**

anamniote
Any *vertebrate* animal, such as a fish or amphibian, that lacks an *amnion*, *chorion*, and *allantois* during *embryonic* development.
Compare *amniote*.

anaphase
Stage of *mitosis* and *meiosis* in which the *chromosomes* move from the equatorial plate toward opposite ends of the *nuclear spindle***.**

anaphase lag
Slowing or stopping of normal migration of *chromosomes* during *anaphase*, resulting in chromosomes being excluded from one of the daughter cells causing *aneuploidy*.

anasarca
hydrosarca
dropsy
Generalized *edema* in the subcutaneous *connective tissue*.
Note: Anasarca may be *congenital* (whole body edema) caused by liver failure, renal failure, right-sided heart failure, or severe malnutrition with resultant protein deficiency.

anastomosis
Connection creating continuity between two tubular body structures, e.g. blood vessels or loops of bowel.
Note: An anastomosis may be a surgical construction (as when the two cut ends are joined following resection of a loop of bowel), may result from trauma, or may

occur as a natural anatomic feature, typically involving blood vessels (as in an arteriovenous anastomosis bypassing a capillary bed; see *arteriovenous shunt*).

anatomic position, fetal
Usual positioning of the developing *fetus* with the back curved forward, head bent forward, and limbs drawn in towards the body.
Note: This position arises from the natural positioning of the embryo as the germ layers develop.

anchoring villus
*Chorion*ic *villus* that is attached to the region of the *endometrium* (see also *decidua*) that interacts with the *trophoblast* during development of the *placenta*.

androblastoma
arrhenoblastoma
Sertoli cell tumor
Rare benign *tumor* of the *testis* histologically resembling the *fetal* testis: the *epithelium* contains *Sertoli cells* that may produce *estrogen* and cause feminization.
[6]

androgen
Substance, such as a naturally occurring *steroid hormone*, that binds to *androgen receptors* to activate the male *accessory sex organs* and induce male *secondary sexual characteristics*.
See also *androgenic*.

androgenic
Producing masculine characteristics.
See also *androgen*.

androgen receptor (AR)
Nuclear receptor that is activated by binding of *testosterone* or dihydrotestosterone.
See also *androgen, androgenic*.

androstenedione
Steroid hormone produced in the *adrenal glands* and *gonads* as a common precursor of male (*testosterone*) and female (*estrogen*) sex hormones.

anemia
Decrease in the number of erythrocytes or total hemoglobin in the blood that results in a decrease in the oxygen-carrying capacity of the blood, sometimes pallor and fatigue.

anencephalus
1. *Fetus* lacking all or most of the neural tissues of brain.
2. *Anencephaly* (see below).

anencephaly (n)/**anencephalic (**adj)
anencephalia
Congenital absence of a major portion of the brain and spinal cord, skull, and scalp that results from abnormal *embryonic* development.

anestrus
Interval of sexual inactivity between two periods of *estrus*.

aneugen (n)/**aneugenic** (adj)
Agent inducing *aneuploidy*.

aneuploid
Referring to a cell or organism with missing or extra *chromosomes* or parts of chromosomes, and thus an abnormal number of chromosomes that is not an exact multiple of the *haploid* number.
[1]
See also *euploid, ploidy*.

aneuploidy
State of being *aneuploid*.

aneurysm
Abnormal bulging of the wall of an artery or a chamber of the heart.
Note: An aneurysm may present a risk of hemorrhage if it ruptures.

angioblast
vasoformative cell
1. Cell taking part in blood vessel formation.
2. Primordial *mesenchymal* tissue from which *embryonic* blood cells and vascular *endothelium* are differentiated.
[5]

angiogenesis (n)/**angiogenic** (adj)
Development of new blood vessels in the *embryo* or from pre-existing vessels; formation of capillary networks.
Compare *arteriogenesis*, *vasculogenesis*.

angiotensin converting enzyme (ACE)
Enzyme that converts angiotensin I to angiotensin II, causing blood vessels to constrict thus increasing blood pressure.
Note: ACE inhibitors are used clinically to lower blood pressure.

ankyloglossia
Congenital oral anomaly, in which the lingual frenulum (the membrane connecting the underside of the tongue to the floor of the mouth) is unusually short and thick.
Note: As a result of this, mobility of the tongue tip is decreased.

anodontia
Congenital absence of all primary or permanent teeth.

anogenital distance (AGD)
Distance along the *perineum* between the anus and the base of the *vagina* or penis, or in the fetus between the anus and the base of the *genital tubercle*.

Note 1: The distance is relatively longer in males than females. This in part relates to dihydrotestosterone levels, and abnormal distances may indicate birth defects, feminization in males, etc.

Note 2: In some species where gender is not obvious at birth, it can be used for a tentative determination of the sex of the *neonate*.

anomaly, developmental
congenital anomaly
Deviation in structure or function arising in the *embryo* or *fetus*, due to genetic or other causes.
See also *congenital malformation*, *variation*.

anonychia
Absence of nails.

Note: This rare disorder may be the result of a *congenital* defect of *ectoderm*, *ichthyosis*, severe infection, severe allergic contact dermatitis, self-inflicted trauma, Raynaud phenomenon, *lichen planus*, epidermolysis bullosa, or severe *exfoliative* diseases.

anophthalmia
Congenital absence of one or both eyeballs.

anorchism
Congenital absence of one or both testes.

anorectal
Relating to the *anus* and rectum.

anotia
Congenital absence of the (outer ear) *pinna*, often with narrowing or absence of the ear canal.

anovulation
Failure of the ovaries to produce, to facilitate maturation of, or to release ova.

anoxia
Strictly, total absence of dioxygen, but sometimes incorrectly used instead of *hypoxia* to mean a decreased dioxygen supply to the tissues.
After [1]

antagonist (in toxicology)
Opposite term: *agonist*
1. Any substance that competes for effect with, or blocks the biological action of, another.
2. At a cell receptor, substance that binds to the receptor without activating it, and prevents a response to the natural ligand (the *agonist*).

antemortem
Before death.

antepartum
Before *birth*.

antidiuretic hormone
See *vasopressin.*

antimitotic
Referring to inhibition of cell division by *mitosis*.

anti-Müllerian hormone (AMH)
Müllerian inhibiting factor (MIF)
Müllerian-inhibiting hormone (MIH)
Müllerian-inhibiting substance (MIS).
Protein that inhibits the development of the *Müllerian ducts* (paramesonephric ducts) in the male *embryo*.
Note: The Müllerian ducts would otherwise differentiate into the *uterus* and *Fallopian tubes*.

antrum
Cavity or chamber, often in bone, with specific meanings in some hollow organs (e.g., the pyloric end or gastric antrum of the stomach).

anus (n)/**anal** (adj)
External opening of the rectum to the body surface, controlled by the anal *sphincter*.
See also *imperforate anus*.

aorta (n)/**aortic** (adj)
Great artery arising from the left ventricle, being the main trunk from which the systemic arterial system proceeds
[6]

aorta-gonad-mesonephros (AGM) **region**
Region of the *vertebrate embryonic mesoderm* that gives rise to the *genitourinary* tract and its blood supply.
Note: The AGM region is the first embryonic site for autonomous *hematopoiesis* and production of hematopoietic stem cells.

aortic arch
Curved portion of the *aorta* between its ascending portion exiting the heart and its descending portion that proceeds to the arteries of the *thoracic* and *abdominal cavities* and the lower body.

aortopulmonary septum
aorticopulmonary septum
Spiral *septum* that, during development, separates the *truncus arteriosus* into a *ventral pulmonary* trunk and a *dorsal aorta*.
After [5]

aphakia
Absence of the lens of the eye, occurring as a *congenital* defect or as a result of trauma or surgery.
Note: Aphakia causes a loss of visual accommodation, far sightedness (hyperopia), and a deep anterior chamber of the eye.

apoptosis (n)/**apoptotic** (adj)
Active process of programmed cell death, characterized by cell shrinkage, nuclear condensation, and fragmentation and loss of individual cells; usually involving activation of *caspase* enzymes and requiring energy provided by hydrolysis of ATP.
Note 1: Other factors trigger cell death with characteristics of apoptosis but independent of caspase activation, an example being release of apoptosis-inducing factor (AIF) from the mitochondrion. Here the term caspase-independent apoptosis is used.
Note 2: While ATP is generally necessary to sustain the apoptotic program, depletion of ATP during the course of apoptosis may cause cells to default to death by *necrosis* (see *necrapoptosis*, *aponecrosis*), or proceed to apoptotic death with features common to necrosis, sometimes called "late apoptosis". Alternatively, in some circumstances apoptosis may proceed without ATP ("ATP-independent apoptosis").
See also *anoikis*, *autophagy*, *extrinsic pathway*, *intrinsic pathway*, *parthanatos*.

appendicular skeleton
Bones and cartilage that support the appendages, including the bones of the shoulders, upper limbs, pelvis, and lower limbs.
See also *axial skeleton*.

appendix (in anatomy)
1. Tube-shaped sac ("vermiform appendix") attached to and opening into the upper end of the large intestine (*cecum*) in humans and some other mammals.
2. Appendage, blind sac, or diverticulum.
See also *epididymal appendix*.

arachnodactyly

Extreme length and slenderness of the fingers or toes.

arachnoid mater
See *arachnoid membrane*.

arachnoid membrane
Weblike *membrane* that lies between the outer (and much thicker) *dura mater* and the deeper *pia mater,* and which covers the brain.

Note: The arachnoid membrane is separated from the pia mater by the subarachnoid space, in which the *cerebrospinal fluid* flows and is absorbed by the arachnoid villi.

arachnoid villus
arachnoid granulation
Microscopic projection of the *arachnoid membrane* into some of the venous sinuses (see *sinus venosus*).

areola (n)**/areolar (**adj)
1. A circular area of different color surrounding a central point, such as that surrounding the nipple of the breast, the part of the iris surrounding the pupil of the eye, or an area surrounding a *vesicle*.
2. Any minute space or interstice in a tissue.
After [6]

arm bud
See *limb bud.*

Arnold-Chiari malformation
Chiari malformation
Congenital herniation of the brainstem and lower cerebellum through the *foramen magnum* into the cervical *vertebral canal*.

Note: This malformation is often associated with *meningocele* and *spina bifida*.
[8]
See also *neural tube defect.*

aromatase
estrogen synthetase
Enzyme of the cytochrome P450 superfamily that converts *testosterone* to 17β-estradiol and androstenedione to estrone.

Note: Inhibiting its action is an approach to the management of breast *cancer*.

arrhenoblastoma
See *Sertoli-Leydig cell tumor*

arteriogenesis
Increase in the diameter of arterial vessels that leads to the formation of large

conductance arteries from pre-existing arterioles.

arteriovenous (AV) **anastomosis**
See *anastomosis*.

arteriovenous (AV) **shunt**
Connection between the arterial and venous sides of the circulation that bypasses the capillary beds.

artificial insemination
Introduction of *semen* into the *cervix*, *uterus* or *Fallopian tubes* by means other than the natural one.
See also *insemination*.

aryl hydrocarbon receptor (AHR)
Ligand-activated *transcription factor* involved in the regulation of biological responses to planar aromatic hydrocarbons.

Note 1: This *receptor* has been shown to regulate xenobiotic-metabolizing enzymes such as various forms of cytochrome P450 family 1 members.

Note 2: It also appears to play a role in cell proliferation and differentiation during vertebrate development, including hematopoiesis and development of the lymphoid and immune systems.

aryl hydrocarbon receptor translocator protein (ARNT)
Protein coded for by a gene on *chromosome* 1q21 that forms a complex with ligand-bound *aryl hydrocarbon receptor*, resulting in translocation of the ligand-binding subunit to the nucleus.

Note: A t(1;12)(q21;p13) *chromosomal translocation*, which results in a translocated ETS leukemia (TEL)-ARNT fusion protein, is associated with acute myeloblastic leukemia.

atelectasis
1. Total or partial collapse of the lung.
2. *Congenital* condition characterized by the incomplete expansion of the lungs at *birth*.

athelia
Congenital absence of one or both nipples.

athymia
1. *Congenital* absence of functioning thymus tissue.
2. Absence of affect; suppressed emotion.

atresia
clausura
Congenital absence or abnormal narrowing of a normal opening or normally patent lumen.

atresia, follicular
Degeneration of those *ovarian follicle*s that do not *ovulate* during the *menstrual cycle*.

atrial septal defect (ASD)
Defect in the septum between the atria of the heart, due to failure of normal closure of the *foramen ovale* in the *perinatal* period.

atrichia congenita
Congenital baldness caused by an abnormality of the hairless *gene*.
Note: It may include loss of hair in early childhood, which never regrows.

atrioventricular
Relating to the atrial and ventricular chambers of the heart.

atrioventricular bundle
See *bundle of His*

atrium
Each of the two upper chambers of the heart from which blood is passed to the ventricles.
Note: The right atrium receives deoxygenated blood from the veins of the body, the left atrium oxygenated blood from the *pulmonary* vein.

atrophy
Wasting away of the body or of an organ or tissue, involving a decrease in size and (or) numbers of cells.
[1]

auditory tube
Eustachian tube
Narrow channel connecting the middle ear and the naso*pharynx*.
[6]

auricle
See *pinna*.
Formerly, *atrium* of the heart.

autopsy
Postmortem examination of the human organs and body tissue to determine cause of death or pathological condition.

autosite
Independent twin of a pair of *conjoined twins*; the other twin is a *parasitic twin*.

autosomal dominant mutation
Change in an *autosomal gene* capable of *expression* when carried by only one of a pair of *homologous chromosome*s.

autosomal recessive mutation
Change in an *autosomal gene* that produces an effect in the organism only when it is *homozygous*.

autosome (n)/**autosomal (**adj)
Any *chromosome* that is not a *sex chromosome*.

avascularity (n)/**avascular** (adj)
Absence of a blood supply.

axial skeleton
Bones of the body axis, including the skull, *spinal column*, ribs and sternum.
See also *appendicular skeleton*.

azoospermia
Absence of viable *spermatozoa* in the *semen*.

Barr body
See *sex chromatin*.

basal ganglia
basal nuclei
Complex structure at the base of the brain consisting of several groups of *neuron*s, the caudate nucleus, the putamen, the globus pallidus, and the substantia nigra.
Note: These ganglia are involved in various functions including voluntary motor movements and involuntary movements such as tremors, bruxism (grinding the teeth), athetosis (involuntary writhing movements), and chorea (involuntary jerky movements).

basal lamina
See *basement membrane*.

basement membrane
basal lamina
Thin layer of *connective tissue* underlying an attached *epithelial* cell layer.

bell stage
Period in which the developing tooth takes on a bell shape in cross section, immediately preceding the "advanced bell stage", in which the hard tissues (dentin and enamel) form the crown of the tooth.

bicornate uterus
Uterus that is divided into two lateral horns as a result of imperfect fusion of the paired *embryonic* tubes from which the uterus is formed.
Note: In humans it is a uterine malformation, but in some mammalian species,

including rodents and pigs, it is normal.

bilaminar embryo
bilaminar blastoderm
Early *blastula* having only two of the three primary *germ layers* that it will ultimately have; the two layers present are the *ectoderm* and *endoderm* attached to a basement membrane before the *mesoderm* has formed.

birth
Emergence of a baby from the body of its mother; the start of life as a physically separate being.

birth defect
congenital defect
Physical or biochemical abnormality that is present at *birth*, and that may either be inherited or be the result of environmental influence.
Compare *congenital malformation*.

bisexual
See *ambisexual*.

blastema
Mass of cells from which an organ or a body part develops, either in normal development or in the regeneration of a lost body part.
After [5]

blastocoel
cleavage cavity
segmentation cavity
Fluid-filled cavity in the *blastula* of a developing *embryo*.

blastocyst
Modified *blastula* that is characteristic of *placental* mammals.
Note: It has an outer cell layer, known as the *trophoblast*, which participates in the development of the placenta, and an inner mass of cells in the *blastocoel*, which develops into the *embryo*.

blastomere
Any of the cells formed by *cleavage* of a *fertilized egg*.

blastula
blastocyst
blastodermic vesicle
Hollow mass of cells formed after a *zygote* has undergone approximately six cell divisions.
See also *blastocoel*, *blastocyst*.

blastulation
Process by which the early *embryo* transforms from the *morula* into the *blastula.*
See also *blastocyst.*

blood-testis barrier
blood-seminiferous tubule barrier
Sertoli cell barrier (SCB).
Occluding barrier, formed by the *Sertoli cells* of the *seminiferous tubules*, that separates the more mature cells of *spermatogenesis* from blood-borne products.
Note: The name "blood-testis barrier" is misleading in that it is not a blood-organ barrier in a strict sense, but is formed between Sertoli cells of the seminiferous tubule and, as such, isolates the further developed stages of *germ cells* from the blood. A more correct term is the "Sertoli cell barrier" (SCB).
After [5]

body cavity
See *coelom.*

bone age
Average age at which children reach a given stage of bone maturation, denoting the stage of skeletal development of an individual *fetus* or child.
Note: A child's current height and bone age can be used to predict *adult* height.

bone morphogenetic protein (BMP)
bone morphogenic protein
Any of a family of *growth factor*s involved in bone and *cartilage* formation and, more generally, in orchestrating tissue architecture through *morphogenetic* signals.
Note: These proteins are also considered to be *metabologen*s.

bone morphogenetic protein-4 (BMP4)
bone morphogenic protein-4 (BMP4)
Bone morphogenetic protein member of the transforming growth factor β (TGF-β) superfamily.
Note: Amongst the multiple functions of BMP4 is a role in early *embryonic* differentiation, where it is secreted from the *notochord* and acts with *sonic hedgehog* protein to establish a *dorsal-ventral* axis.
See also *Spemann organizer*.

brachydactyly
brachydactylia
Congenital abnormal shortness of fingers and toes.

branchial
Of, relating to, or resembling the gills of a fish or the *homologous embryonic* structures and their derivatives in higher animals.

branchial arch
gill arch
1. In *embryology*, one of several arches, resembling the gill arches of a fish, found in the *embryo* of a higher *vertebrate*; these arches develop into structures of the ear and neck.
2. In biology, one of several bony or *cartilaginous* arches located on either side of the *pharynx* and supporting the gills in fish and amphibians.

branchial cyst, congenital
branchiogenic cyst
Congenital cyst arising in the lateral aspect of the neck, from *epithelial* remnants of a *pharyngeal groove*.

brevicollis
Shortness of the neck.

bronchopulmonary segment
Largest subdivision of a lobe of the lung with its air supply from a major branch of the bronchus and having its own arterial blood supply.

buccopharyngeal membrane
oropharyngeal membrane
Membrane present in *fetal* life that separates the *nasal* cavities from the *pharynx*.

bud
Small protuberance resembling the bud of a plant and having the potential for growth and differentiation.

bulb, olfactory
Region of the frontal lobe of the brain, receiving input from *neurons* of the *nasal mucosa* and involved in the sense of smell.

bulbourethral gland
Cowper's gland
One of two small *glands* located on each side of the *prostate*, draining to the *urethra*. Bulbourethral glands secrete a fluid component of the *seminal fluid*

bulbus cordis
Outflow tract of the *embryonic* heart between the primitive ventricle and the *aorta*.
[9]

bundle of His
atrioventricular bundle
Band of specialized cardiac muscle fibers connecting the atria with the ventricles of the heart.
Note: These muscle fibers conduct the electrical impulse that regulates the heartbeat

from the right atrium to the ventricles.
After [6]

bursa
Padlike fluid-filled sac or sac-like cavity, especially one reducing friction at a joint.

Caesarian section
Caesarian delivery
Surgical operation for delivering a child by opening the mother's abdominal wall and *uterus*.

canal
In biology and medicine, a relatively narrow tubular passage or channel.

cancer
Disease resulting from the development of a *malignant tumor*.
[1]

capacitation (of sperm)
Sum of biochemical changes undergone by mammalian *spermatozoa* in the female *genital tract* that enables them to penetrate and fertilize (see *fertilization*) an *egg*.
[10]

caput epididymis
globus major
head of epididymis
Upper and larger extremity of the *epididymis*.

carcinogenesis (n)/**carcinogen(et)ic (**adj)
Induction, by chemical, physical, or biological agents, of *malignant neoplasms* and thus of *cancer*.
[1]

cardiac
Pertaining to the heart.

cardiac jelly
Gelatinous substance, present between the *endothelium* and *myocardium* of the heart in early *embryos*, that develops into the *connective tissue* of the *endocardium*.

cardiogenesis
Development of the heart in the *embryo*.

cardiogenic
1. Originating in the heart; describing anything caused by normal or abnormal function of the heart.

2. Pertaining to *cardiogenesis*.

cardiovascular
Pertaining to the heart and blood vessels.

cartilage (n)/**cartilaginous** (adj)
Specialized, fibrous *connective tissue* present in *adults*, forming the temporary skeleton in the *embryo*, providing a model in which the bones develop, and constituting a part of the organism's growth mechanism.

castration
Removal of the *testicles* or *ovaries*.
See also *sterilization*.

cataract
Partial or complete opacity (clouding) of the lens of the eye.

catecholamine
Any one of a group of hormones that contains a catechol (1,2-dihydroxyphenyl) moiety (e.g., dopamine, epinephrine, norepinephrine) and affects the sympathetic nervous system.

cauda epididymis
globus minor
Tail of the *epididymis* that opens into the ductus deferens; part of the reservoir of *spermatozoa*.

caudal
Situated more toward the cauda, or tail, than some specified reference point; toward the inferior (in humans) or posterior (in animals) end of the body.
[6]

cavitation (in biology)
Formation of a cavity, as in formation of the *amnion* in mammalian development.

cecum
Pouch connected to the junction of the small and large intestines.
See also *appendix, vermiform*.

central nervous system (CNS)
Part of an animal's nervous system that exerts control over the rest of the nervous system; in *vertebrates*, the brain and spinal cord protected within the *dorsal* body cavity (cranial and spinal cavities).

centromere
Constricted region of a *chromosome* that joins the two *chromatids* to each other and attaches to spindle fibers in *mitosis* and *meiosis*.

centromere, acrocentric
Having the *centromere* very close to one end.

cerebral hemisphere
Right or left half of the brain in sagittal section.

cerebral palsy
spastic paralysis
Condition marked by lack of muscle control, resulting from brain damage before, at, or shortly after *birth*.

cerebrospinal fluid (CSF)
Clear colorless extracellular fluid that is found in the brain and spinal cord filling the ventricles and subarachnoid spaces.
Note: The fluid acts as a cushion providing mechanical and immunological protection to the brain, and plays an important role in the homeostasis and metabolism of the *central nervous system*.

cervical rib
costa cervicalis
Supernumerary rib arising from a cervical *vertebra*.

cervix
cervix uteri
uterine cervix
Narrow lower end of the *uterus* that opens into the *vagina*.

checkpoint pathway
Type of pathway used in intracellular signaling, activated in response to a cell's own internal imbalance or to errors in its synthetic activities.
Note: Activation of checkpoint pathways leads to a delay in certain synthetic processes until other processes are complete, thereby averting damage.

cheiloschisis
See *cleft lip.*

Chernoff-Kavlock assay
Group of testing methods for assessing *parturition*, *postnatal* growth, and *viability* of *prenatally* exposed litters of test animals.

Chiari malformation
See *Arnold-Chiari malformation*.

chimera (n)/**chimeric** (adj)
1. Animal consisting of genetically different cells derived from two (or more) different

zygotes.
2. Substance, such as an antibody, created from the proteins or *genes* of two different species.

chondrification
Formation of *cartilage*; transformation into cartilage.

chondroblast
Cartilage-producing *mesenchymal* progenitor cell, capable of proliferating and maturing into a *chondrocyte* or *osteoblast*.

chondrocyte (n**)/chondrocytic (**adj**)**
Any one of the cells embedded in the lacunae of the *cartilage* matrix.
After [6]

chordin
Secreted protein that *dorsal*ises early *vertebrate embryonic* tissues by binding to *ventral*izing transforming growth factor β (TGF-β)-like *bone morphogenetic proteins*, sequestering them in latent complexes.

chorioallantoic placenta
Placenta developed from the *allantois* and *chorion*, establishing a nutritive and excretory connection between the blood of the *fetus* and that of the mother.

chorion
1. In human *embryology*, the cellular, outermost extra-*embryonic membrane*, composed of *trophoblast* lined with *mesoderm*.
Note: The chorion develops *villi*, becomes vascularized by *allantoic* vessels, and forms the *fetal* part of the *placenta*.
2. In mammalian embryology, the cellular, outer extra embryonic membrane, not necessarily developing villi.
3. In biology, the noncellular membrane covering *eggs* of various animals, e.g., fish and insects.
After [6]

chorionic gonadotropin
Hormone secreted by the *chorionic villi* of the *placenta* in mammals, especially *human chorionic gonadotropin*.
Note 1: Chorionic gonadotropin promotes the secretion of *progesterone* by the *corpus luteum*.
Note 2: Human chorionic gonadotropin is the hormone that is detected by *pregnancy* tests.

chorionic sac
Outermost *membranous* sac that encloses the *embryo* in higher *vertebrates* (reptiles, birds and mammals), formed by fusion of the *chorion* and *allantois*.

chorionic villus
Any of the tiny extensions from the *chorion* that contain *fetal* blood vessels and combine with the *uterine* tissue to form the *placenta*.

chorioretinitis
Inflammation of the choroid layer behind the *retina* of the eye.

choroid plexus
Infoldings of blood vessels of the *pia mater*, projecting into the cerebral ventricles and secreting *cerebrospinal fluid*.

chromaffin cell
Cell of the *adrenal* medulla that secretes *epinephrine* and *norepinephrine*, and contains granules that are readily stained with chromate salts.

chromatid
One of a pair of *chromosomes* arising by duplication during *mitosis* or by pairing during *meiosis*, and joined together at the *centromere*.

Note: Sister chromatid refers to either one of the joined pair arising from the same chromosome by duplication, and non-sister chromatid refers to either of the joined homologous chromosomes of maternal or paternal origin arising during meiosis.

chromosomal abnormality
Abnormality in the number or structure of *chromosomes*.

chromosomal translocation
See *translocation, chromosomal*.

chromosome
1. Self-replicating structure consisting of DNA complexed with various proteins and involved in the storage and transmission of genetic information.
2. Physical structure that contains the *genes*.
After [1]

chromosome, acrocentric
See *centromere, acrocentric*.

chromosome deletion
Loss of a *chromosome* or part of a chromosome.

chromosome ring
Abnormal *chromosome* structure in which both ends have been lost and the two broken ends have reunited to form a ring-shaped figure.
See also c*hromosome deletion*.

clastogen (n)/**clastogenic** (adj)
Agent causing *chromosome* breakage and (or) consequent gain, loss, or rearrangement of pieces of chromosomes.
[1]

cleavage (in embryology)
First few divisions of a *fertilized egg*.
Note: There is little or no growth during these divisions and the cytoplasm is cleaved into smaller and smaller units with individual biochemistry that contributes to subsequent cell differentiation.
See also *blastocyst, blastomere, blastula, gastrulation, holoblastic, inner cell mass, meroblastic, trophoblast,* and *zygote*.

cleavage, meroblastic
Partial *cleavage* of the *egg*, occurring in some animals such as reptiles and birds whose eggs have a large amount of yolk, resulting in unequal *blastomeres* and only part of the egg progressing to further cell division; the yolk mass remains and has nutritive value.

cleavage, holoblastic
Cleavage producing separate, equal *blastomeres*.

cleft (n)
fissure
Gap in soft tissue, bone, or both.

cleft (adj)
Split, divided, or partly divided into two.

cleft lip
cheiloschisis
hare lip
Congenital malformation consisting of one or more *clefts* in the upper lip, the result of failed closure in the *embryo* of the *maxillary* and median *nasal* processes.
See also *cleft palate*.
[8]

cleft palate
Congenital fissure along the midline of the hard *palate*.

cleft sternum
Rare *congenital malformation* resulting from defective fusion in the *embryo* of paired *mesodermal* bands in the *ventral* midline.

clitoral hood
See *prepuce*.

clitoris
Erectile body in the female genitalia, homologous with the penis in the male.

cloaca (in zoology)
Common cavity at the end of the digestive tract in *vertebrates* (apart from most mammals) into which are released both excretory and *genital* products.

cloacal membrane
Membrane that covers the *embryo*nic *cloaca* during the development of urinary and reproductive organs in those *vertebrates* where the cloaca occurs.

clover disease
estrogenism
Condition caused by the continued ingestion of low but toxic levels of *estrogens*.

Note 1: The most important occurrence is in farm animals pastured on plants containing *phytoestrogens*. The signs are those related to *endometrial* hyperplasia and *vaginal* tumefaction (swelling and puffiness), including long-term *infertility* and *rectal prolapse*, especially in pigs; *uterine* prolapse, especially in ewes; and *feminization* of males that have undergone *castration*.

Note 2: Dogs are particularly susceptible to the *myelotoxic* effects of estrogens and high dose or prolonged administration causes severe bone marrow depression with *thrombocytopenia*, followed by *leukopenia* and *anemia*.

After [9]

clubfoot
talipes
Deformed foot that is twisted out of shape or position, usually *congenital* (congenital talipes equinovarus (CTEV)).

coarctation
Narrowing or constriction of a short section of the *aorta* or of a blood vessel.

cochlea
Spiral cavity of the inner ear containing the *organ of Corti* that transduces sound into nerve impulses.

coelom
Body cavity of many multicellular animals, lined with *mesodermal epithelium* and containing the digestive tract and other *visceral* organs

Note: The principal cavities of the trunk arise from the intra*embryonic* coelom.

collagenous
Rich in the fibrous *connective tissue* protein, collagen.

collembolan reproduction test
Procedure in which collembolans (small soil-inhabiting insects) are exposed to soil that

has been treated with a test substance, and *adult* mortality and reproductive output are studied.

coloboma
Any defect resulting from incomplete closure of the *retina*l fissure.
Note: The defect may be *congenital*, pathological, or artificial.

combined repeated dose toxicity study
Procedure to evaluate both general systemic toxicity, with an emphasis on neurological endpoints, and notably reproductive effects and developmental progression in rodents. Groups of males and females are administered a test substance in graded doses prior to mating, during the mating period, and subsequently (up to two weeks post-mating in males and four days post-delivery in females).

compaction
1. Complication of *labor* in *twin births* in which there is attempted simultaneous expulsion of both twins, so that the lower part of the mother's pelvis is filled and further descent through the birth canal is prevented.
2. In *embryology*, process during which *blastomeres* change their shape and align themselves tightly against each other to form the compact *morula*.

conal growth hypothesis
Hypothesis that explains *transposition of the great arteries* of the heart by failure of the *aortopulmonary septum* to follow a spiral course during partitioning of the *bulbus cordis* and *truncus arteriosus* in the process of forming the *aorta* and *pulmonary trunk*.

conception
Formation of a viable *zygote* by the union of a *spermatozoon* and an *ovum*.
See also *fertilization*.

conceptus
Embryo and associated membranes in the *uterus*, especially during the early stages of *pregnancy*.

congenital
Present from *birth*, as of a disease or physical abnormality.

congenital adrenal hyperplasia
adrenogenital syndrome
Group of disorders caused by *hyperplasia* of the *adrenal* cortex or by *malignant tumor*s, resulting in excess secretion of adrenocortical *androgenic hormones*, and characterized by *masculinization* of women, *feminization* of men, or precocious *puberty* in the male.
Note: The condition is associated with a decrease in the blood level of cortisol and an increase in the level of *androgens* in both sexes, most commonly as a result of *21-hydroxylase* deficiency.

congenital malformation
Malformation existing at *birth*, or developing during the first month of life, regardless of the cause.
See also *birth defect*.

conjoined twin
One of a pair of *identical twins* fused together with varying degrees of union and of residual duplication of organs.
After [5]

connective tissue
Extracellular matrix of fibrous proteins and glycoproteins, with associated cells such as *fibroblasts*, that fills the spaces between and within organs and tissues.
Note 1: Connective tissue provides the organs and tissues with structural and metabolic support.
Note 2: Specialized connective tissues also include bone, cartilage, blood components, and adipose tissue.

contraceptive
Anything that prevents, or reduces the probability of *pregnancy*.

convulsion
Sudden, violent, irregular movement of the body caused by involuntary contraction of muscles and associated with brain disorders such as *epilepsy*, fever in children, or drug or alcohol abuse.

corpus cavernosum
Either of the two columns of erectile tissue forming the body of the clitoris (corpus cavernosum clitoridis) or penis (corpus cavernosum penis).
After [6]

corpus luteum
Glandular mass of yellowish tissue in the *ovary*, formed by a *Graffian ovarian follicle* that has matured and released its *oocyte*.
After [6]
Note: Observed in animal reproductive testing to calculate preimplantation loss.

cortex (in anatomy)
Outer layer of an organ such as the kidney, the cerebellum, or the *adrenal gland*.
See also *cortex, cerebral*.

cortex, cerebral
Outer layer of the cerebrum, composed of folded *grey matter*, playing an important role in consciousness.

Cowper's gland

See *bulbourethral gland.*

cranial placodes
Thickenings in the surface *ectoderm* of the *embryo* associated with future eye and ear regions.

cranial suture
Line where the bony plates of the skull are joined together by fibrous bands of tissue, easily felt in the newborn before closure by *ossification*.
See also *fontanelle*.

craniofacial
Pertaining to the *cranium* and the face.

craniorachischisis
Neural tube defect in which both the *cranium* and *vertebral* column remain open.

cranioschisis
Developmental failure of the *cranial sutures* to close completely, especially at the *occiput*, usually leading to grossly defective development of the brain.

craniosynostosis
Premature closure of the *cranial sutures*.
[6]

cranium (n)/**cranial** (adj)
Bony structure surrounding the brain, excluding the bones of the face.

Cre/loxP
Bacterial system in which the Cre protein mediates DNA recombination between specific DNA sequences known as lox-P sites.
Note: This system is used in mammalian cells to delete (or invert) a stretch of DNA by flanking it with lox-P sites and then exposing the cell to Cre protein at some predetermined time.

cretinism
Developmental disorder caused by deficiency of *thyroid hormone*, characterized by severe mental retardation and stunted physical growth, sometimes resulting from maternal iodine deficiency.

cri du chat syndrome
Lejeune syndrome
$5p^-$ syndrome
Hereditary *congenital syndrome* due to deletion of the short arm of *chromosome* 5.
Note: This syndrome is characterized by *hypertelorism*, *microcephaly*, severe mental deficiency, and a plaintive cat-like cry.

After [6]

crista
One of the inward projections or folds of the inner *membrane* of a mitochondrion.

critical period
Specific time in the development of a biological system when it is particularly vulnerable to injury or misdirection.

Crouzon syndrome
branchial arch syndrome
Group of autosomal dominant genetic diseases characterized by midfacial *hypoplasia*, *craniosynostosis*, *exophthalmos*, and a shortened head.
Note 1: This affects the first *branchial arch* (pharyngeal arch), which is the precursor of the maxilla and mandible.
Note 2: This syndrome is thought to be caused by a genetic *mutation* of the FGFR3 gene, located on *chromosome* 10.

crypt (in anatomy)
Small tubular *gland*, pit, or depression.

cryptophthalmos
Failure of the eyelids to develop with a fissure between them, usually with defective formation of the eyeballs.

cryptorchidism
See *undescended testis*.

cumulus oophorus
Mass of *follicular* cells surrounding the *oocyte* in the *Graafian follicle*.

cycle, reproductive
Cycle of physiological changes in the female reproductive organs, from the time of *fertilization* of the *oocyte* through *gestation* and *parturition*.
[6]

cyanosis
Bluish discoloration of the skin and *mucous membranes* due to excessive concentration of deoxygenated haemoglobin, owing to poor circulation or inadequate oxygenation of the blood.

cyclopia
cyclocephaly
synophthalmia
Rare form of *holoprosencephaly*, a *congenital* disorder characterized by a single orbital *fossa* due to the failure of the *embryonic prosencephalon* to divide the *orbits* of the eye correctly into two cavities.

cyst
1. In an animal or plant, thin-walled hollow organ or cavity containing a liquid secretion.
2. Sac, *vesicle*, or bladder.

cytogenetics
Branch of genetics in which the structure and function of chromosomes and of other cell constituents concerned with heritable properties and their expression are studied.

cytomegalovirus
Type of *Herpes* virus that usually produces very mild symptoms in an infected person but may cause severe neurological damage in people with weakened immune systems and in the newborn.

cytotrophoblast
Inner cellular layer of the *trophectoderm* (*trophoblast*); part of the mammalian *placenta*.

Daphnia magna reproduction test
Procedure in which young female *Daphnia* are exposed to a substance added to the water and numbers of living offspring and surviving parent organisms are recorded.

decidua
Modified *endometrial* layer that lines the *uterus* during *pregnancy* and is shed with the afterbirth.

decidual cell
Enlarged, ovoid, *connective tissue* cell appearing in the *endometrium* during *pregnancy*.

decidual cell response technique
Biological test method in which *pseudopregnant* rats undergo a surgical treatment of the *uterus* to induce uterine differentiation and proliferation, resulting in massive tissue growth that mimics the response of the uterus during normal *blastocyst implantation*.
Note: Measurement of *decidual* growth during chemical treatment can be used to assess both *hormonal* status and uterine function. Uterine weight is a sensitive measure of the success of the *decidual cell* response.

decidualization
Changes in response to *progesterone* that include the *eosinophil*ic proliferation around arterioles after *ovulation* or progesterone action on *endometrium.*
Note: Decidualization increases *glandular epithelial* secretion, stimulates glycogen accumulation in *stromal cell* cytoplasm, and promotes stromal vascularity (*spiral arterioles*) and *edema*.

deciduum
Swelling of a *uterine crypt* produced by its reaction to an *implanted embryo*.
[7]

decussate (v)/**decussation** (n)
Pertaining to two or more things that cross or intersect each other to form an X.
See also *chiasma.*

defeminized gonadotropin secretion
Gonadotropin secretion without female sex *hormones*.

demasculinized
castrated
Describing a male animal from which the *testicles* have been removed.

dermis
Layer of the skin deep under the *epidermis*, consisting of a bed of vascularized *connective tissue*, and containing the nerves and organs of sensation, the hair roots, and sebaceous and sweat *glands*.
After [6]

desynapsis
Failure of *synapsis* due to separation of *homologous chromosomes* after initial pairing in *meiosis*.

developmental biology
Study of biological development from *fertilization* to *adulthood*, usually with an emphasis on the *prenatal* period and regulation of *morphogenesis*, and neural development on through adolescence.
Note: Common model organisms include *Caenorhabditis elegans*, *Xenopus*, *Drosophila*, zebrafish (*Danio rerio*), chick, and mouse.

developmental neurotoxicity study
Procedure in which female rodents are exposed to a test substance from the time of *implantation* throughout *lactation*; offspring may be exposed during the preweaning period, either directly or through milk, and are studied with regard to neurologic and behavioral abnormalities during the *postnatal* development and until *adulthood*.

developmental susceptibility gene
Any *gene* that encodes a *gene product* that can be altered by environmental agents to cause disturbance of normal development.

developmental toxicology
Study of adverse effects on the developing organism that result from exposure of either parent to an agent or substance prior to *conception*, of the mother and *fetus* during *prenatal* development, and of the child from birth until the time development is completed.
Note: Functional brain development continues past the time of *sexual maturation*.

dextrocardia

Congenital defect in which the apex of the heart is directed toward the right side of the thorax (isolated dextrocardia), or the heart is found in a mirror image position on the right side of the body (dextrocardia *situs inversus*).

dextroposition
Displacement to the right.

Di George syndrome (DGS)
congenital thymic aplasia
conotruncal anomaly face syndrome
DiGeorge anomaly
Shprintzen syndrome
Strong syndrome
thymic hypoplasia
velocardiofacial syndrome
Condition caused by the deletion of a small piece of *chromosome* 22 near the middle of the chromosome at a location designated 22q11.2.

Note: Characteristic signs and symptoms may include *birth defects* such as *congenital* heart disease, defects in the *palate*, most commonly related to neuromuscular problems with closure (*velopharyngeal insufficiency*), learning disabilities, mild deviations in facial features, and recurrent infections.

diaphragm
Dome-shaped muscular *membranous* partition separating the thoracic cavity from the *abdominal cavity* in mammals.

Note: The diaphragm plays a major role in breathing, as its contraction increases the volume of the thorax and so inflates the lungs.

diathesis
Hereditary predisposition to a particular medical condition.

diencephalon
Posterior part of the forebrain (*prosencephalon*), containing the *hypothalamus* and other *thalamic* components, and enclosing the third ventricle.
Compare with *telencephalon*.

diethylstilbestrol (DES)
4,4'-[(3*E*)-hex-3-ene-3,4-diyl]diphenol
Synthetic non*steroidal* substance with *estrogen*ic activity.

Note 1: DES was formerly given to reduce the risk of complications and loss of *pregnancy* but was shown to cause a rare *vaginal tumor* in female offspring who had been exposed to this drug *in utero*.

Note 2: DES also has effects on the reproductive organs of male progeny exposed *in utero*.

diploid
Cell or nucleus containing two complete sets of *chromosomes*, one from each parent, or

an organism composed of such cells.
Compare *haploid*.

disc, embryonic
blastodisc
germinal disc
Bilayer plate of cells in the *blastocyst* from which the mammalian *embryo* develops.

dishevelled
See *WnT*.

dispermy
Entrance of two *spermatozoa* into one *egg*.
Compare *monospermy, polyspermy*.

disruption
Disturbance that interrupts a process or disorganizes a structure.

distal (in anatomy)
Situated away from the centre of the body or from the point of attachment.
Opposite term: *proximal*.

diverticulum
Outpouching of a hollow structure in the body, that may be acquired (as in colonic diverticulitis) or be present at *birth* (e.g., Meckel diverticulum or Zenker diverticulum).

dominant
Of a *gene*, determining the *phenotype* even when present only in one copy or inherited from only one parent.
Compare *recessive*.

dorsal
On or relating to the upper side or back of an organism.
Opposite term: *ventral*.

Down syndrome
See *trisomy 21*.

drug metabolizing enzyme (DME)
Any enzyme that *metabolizes* xenobiotics.
Note: Most if not all these enzymes also metabolize endogenous *substrates*.

duct
Vessel for transporting fluids such as *lymph*, or *glandular* secretions such as tears or bile.

duct, excurrent

See *excurrent.*

ductus arteriosis
Fetal blood vessel connecting the *pulmonary artery* to the *proximal* descending *aorta*.
Note: This vessel allows most of the blood from the right ventricle to bypass the fetus's fluid-filled non-functioning lungs. Upon closure at *birth*, it becomes the *ligamentum arteriosum*.
See also *patent ductus arteriosis*.

dung fly test
Dipterian dung fly test
Procedure using dung flies of the order *Diptera* where a test substance is mixed with bovine feces to which *eggs* of the fly are added; number, sex, and morphology are determined when the last *adult* has emerged.

duodenum
First portion of the small intestine, between the stomach and the *jejunum*, where bile and pancreatic digestive juices enter the intestinal tract.

dura mater
See *meninx*.

dysgenesis
Defective or abnormal development of an organ.

dysgonesis
Dysgenesis of the *gonads*.

dysostosis
Defect in the normal *ossification* of *fetal cartilage*.

dysmenorrhea
Difficult and painful *menstruation*.
[5]

dysmorphia (n)/**dysmorphic (**adj)
dysmorphism
Abnormality of shape of a body part or organ, often referring to a *birth defect*.

dysmorphogenesis
Production of *dysmorphia.*

dysplasia
Abnormal development of an organ or tissue identified by *morphological* examination.
[1]

early life stage (ELS) **test**
Toxicity test using an organism in an early life stage such as the *embryo* or larva, noting that this stage is often the most sensitive part of the species life cycle.
After [2]

earthworm reproduction test
Procedure in which *adult* worms (*Eisenia* sp.) are exposed to a test substance mixed into the soil; number, weight and behaviour of the adult worms are studied after four weeks and the number of juveniles hatched is counted after a further four weeks.

eclampsia
Acute, life-threatening complication of *pregnancy* characterized by tonic-clonic *seizures* (*convulsions*), usually in a woman who has developed *pre-eclampsia*.

ecogenetics
Study of the influence of hereditary factors on the response of individuals or *populations* to environmental factors.

ectoderm
In an *embryo*, outermost layer that develops into the skin and nervous system.

ectopia (n)/**ectopic** (adj)
ectopy
Abnormal location or malpositioning of an organ or body part, usually *congenital*.

ectopic expression
Expression of a *gene* in a tissue in which it is not normally expressed.
[12]

ectopic pregnancy
Complication of *pregnancy* in which the *embryo* implants (see *implantation*) and develops outside the cavity of the *uterus*.

ectrodactyly
Congenital absence or deficiency of one or more of the central digits of the hand or foot.

ectrosyndactyly
Congenital absence or deficiency of one or more of the central digits of the hand or foot with fusion of the existing ones.

edema
oedema
Presence of abnormally large amounts of fluid in body cavities and intercellular spaces of tissues.
[1]

efferent duct
efferent ductule
Seminal duct leading from the *testis* to the head of the *epididymis*.

egg
1. Female *gamete* after completion of the second *meiotic* division.
See also *ovum*, *zygote*.
2. Often loosely used for secondary *oocyte*s and early *embryo*s.

ejaculation
Expulsion of *semen* from the *genital ducts* and *urethra*, usually resulting from a reflex process during sexual stimulation

ejaculatory duct
Passage formed by the junction of the duct of the *seminal vesicles* and the *ductus deferens* through which *semen* enters the *urethra*.
[8]

electroporation
Means of introducing molecules into cells by transiently permeabilizing their *membranes* with brief electric field pulses.
[12]

embryo (n)/**embryonic** (adj)
1. Stage in the developing mammal at which the characteristic organs and organ systems are being formed: for humans, this involves the stages of development from the second to the eighth week post*conception* (inclusive).
2. In birds, the stage of development from the *fertilization* of the *ovum* up to hatching.
3. In plants, the stage of development within the seed.
[1]

embryoid body
Structure resembling an *embryo* which is formed by *embryonic stem cells* or *teratocarcinoma* cells when they are removed from a growth-promoting medium.

embryonic induction
Process whereby the development of one group of cells, called the competent region, is altered by an inducing factor from another group, called a signaling center or organizer.

embryo transfer
Process of *implanting* a *fertilized ovum* into a *uterus*.

embryo transport rate analysis
Method to evaluate the potential for early *embryonic* loss in rodents caused by accelerated or retarded arrival of embryos into the *uterus*.

embryogenesis
Development and growth of an *embryo* in the period from formation of the *bilaminar embryo* to the beginning of the *fetal* period (in humans, the second through the eighth week after *conception*).

embryology
Science of the origin and development of the organism from *fertilization* of the *oocyte* to the beginning of *fetal* life (in humans, the end of the eighth week).
Note: In common usage this term includes all the stages of *prenatal* life.
After [5]

embryonic period
Period from *fertilization* to the end of major *organogenesis*.
See also *embryo*, *embryogenesis*.
[1]

embryonic stem (ES) **cell**
Undifferentiated, *pluripotent* cell from an early stage of the pre*implantation embryo* (inner cell mass of the *blastocyst*).
Note: Embryonic stem cells have the potential to proliferate and differentiate into various cell types of the body.

encephalitis
Inflammation of the brain.

encephalocele
Congenital protrusion of brain tissue through a fissure or defect in the skull.

endocardial cushion
atrioventricular canal cushion
Subset of cells in the primordial tube-like heart that is essential to the development of the *ventricular septum* and the *atrioventricular* valves of the heart.
Note: Endocardial cushion defects may cause various types of heart *malformation*.

endocardium
Endothelial lining of the heart chambers, also containing small blood vessels and a few bundles of smooth muscle, continuous with the endothelium of the great blood vessels.

endochondral ossification
Formation and growth of bone tissue (especially of the long bones) during *fetal* development of the mammalian skeletal system, and in repair of bone fractures, that takes place in the presence of *cartilage*.
Note: Endochondral ossification is one of two mechanisms for bone formation, the other being *intramembrous ossification*.

endocrine

Pertaining to *hormones* or to *glands* that secrete hormones directly into the bloodstream.
[1]

endocrine disrupter
endocrine modifier
Exogenous substance that, at some dose, alters function(s) of the *endocrine* system and consequently causes adverse health effects in an intact organism, its progeny, or (sub)populations.
After [1]

endocytosis
Uptake of material into a cell by invagination of the plasma *membrane* and its internalization in a membrane-deliminated vesicle.
After [1]

endoderm (n)**/endodermal (**adj)
hypoblast
Innermost of the three primary *germ layers* of an *embryo*, developing into the gastrointestinal tract, the lungs, and associated structures.
[10]

endometrium
Inner lining of the *uterus* that is shed during *menstruation*.
[13]

endothelium (n)/**al** (adj)
Layer of flat cells that line the blood vessels, lymphatic vessels, and the heart.

environmental factor
Physical, chemical, or biological agent or condition in the environment that has the potential to affect development and health of an organism, either in a positive or a negative manner.

epaxial
Located above or on the *dorsal* side of an axis.

epiblast
Primitive *ectoderm* of the early *embryo*.
[13]

epicardium
visceral pericardium
Inner layer of the *pericardium*, a sac of fibrous tissue that surrounds and lies upon the heart and the base of the great vessels.

epidemiology

Study of the distribution and determinants of health-related states or events in specified populations and the application of this study for the control of health problems.
[1]

epidermis
In *vertebrates*, protective outer stratified squamous layer of the skin consisting mainly of keratinocytes.

epididymis (n)/**epididymal** (adj)
Tightly-coiled, thin-walled tube that conducts *sperm* from the *testis* to the *vas deferens*.
[13]

epididymal appendix
appendix epididymidis
Cystic structure sometimes found on the head of the *epididymis*.
Note: The epididymal appendix represents a remnant of the *mesonephric duct*.
[8]

epigenesis (n)/**epigenetic** adj)
Phenotypic change in an organism brought about by alteration in the *expression* of genetic information without any change in the *genomic* sequence itself.
Note: Common examples include changes in nucleotide base methylation and changes in histone acetylation. Changes of this type may become heritable.
[1]

epilepsy
Chronic neurological disorder marked by sudden recurrent episodes of sensory disturbance, loss of consciousness, or *convulsions*, associated with abnormal electrical activity in the brain.

epinephrine
See *adrenaline*.

epiphyseal plate
The disk of hyaline *cartilage* between the metaphysis and the epiphysis of an immature long bone that permits the bone to grow longer.
[5]

epispadias
Malformation in which the *urethra* does not develop to full length, opening typically on the dorsum of the penis (and rarely, in females, between the clitoris and labia); frequently associated with *exstrophy* of the bladder.

epistasis
Situation in which the *phenotypic expression* of one *gene* obscures the phenotypic effects of another gene.

[12]

epithelium (n)/**epithelial** (adj)
Sheet of one or more layers of cells covering the internal and external surfaces of the body and hollow organs.
[1]

epithelial-to-mesenchymal transition (EMT)
Sequence of events, where *epithelial* cells detach, migrate and become *mesenchymal stem cells* that can differentiate.
Note: This transition plays a role in *embryogenesis*, wound healing and *cancer*.
See also *mesenchymal-to-epithelial transition.*

epoxide hydrolase
epoxide hydratase
Detoxification enzyme, located mainly in the endoplasmic reticulum, that hydrolyzes epoxides, converting them to metabolites that can be more rapidly excreted.
[13]

erectile dysfunction
Inability of a male to have or to maintain an erection.

erythroblastosis
See *hemolytic disease of the newborn*.

estradiol
17β-estradiol
Steroid sex *hormone*, involved in many regulatory processes, but most prominently in the development of female sex organs, the *menstrual cycle*, and *pregnancy*.

estriol
Hormonally active metabolite of *estradiol*, eliminated in urine, especially during *pregnancy*.

estrogen
Any substance, natural or synthetic, that exerts the *hormonal* effects of the natural *estrogen*, *estradiol*, usually by interaction with the estrogen receptor.
Note: Phytoestrogens are substances that occur in plants and have estrogenic activity.

estrogen activity assay, in vitro
1. Procedure in which a *tumor* cell line is exposed to a test substance and activation of the *estrogen receptor* is studied by a reporter molecule in order to assess the estrogen-sensitivity of the tumor.
2. Test using estrogen-sensitive cells to evaluate estrogenic activity of a substance or environmental sample.
Compare *uterotrophic assay*.

estrogen-mimetic
Behaving like an *estrogen*.

estrogenic
Exhibiting *hormonal* activity similar to that of *estrogens*.

estrogenism
See *clover disease.*

estrous cycle
Sequence of recurring physiological *uterine*, *ovarian*, and other changes, induced by reproductive *hormones* in higher female animals, resulting in readiness for *insemination*. This cycle starts in *adulthood* (at *menarche*), transiently discontinues during *pregnancy*, and disappears at the *menopause*.

estrus
oestrus
heat
Recurrent period of sexual receptivity and arousal in the female of most mammals except the higher primates, during which *conception* is possible.

estrus syndrome
Persistent *estrus* caused by elevated *estrogenic* activity, either due to endogenous estrogens (e.g., in *polycystic ovary* syndrome) or due to exogenous substances.
Note: Estrus syndrome is associated with *infertility*.

euploid
Referring to a cell or organism with *chromosome*s present in an integral multiple of the *haploid* number.
Note: A human cell with the normal number of 46 chromosomes, an integral multiple of the monoploid number, 23, is thus euploid However, a human with abnormal, but integral, multiples of this full set (e.g., 69 chromosomes) would also be considered as euploid.

eutherian
Subclass of mammals having a *placenta* through which the fetus is nourished.

eventration
herniation of intestines
Protrusion of *omentum* and/or intestine through a defect or weakness in the abdominal wall while the skin remains intact.
After [1]
See also *omphalocele*.

evocation

Specific *induction* of a tissue within a developing *embryo* that results from the action of a single *hormone* or other chemical (the evocator).

excurrent
Pertaining to a vessel (or opening) conveying fluid outwards.
Note: The male excurrent *ducts* are those involved in the transport, enrichment and *ejaculation* of *semen*.

exencephaly
exencephalus
Exposed brain resulting from failure of the neural tube to close and absence of the top of the skull.
Note: In humans this is followed by degeneration of the brain, resulting in *anencephaly*.
[13]

exfoliation (n)**/exfoliative (**adj)
desquamation
Detachment and shedding of superficial cells of an *epithelium* or tissue surface, especially of the horny layer of the *epidermis*.
[10]

exocrine
Relating to or denoting *glands* that secrete through *ducts* opening on to superficial *epithelium* (e.g., the intestinal tract) rather than into the blood.

exomphalos
omphalocele
Hernia in which bowel or *omentum* protrudes through the abdominal wall under the skin at the *umbilicus*.
After [5]

exophthalmia
exophthalmos
Marked protrusion of the eyeballs, usually resulting from an increased volume of the *orbital* contents.
After [8]

expressed sequence tag (EST)
Partial or full complementary DNA sequence that can serve as a marker for a region of the *genome* that encodes an expressed product.
[1]

expression, gene
Translation of a *gene* into a *gene product*.

exstrophy
Congenital malformation in which a hollow organ has its interior exposed through eversion; most commonly observed in the urinary bladder (ectopia vesicae).

external genitalia
Genitalia visible outside the body.

extracellular matrix (ECM)
Mesh of molecules, secreted by cells into the surrounding extracellular space.
Note: Cells may adhere to the matrix and this can provide them with structural and biochemical support.

extraembryonic membranes
Membranes that surround the *embryo*; the *yolk sac*, *allantois*, *amnion*, *chorion,* and *decidua.*
After [6]

extraembryonic mesoderm
Cells outside the *embryo* that, although derived from the *zygote*, are not part of the embryo proper, and contribute to the *fetal* membranes (*yolk sac, allantois, amnion,* and *chorion*).

extrinsic pathway
Apoptotic pathway of cell death initiated upon occupancy of so-called death receptors at the cell surface with their ligands such as *Fas/CD95* and *tumor necrosis factor-α*, and involving activation of *caspase* 8.
Note: This pathway converges with the *intrinsic pathway* at the level of cleavage of procaspase 3 by either caspase 8 (extrinsic pathway) or caspase 9 (intrinsic pathway).

F1 generation
Indicating 'first filial' generation, denoting offspring from genotypically (see *genotype*) distinct parents.
Note: F2 denotes offspring resulting from mating (inbreeding) of individuals from F1. The term may be extended to F3, etc.

F2 generation
See *F1 generation*.

facial cleft
Congenital anomaly resulting from the failure of facial structures in the *embryo* to fuse properly.
See also *orofacial cleft*.

facies
In medicine, facial expression of an individual that is typical of a particular *syndrome*,

disease, or condition.

Fallopian tube
oviduct
uterine tube
salpinx
One of a pair of tubes, on either side of the upper or outer extremity of the *ovary* that provides a path by which an *ovum* travels from the ovary to the *fundus* of the *uterus*.
Note: Each tube is largely enveloped by its expanded *infundibulum*, where, if the ovum is fertilized in the tube, it will implant (see *implantation*) as a *zygote*.
Modified from [5]

fecundation
impregnation
Process of *fertilization*.
[2]

fecundity
1. Ability to produce offspring within a given period of time.
2. Quantity of reproductive output.
Note 1: The potential reproductive capacity of an organism or population may be measured by the number of *gametes*.
Note 2: Fecundity is controlled by both genetic and environmental factors, and is a major determinant of *fitness*.
After [1]

feminization
Development of female characteristics in a male.

fertility, female
1. Ability to *conceive*.
2. Production of live offspring.

fertility, male
Ability to induce *conception*.
Note: Sperm count and motility are important contributing factors.

Fertility Assessment by Continuous Breeding (FACB)
Reproductive Assessment by Continuous Breeding (RACB)
Reproductive toxicity test in rodents in which female animals are repeatedly mated and frequency and size of litter and other parameters are measured; second or later generation fertility is also studied.

fertilization
In reproductive biology, union of male and female *gametes* to form a *zygote* from which an *embryo* can develop.

See also *conception*.

fetal alcohol syndrome (FAS)
Condition developing in the *fetus* and resulting in *congenital* abnormalities, caused by alcohol intake by the mother during pregnancy, typically characterized by decreased cognitive development, stunted growth and a characteristic *facies*.
Note: FAS is the most serious form of fetal alcohol spectrum disorder (FASD), a range of milder forms that may show reduced skills in learning, social development, memory, and control of emotions.

fetal period
See *fetus*.

fetal pole
Thickening on the margin of the *yolk sac* of a *fetus* during *pregnancy*.
Note: Appearance of the fetal pole is used as the earliest sign of a baby in *ultrasound* examination.

FETAX
Assay for *teratogenicity* using *embryos* of the frog, *Xenopus laevis*.
Note: The term is derived from the first letters of "frog embryo teratogenesis assay *Xenopus*".
After [2]

fetoscopy
Procedure in which a *fetus* may be directly observed *in utero*, using a fiber-optic endoscope (fetoscope) introduced through a small incision in the abdomen under local anesthesia.
Note: Photographs may be taken, and *amniotic fluid,* fetal cells, or blood may be sampled for prenatal diagnosis of many *congenital* anomalies or genetic defects.
After [8]

fetus (n)/**fetal** (adj)
Young mammal within the *uterus* of the mother, from the visible completion of characteristic *organogenesis* until *birth*.
Note: In humans, this period is usually defined as from the third month after *fertilization* until birth; prior to this the young mammal is referred to as an *embryo*.
[1]

fibroblast
fibrocyte
desmocyte
Flat fibrous tissue cell, with stellate or spindle shape, associated with the formation of collagen fibers and intercellular *extracellular matrix*.
Note: This cell may develop into a number of precursor cells, such as collagenoblasts, *osteoblasts*, and chondroblasts.

fibroblast growth factor (FGF)
Any member of a family of more than twenty protein *growth factors* involved in *angiogenesis*, wound healing and, in early embryonic development, induction of *mesoderm*, patterning and *morphogenesis*, and development of the limbs and brain.
See also *sonic hedgehog*.

fish embryo test (FET)
Fish embryo acute toxicity test
Procedure in which fish (often zebrafish, *Danio rerio*) *eggs* and *embryos* are exposed to a test chemical and subsequent development or death of the animals is studied.

fish reproduction assay
Procedure in which sexually mature male and spawning female fish are exposed to a test substance and multiple endpoints including *egg* production, *endocrine* activity, *vitellogenin*, and *gonadal* histopathology are measured.

fish sexual development test
Procedure in which fish are exposed from the time of *fertilization* of the *egg* until sexual differentiation is completed and markers of possible *endocrine disruptor* activity are studied, including *vitellogenin* concentration, *gonadal* histopathology, sex ratios, and the occurrence of *intersex*.

fistula
Permanent abnormal passage from an internal organ to the body surface or between two internal organs or structures.

fitness
Ability to survive and reproduce.

flexure, hepatic
flexure, right colic
Bend between the ascending colon and the transverse colon.

foetus
Alternative spelling of *fetus* found in British English usage.

fold
plica
1. Ridge or margin apparently formed by the doubling back of a lamina.
Note: In anatomy, used as a common identifier, as in nail f., neural f., tail f., transverse f., *urogenital* f., etc.
2. In the *embryo*, a transient elevation or reduplication of tissue in the form of a lamina.
After [5]

folic acid

Water-soluble B vitamin involved in breakdown of carbohydrates, releasing energy and promoting biosynthesis.

Note: Folic acid deficiency may lead to a range of serious abnormalities of the developing *fetus*, including *neural tube defects*.

follicle (n)/**follicular** (adj)
1. Small, secretory sac, such as the dental follicles that enclose the teeth before eruption or the hair follicles within the *epidermis*.
2. Fluid- or colloid-filled ball of cells in some *glands* such as the *thyroid gland* and the *ovaries*.
[11]

follicle-stimulating hormone (FSH)
Hormone secreted by the anterior *pituitary* that stimulates the *Graafian follicles* of the *ovary* and subsequent *follicular* maturation, and in the male contributes to inducing *spermatogenesis*.
After [5]

follicle-stimulating hormone releasing hormone (FSH-RH)
gonadoliberin
Hormone, released by the *hypothalamus*, inducing the secretion of *follicle-stimulating hormone* and *luteinizing hormone* by the *pituitary gland*.

follicular
See *follicle*.

follicular atresia
Degeneration and resorption of an *ovarian follicle* before it reaches maturity and ruptures.

follicular phase
First half of the human *menstrual cycle*, during which one or more *follicles* in the *ovary* may mature, culminating in *ovulation*.

fontanelle
Any of several soft spots in specific locations on the skull of the newborn where the bones have not yet fused and the brain is covered by skin and a tough *membrane*.
See also *cranial suture*.

foramen (pl. foramina)
Opening, hole.

Note 1: The skull has several such openings that act as passageways for structures, notably *nerve*s and blood vessels.

Note 2: The *vertebral column* is perforated by the vertebral foramina through which nerves from the *spinal cord* exit to the periphery.

foramen magnum

Large *foramen* in the base of the skull, through which the *spinal cord* passes.

foramen ovale
1. In the *fetal* heart, opening that allows shunting of blood between the right and left *atria* and normally closes at birth.
2. One of the larger *foramina* in the base of the skull.

forebrain
See *prosencephalon*.

foreskin
See *prepuce*.

forward genetics
Approach to genetic investigation, in which the aim is to identify the *gene* that governs a particular function.
Note: Mutant *phenotypes* indicate the responsible gene, and co-inherited genetic markers indicate the region of the *genome* where it occurs.
See also *reverse genetics*.

fossa
In anatomy, a depression or hollow, often in a bone.

fossa ovalis
Oval depression in the heart, on the lower part of the *septum* of the right *atrium*.
Note: The fossa ovalis is a remnant of the *foramen ovale*.
After [5]

frontonasal dysplasia (FND)
frontonasal dysostosis
frontonasal malformation
median cleft face syndrome
Tessier cleft numbers 0/14 (See *Tessier classification.)*
Congenital malformation of the midface in which the nose has a flat, wide appearance, the eyes may be wide-set, and there is a groove of varying size, running down the middle of the face across the nose.

functional genomics
Development and implementation of technologies to characterize the mechanisms through which *genes* and their products function and interact with each other and with the environment.
[5]

fundus
Part of a hollow organ (e.g., the *uterus*) that is furthest from its opening.

gall bladder
Pear-shaped muscular sac underneath the liver that stores bile secreted by the liver before its release into the *duodenum*.

gamete
Reproductive cell (e.g., *sperm* or *egg*) containing a *haploid* set of *chromosomes*.
[5]

gamete intrafallopian transfer (GIFT)
Technique of assisted reproduction by placing *eggs* and *sperm* into a woman's *Fallopian tubes* in order that *fertilization* may occur there.
Note: The *embryo* is expected to travel through the Fallopian tube and *implant* in the *uterus* as it would have done had natural fertilization occurred.

gametogenesis
Development of male or female *gametes* to maturity.

gastroschisis
Congenital defect characterized by a fissure in the anterior abdominal wall through which the small and (or) large intestine protrude.

gastrula
Embryonic stage that develops from two to three *germ layers* during *gastrulation*.

gastrulation
Stage of *embryo* development in which the two-layered *blastula* (consisting of *ectoderm* and *endoderm*) transforms into the *gastrula* by developing a third layer (*mesoderm*) through the movement of specific cells.

gene
Length of DNA or RNA (in viruses) that encodes a functional product, which may be a polypeptide or a ribonucleic acid.
Note: A gene is the fundamental unit of heredity.
[1]

gene product
Both the messenger RNA resulting from transcription of a *gene* and the proteins and peptides translated from that mRNA.

gene targeting
Use of *homologous recombination* to change a *gene*, e.g., to delete a gene, remove exons, add a gene, or introduce point mutations.

genital
1. Of or relating to human or animal reproduction.
2. Of or relating to the *genital organs*.

3. Of or relating to the final stage of psychosexual maturation.
4. *Genital organ*.

genitalia
1. Plural of *genital*.
2. Externally visible sex organs.

genital fold
genital ridge
genitourinary ridge
urogenital ridge
Embryonic structure that will differentiate into the penis in males or the labia in females.

genital organ
Organ of reproduction or generation, both external and internal to the body.

genital tract
reproductive tract
genital duct
Genital passages of the *urogenital* apparatus.
Note: In females, the tract runs from the *ovaries* to the *vulva*, in males from the *testicles* to the external *urethral* orifice of the penis.

genital tubercle
Primordium of the penis or *clitoris*.

genitourinary
See *urogenital.*

genome
Complete set of *chromosomal* and extrachromosomal *genes* of an organism, a cell, an organelle (e.g., mitochondria or chloroplasts), or a virus, i.e., the complete DNA component of an organism (or the complete RNA component of an RNA virus).
After [1]

genomics
1. Science of using DNA-and RNA-based technologies to demonstrate alterations in *gene expression*.
2. In toxicology, method providing information on the consequences for gene expression of interactions of the organism with environmental stress, xenobiotics, etc.
[1]

genotoxic
Capable of causing a change to the structure of the *genome*.
[1]

genotype
Genetic constitution of an organism as revealed by genetic or molecular analysis; the complete set of *genes* possessed by a particular organism, cell, organelle, or virus.
[1]

germ cell
See *germ line cell*.

germ cell gene mutation assay
Procedure in which *mutations* induced by an agent are studied in *germ cells* or *somatic stem cells* from a *transgenic* animal (rodent), containing reporter *genes* for detection of various *mutations*.

germ line cell
germ cell
Gamete or an *embryonic* cell that can develop into a gamete.

germ layer
Any of three distinct layers of cells (*endoderm*, *ectoderm*, and *mesoderm*) that become recognizable as the *embryo* develops.

gestation
pregnancy
Period between *conception* and *birth* during which an *embryo* or *fetus* is carried in the *uterus* of a female mammal.

gestation period
Time from *conception* to *birth,* during which a *fetus* develops.

gigantism
Condition of abnormal size or overgrowth of the entire body or of any of its parts.
Note: Often caused by increased levels of *growth hormone*.
See also *acromegaly*.

gland
Organized aggregation of cells functioning as a secretory or excretory organ.
[5]

glans
Any small rounded mass or *gland*-like body.

glans clitoridis
Rounded mass of sensitive erectile tissue that forms the head of the *clitoris*.

glans penis
Rounded mass of sensitive erectile tissue at the distal end (head) of the *penis*, analogous

to the *clitoris*.

glaucoma
Disease of the eye characterized by increased intraocular pressure, resulting in *atrophy* of the optic nerve.
After [5].

glomerulus
Tuft or a cluster, as of a plexus of capillary blood vessels or nerve fibers (e.g., capillaries of the filtration apparatus of the kidney).
[1]

glucocorticoid
Any of a group of *steroid hormones*, such as cortisone, produced by the *adrenal cortex*, inhibiting inflammation, and mediating a response to stress that alters protein, fat, and carbohydrate metabolism.

glycolysis
Biochemical breakdown of glucose into pyruvic acid with the production of ATP.
Note: If the resulting pyruvate is not used efficiently in aerobic metabolism, it may then be converted to ethanol (fermentation) or lactic acid (anaerobic glycolysis).

gonad
Organ in animals that produces *gametes*, i.e., the *testis* or the *ovary*.

gonadotropin-releasing hormone (GnRH, GRH)
gonadoliberin
luteinizing hormone-releasing hormone (LHRH)
Any factor from the *hypothalamus* that stimulates the anterior *pituitary* to release both *follicle-stimulating hormone* and *luteinizing hormone*.
Modified from [5]

gonadotropin
gonadotrophin
Glycopeptide hormone, produced by the *fetal placenta*, that maintains the function of the *corpus luteum* during the first few weeks of *pregnancy*.

Graafian follicle
vesicular ovarian follicle
Mature *ovarian follicle* within which an *oocyte* attains full size and which ruptures during *ovulation* to release the *ovum*.

granulocyte
White blood cell, distinct from a lymphocyte, containing cytoplasmic granules.

granulosa

Pertaining to cells of the *cumulus oophorus*.
[6]

grey matter
Regions of the brain and *spinal cord* that are made up primarily of cell bodies and dendrites of nerve cells rather than of *myelinated* axons.
After [5]
Compare *white matter*.

growth factor
Naturally occurring or genetically engineered protein or *steroid hormone* that binds to a *receptor* to regulate cell growth, proliferation or differentiation.

growth hormone (GH)
somatotropin
somatotropic hormone (STH)
Peptide *hormone* secreted by the anterior *pituitary* that stimulates growth, energy metabolism and cell proliferation.
Note: Human growth hormone (hGH) isolated from cadavers or produced by recombinant technology is used clinically to treat deficiency of the hormone and other growth disorders, and inappropriately to enhance athletic performance.

growth hormone releasing factor (GHRF)
Substance produced in the *hypothalamus* that regulates release of *growth hormone* by the anterior *pituitary*.

gubernaculum
Fetal mesenchyme ligament that passes through the anterior abdominal wall and connects the lower pole of each developing *gonad* with the developing *scrotum* in men, and with the developing labia majora in women.
Note: In men, it guides descent of the *testes* into the scrotum.

haploid
monoploid
State in which a cell contains only one set of *chromosome*s.
[1]

harelip
See *cleft lip.*

hemal
1. Pertaining to blood or blood vessels.
2. Situated, in common with the heart and major blood vessels, on the *ventral* side of the body with respect to the vertebral column or its *embryonic* precursors.

hemangioma

Benign *tumor* formed by a vascular *malformation* present at birth or developing during life, in which proliferation of blood vessels leads to a vascular tangle.

Note 1: Hemangiomas can occur anywhere in the body but are most frequently noticed in the skin and subcutaneous tissues; most hemangiomas present at birth undergo spontaneous regression.

Note 2: Hemangioma in the brain (central nervous system cavernous hemangioma) can be accompanied with multiple neurological symptoms, ranging from headache to seizures.

hematopoiesis
hemopoiesis
Development of each of the types of blood cell from common precursor cells, located mainly in the bone marrow.

hemimelia
Congenital partial absence of all or part of the distal half of a limb.

hemivertebra
Congenital defect of the *vertebral* column in which one side of a vertebra fails to develop completely due to failure of the *chondrification* center to form on that side.

Note: The resulting wedge-shaped vertebra can cause an angle in the spine leading to *kyphosis*, *scoliosis*, or *lordosis*.

After [5]

hemolytic disease of the newborn
erythroblastosis fetalis
erythroblastosis
Severe form of *anemia* in a *fetus* or newborn infant caused by incompatibility with the mother's blood type, typically when the mother is *rhesus factor* negative (Rh -ve) and produces antibodies which attack (Rh +ve) fetal blood through the *placenta*.

hepatosplenomegaly
Enlargement of the liver and spleen.

hermaphrodite
Having the reproductive organs and many of the *secondary sex characteristics* of both sexes.

Note: Pseudohermaphroditism is a state in which the person is of an unambiguous *gonadal* sex (possessing either *testes* or *ovaries*) but has ambiguous external *genitalia*.

hermaphroditism
State of being *hermaphrodite*.

hernia
Protrusion of an organ or structure through an abnormal opening in *connective tissue* or

in the muscle wall of the cavity in which it is normally enclosed.

hernia, hiatal
hernia, hiatus
Hernia of a part of the stomach through a rupture of the *diaphragm* at the esophageal opening.

Herpes
Family of viruses including herpes simplex types 1 and 2, and herpes zoster (also called varicella zoster).
Note: Herpes viruses cause several infections, all characterized by blisters and ulcers, including chickenpox, shingles, genital herpes, and cold sores or fever blisters. [14]

Hershberger bioassay
Short-term in vivo procedure in which the *androgenic* or antiandrogenic effects of a test substance are studied in castrated, peripubertal male rodents, as indicated by changes in the weights of androgen-dependent tissues.

hexosaminidase A
Hydrolytic enzyme (EC 3.2.1.52) that acts on ganglioside G_{M2}, producing *N*-acetyl-D-galactosamine and ganglioside G_{M3}.
Note: Deficiency of this enzyme is associated with *Tay-Sachs disease*.

hippocampus
Structural component of the limbic system of the *vertebrate* brain involved in short-term and long-term memory and spatial navigation.

Hirschsprung syndrome
aganglionic megacolon
Absence of nerve ganglia throughout all or part of the gastrointestinal tract, causing dysregulation of intestinal motility.

hirsutism
Presence of excessive bodily and facial hair.
After [5]

holoprosencephaly
(formerly arhinencephaly)
Birth defect in which the *embryonic forebrain* fails to divide completely to form the *cerebral hemispheres*.
Note: This results in varying degrees of mental impairment and abnormal development of eye, nose, and lip.

homeobox
Any of a class of closely similar DNA sequences, occurring in various *genes* and

involved in regulating pattern formation, segmentation and *morphogenesis* during *embryonic* development in many species.
See also *homeosis*.

homeobox gene
Gene containing a *homeobox* sequence.

homeosis (n)/**homeotic** (adj)
Replacement of part of one segment of an insect or other segmented animal by a structure characteristic of a different segment, especially through *mutation*.

homologous
1. Having the same relationship, relative position, or structure.
2. (Of organs) Similar in position, structure, and evolutionary origin but not necessarily in function.
3. (Of *chromosomes*) Pairing at *meiosis* and having the same structural features and pattern of *genes*.
4. (Of a series of chemical compounds) Having the same functional group(s) but differing in structure by a fixed group of atoms.

homologous recombination
Crossing over between two similar or identical strands of DNA, resulting in exchange of corresponding stretches of DNA between two sister *chromosomes*.

honey bee larval toxicity test
Procedure in which larvae of honey bee (*Apis mellifera*) are exposed to a test chemical in the diet and subsequent mortality is recorded daily up to the 72-h LD50.

hormone (n)/**hormonal** (adj)
Substance formed in one organ or part of the body and carried in the blood to another organ or part where it selectively alters functional activity.
[1]

human chorionic gonadotropin (HCG)
See *chorionic gonadotropin.*

Human Genome Project (HGP)
International research project that started in 1990 with the goal of determining the base-pair sequence of the human *genome*. The project was declared complete in 2003.
Note: HGP also involved studying the genome of a number of organisms other than humans, including insects, fish, plants, and other mammals.

hydatidiform mole
Vesicular or *polycystic* mass resulting from the proliferation of the *trophoblast*, with *hydropic* degeneration and *avascularity* of the *chorionic villi*.
Note: The abnormal tissue typically results from *gene expression* from paternally

derived *chromosomes* and a loss of maternal chromosomes.
[5]

hydranencephaly
Rare condition in which the brain's *cerebral hemispheres* are replaced by sacs filled with *cerebrospinal fluid*.
[13]

hydrocele
Accumulation of *serous* fluid in a sacculated cavity; specifically, such an accumulation in the space of the *tunica vaginalis testis*, or in a separate pocket along the *spermatic cord*.
After [5]

hydrocephalus
Accumulation of excess *cerebrospinal fluid* within the *ventricles* of the brain; head enlargement and brain damage may occur.
[13]

hydromicrocephaly
Microcephaly with excess *cerebrospinal fluid.*

hydronephrosis
Swelling of the funnel-shaped part of the kidney, where urine is collected to enter the ureter.
Note: Hydronephrosis may be a *congenital* deformity or the consequence of an obstruction in the ureter.

hydrops (n)/**hydropic** (adj)
Gross *edema* of the entire body, with severe *anemia*, occurring in *hemolytic disease of the newborn*.
[6]

hydroureter
ureterectasia
Dilation of a ureter with fluid.

21-hydroxylase
21α-hydroxylase
steroid 21-monooxygenase
Member (EC 1.14.99.10) of the cytochrome P-450 family of enzymes required for the synthesis of some *steroid hormones* including aldosterone and cortisol.

hygroma (n)/**hygromous (**adj)
hydroma
Accumulation of fluid in a sac, *cyst*, or *bursa*.
[6]

hymen
Thin, *membranous* fold of highly variable appearance that, before its rupture, partly occludes the opening of the *vagina*.

hyoid arch
Second *pharyngeal* or *branchial* arch of the developing *embryo*, from which different tissues around the neck, ear and face will develop.

hypaxial
Ventral to the long axis of the body.

hyperextension
Extension of a limb or part of a limb beyond the normal limit.

hyperflexion
Flexion of a limb or part of a limb beyond the normal limit.

hyperplasia
Abnormal multiplication or increase in the number of normal cells in a tissue or organ.
[1]

hypertelorism
Abnormally wide space between two organs, especially referring to the eyes.

hypertrichosis
See *hirsutism*.

hypertrophy
Enlargement of an organ or tissue as a result of the increase in the size of its cells.

hypoblast
Innermost of the three primary *germ layers*, adjacent to the *blastocyst* cavity, that develops into the *endoderm*.
[13]

hypogonadism
Inadequate functioning of the *testes* or *ovaries* as manifested by deficiencies in *gametogenesis* or in secretion of *gonadal hormones*.
Note*:* Primary hypogonadism refers to a defect that is inherent in the gonad while secondary hypogonadism refers to a defect lying outside the gonad, often an *endocrine* effect.

hypophysis
See *pituitary*.

hypoplasia
Underdevelopment or *atrophy* of a tissue or organ.

hypospadias
Birth defect in which the *urethra* opens on the underside of the penis, or into the vagina.

hypothalamus
Region at the base of the brain containing specialized nerve cells that help activate, control, and integrate peripheral autonomic mechanisms, endocrine activities, and some *somatic* functions such as body temperature, sleep, and appetite.

hypoxia
1. Abnormally low dioxygen content or tension.
2. Deficiency of dioxygen in the inspired air, in blood, or in tissues, short of anoxia.
[1]

ichthyosis (n)/**ichthyotic** (adj)
fish skin disease
xeroderma
Congenital disorder of *keratin*ization, characterized by dryness and scaling of the skin, often associated with other defects and with abnormalities of lipid metabolism.
After [5]

identical twins
monozygotic twins
Twins resulting from one *zygote* that, at an early stage of *embryonic* development, separated into two independently growing cell aggregations giving rise to two individuals of the same sex and identical genetic constitution.
[5]

ileocecal
Relating to the *ileum* and the *cecum*.

ileum
Third portion of the small intestine, between the *jejunum* and the *cecum*.

iliac artery
hypogastric artery
Main artery of the pelvis.

imperforate anus
anal atresia
Congenital absence of an *anal* opening due to the persistence of *epithelial* plug (persistence of the anal membrane) or to complete absence of the *anal canal*.
[5]

implantation
nidation
Embedding of the early *embryo* in the lining of the *uterus*.
[13]

imposex
Pseudohermaphroditic condition in female gastropods (snails) manifested by the development (imposition) of male characteristics such as a penis or *vas deferens*.
Note: Quantitation of imposex in the dog whelk (*Nucella lapillus*) has been used to monitor pollution by the antifouling agent tributyltin oxide (TBTO) in marine environments.
[2]

imposition
See *imposex*.

imprinting (in genetics)
Differential *expression* of a *gene*, depending on whether it was transmitted through the *sperm* or the *egg*.
After [13]
Note: Imprinting is an *epigenetic* modulation of gene expression, thought to be regulated by attachment of methyl groups to the DNA, and by chromatin structure.

inbred strain
Strain of an animal that has been inbred by brother-sister matings for more than 20 generations, and consequently all the individuals of the strain are more than 98% genetically identical.
After [12]

index, female fertility
In rodents, number of *pregnant* females divided by the number of females mated, multiplied by 100.
Note: This index measures the female's ability to become pregnant and may be used as a general indicator of *fertility*.

index, gestation
In rodents, number of females with live born *offspring* divided by number of females with evidence of *pregnancy*, multiplied by 100.

index, male fertility
In rodents, number of males impregnating females divided by number of males mated, multiplied by 100.
Note: This index measures the male's ability to produce *sperm* that are capable of impregnating a female, assuming all mated females are *fertile*.

index, tubular fertility

Percentage of *seminiferous tubules* containing identifiable *spermatogonia*.

induced pluripotent stem cell (iPS)
Pluripotent stem cell that is generated from an *adult* cell by genetic reprogramming.

induction
1. Process of stimulating and determining *morphogenetic* differentiation in a developing *embryo* through the action of chemical substances transmitted from one *embryonic* part to another.
See also *evocation*.
2. Increased expression of a protein or set of proteins triggered by an endogenous mediator or a xenobiotic.

infecundity
See *infertility*.

infertility
barrenness
infecundity
sterility
Persistent inability of either a male or a female to achieve *conception* or to produce offspring.

infundibulum
Hollow stalk that connects the *hypothalamus* and the posterior *pituitary* gland.

inguinal canal
Passage in the lower anterior abdominal wall, which in men conveys the *spermatic cord* and in women the *round ligament* of the *uterus*.

inhibin
Any of a group of peptide *hormones* secreted by the *follicular granulosa cells* of the *ovary* and the *Sertoli cells* of the *testis*, inhibiting *follicle stimulating hormone* secretion by the anterior *pituitary*.

iniencephaly
Malformation producing a cranial defect at the *occiput*, with the brain exposed, often combined with a cervical *rachischisis* and retroflexion.
After [5]

iniopagus
Twins conjoined at the *occiput*.

insemination
Delivery of *sperm* into the female reproductive system for the purpose or with the result of causing *pregnancy*.

integrin
Any of a family of cell membrane glycoproteins that mediate cell-to-cell and cell-to-*extracellular matrix* interactions.

intermediate filament (IF)
Any of a group of fibrous proteins (including *keratin* fibres, neurofilaments, desmin, and vimentin) that make up part of the cytoskeleton of most eukaryotic cells; so named because, at about 10 nm diameter, they are intermediate in thickness between actin filaments and microtubules.
Note: Most types of intermediate filaments are cytoplasmic, but one type, the lamins, is nuclear.

intersexuality
intersex
Condition of having both male and female characteristics: thus, the state of being intermediate between the sexes.
[5]

intracytoplasmic sperm injection (ICSI)
Infertility treatment in which the *sperm* is injected through the *membrane* of the *egg* into its cytoplasm.
[13]

intramembrous ossification
Creation of bone tissue during *fetal* development of jawed *vertebrates*, and in the healing of bone fractures; the tissue forms from *mesenchymal stem cells* residing in an *extracellular matrix* devoid of collagen.
Note: Intramembrous ossification is one of two mechanisms of bone formation, the other being *endochondral ossification*.

intrauterine
Within the *uterus*.

intrauterine growth restriction (IUGR)
intrauterine growth retardation
Subnormal, poor growth of the *fetus*.
Note: Growth restriction can be due to maternal or fetal causes, as well as to malnutrition and toxic exposures.

intrinsic pathway
Apoptotic pathway of cell death initiated from within the cell by signals initiated by mitochondrial damage and (or) DNA damage, a defective cell cycle, detachment from the extracellular matrix, hypoxia, loss of cell survival factors, or other types of severe cell stress; characterized by the activation of *caspase* 9.
Note1: This pathway involves the release of pro-apoptotic proteins from the

mitochondria.
Note 2: The intrinsic and *extrinsic pathways* converge with cleavage of procaspase 3 by either caspase 8 (extrinsic pathway) or caspase 9 (intrinsic pathway).

introitus
See *ostium*.

in utero
See *intrauterine*.

inversion, chromosomal
Rearrangement of a *chromosome* in which, after breakage at two points, a segment is reversed, resulting in a change in sequence of nucleotides.

in vitro fertilization (IVF)
Fertilization outside the body, used as a treatment for *infertility*.
[13]

ischemia
Local deficiency of blood supply, and hence of dioxygen, to an organ or tissue, caused by constriction or obstruction of the blood vessels.
After [1]

isotretinoin
Vitamin A-like medication (1,3-cis retinoic acid) used, amongst other things, for acne treatment.
Note: Intake during *pregnancy* has a high *teratogenic* risk.

jejunum
Second part of the small intestine between the *duodenum* and *ileum*.

karyolysis
Dissolution of a cell nucleus, especially during *mitosis* and *meiosis* but also following *necrosis*.
See also *karyorrhexis*.

karyorrhexis
Irreversible fragmentation of the nucleus of a dying cell following *karyolysis*, whereby its chromatin is distributed irregularly throughout the cytoplasm.

karyotype
1. Characterization of the number, form, and size of the *chromosomes* of an individual or a species.
2. Photomicrograph of an individual's chromosomes, arranged according to a standard classification for the species.

keratin
Fibrous protein forming the main structural constituent of hair, feathers, hoofs, claws, horns, etc.

ketoacidosis
Acidosis, as in diabetes, *pregnancy*, or starvation, accompanied by the accumulation of *ketone bodies* in body tissues and fluids.

ketone body
Ketone that is an intermediate product of the breakdown of fats in the body; any of three compounds, acetoacetic acid, acetone, and (or) β-hydroxybutyric acid, found in excess in blood and urine of persons with metabolic disorders.

Note: Ketone bodies tend to accumulate in the blood and urine of individuals affected by starvation or uncontrolled diabetes mellitus.

Klinefelter syndrome
Syndrome in males resulting from a genetic defect in which an extra female *X chromosome* (thus an XXY *genotype*) is present in a male, characterized by small *testes*, long legs, enlarged breasts, reduced *sperm* production, and mental retardation.

knockout mutation
null mutation
Mutation that leads to the loss of function of a particular *gene*.
[12]

kyphosis
hunchback
Rearward curvature or convexity of the spine in excess of normal, resulting in a protuberant upper back.

labor
Physical efforts of expulsion of the *fetus* and the *placenta* from the *uterus* during *birth*.

lactation
Secretion of milk from the *mammary gland*, usually to feed the infant during the *neonatal* period.

lactation period
Time following *pregnancy* during which the *mammary glands* secrete milk.

lamina propria
Layer of *connective tissue*, underlying the *epithelium* of a *mucus membrane*, containing capillaries and *lymphatic* vessels as well as *fibroblasts* and cells of the immune system.

larynx
Part of the respiratory tract between the *pharynx* and the *trachea*, having walls of

cartilage and muscle and containing the vocal cords.

leprosy
Disease caused by infection with the bacterium *Mycobacterium leprae*, often affecting the skin and nerves and causing body parts to become deformed.
Note: Thalidomide is used as a therapeutic drug and thalidomide-associated *embryo*pathy occurs in regions where leprosy is endemic.

leptocephaly
Malformation characterized by an abnormally tall, narrow cranium.
[5]

leptodactyly
Abnormally slender digits.

leucism
Lack of pigmentation in the skin, hair, or feathers as a result of a failure of pigment cells to develop, or to migrate to those locations from their origin in the *neural crest*, in the *embryo*.
Note: Unlike *albinism*, where the defect is in the production of melanin pigment only, animals with leucism usually have pigment in the eye, as *retinal* pigment cells do not derive from the neural crest.

leukopenia
Abnormally low concentration of white cells (leukocytes) in the blood.

levocardia
Normal position of the heart in the left hemithorax with the apex pointed to the left, and transposition of other viscera.
See also *dextrocardia*, *situs inversus*.

Leydig cell
Cell in the *testis* that produces *androgens,* mainly *testosterone*, in the presence of *luteinizing hormone*.

ligamentum arteriosum
Fibrous remnant of the *ductus arteriosus* linking the *aortic arch* and the top of the left *pulmonary artery*.

limb bud
Embryonic outgrowth of *mesoderm* covered in *ectoderm* that will give rise to one of the forelimbs or hindlimbs.

limit test
Acute toxicity test in which, if no ill effects occur at a preselected maximum dose, no further testing at greater exposure levels is required.

[2]

linkage analysis
Technique that studies patterns of heredity in high-risk families, in order to locate a disease-causing *gene* mutation by identifying co-inherited traits, usually by producing a *LOD score*.

linkage disequilibrium
Occurrence in members of a population of combinations of linked *genes* in non-random proportions, implying that the genes are close enough together on a *chromosome* to make it unlikely that they will be separated by recombination (see *homologous recombination*) during *meiosis*.

lipidosis
Disorder of fat metabolism characterized by the accumulation of abnormal levels of certain lipids in the body.

litter
Offspring produced at one *birth* by a mammal.

lobster-claw deformity
split hand
cleft hand
See *ectrodactyly*.

locus
In genetics, specific location of a *gene* or DNA sequence on a *chromosome*.

LOD score
logarithm (base 10) of odds
Ratio of the likelihood of two or more *loci* remaining together when chromosomes recombine (true linkage) to the likelihood of this occurring by chance alone.
See also *linkage analysis*.

lordosis
Forward (*ventral*) curvature of the spine in the lumbar and cervical regions.
Note 1: Some degree of lumbar curvature is normal. Excessive curvature (lumbar hyperlordosis) is sometimes called swayback.
Note 2: This posture is also associated with a rodent being in heat.

lumbar puncture
spinal tap
Piercing into the subarachnoid space of the lumbar region in order to obtain spinal fluid for diagnostic purposes or to inject a drug.

luteal phase (menstrual cycle)

Phase of the human *menstrual cycle*, usually lasting 14 days, beginning with formation of the *corpus luteum* and ending, in the absence of *fertilization*, with the onset of *menstruation*.
Modified from [6]

luteinizing hormone (LH)
Hormone made by the *pituitary* gland that acts on the *ovary* to control *egg* maturation and to trigger *ovulation*. The same hormone acts in the *testes* to trigger production of *testosterone*.

luteinizing hormone-releasing hormone (LHRH)
See *gonadotropin-releasing hormone*.

lymph
Transparent fluid, containing chiefly lymphocytes, that bathes the tissues and drains through a system of vessels (the *lymphatic* system) into the venous bloodstream through the *thoracic duct*.

lymphatic
Relating to *lymph* or its secretion.

lymphoid
Relating to or denoting tissue responsible for producing lymphocytes and antibodies.
Note: Lymphoid tissue occurs throughout the body in *lymph* nodes, *thymus*, *tonsils*, and spleen.

Lyon hypothesis
Lyon law
X-inactivation
lyonization
Hypothesis (named after Mary Lyon) that random inactivation of all but one *X chromosome* occurs in each female mammalian cell in early development, thus explaining why the effect of the X chromosome on *phenotype* is the same in males with one copy as in females with two copies.
Note 1: The *Barr body*, visible in some female cells, is an inactivated X chromosome.
Note 2: This phenomenon leads to *mosaicism* for *X-linked genes* in the female, since the paternal X chromosome is inactivated in some cells and the maternal one in others.
Note 3: The Lyon hypothesis was designated the Lyon Law by the European Molecular Biology Organization (EMBO) in 2011.

lysosomal storage disease
One of a group of rare inherited metabolic disorders resulting from a defect in lysosomal function, commonly deficiency of enzymes required for the metabolism of lipids, glycoproteins, or mucopolysaccharides, resulting in their accumulation in the cell.

macrocephaly
megacephaly
megalocephaly
Congenital disorder characterized by an abnormally large head and (or) brain.

macroglossia
Congenital disorder characterized by an abnormally enlarged tongue.
Note: This is often seen in Down syndrome.

macrognathia
megagnathia
Congenital disorder characterized by enlargement or elongation of the jaw.

macromelia
megalomelia
Congenital disorder characterized by an abnormally large limb or limbs.

macrosomia
Congenital disorder characterized by an abnormally large body or body part.

macrostomia
Congenital disorder characterized by an abnormally large size of the mouth.

male efferent duct
See *efferent duct*.

malformation
Structural defect as a result of abnormal development.

malignant
Opposite term: *benign.*
1. Occurring in a severe form, tending to become progressively worse, resistant to treatment, and likely to result in death.
2. In *cancer*, cells showing both uncontrolled growth and a tendency to invade and destroy other tissues.
After [1]

mammary gland
Milk-producing organ in female mammals.

Marfan syndrome
Congenital connective tissue disorder associated with mutation of the fibrillin-1 gene FBN1.

masculinization
Condition defined by the appearance of male characteristics, such as facial hair, either as

part of normal male maturation, or pathologically by people of either sex as a result of *hormonal* imbalance.

maternal serum alpha-fetoprotein (MSAFP)
Protein made in the *fetus* that normally leaks, in small amounts, into the mother's circulation.
[13]

Note: If there is an abnormal opening in the fetus, such as a *neural tube defect*, larger amounts appear in the mother's serum, providing a screening test for such fetal anomalies.

maxillary
Relating to the maxilla (upper jaw).

Meckel diverticulum
ileal diverticulum
Congenital pouch in the *ileum* resulting from incomplete closure of the *yolk sac*.

meconium
First intestinal discharges of the newborn infant, greenish in color and consisting of *epithelial* cells, *mucus*, and bile.
[5]

median teratogenic concentration (TC)
Median concentration resulting in developmental *malformations* for 50% of exposed test animals within a predetermined time, e.g., 96 h.
[2]

mediastinum
Region in the middle of the thorax between the two lungs, containing the regional vessels, *trachea*, esophagus, bronchi, *lymph* nodes, and heart.

medulla
medulla oblongata
Lower part of the brain stem continuous with the *spinal cord*, containing neural centers regulating the autonomic functions of breathing, heart rate, and blood pressure.

megacolon
Condition of extreme dilation of the colon that can be *congenital* (as in *Hirschsprung* disease) or acquired (as when children refuse to defecate).

Note: Aganglionic megacolon is a condition, where parts of the colon have abnormal motor activity, resulting in spasms and massive distention of the colon *proximal* to the spasm.

megadactyly
macrodactylia

Disorder characterized by an abnormally large fingers and (or) toes.

meiosis
Process of "reductive" cell division, occurring during the production of *gametes*, by means of which each daughter nucleus receives half the number of *chromosomes* characteristic of the *somatic* cells of the species.
[5]
Not to be confused with *miosis*.

membrane
1. In anatomy, thin layer of tissue separating or connecting structures or organs.
2. In cell biology, phospholipid-based bilayer structure, surrounding and isolating cells and organelles.

menarche
First *menstrual cycle* of a woman.

Mendelian gene
Gene located in a *chromosome* that obeys the laws of *Mendelian inheritance*.
[12]

Mendelian inheritance
Inheritance in which stable and indivisible characteristics are controlled entirely or overwhelmingly by a single genetic *locus* and transmitted over many generations.
[5]

Mendelian trait
Phenotype that shows a pattern of *Mendelian inheritance*.

meninx (s)/**meninges (**pl)
Any of the three membranes (the *dura mater*, *arachnoid*, and *pia mater*) that line the skull and vertebral canal and enclose the brain and *spinal cord*.

meningocele
Herniation of the *membranes* of the brain or *spinal cord* (see *meninx*) through a defect in the cranium or *spinal column.*
After [5]

meningomyelocele
meningoencephalocele
Birth defect following failure of the *neural tube* to close, resulting in protrusion of a sac of nerve tissue and its covering *membranes*.
[13]

menopause
Cessation of reproductive capability in a woman, marked by declining *ovarian* function

and an end to *menses*.

menstrual cycle
The period, normally lasting 28 days in the human female, during which an *ovum* matures, is *ovulated*, and enters the *uterus* through the *Fallopian tubes*. If *fertilization* occurs, the cycle is interrupted by *pregnancy*; otherwise, the cycle ends with *menstruation*.

menstruation
menses
Cyclic *endometrial* shedding and discharge of a bloody fluid from the uterus during the *menstrual cycle*.
[5]

meromelia
Congenital absence of a part of a limb, resulting in a shrunken and deformed extremity.
See also *amelia*, *hemimelia*, *phocomelia*.
After [5]

mesectoderm
ectomesenchyme
Embryonic migratory cells derived from the *neural crest* of the head that contribute to the formation of the meninges (see *meninx*) and become pigment cells.
[6]

mesencephalon
midbrain
Part of the *vertebrate* brain that develops from the middle section of the *embryonic neural tube*.

mesenchymal-to-epithelial transition (MET)
Process in which motile *mesenchymal* cells undergo a development to planar, polarized fixed cells, forming *epithelia*.
Note: This transition occurs in both normal development and *tumor metastasis*.
See also *epithelial-to-mesenchymal transition.*

mesenchyme (n)/**mesenchymal** (adj)
Meshwork of *embryonic connective tissue* in the *mesoderm*, from which are formed the bone, muscular, and connective tissues of the body; and also the *urogenital* system, blood vessels, and *lymph* vessels.
[9]

mesentery
Membranous sheet attaching various organs to the body wall, especially the *peritoneal* fold attaching the intestine to the *dorsal* body wall.
[9]

mesoderm
embryonic mesoderm
Middle layer of cells in the *embryo*, lying between the *ectoderm* and the *endoderm*. It includes the following tissues:

a. Lateral mesoderm: peripheral portion of intraembryonic mesoderm.
b. Intermediate mesoderm: origin of the nephrogenic cord.
c. *Parietal* (*somatic*) mesoderm: cell source for the formation of the lateral and *ventral* body wall.
d. *Visceral* (*branchial*, *pharyngeal*, *splanchnic*) mesoderm: inner layer of lateral mesoderm that, with the *endoderm*, provides the cells from which the gut and lungs and their coverings arise.

See also *mesenchyme*.

mesogastrium
Part of the *embryonic mesentery* that is attached to the early stomach.

mesonephric duct
Wolffian duct
Embryonic *duct* of the *mesonephros*, which in the male becomes the *vas deferens* and in the female becomes *vestigial*.

mesonephros
Middle part of the *embryonic* kidney in *vertebrates*, becoming the *adult* kidney in fishes and amphibians and the *epididymis* in reptiles, birds, and mammals.
See also *pronephros*, *metanephros*

mesothelium
Single layer of flattened cells forming an *epithelium* that lines *serous* cavities such as the *peritoneum*, *pleura*, and *pericardium*.
After [5]

messenger RNA (mRNA)
RNA that results from transcription of *genes* coding for polypeptides.

metabologen
Morphogen, including *bone morphogenetic protein*, that affects metabolism and homeostasis.

metallothionein
One of a family of low-molecular weight proteins that binds metals such as zinc, copper, cadmium and mercury.

metanephros
Primordium of the permanent kidney, developing later than, and *caudal* to, the *mesonephros*.
[6]

metaphase
Stage of *mitosis* or *meiosis* in which the *chromosomes* become aligned on the equatorial plate of the cell, separating the *centromeres*.

metaplasia
Abnormal transformation of an *adult*, fully differentiated tissue of one kind into a differentiated tissue of another kind.
[5]

methylation
Attachment of a methyl group to a molecule.
Note: Methylation of DNA on cytosine bases is an *epigenetic* event that alters *gene expression*.

microcephaly
Congenital occurrence of an abnormally small head.

microcheiria
Congenital occurrence of abnormally small hands.

microglossia
Congenital occurrence of an abnormally small tongue.

micrognathia
Congenital occurrence of an abnormally small jaws, especially effecting the mandible.

micromass culture
Laboratory technique in which dispersed cells from an *embryonic* organ or tissue, such as the brain, *limb bud* or *cartilage,* are allowed to reaggregate in culture.
After [13]

micronucleus test
1. Test for *mutagenicity* in which animals are treated with a test agent after which time the frequency of micronucleated cells is determined.
Note: If a test group shows significantly increased levels of micronucleated cells compared to a control group, the chemical is considered capable of inducing *chromosomal* damage.
[1]
2. Procedure to detect *clastogenic* or *aneugenic* agents by microscopic examination of chromosomes.
Note: The test can be performed in vivo in rodents, or in cell culture (in vitro mammalian cell micronucleus test).

microphallus
Abnormally small penis.

microphthalmia
Congenital occurrence of abnormally small eyeballs.

microsatellite (in genetics)
short tandem repeat (STR)
Non-coding segment of DNA consisting of short nucleotide sequences (2-6 base pairs), typically occurring in 10-100 consecutive (tandem) repeats.
Note 1: The number of repeats varies between members of any given species.
Note 2: Microsatellites are used as markers in determining genetic diversity, in identifying important genetic traits, in forensic science, in population studies, and in determining paternity.

microsome
Spherical vesicle, prepared by tissue fractionation methods, that is rich in membranes of the endoplasmatic reticulum
Note: The microsomal fraction obtained in this way is often used as a source of monooxygenase enzymes in drug metabolism studies.
After [1]

microstomia
Congenital occurrence of an abnormally small opening of the mouth.

midgut
mesenteron
Middle section of the digestive tract in a *vertebrate embryo,* from which the *ileum*, *jejunum*, and portions of the *duodenum* and colon develop.

Minamata disease
Neurological disease caused by methylmercury, first seen in subjects ingesting contaminated fish from Minamata Bay in Japan.
[1]

minisatellite
variable number tandem repeat (VNTR)
Non-coding segment of DNA, found throughout the *genome*, usually near the ends of *chromosomes*, that consists of tandem repeats of sequences of about 10–100 base pairs.
Note: These VNTRs are useful for genetic research and analysis.
Compare *microsatellites*.

miscarriage
Lay term for *spontaneous abortion.*

mitosis (n)/**mitotic** (adj)
Process by which a cell nucleus divides into two daughter nuclei, each normally having the same genetic complement as the parent cell: nuclear division is usually followed by

cell division.
[1]

molecular epidemiology
Use in *epidemiological* studies of techniques of molecular biology such as DNA profiling and genetic analysis, with the aim of detecting genetic patterns characteristic of susceptible populations or of groups at risk of disease.

monophthalmos
Congenital absence of one eye.

monosomy
Disorder in which body cells have only one pair instead of the normal two pairs of a particular *chromosome*.

monozygotic twin
See *identical twin*.

morphogen (n)/**morphogenetic** (adj)
Any of various signalling factors in *embryonic* tissue that influences the movement and organization of cells during *morphogenesis* by forming a concentration gradient.

morphogenesis
Shaping of an organism during *embryological* development by differentiation of cells, tissues, organs and organ systems, according to the genetic program of the organism, and influenced by *morphogens* and environmental conditions.
After [15]

morphological
Pertaining to structure or form.

morula
Early multi-celled stage of the *embryo* from which the *blastocyst* is formed.
[13]

mosaicism
Condition in which an individual or an organism that develops from a single *zygote* has two or more cell populations that differ in genetic constitution.
Note: Mosaicism is seen in humans in *Down syndrome*, *Turner syndrome* and *Kleinfelter syndrome*.
After [8]

motility, sperm
Energy-dependent forward movement of the *sperm*, allowing it to reach and penetrate the *egg*.
Note: Decreased sperm motility is an indicator of reduced *fertility*.

mucosa
See *mucous membrane*.

mucous membrane
Layer of *epithelial* tissue with a thin underlying layer of *connective tissue* (the *lamina propria*) that lines many body cavities, including the gut, respiratory passages, and tubular organs; it secretes, and is covered in, *mucus*.

mucus (n)/**mucous** (adj)
Slippery viscous fluid, consisting largely of water and glycoproteins, secreted by *mucous membranes*.

Müllerian duct
See *paramesonephric duct*.

Müllerian inhibiting factor (MIF)
See *anti-Müllerian hormone*.

Müllerian-inhibiting hormone (MIH)
See *anti-Müllerian hormone*.

Müllerian inhibiting substance (MIS)
See *anti-Müllerian hormone*.

multicotyledonary placentation
Formation of a *placenta* with many lobes.
[13]

multifactorial inheritance
Transmission from parents to offspring of a trait that is determined by multiple genetic and environmental factors, each with a small effect.
[13]

multigenerational study
1. Animal test of reproductive toxicity in which two to three generations of the test organism are exposed to the substance being assessed.
2. Animal test of reproductive toxicity in which only one generation is exposed and effects on subsequent generations are assessed.
After [1]

mutagen (n)/**mutagenic** (adj)
Agent that can induce heritable changes (*mutations*) in the *genotype* of a cell, as a consequence of alterations in, or loss of, genetic material.
[1]

mutation
Any relatively stable heritable change in genetic material that may be a chemical transformation of an individual *gene* (gene or point mutation), altering its function; or a rearrangement, gain, or loss of part of a *chromosome*, which may be microscopically visible (chromosomal mutation).

Note: A mutation can be either germinal and inherited by subsequent generations, or *somatic* and passed through cell lineage by cell division.

[1]

mutation (in immunology)
See *somatic hypermutation*.

mycoplasma
Very small infectious microorganism, related to bacteria, but without a cell wall.

Note: Genital mycoplasmas may lead to spontaneous preterm *labor* or *perinatal* morbidity and mortality.

myelencephalon
Part of the brain in the *embyo* that gives rise to the *medulla oblongata*.

myelination
The acquisition, development, or formation of a myelin sheath around a nerve fiber.

myeloblast (n)/**myeloblastic** (adj)
Immature bone marrow cell that is a precursor of the *granulocyte* series.

myelotoxic
Harming bone marrow or any of its components.

myoblast
Mononucleate cell that is committed to differentiate into muscle.
[13]

myocarditis
Inflammation of the heart muscle.

myocardium
Muscle of the heart

myometrium
Muscular wall of the *uterus*.

myositis
Inflammation of muscle.

myotome

In the *embryo*, that part of a *somite* that develops into skeletal muscle.

nasal
Relating to the nose.

natality
Rate of *birth*, the number of newborn individuals per unit time.
Note: Natality and mortality graphs together form a life table.
[2]

navel
See *umbilicus*.

necropsy
Postmortem examination of the organs and body tissue of a non-human animal to determine cause of death or pathological condition.

necrosis (n)/**necrotic (**adj)
Sum of morphological changes resulting from cell death by lysis and (or) enzymatic degradation, usually accompanied by inflammation and affecting groups of cells in a tissue.
Note: Distinct from *apoptosis*, *autophagy*, and other modes of cell death.
[1]

neonate (n)/**neonatal (**adj)
Newborn animal or human infant during the first four weeks of *postnatal* life.
Note: For statistical purposes, some scientists have defined the period as the first seven days of human postnatal life. The precise definition varies from species to species.
After [1]

neoplasm
New and abnormal formation of tissue as a consequence of growth by cell proliferation, which may continue after the initial stimulus that initiated the proliferation has ceased, and may develop into a *tumor*.

neural
1. Pertaining to a nerve or to the nervous system.
2. Pertaining to the *dorsal* side of the *vertebral* bodies or to their precursors.
Compare *hemal*.
After [5]

neural arch
1. *Dorsal* bony covering of the spinal cord.
Syn. vertebral arch.
2. *Cartilaginous* structures surrounding the *embryonic spinal cord*.

neural crest
Band of cells on either side of the *neural tube*.
Note: Cells from the region of the neural crest migrate to form parts of the nervous system, face, skin, and heart.
After [13]

neural plate
Area in the middle of the early *embryo* that rolls up to form the *neural tube*.
After [13]

neural tube
Embryonic tubular structure that becomes the brain and *spinal cord*.
After [13]

neural tube defect
Failure of the *neural tube* to close properly during *gastrulation*.
See also *anencephaly*, *spina bifida*.

neuroblast
Cell derived from *neural stem cell* that will differentiate into a *neuron*.
See also *neuroblastoma*.

neuroblastoma
Malignant neoplasm consisting of poorly differentiated *embryo*nic nerve cells (*neuroblasts*).

neurobehavioral
Pertaining to the function of the nervous system as it relates to behavior.
[13]

neuroectoderm
Central region of the early *embryonic ectoderm* that will give rise to the brain and *spinal cord*, together with the *neural crest* cells that will form the peripheral nervous system.

neuroendocrine (system)
Combined cooperating network of the nervous system and *hormonal* systems.

neuroendocrine
Pertaining to the nervous and *endocrine* systems in anatomical or functional relationship.

neurohypophysis
Posterior lobe of the *pituitary gland*, involved in the storage and secretion of *oxytocin* and *vasopressin*.

neuron (n)/**neuronal** (adj)

Nerve cell.

neuropore
Opening at either the *cranial* (*caudal*) or anterior (*rostral*) end of the *neural tube* before it completes closure in the early *embryonic stage*.

neurotrophin
One of several protein *growth factors* that regulates development, maintenance, and function of the *vertebrate* nervous system.

neurulation
Formation of the *embryonic neural plate* and its rolling up into the *neural tube*.

nipple
Projection on the apex of the breast through which the *ducts* of the milk-producing glands open.
After [5]

nodal (protein)
Growth factor of the transforming growth factor β (TGF-β) superfamily, coded by a *gene* designated NODAL, that plays crucial roles in *embryogenesis*, particularly in signalling from the *primitive streak* to the *mesoderm* to establish left-right assymetry as well as aspects of *stem cell* differentiation.
Note: The name derives from *expression* of the gene in the *primitive node*.

noggin (NOG)
Signaling protein released by the *notochord*, important in *somite* patterning and nervous system development.
See also *Spemann organizer*.

nondisjunction
Failure of *chromosome*s to separate during *meiosis*, resulting in an uneven distribution of chromosomes in the two *gamete*s (24 and 22 in humans).

noradrenaline
norepinephrine
4-[(1*S*)-2-amino-1-hydroxyethyl]benzene-1,2-diol
Catecholamine hormone acting as a postganglionic adrenergic mediator at α- and β-adrenergic receptors.
Note 1: Norepinephrine is also stored in, and released from, *chromaffin* granules in the *adrenal* medulla.
Note 2: Norepinephrine has strong vasoconstrictive effects.

norepinephrine
See *noradrenaline*.

notochord
Rod-shaped structure of cells derived from *mesoderm*, lying *ventral* to the *neural tube* and defining the *primitive axis* of the *embryo*.

nuclear spindle
mitotic spindle
Structure, formed from microtubules, that draws the newly duplicated *chromosomes* apart during *mitosis* and *meiosis*.

nuclear type I receptor
Steroid hormone receptor, found in the cytosol, that upon ligand binding translocates into the nucleus and interacts with DNA as a homodimer to drive specific *gene* transcription.
Compare *nuclear type II receptor.*

nuclear type II receptor
Steroid hormone receptor, found in the nucleus, that upon ligand binding interacts with DNA as a heterodimer (usually with the *retinoid* X receptor, RXR) to drive specific *gene* transcription.
Compare *nuclear type I receptor.*

nulligravida
Never having been *pregnant*.
Compare *nulliparous*.

nulliparous
Never having given *birth* to a live infant.
Compare *nulligravida*.

occiput (n)/**occipital** (adj)
Back part of the head or skull.

odontoblast
Dentin-forming cell of the pulp cavity of a tooth, arising from the *mesenchyme* of the *neural crest*.

offspring
Child or children of a person, or the young of an animal, in relation to the parent(s).

oligodactyly
Congenital occurrence of fewer than the usual number of digits, resulting in humans having fewer than five fingers or toes on a hand or foot.

oligodontia
Congenital absence of some of the teeth.

oligomenomenorrhea

Infrequent or scanty *menstruation*.

oligospermia
oligospermatism
oligozoospermia
Subnormal concentration of *sperm* in the male ejaculate (see *ejaculation*).

omentum
Fold of *peritoneal membrane* passing between the stomach and another abdominal organ.
After [5]
See also *omentum, greater*; *omentum, lesser.*

omentum, greater
Omentum passing from the greater curvature of the stomach in front of the small intestine, folding back on itself to fuse into four layers of *peritoneal membrane*, and ascending to the transverse colon.

Note: The greater omentum functions in fat deposition, contains islands of macrophages that contribute to immune function, and can delimit areas of traumatic tissue damage or infection.

omentum, lesser
Double-layer of *peritoneal membrane* (*omentum*) passing between the lesser curvature of the stomach and the duodenum.

omphalocele
exomphalos
*Congenital hernia*tion of *abdominal viscera* into the base of the *umbilical cord*.
Compare *gastroschisis*.

omphalosite
Lesser developed of two *monozygotic twin*s that failed to separate completely during *embryogenesis*.

Note: The omphalosite is joined to the other twin (the *autosite*) by the *umbilical* vessels, receives its blood supply from the *placenta*, and is incapable of survival after separation from the placenta.

one-generation reprotox study
Procedure in which male rodents are dosed with a test substance for at least one *spermatogenic* cycle and females for two *estrous cycles*, and then further exposed during mating, *pregnancy* and nursing; adverse effects on reproduction, *parturition*, *lactation* and *postnatal* growth are studied.
Compare *extended one-generation reprotox study.*
See also *two-generation reprotox study*.

oocyte
ovocyte

Immature precursor of the *ovum* resident in the *ovary*.

oocyte, primary
Oocyte during growth phase before completion of the first *meiotic* division.
Note: The primary oocyte is *diploid* and becomes a *secondary oocyte* before birth.

oocyte, secondary
Oocyte in which the first meiotic division to a *haploid* cell has been completed.
Compare *oocyte, primary*.

oogenesis
Process of formation and development of an *ovum*.
[5]
See also *oocyte*; *oocyte, primary*; *oocyte, secondary; oogonium*.

oogonium
Primitive *germ cell* that proliferates by *mitosis* and develops into a *primary oocyte* prior to *birth*.
After [5]

open reading frame (ORF)
DNA sequence that begins with an initiation codon and ends with a termination codon that codes for and is potentially translatable into polypeptide.

optic
Relating to the eye or vision.

orbit (in anatomy)
eye socket
Cavity in the skull of a *vertebrate* that contains the eye.

organ of Corti
spiral organ
Specialized collection of *epithelial* hair cells in the inner ear, involved in hearing.

organogenesis
Formation and development of organs.

orofacial cleft
Failure of the lip or *palate* to fuse properly.
See also *facial cleft*.

oropharyngeal membrane
See *buccopharyngeal membrane*.

ossification

See *osteogenesis*.

osteoblast
Fibroblast-derived bone-forming cell that produces a collagen type-I-rich matrix; this matrix calcifies to become bone.

osteoclast
Large multinucleate cell that resorbs bone, allowing for the deposition of new bone.
Note: Osteoclasts secrete enzymes and acids that dissolve the calcium phosphate matrix of old bone tissue.

osteogenesis
Laying down of new bone tissue.

ostium
Opening into a vessel or cavity of the body.

otic
auricular
Pertaining to, or located near the ear.

otocephaly
Congenital anomaly characterized by the absence or extreme underdevelopment of the lower jaw, producing closeness of the ears below the face.
See also *agnathia*, *synotia*.

ovarian cycle
Sequence of events occurring in the *ovary* involved in *ovulation*.
Note 1: It consists of the *follicular phase* with maturation of the *ovarian follicle* under control of *follicle stimulating hormone* (FSH), *ovulation* with release of the *secondary oocyte*, and the *luteal phase* in which FSH and *luteinizing hormone* drive formation of the *progesterone*-producing *corpus luteum*.
Note 2: Together with the *uterine cycle*, it comprises the *menstrual cycle*.

ovarian follicle
Cavity in the *ovary* containing a maturing *ovum*, at any stage of development, surrounded by its encasing cells.
After [6]

ovary (n)/**ovarian** (adj)
One of the paired female reproductive *glands* containing the ova (see *ovum*).
[5]

ovotestis
Abnormal *gonad* in which both *ovarian* and *testicular* tissues are present, and thus a form of *hermaphroditism*.

After [5]

ovulation
Release of a mature *ovum* from the *ovary* into the *Fallopian tube*.

ovum
Mature female sex cell, capable of undergoing *fertilization*.
See also *egg*, *gamete*, *oocyte*.

oxytocin
Peptide *hormone* secreted by the *neurohypophysis* that stimulates contraction of the *myometrium* during *labor* and secretion of milk during *lactation*.
Note: Oxytocin is used clinically in the induction of labor and in the management of *postpartum* hemorrhage.

palate (n)/**palatine** (adj)
Roof of the mouth, separating the oral and *nasal* cavities.
Note 1: In *embryonic* development an anterior, primary palate is distinguished from a posterior, secondary palate.
Note 2: The embryonic primary palate gives rise to an anterior bony part called the hard palate, and a posterior muscular part called the soft palate.
See also *orofacial cleft.*

palatine raphe
Medial central ridge of the *palate*.

palatoschisis
See *cleft palate*.

Papanicolaou smear
Papanicolaou stain
Pap smear
Pap test
cervical smear
Examination by light microscopy of a sample of cells scraped from the *uterine cervix*, used to screen for cervical cancer.

paracrine
Type of signaling in which a cell secretes into the intercellular space a molecular messenger that diffuses and binds to receptors on nearby target cells, producing a signal in those cells.
After [3]

parafollicular cell
C cell
Neuroendocrine cell that migrates into the *thyroid gland* during *embryo*nic development

and secretes the *hormone* calcitonin.

paramesonephric duct
Müllerian duct
One of two paired *embryonic ducts* of *mesodermal* origin that will become the *Fallopian tubes*, *uterus*, *cervix* and upper part of the *vagina* in the female, and will regress in the male.

parametrium
Connective tissue of the floor of the female pelvis that lies in front of the *uterine cervix* and separates it from the bladder.

parasitic twin
Smaller of unequal *conjoined twin*s.
[5]
See also *autosite*.

paraxial mesoderm
somitic mesoderm
Area of *mesoderm* in the *embryo* that forms during *neurulation*, lies along both sides of the *neural tube*, and gives rise to the *somites*.

parenchymal cell
Distinguishing or specific type of cell of an organ or *gland*, contained in, or supported by, the *connective tissue* framework provided by the *stromal cell*s.
After [5]

parietal
Relating to or denoting the wall of the body or of a body cavity or hollow structure.

parietal cell, gastric
Acid-producing cell in the stomach.

parthenogenesis
apogamia
Type of non*sexual reproduction* in which an un*fertilized ovum* develops into an *embryo*.

parturition
Process of giving *birth* by a maternal organism.

patent ductus arteriosus
Congenital disorder wherein the *ductus arteriosus* fails to close after birth.
Note: This may lead to failure to thrive and increased breathing in early life.

pelvic kidney
ectopic kidney

P.O. 13757, Research Triangle Park, NC (919) 485-8700

Congenital abnormality in which a kidney develops and remains in the pelvic area.
Note: Pelvic kidney is generally asymptomatic but may produce complications.

pericardium
Serous membranous sac that surrounds the heart, consisting of an inner *visceral* layer (the *epicardium*), and an outer *parietal* pericardium that is attached to the sternum and *diaphragm*.

perinatal
Relating to the period from shortly before to shortly after *birth*, in humans usually from the 20th to the 29th week of *gestation* to 1 to 4 weeks after birth.
After [1]

perineum
Muscular structure of the lower pelvis, between the legs and extending from the anus to the *pubic symphysis*, or alternatively including the *anus* and *vagina* in the female and the region from the anus to the base of the *scrotum* in the male.

peritoneal cavity
Potential space between the two layers (*visceral* and *parietal*) of the *peritoneum*.

peritoneal membrane
See *peritoneum*.

peritoneum (n)/**peritoneal (**adj)
Thin double layer of *mesothelium* and irregular *connective tissue* that lines the *abdominal cavity* and covers most of the abdominal organs.
Note: The two layers of the peritoneum consist of the *parietal* peritoneum that lines the abdominal wall and the *visceral* peritoneum that covers the abdominal organs.
See also *peritoneal cavity*.

phage display
Method that enables the presentation of large peptide libraries on the surface of phage particles, from which proteins with desired functional properties can be selected rapidly.
After [12]

pharyngeal groove
One of several paired grooves in the *embryonic endoderm,* lateral to the corresponding *pharyngeal pouch* in the *ectoderm*.

pharyngeal pouch
branchial pouch
One of several paired evaginations in the *embryo*nic *endoderm* that develop into *epithelial* tissues and organs such as the *thymus* and *thyroid gland*.
After [5]

pharynx (n)/**pharyngeal** (adj)
Part of the digestive tube lying between the esophagus below and the mouth and *nasal* cavity above and anterior.

Note: The pharynx is subdivided into the nasopharynx lying at the base of the nasal cavity, the oropharynx behind the mouth, and the laryngopharynx posterior to the larynx.

phenotype (n)/**phenotypic** (adj)
Observable characteristics or traits of an organism, including those at a biochemical level, resulting from interaction of its *genotype* with *epigenetic* and environmental factors.

phenylketonuria (PKU)
Autosomal recessive disorder resulting from mutations that impair the function of the enzyme phenylalanine hydroxylase (EC 1.14.16.1).

Note 1: The resulting failure of phenylalanine metabolism in the liver leads to its accumulation, causing mental retardation, seizures, and other neurological disorders in untreated individuals.

Note 2: The excess phenylalanine is metabolized to phenyl pyruvate ("phenylketone") that is detected in the urine and is used for screening newborns.

philtrum
Groove in the midline of the upper lip below the nose.

phocomelia
Congenital abnormality in which one or more of the hands or feet is attached to an underdeveloped limb, and therefore too close to the body.

Note: This very rare disorder is associated with prenatal exposure to *thalidomide*.

phytoestrogen
Non-*steroidal* natural product from a plant that, because of a structural similarity to 17-β-*estradiol* can exert mild *estrogenic* effects, or antagonize them.

Note 1: Examples include isoflavones and coumestans.

Note 2: While foods containing phyto-estrogens are often promoted as beneficial, medical benefits are not well established.

pia mater
See *meninx*.

piebaldism (n)/**piebald** (adj)
Patchy absence of pigmentation of the hair or skin or, depending on the species, of feathers, scales, or other body surfaces.

pineal gland
epiphysis
Pea-sized conical mass of tissue behind the third ventricle of the brain, secreting the *hormone*-like substance melatonin in some mammals.

pinna
1. Externally visible portion of the ear.
See also *auricle*.
2. Feather or fin.

pituitary
hypophysis
pituitary gland
Small *endocrine gland* sitting in a bony cavity (the *sella turcica*) at the base of the brain and connected to the *hypothalamus*.

Note: The pituitary is structurally and functionally divided into anterior and posterior lobes. The anterior lobe secretes *growth hormone* (*somatotropin*), *thyroid-stimulating hormone* (TSH), *adrenocortocotropic hormone* (ACTH), *prolactin* (PRL), *luteinizing hormone* (LH), and *follicle-stimulating hormone* (FSH). The posterior lobe develops from the hypothalamus and secretes *oxytocin* and *antidiuretic hormone* (ADH) (also called arginine *vasopressin* (AVP)). An intermediate lobe (indistinct in humans) secretes melanocyte-stimulating hormone (MSH).

placenta
Organ of exchange of nutrients and waste products between mother and *fetus*, having parts derived from both.
See also *placental barrier*.

placental barrier
placental membrane
Multilayered *membrane* of *fetal* tissue within the *placenta* that separates the maternal blood from the fetal blood and allows selective passage of substances between the two.

Note: This membrane blocks only a few xenobiotics.

placental circulation
Circulation of blood through the *placenta* during *intrauterine* life, serving the needs of the *fetus* for oxygenation, nutrition, and elimination of waste.
After [5]

placental insufficiency
Inadequate blood flow through the *placenta* to maintain the needs of the *fetus* for oxygenation and metabolic balance.
See also *placental circulation*.

placental membrane
See *placental barrier*.

placental transfer
Delivery of substances from the maternal circulation to the *fetus*, across the *placental*

barrier.

pleiotropism (n)/**pleiotropic** (adj)
1. Having more than one effect.
2. Relating to a *gene*, *expression* of which gives rise to multiple *phenotypic* traits.

pleura (n)/**pleural** (adj)
Each of a pair of *serous membranes* lining the *thorax* and enveloping the lungs in humans and other mammals.

Note: The pleural membrane covering the lungs and extending into the fissures of the lobes is called the *visceral* pleura and lacks a nerve supply. That lining the chest cavity, *mediastinum* and *diaphragm* is called the *parietal* pleura; it is innervated and sensitive to pain.

pleural cavity
Potential space between the *pleural* membranes lining the chest cavity (*parietal* pleura) and covering the lungs (*visceral* pleura).

Note: In pathological conditions, fluid may accumulate in the pleural cavity, between the visceral and parietal pleura.

ploidy
Number of *haploid* sets of *chromosome*s in a cell.

pluripotent
Able to differentiate into a variety of cell types.

Note: Examples are the *ovum* and *embryonic stem cell*s.

polycystic
Composed of many *cysts*.

polydactyly
Congenital occurrence of *supernumerary* fingers or toes.

polymorphism (n)/**polymorphic** (adj)
1. Occurrence of a *gene* in more than one distinct nucleotide sequence in a population, resulting from *mutation*(s) and potentially producing *gene products* with different levels of function.

Note: It is sometimes considered that the least frequent of polymorphic gene sequences should be present in at least 1% of the population; otherwise the variant is a mutation rather than a polymorphism.

2. Occurrence of different *phenotype*s of a single trait.

polyploidy
Occurrence of more than two complete sets of *chromosomes*.
See also *ploidy*.

porencephaly
Occurrence of a *cyst* in the substance of the brain that usually communicates with one of the lateral ventricles.
Note: These abnormal cavities may result from brain tissue destruction or maldevelopment.

post-implantation
Occurring after the early *embryo* embeds in the lining of the *uterus*.

postnatal
Referring to events in the life of the mother or *fetus* following *birth*.

postpartum
Period following the *birth* of an infant, often considered to be about six weeks in the human.

predatory mite test
Procedure in which *adult* females of the predatory mite (*Hypoaspis (Geolaelaps) aculeifer*, considered representative of soil fauna) are exposed to a test substance in artificial soil and the number of surviving females and of juveniles is determined.

pre-eclampsia
Pathological condition in *pregnancy* with symptoms of high blood pressure, kidney dysfunction and *edema*.
See also *eclampsia*.

pre-embryo
Fertilized *ovum* up to 14 days of age and before *implantation*.

pregnancy (n)/**pregnant (**adj)
State of a female between *conception* and the termination of *gestation*.

pre-implantation
Occurring before the early *embryo* embeds in the lining of the *uterus*.

premature birth
Delivery before the expected length of *gestation* for the species; in humans taken as *birth* before a gestational age of 37 weeks.

prenatal
antenatal
Referring to events in the life of the mother or *fetus* preceding *birth*.

prenatal development study
Procedure in which a substance is administered to *pregnant* animals (usually rodents or rabbits) from the time of *implantation* until closure of the hard palate. The animals are

killed one to two days before a scheduled delivery, whereupon *uterine* contents and the *fetuses* are evaluated for abnormalities.

preoptic area
preoptic region
Region of the anterior *hypothalamus* primarily involved in regulating body temperature.

prepubertal
Stage of human development before the onset of *puberty*.
Compare *prepubescence*.

prepubescence
Period before *pubescence*.
Note: Whereas *prepubertal* refers to any time before *puberty*, prepubescence refers less specifically to a time closely preceding early puberty.
See also *pubescent*.

prepuce
Skin protecting the *glans penis* in the male (foreskin) or the *clitoris* in the female (clitoral hood).

preputial separation
Separation of the *prepuce* from the *glans penis*.

prethalamus
See *subthalamus*.

primary sex organ
Gonads, which form *gametes*; *ovaries* in the female and *testes* in the male.
See also *accessory sex organ*.

primitive axis
Thickening of the *embryonic* tissue extending forward from the *primitive streak*.

primitive groove
Shallow depression in the *primitive streak* that extends anteriorly to communicate with the *yolk sac*.

primitive node
primitive knot
Group of cells at the anterior end of the *primitive streak*, involved in secreting chemical signals that regulate differentiation of the *germ layer*s during *gastrulation*.

primitive pit
Depression in the *primitive node* contiguous with the *notochord*.

primitive streak
Structure forming in the *blastula* during early *embryogenesis* that establishes bilateral symmetry and determines the site of *gastrulation* and *germ layer* formation.

primordial follicle
Early stage of the *oocyte* in which it is surrounded by a single layer of *follicular* cells.
See also *follicle*.

primordial germ cell
Germ cell in the earliest stages of development.

primordium
Organ or tissue at its earliest recognizable stage of development.

proctodeum
anal pit
Ectodermal depression of the *caudal* end of the *embryo*, where later the *anus* is formed. [6]

progesterone
pregn-4-ene-3,20-dione
Steroidal hormone produced in the *ovary* by the *corpus luteum*.
Note: Progesterone is involved in sexual development and the *ovarian cycle*, and essential for maintenance of *pregnancy*.

progestin
Synthetic variant of *progesterone*, often used in oral *contraceptive* pills or to suppress *hyperplasia* of the *endometrium*.

progestogen
gestagen
Member of a family of *hormone*s, based on the 21-carbon pregnane skeleton, involved in maintaining *gestation* and regulating the *ovarian cycle*.
See also *progesterone*, *progestin*.

prolactin
Hormone released from the anterior *pituitary gland* that stimulates milk production after childbirth.

prolapse
Falling or slipping out of place of an organ or other body part.
Note: Uterine prolapse occurs when the ligaments holding the uterus weaken and the uterus slips down into, or even protrudes from, the *vagina*.

pronephros
Collection of cells in the *vertebrate embryo* that represent the earliest stage of

development of the kidney.

pronucleus
Haploid nucleus formed by either the head of the *sperm* or the nucleus of the *oocyte* after *fertilization* but before their nuclei fuse to form the *diploid zygotic* nucleus.

propharynx
See *pharynx*.

prophase
First phase of *meiosis* or *mitosis* in which thickening and orientation of the *chromosome*s occurs.

prosencephalon
forebrain
Most forward part of the brain that includes most of the cerebral cortex, the *thalamus* and *hypothalamus*, and the *basal ganglia*.

prostate
Male *exocrine gland* whose secretion contributes alkaline fluid to the ejaculate (see *ejaculation*).
Note: The alkaline environment facilitates *sperm* transport and prolongs the survival of sperm in the acidic environment of the *vagina*.

protamine
Small, basic (arginine-rich) protein involved in *sperm* maturation and DNA packaging during *spermatogenesis*.

protein kinase
Any enzyme catalyzing protein phosphorylation, often for the purpose of *signal transduction*.

proteomics
Global analysis of *gene expression* using a variety of techniques to identify and characterize proteins.
Note: In toxicology, proteomics can be used to study changes caused by exposure to substances and to determine if changes in mRNA expression correlate with changes in protein expression: the analysis may also show changes in post-translational modification, which cannot be distinguished by mRNA analysis alone.
[1]

proximal (in anatomy)
Nearer to an anatomical point of origin or attachment, or the midline of the body. Opposite term: *distal*.

pseudohermaphrodite
Organism possessing either male (*testes*) or female (*ovaries*) *gonads*, but with ambiguous *external genitalia*.
Compare *hermaphrodite*.

pseudocyesis
See *pseudopregnancy*.

pseudopregnancy
pseudocyesis
false pregnancy
Development of signs of pregnancy in the absence of an embryo.
Note: This is commonly called pseudocyesis in humans and pseudopregnancy in other mammals.

psychomotor retardation
Delayed development of both *cognitive* and motor function.

puberty
Process in which an individual undergoes sexual development, including the onset of *gametogenesis*, changes in *hormonal* secretions, *secondary sexual characteristic*s, and reproductive competence.

pubescent
Being in the early stage of *puberty*.

pubic
Relating to the region of the most *ventral* bone of the pelvis (the pubic bone), and thus the region around the genital area, normally showing hair growth (pubic hair) in the *adult*.

pubic symphysis
Cartilaginous joint between the *pubic* bones forming the front of the pelvis.

pulmonary
Pertaining to the lungs.

pulmonary artery
Large vessel that transports blood from the heart to the lungs.

pulmonary valve stenosis
Condition in which the flow of blood from the heart to the lungs is slowed by a deformity on or near the *pulmonary* valve that controls the blood flow from the right heart to the lungs.

pup
1. (n) Young or newborn dog, rat or seal.

2. (v) Give birth to a pup.

pyloric stenosis
Narrowing of the *sphincter* (the pylorus) between the stomach and *duodenum*.

quickening
Initial awareness of *fetal* movement by the *pregnant* mother, usually occurring early in the second *trimester*.

rachischisis
Failure of the *neural tube* to close *in utero*, resulting in a *birth defect* that leaves a fissure in the vertebral column with part of the *spinal cord* exposed.

receptor
Molecular component in or on a cell that is specifically recognized by and binds a molecular structure (ligand),leading to physiological signal transduction or mediation of an effect.

receptor, nuclear
Receptor that encounters its ligand in the cytosol and translocates to the nucleus, where it binds DNA and acts as a factor regulating *gene* transcription.

recessive
In genetics, relating to or denoting heritable characteristics controlled by *genes* which are expressed in offspring only when inherited from both parents.
Compare *dominant*.

reciprocal mesenchymal-epithelial interaction
Process in tissue or organ development in which *epithelium* induces changes in the *mesenchyme* and the mesenchyme also induces changes in the epithelium, through *paracrine signaling*.

Note: An example occurs during development of the *prostate*, in which mesenchyme of the *urogenital sinus* influences differentiation and patterning of the prostatic epithelium, and the developing epithelium induces prostatic mesenchymal cells to differentiate into smooth muscle and other prostatic *stromal cells*.

See also *epithelial-to-mesenchymal transition*, *mesenchymal-to-epithelial transition*.

reciprocal translocation
Chromosomal translocation in which crossing over between two non-*homologous* chromosomes leads to each carrying genetic material from the other.

Note: If the exchange is equal (i.e., no genetic material is missing) it is called a balanced translocation, and may be without severe consequences for the developing *embryo*. If extra or missing genetic material results from the process, it is called an unbalanced translocation, and the consequences are often more harmful.

recombination, genetic
1. Referring to new *gene* sequences, and thus to new heritable information, caused by gene crossovers, occurring naturally in either *meiosis* or *mitosis*, or constructed artificially, for the purpose of introducing a new trait into an organism or cell line.
2. In immunology, random scrambling of specific gene sequences to produce the vast array of possible immunoglobulin and T cell receptor sequences required to recognize, potenially, all possible antigens.

rectum (n)/**rectal** (adj)
Terminal part of the large intestine, ending at the anus.

5α-reductase
Enzyme (EC 1.3.99.5) that converts *testosterone* to 5α-dihydrotestosterone in peripheral tissues.

5α-reductase deficiency
Condition caused by a *mutation* of the *5α-reductase* type II gene, with *autosomal recessive* inheritance.

renal
Pertaining to the kidneys.

reproductive senescence
Progressive decline in reproductive capacity with age, marked by *menopause* in females.

reproductive toxicant
Agent that interferes with reproductive function, including sexual performance, *fertility*, and development of the *fetus* and *embryo*.

Note 1: Effects on fertility may include effects on *sperm* count and sperm *viability*, *oogenesis* and *ovulation*, placental function, lactation, male erectile function, genetic intactness, etc.

Note 2: Effects on development may include effects on embryo viability, fetal growth, *morphogenesis*, functional integrity, etc.

Note 3: Reproductive toxicants may show long-term effects not detectable before the second or later generations.

See also *developmental toxicology*.

reproductive toxicity test
Procedure based on specific guidelines in which adverse effects of a substance on reproduction and development are studied either in animals or by use of in vitro assays.

resorption
1. Removal of mineralized tissue by natural processes, as in breakdown of bone by *osteoclasts*, or disappearance of a tooth.

2. Disintegration and assimilation of an *embryo* or *fetus*, through a natural process involving lysis and removal of all the products of *conception* by cells of the maternal immune system.
3. In multigestational pregnancies, death of one fetus followed by absorption of its tissue by another, sometimes referred to as "vanishing twin".

restriction fragment length polymorphism (RFLP)
Variations in DNA nucleotide sequence that are indicated by the presence or absence of particular *restriction site*s in the DNA.
Note: RFLP analysis is a common method used for DNA profiling.

restriction site
Short DNA nucleotide sequence that is recognized by a sequence-specific enzyme (restriction enzyme) that cleaves the double stranded DNA.

rete
Fibrous mesh or network.

rete testis
Rete in the *testis* that carries *sperm* from the *seminiferous tubules*.

retina
Multicell-layer *membrane* in the back of the eye that is sensitive to light and transduces incoming optical information into signals that are necessary for vision.

retinoic acid
(2E,4E,6E,8E)-3,7-dimethyl-9-(2,6,6-trimethylcyclohexen-1-yl)nona-2,4,6,8-tetraenoic acid
Acidic metabolite of Vitamin A.
Note 1: Retinoic acid binds to the retinoic acid *receptor* (RAR), which then acts as a *transcription factor*.
Note 2: The role of RAR in development (e.g., in regulating *homeobox genes*) accounts for the *teratogenicity* of related pharmaceuticals.

retinoid
Member of a class of substances structurally related to vitamin A.
Note: Retinoids play roles in cell growth and differentiation, *tumor* suppression, immune function, and vision. At higher concentrations they cause multiple toxicities, including effects on the long bones, spleen and *lymph* nodes, and *retina*.

retinopathy
Noninflammatory degenerative disease of the *retina*.
[5]
Note: Retinopathy of prematurity (see *premature birth*) is a risk for preterm infants, possibly induced by oxygen therapy and related to disorganized *retinal* blood vessels.

retinoschisis, congenital
juvenile retinoschisis
X-linked retinoschisis
Congenital splitting of the retina into two layers.

retroperitoneal
Outside of and posterior to the *peritoneum*.

reverse genetics
Approach to elucidating the function of a *gene* by studying the effects on *phenotype* of expressed variations in a known DNA sequence.
Note: The term is intended to indicate the reverse of the approach (starting from a phenotype and working back to identify the gene) of *forward genetics*.

rhesus (Rh) **factor**
Antigen that occurs on the red blood cells of about 85 per cent of humans and can cause *hemolytic disease of the newborn* (erythroblastosis fetalis) and hemolytic transfusion reactions.
Note: The Rh factor was first identified in the blood of a rhesus monkey.

rhombencephalon
hindbrain
Posterior portion of the brain that includes the *cerebellum*, *pons*, and *medulla*.

RNA interference (RNAi)
Effect of small, often double-stranded RNA targeting a specific messenger RNA (mRNA), blocking its translation, and thereby silencing *expression* of the corresponding *gene*.
Note 1: Cells produce two types of small RNA, microRNA (miRNA) and small interfering RNA (siRNA) that are both involved in regulation of gene expression.
Note 2: As an experimental technique, RNAi uses designed sequences to silence a gene of interest.
Note 3: Short hairpin RNAs (shRNA) are sequences, designed for improved effect in RNAi experiments, that have a base-paired stem representing the double-stranded portion and an intervening unpaired loop.

Robertsonian translocation
Chromosomal translocation in which *chromosomes* with *acrocentric centromere*s break the centromere to fuse the long arms into a new large chromosome and the short arms into another small one that may be lost, leaving a *karyotype* in the human of 45 chromosomes.

rostral
1. Pertaining to, resembling, or having a rostrum or beak.
2. Situated toward the beak (thus, oral and nasal region), which may mean superior (in

relationships of areas of the *spinal cord*) or anterior or *ventral* (in relationships of brain areas).
After [6]
3. Closer to the head.
Compare *caudal*.

runt
Smallest and weakest animal of a litter.
Note: A runt may be disadvantaged in competing with its siblings for resources and its mother's attention.

sacral agenesis
caudal regression syndrome
Absence or significant underdevelopment of the lower part of the spine and the lower limbs.
Note: Sacral agenesis is associated with maternal diabetes.
After [13]

sagittal
Vertical (longitudinal) plane dividing the body into right and left sections.

Salmonella test
See *Ames test*.

salpingectomy
Surgical removal of the *Fallopian tubes*.

saturation mutagenesis
Mutagenesis screening in which a large number of *mutations* are introduced in a target area of the *genome* with the aim of identifying all the *genes* or their functions that are associated with that area.

scaphocephaly (n)/**scaphocephalic** (adj)
Elongated and narrow head with decrease of the *parietal* regions and conspicuous frontal and *occipital* protrusions; a type of *craniosynostosis*.
*Note:*Scaphocephaly is a result of premature closure of the sagittal suture and usually accompanied by mental retardation.

scoliosis
Abnormal lateral and rotational curvature of the *vertebral spinal column*.
[5]

scrotum
Pouch of skin containing the *testicles* and their accessory tissues.

secondary sexual characteristic

Feature of the *adult* animal, appearing during *puberty* in humans and distinct between the sexes although it is not part of the reproductive system.

Note: Examples include enlargement of the female breasts and sex-specific patterns of body hair such as facial hair in the male and the male or female *pubic* escutcheon.

secondary spermatocyte
See *spermatocyte*.

seizure
Sudden change in neural activity, leading to *convulsion*s and (or) changes in consciousness of varying degrees of severity.
See also *epilepsy*.

selector gene
Member of a group of *genes* that codes factors driving differentiation and regional patterning during development.

sella turcica
Depression on the upper surface of the *sphenoid bone*, accommodating the *pituitary gland*.

semen (n)/**seminal** (adj)
ejaculate (n)
seminal fluid
Fluid, containing *spermatozoa*, that is expelled from the penis during *ejaculation*.

seminal fluid
See *semen*.

seminal vesicle
One of a pair of *glands* of the male reproductive system that together produce a significant portion of the *semen*.

Note: Seminal vesicle secretion does not contain *spermatozoa*, but provides nutrients and an alkaline environment that prolongs their survival.

seminiferous tubule
One of numerous coiled tubes, found in the *testis*, in the walls of which *spermatogenesis* occurs.

sensitized strain
Model organism containing a mutation in a pathway (e.g., metabolic or signal transducing) that does not itself cause a change in *phenotype*, but makes the organism more sensitive to another change elsewhere in the pathway.
After [12]

septum (n)/**septal** (adj)
In anatomy, thin wall dividing two cavities or masses of softer tissue.

serous
Containing, resembling, or secreting serum.

Sertoli cell
Somatic cell in the *seminiferous tubule* that supports *spermatogenesis*.
Note: Tight junctions between Sertoli cells contribute to the *blood-testis barrier*.

Sertoli-Leydig cell tumor
Ovarian tumor composed of both *Sertoli* and *Leydig cells*.
Note: The tumor may secrete *androgen*s, thus causing *masculinization*.

sex chromatin
Barr body
Condensed mass of one inactivated *X chromosome* seen inside the nuclear *membrane* of an interphase cell.
Note: The Barr body is not seen in normal male cells (XY), but one body may be seen in normal female cells (XX). In *chromosomal* abnormalities, the number seen is one less than the number of X chromosomes.
See also *Lyon hypothesis*.

sex chromosome
One of the pair of *chromosomes* determining sex; in humans designated an *X chromosome* and a *Y chromosome*, with females having an XX *genotype* and males an XY genotype.

sex-determining region Y (SRY) **protein**
testis-determining factor (TDF)
Transcription factor coded by a gene on the *Y chromosome* that initiates development of the male sex organs (i.e., *testicular* differentiation) in the *embryo*.

sexual dimorphism
Phenotypic difference between the sexes of a species.

sexually dimorphic nucleus (SDN)
Compact area of large cells in the anterior *hypothalamus*, larger in men than women, and believed to influence sexual behaviour.
See also *sexual dimorphism*.

sexual maturation
Process of reaching the age or stage when an organism can reproduce sexually.

sexual maturity
Age or stage when an organism can reproduce sexually.

sexual reproduction
Creation of a new organism requiring combination of the genetic material from two different sexes.

Siamese twin
See *conjoined twin*.

sibling
sib
One of two or more individuals with a common pair of parents.

signal transduction
Process whereby a signal arising outside the cell is converted through a series of intermediate chemical reactions inside the cell to produce a functional change in the cell. [3]

single-nucleotide polymorphism (SNP)
Single base variation at a *chromosomal locus*, which exists stably within populations (typically defined as each variant form being present in at least 1 to 2 % of individuals). [1]

sinoatrial node
sinuatrial node
Mass of specialized *cardiac* muscle cells ("pacemaker cells") that spontaneously depolarize to initiate rhythmic contraction of the heart.

sinus
1. Hollow or cavity.
2. Channel for the passage of fluid, lacking the usual lining of a blood or *lymphatic* vessel; especially a dilatation for the passage of venous blood.

sinus venosus
venous sinus
Cavity at the *caudal* end of the developing *embryonic* heart where intra- and extra-*embryonic* veins meet.
Note: The sinus venosus develops into the portion of the right *atrium* in the *adult* heart that receives blood from the *vena cava*.

siRNA
See *RNA interference*.

sister chromatid
See *chromatid*.

sister chromatid exchange (SCE)

Reciprocal exchange of chromatin between two replicated *chromosomes* that remain attached to each other until *anaphase* of *mitosis*.

Note: SCE is used as a measure of *mutagen*icity of substances that produce this effect.

[1]

situs inversus
Developmental anomaly in which major *visceral* organs are found in a mirrored position to their normal location.
See also *dextrocardia*.

small interfering RNA (siRNA) **molecule**
short interfering RNA
See *RNA interference*.

somatic
Pertaining to the body or describing cells that form the body other than *germ line cells* or undifferentiated *stem cells*.

somatic hypermutation (SHM)
Programmed process of mutation affecting the variable (V) regions of immunoglobulin (Ig) genes. SHM affects only individual immune cells, and the mutations are not transmitted to offspring.

Note 1: This process is part of the way the *immune system* adapts to new antigens.

Note 2: Mistargeted SMH is a likely mechanism in the development of B-cell lymphoma.

[3]

somatomammotropin, human chorionic
human placental lactogen (hPL)
Placental hormone that affects maternal metabolism and supports *fetal* growth by making more glucose and fatty acids available to the fetus.

somatomedin
Any of a group of peptide *growth factors* produced by the liver following stimulation by *somatotropin*.

Note: Somatomedin acts directly on *cartilage* cells to stimulate skeletal growth.

somatotropin
growth hormone
Hormone produced in the *pituitary gland* that stimulates the liver to produce *somatomedin*.

somite
One of bilaterally paired, segmented masses of *mesodermal* tissue lying along the *notochord* that gives rise to the *vertebrae* and associated muscle and *connective tissue*.

sonic hedgehog
Protein *morphogen* produced in the *notochord* that plays a critical role in early development, including *vertebrate organogenesis*, brain development and limb formation.
Note: Production in the *embryo* is dependent upon secretion of *fibroblast growth factors*.
See also *bone morphogenetic protein 4*.

spawn
1. (v) Release gametes. (Of mature adult fish, frogs, molluscs, crustacea etc.).
2. (n) Fertilized eggs of mature adult fish, etc.

spawning
1. (n) Release of *gametes* (*eggs* or *sperm*) from mature adult fish, frogs, molluscs, crustacea, etc.
2. (adj) Describing behavior related to the readiness of mature adult fish, etc. to release gametes.

Spemann organizer
Group of cells in the amphibian *embryo* that is important in orientation of surrounding cells and facilitates development of the *central nervous system*.
Note: Cells on the *ventral* side of the *Xenopus blastula* secrete factors such as *bone morphogenic protein-4* (BMP-4) to signal the overlying *ectoderm* to become skin. The Spemann organizer blocks the action of BMP-4 by secreting *chordin* and *noggin*, allowing the ectoderm to develop into the brain and *spinal cord* by default.

sperm
See *spermatozoon*.

sperm banking
Storage of frozen donor *sperm* for use in *artificial insemination*.

spermatid
Haploid cell in the late stage of developing into a *spermatozoon*, derived from the *secondary spermatocyte*.

spermatocide
spermicide
Agent that kills *spermatozoa*.

spermatocyte
Parent cell of a *spermatid*, derived by *mitotic* division from a *spermatogonium*. [5]
Note: The primary spermatocyte gives rise to a pair of *haploid* secondary spermatocytes by *meiosis*.

spermatogenesis

Entire process by which *spermatogonial stem cell*s divide and differentiate into *spermatozoa*.
[5]

spermatogonial chromosome aberration test
Procedure in which rodents are exposed to a test substance and *chromosome* aberrations are then studied microscopically in *germ cells*.

spermatogonium
Primitive cell derived from *mitosis* of the *germ cell* that becomes the *diploid* primary *spermatocyte*.

spermatozoon
sperm cell
Mature male *gamete*.

spermiation
Release of mature *spermatozoa* from the *Sertoli cell*s.

spermicide
See *spermatocide*.

spermiogenesis
Maturation of an immature *spermatid* into a *spermatozoon*.

sphenoid bone
sphenoid
Irregular wing-shaped bone at the anterior base of the skull, forming part of the *orbit*, serving as an attachment site for muscles of mastication, and containing *foramina* for nerves and vessels of the head and neck.

Note: The complex structure, function, and development of the sphenoid bone have been linked with developmental disorders such as sphenoid *dysplasia* and *cystic* degeneration of the sphenoid.

sphincter
Ringlike muscle that maintains closure of a body passage or orifice by contracting, and opens it by relaxing.

spina bifida
Failure of the *neural tube* to close, resulting in the absence of part of the *vertebral* arch at the midline of the *spinal column* and exposure of the *spinal cord* and its covering membranes.

spinal column
spine
vertebral column

Backbone.

spinal cord
Portion of the *central nervous system* outside the brain and inside the *vertebral* column.

spiral arteriole
spiral artery
spiral endometrial artery
corkscrew-like artery
coiled artery of the uterus
One of the corkscrew-like arterioles in pre*menstrual* or prog*estation*al *endometrium*.
[6]

splanchnic
Relating to the *visceral* organs, especially those of the abdomen.

spongioblast
Embryonic epithelial cell that develops into a neuroglial cell.

stalk
In anatomy, narrow connection with an organ or other structure.
After [5]

stalk, allantoic
Narrow connecting tube between the intra- and extra-*embryonic* parts of the *allantois*.
After [5]

stem cell
Multipotent cell, with *mitotic* potential, that may serve as a precursor for many kinds of differentiated cells.
[1]

Note: Embryonic stem cells give rise to the embryonic *germ layers*, whereas *adult stem cell*s are involved in tissue regeneration, repair processes and possibly in *carcinogenesis*.

See also *induced pluripotent stem cell*.

stenosis
Abnormal narrowing of a passage or opening in the body.

sterility (n)/**sterile** (adj)
1. Infertility
2. Asepsis.

sterilization
1. Process that makes an organism incapable of *fertilization* or reproduction, e.g, *castration*, *vasectomy*, or *salpingectomy*.

2. Process that makes an object aseptic.

steroid (n)/**steroidal (**adj)
Naturally occurring compounds and synthetic analogues, based on the cyclopenta[*a*]phenanthrene carbon skeleton, partially or completely hydrogenated; there are usually methyl groups at C-10 and C-13, and often an alkyl group at C-17. By extension, one or more bond scissions, ring expansions, and/or ring contractions of the skeleton, may have occurred.
After [16]

Note: Natural steroids are derived in biogenesis from triterpenoids; they play important roles as *hormones* (sex hormones), *membrane* components (cholesterol) and emulsifying agents (bile acids).

steroidogenesis assay
Procedure in which the effect of a test substance on *steroid* synthesis is studied, usually in a human adrenocortical carcinoma cell line.

Note: This assay is part of the OECD framework for the "Testing and Assessment of Endocrine Disrupting Chemicals".

stillbirth
Birth of a baby without any signs of life, at a time variously taken as 20-28 weeks of *pregnancy*, The baby may have died during pregnancy (called *intrauterine* death), labor or birth.
Compare *miscarriage*.

stress-response pathway
Signaling events induced when normal cell function or development is disrupted by environmental (physical or chemical) factors.

Note: Induction of stress pathways may lead to cellular repair and counteraction of stress effects, or to adverse effects.

stromal cell
Cell producing the *connective tissue* framework of an organ or other anatomical structure.
See also *parenchymal cell*.

subthalamus
Part of the *diencephalon*, of which the major part is the *subthalamic nucleus*, and which connects to the globus pallidus, part of the *telencephalon*.

sulcus
Any long, narrow groove, furrow or shallow depression, specifically referring to one of the fissures on the surface of the brain.
After [5]

superfecundation
Fertilization of two or more *ova* released in the same period of *ovulation*, either by

different males or by the same male in separate acts of intercourse.

Note: If there are two or more different fathers, the state may be called heteropaternal superfecundation. Rare in humans, heteropaternal superfecundation is common in some species such as cats and dogs.

superfetation
Presence of two *fetuses* in the *uterus* at different stages of development, resulting from *fertilization* of *ova* released in two successive periods of *ovulation*.
After [5]

supernumerary
In anatomy, exceeding the usual number, e.g.,a sixth finger on one hand or a third nipple in a human.

surfactant, pulmonary
Surface-active layer of phospholipids and proteins coating the *pulmonary alveoli* that increases lung compliance, facilitates lung expansion, and stabilizes alveolar volume.

Note: Lack of pulmonary surfactant is more common following *premature birth* and is a cause of infant respiratory distress syndrome.

synapsis
syndesis
Point-wise pairing of *homologous chromosome*s during the *prophase* of *meiosis*.

synaptonemal complex
Structure of filamentous proteins that forms between *homologous chromosome*s when they pair during *meiosis*; it may contribute to *synapsis* and genetic recombination.

syncephalus
monocephalus
Conjoined twins with two bodies and a fused head.

syncytiotrophoblast
Outer *syncitial* layer of *trophoblast* cells that invades the *endometrium* during *implantation*.

Note: The syncytiotrophoblast is the site of synthesis of *human chorionic gonadotropin* and is involved in *implantation*.

syncytium (n)/**syncytial** (adj)
Referring to a large multinucleated mass of cellular contents that arises from the fusion of originally individual cells.

syndactyly
Congenital occurrence of fusion or webbing of the fingers or toes.

syndrome

Group of signs and symptoms occurring together, having a common cause and defining a disease.

synophthalmia
cyclopia
monophthalmos
Congenital fusion of the *orbit*s in the midline, which then contains one eyeball.

synotia
Congenital malformation characterized by the union or approximation of the ears in front of the neck, often accompanied by the absence or defective development of the lower jaw. [11]
See also *agnathia*, *megagnathia*, *otocephaly*.

tail bud
In the *vertebrate embryo*, mass of proliferating cells at the *caudal* end that arises from the *primitive node*.

talipes
See *clubfoot*.

Tay-Sachs disease
infantile GM2 gangliosidosis
Autosomal recessive inheritance of *hexosaminidase A* deficiency leading to a *lysosomal storage disease* characterized by central and peripheral neuronal involvement and early death.

tegmentum
Floor of the midbrain.
Note 1: In the *embryo* this term refers more generally to the anterior portion of the *neural tube*.
Note 2: The tegmentum is the site of the nuclei of several cranial nerves.

telencephalon
Embryonic structure that develops into the *cerebrum*.

telophase
Final phase of both *meiosis* and *mitosis* in which distinct nuclei form in each daughter cell.

teratocarcinoma
Malignant teratoma, occurring most often in the *testis*.

teratogen (n)/**teratogenic** (adj)
Chemical, physical, or biological agent that, when administered to a parent either prior to conception or before *birth* of the child, induces permanent structural *malformation*s or

*birth defect*s in the offspring.
Modified from [1]

Note 1: Teratogens may act at vulnerable points in the development of *gametes* in parents or of organ development in the *embryo* and *fetus*.

Note 2: Their modes of action include mimicry of *morphogens* (thus interference with morphogenesis), modulation of *genes* and *gene expression*, and direct alterations in protein function.

teratogenesis
Process of development of *malformations* or *birth defect*s.
See also *teratogen*.

teratogenetics
Study of how *genes* and *teratogens* interact to cause *birth defects*.

teratogenic index (TI)
Mortality of *eggs* expressed as a lethal concentration divided by the threshold concentration for production of abnormal *embryos* with nonheritable permanent structural *malformations* or defects following exposure to a *teratogen*.

Note: The TI is thought to reflect the developmental hazard of a contaminant.

teratogenicity
Inherent ability to act as a *teratogen*.

teratology
Study of the causes, mechanisms and manisfestations of developmental deviation of either structure or function.

teratoma
dermoid cyst
Benign *germ cell*-derived *tumor* containing *embryonic* elements of the three primary *germ layers* such as skin, hair and muscle, occurring most frequently in the *ovary*.
See also *teratocarcinoma*.

Tessier classification
Classification of bony and soft tissue *facial clefts* based on their anatomic location.

Note: They are numbered from 0-14, with 0 and 14 being in the midline.

testicular feminization
Type of male *pseudohermaphroditism* in which the individual has a male *karyotype* and *testes* present within the *abdominal cavity*, but develops external female *genitalia* and female *secondary sexual characteristics*.

Note 1: Testicular feminization is due to an *androgen receptor mutation*, causing the target tissues to be insensitive to the *masculinizing* effects of *androgens*.

Note 2: Clinical presentation is usually as a *phenotypic* female with primary *amenorrhea*.

testis (n)/**testicular** (adj)
testicle
Gonad of a male animal, involved in secretion of *androgen*s and the site of *sperm* production.

testosterone
*Androgen*ic *steroid hormone* produced primarily in the *testis*, responsible for the development of the male sexual organs and male *secondary sexual characteristic*s.
Note: The *ovary* also secretes testosterone, but circulating levels in the female are much lower than in the male.

tetracycline
(4*S*,4a*S*,5a*S*,6*S*,12a*R*)-4-(dimethylamino)-1,6,10,11,12a-pentahydroxy-6-methyl-3,12-dioxo-4,4a,5,5a-tetrahydrotetracene-2-carboxamide
Broad-spectrum antibiotic of polycyclic polyketide structure.
Note: Tetracyclines are considered to be *teratogens* because they can deposit in, and cause discoloration of, the developing teeth, while also inhibiting the tooth development process.

tetralogy of Fallot
Set of four *congenital cardiac* defects involving an opening in the wall that should separate the right and left ventricles (*ventricular septal defect*) allowing the aorta to receive venous as well as arterial blood, *stenosis* of the *pulmonary artery*, *hypertrophy* of the right ventricle, and displacement of the *aorta*. Right ventricular *hypertrophy* is the fourth part of the tetralogy, although it may also be a consequence of the other defects.
Note 1: The constellation of anatomical defects is understandable in terms of a flaw in the ordered sequence of events in the normal development of the heart and associated vessels.
Note 2: These anatomical defects are the most common cardiac cause of *cyanosis* in infants.

thalamus
Either of two masses of *grey matter*, the largest part of the *diencephalon*, lying between the *cerebral hemispheres* on either side of the third ventricle, relaying sensory information and acting as a centre for pain perception.

thalidomide
Teratogenic indole-based drug with sedative and anti-*angiogenic* properties.
Note 1: The introduction of thalidomide for alleviating nausea in *pregnancy* in some countries in 1957 was soon linked to severe *birth defects* in the infant, with *phocomelia* being highly characteristic.
Note 2: Currently, it is used successfully to treat and prevent the moderate to severe skin lesions caused by leprosy, and is used together with dexamethasone to treat multiple myeloma.

theca
Bilayer covering of the *ovarian follicle* (thus theca interna and externa), of which the theca interna is involved in production of *androstenedione*.

thoracic duct
Largest of the *lymphatic* vessels; it conducts *lymph* from its origin in the *abdomen* to the venous circulation at the junction of the left subclavian and jugular veins.

thrombocytopenia
Abnormally low concentration of platelets (thrombocytes) in the blood.
Note: Thromocytopenia is an unwanted effect of some drugs and carries an increased os spontaneuous bleeding.

thymus
Pyramid-shaped organ in the thoracic or cervical r egion of mammals, composed of *lymphatic tissue* in which minute concentric bodies (thymic corpuscles, the remnants of *epithelial* structures) are found.
Note 1: *Stem cells* in the outer cortex of thymus develop into different kinds of *T cells*. Some migrate to the inner *medulla* and enter the bloodstream; those that do not may be destroyed to prevent *autoimmune* reactions.
Note 2: This organ is necessary for the development of thymus-derived lymphocytes (T cells) and is the source of several hormones involved in T-cell maturation, for example, thymosin, thymopoietin, thymulin, and thymocyte humoral factor.
Note 3: If a newborn's thymus is removed, not enough T cells are produced, the spleen and *lymph* nodes have little tissue, and the immune system fails, causing a gradual, fatal wasting disease. Thymus removal in adults has little effect.
[3]

thyroglossal duct
Connection in the *embryo* between the site of initiation of development of the *thyroid gland* and its final location in the neck.

thyroid gland
Bilobar *endocrine gland*, located below the prominence of *cartilage* surrounding the *larynx* (the Adam's apple), that produces and secretes the *hormone*s triiodothyronine (T3), thyroxin (T4), and calcitonin.

thyroid tissue, accessory
Ectopic thyroid tissue arising from remnants of the *thyroglossal duct*.

thyroid stimulating hormone (TSH)
Pituitary hormone that stimulates the *thyroid gland* to produce thyroxine (T4), and then triiodothyronine (T3).

tonsil
Small, rounded mass of tissue, especially of *lymphoid* tissue; generally used to designate

one of the paired *palatine* tonsils.
[3]

toxicity
1. Capacity to cause injury to a living organism defined with reference to the quantity of substance administered or absorbed, the way in which the substance is administered and distributed in time (single or repeated doses), the type and severity of injury, the time needed to produce the injury, the nature of the organism(s) affected, and other relevant conditions.
2. Adverse effects of a substance on a living organism defined as in 1.
3. Measure of incompatibility of a substance with life that may be expressed as the reciprocal of the absolute value of median lethal dose (1/LD50) or concentration (1/LC50).
[1]

toxoplasmosis
Infection with the parasite *Toxoplasma gondii* that, when acquired by the *fetus*, can lead to a variety of *congenital* abnormalities that may include *hydrocephalus* or *microcephaly*, mental retardation, and problems with vision and hearing.
Note: Infection of the fetus is from the mother who may acquire it from contact with feces of the domestic cat or from undercooked meat.

trachea
Thin-walled, *cartilaginous* tube descending from the *larynx* to the bronchi and carrying air to the lungs.

transcription factor
DNA-binding protein that is involved in regulating *gene expression*.

transgenic
Describing an organism that is genetically changed by the addition or deletion of genetic material or whose existing *genes* are altered by *gene targeting*.

translocation, chromosomal
Rearrangement involving transfer or exchange of genetic material between non-*homologous chromosome*s that may occur during *gametogenesis* or in *somatic* cells, potentially leading to *birth defects*.
See also *reciprocal translocation*, *Robertsonian translocation*.

transplacental carcinogen
Substance that crosses the *placenta* and subsequently causes *cancer* in the child or young *adult*.
After [17]

transposition of the great arteries
transposition of the great vessels

Congenital cardiovascular *malformation* in which the position of the chief blood vessels of the heart (*aorta* and *pulmonary artery*) is reversed.

Note: Survival then depends on a crossflow of blood between the right and left sides of the heart, as through a *ventricular septal defect*.

After [6]

See also *conal growth hypothesis*.

Treacher Collins syndrome

Treacher Collins–Franceschetti syndrome

mandibulofacial dysostosis

Congenital deformity characterized by structural abnormalities of the head and face.

See also *craniofacial*.

Note: Autosomal dominant mutations have been identified in several *genes* involved in early development of bone and the tissues of the face, the most frequently implicated being TCOF1.

trilaminar embryo

trilaminary blastoderm

Disc-like *embryonic* stage in which differentiation into the three *endoderm*, *mesoderm*, and *ectoderm* layers has occurred.

Note: In the human embryo this occurs in the third week, following the onset of *gastrulation*.

trimester

In *pregnancy*, one of three equal timed divisions of the normal human *gestation period*, each lasting approximately three months.

triple screen

triple test

Measurement of maternal serum levels of *alpha-fetoprotein*, *human chorionic gonadotropin*, and *estriol*, usually in the second *trimester* of *pregnancy*, that can serve as an indicator of risk for certain *fetal chromosomal abnormalities* and *neural tube defect*s.

triploidy

Presence of three *haploid* sets of *chromosomes* in the cell.

Note: The condition is fatal in *fetal* or early *neonatal* life.

See also *diploid*, *euploid*, *ploidy*.

trisomy

Condition of having three *homologous chromosome*s in each *somatic* cell instead of the normal pair.

trisomy 8

Warkany syndrome 2

Presence of an extra *chromosome* 8.

Note: Complete *trisomy* 8 is lethal, but most affected individuals show *mosaicism*

with *craniofacial* abnormalities, a short wide neck, multiple joint defects, and deep creases in the palms and soles.

trisomy 13
Patau syndrome
trisomy D
Presence of part or all of an extra *chromosome* 13 from nondisjunction during meiosis.
Note 1: This leads to multiple *congenital abnormalities* and mental retardation, and is usually fatal in early childhood.
Note 2: Patau syndrome can also occur with an extra partial chromosome 13 resulting from a *Robertsonian translocation*.

trisomy 18
Edwards syndrome
Presence of part or all of an extra *chromosome* 18 from nondisjunction during meiosis.
Note: This leads to multiple *congenital abnormalities* and mental retardation, and is usually fatal in early childhood.

trisomy 21
Down syndrome
Presence of an extra *chromosome* 21.
Note 1: This produces a characteristic constellation of physical abnormalities with delayed growth and mental development, but is compatible with life into *adulthood*.
Note 2: The formerly used terms mongoloid and mongolism are now considered offensive.

trophectoderm
Outer layer of the *blastocyst* that contacts the *endometrium*, establishes nutrition for the *embryo*, and differentiates into the *trophoblast*.

trophoblast
Outer layer of the *blastocyst* that invades the *endometrium* and establishes nutrition for the *embryo*.
Note: Trophoblast cells do not form part of the *embryo*, but contribute to the development of the *placenta*.

truncus arteriosus
Arterial trunk, opening from the *fetal* heart and developing into the *aorta* and *pulmonary artery*.

tuberoinfundibular pathway
Group of dopaminergic neurons in the *hypothalamus* involved in regulating *prolactin* secretion from the anterior *pituitary gland*.

tumor

tumour
Any abnormal swelling or growth of tissue, whether *benign* or *malignant*.
Compare *neoplasm*.

tunica albuginea
Dense, *collagenous* fibrous coat surrounding an anatomical structure, and in particular surrounding the *ovaries*, *testicle*s, and *corpora cavernosa* of the penis.

tunica vaginalis
Membranous sheath, derived from the *peritoneum*, surrounding the *testis* and *epididymis*.

Turner syndrome
Ullrich–Turner syndrome
Phenotypic female lacking one *X chromosome*, the *genotype* being designated XO.
Note: This results in a number of developmental abnormalities including short stature, *webbed* neck, sexual immaturity, and *sterility*.

two-generation reprotox study
Procedure in rodents wherein parents (P0 generation) and their offspring (*F1 generation*) are both exposed to a test substance and the second generation (F2) is examined for possible toxic effects.
See also *one-generation reprotox study*.

tympanic
In anatomy, relating to the resonant cavity and *membrane* of the inner ear.

ultrasonography
Imaging technique that creates a picture of internal body structures from differentially reflected *ultrasound* waves.
Note: By using this technique, the human *embryo* can be observed *in utero* as early as 5 1/2 weeks of *gestation*, and *fetal* monitoring by the technique (obstetric ultrasound) is standard.

ultrasound
1. Sound waves of frequency higher than the range audible to the human ear.
2. Imaging technique that uses such sound waves to create a picture of internal body structures.
See also *ultrasonography*.

umbilical
omphalic
Relating to the *umbilicus*.

umbilical artery
Paired artery that, in the *fetus*, returns deoxygenated blood from each half of the *fetal* body to the *placenta*, via the *umbilical cord*.

Note: In the *adult*, part of the umbilical artery remains open as a branch of the internal *iliac artery*, and part ceases to be an artery and becomes the *medial umbilical ligament*.

umbilical cord
Cord-like structure connecting the *fetus* with the *placenta* and housing the *umbilical artery* and *umbilical vein* that carry nutrients from the mother and remove wastes from the fetus.

umbilical hernia
Protrusion of bowel or *omentum* through the abdominal wall at the *umbilicus*.

umbilical vein
left umbilical vein
Vessel within the *umbilical cord*, entering the *fetus* at the *umbilicus*, and carrying oxygenated blood from the *placenta*.

umbilicus (n)/**umbilical** (adj)
navel
belly button
Feature marking the point in the abdominal wall where the *umbilical cord* entered the *fetus*.

undescended testis
cryptorchid testis
cryptorchisism
Testis that has failed to descend completely from its developmental origin in the lower *abdominal cavity* into the *scrotum*.

urethra
Duct by which urine is conveyed out of the body from the bladder, and which in male *vertebrates* also conveys *semen*.

urogenital
genitourinary
Of, relating to, or involving both the urinary and *genital organs*.

urogenital sinus
Embryonic structure that forms in the *ventral* part of the *cloaca* when it separates from the *anal canal* to give rise to the *genitourinary* organs.

Note: A rare urogenital sinus anomaly occurs as a birth defect in the female when the *urethra* and *vagina* open into a common channel.

uterine crypt
Chamber on the interior surface of the *uterus* that serves as a site of *embryo* homing and *implantation*.

uterine cycle
Regular, periodic changes that occur in the *uterus* and, together with the *ovarian cycle* constitute the *menstrual cycle* necessary for female *fertility*.

Note 1: The uterine cycle consists of three phases: i) *menstruation*, ii) a proliferative phase in which the uterine wall thickens under the influence of *estrogen*, and iii) a secretory phase in which the *corpus luteum* is producing *progesterone* and the *endometrium* becomes receptive to *implantation* of the *blastocyst*.

Note 2: The three phases of the uterine cycle correspond to the three phases of the *ovarian cycle*.

uterotrophic
uterotropic
Having an effect on the *uterus*.

Note: This usually refers to *estrogen*-like effects of uterine cell proliferation caused by some drugs and other substances with weak *estrogen*-mimetic properties.

uterotrophic assay
Procedure in which immature female rodents are treated for three days with a test substance. A resultant increase in *uterine* wet weight suggests an *estrogenic* activity of the substance.

uterus (n)/**uterine** (adj)
womb
Hollow muscular organ of the female reproductive system that receives the *fertilized ovum* (see *implantation*) and supports the subsequent development of the *fetus*.

uvula
palatine uvula
Muscular projection from the posterior edge of the soft *palate*.

Note: The uvula contributes to the gag reflex and is involved in shaping some sounds of human speech.

vagina
Fibromuscular canal passing between the *uterine cervix* and the opening to the *vulva*.

Note: The vagina permits sexual intercourse and delivery of babies.

vaginal cornification
Conversion of the normal *epithelium* of the *vagina* to a *keratinized* squamous (flattened) *epithelium*.

Note: The appearance of keratinized ("cornified") epithelial cells in a vaginal smear is an indication of increased *estrogen* levels.

vaginal patency
Referring to the opening of the *vagina* that usually occurs at *sexual maturity* and is maintained by hormonal influences pre-*menopausally*.

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vaginal smear
Examination by light microscopy of a sample of a vaginal discharge, used in the diagnosis of a vaginal infection.
Note: Not to be confused with a *Papanicolaou smear*.

variation, developmental
Anatomical deviation that is not life-threatening.

vasculogenesis
De novo development of blood vessel *endothelium* in absence of preexisting vessels, e.g., during *fetal* development or in connection with tissue repair, initiated by migration of *mesodermal* precursor cells.
Compare *angiogenesis*, *arteriogenesis*.

vas deferens
ductus deferens
spermatic duct
Secretory *duct* of the *testis* running between the *epididymis* and the *ejaculatory duct*.

vasectomy
Surgical removal of all or part of each *vas deferens*, typically as a means of *sterilization*.

vasopressin
Pituitary hormone that acts to promote the retention of water by the kidneys and to increase blood pressure.

velopharyngeal insufficiency
velopharyngeal incompetence
Inability to achieve closure of the velopharyngeal *sphincter* (closure of the muscle of the *soft palate*) during speech, owing to muscular dysfunction, *cleft palate*, or other disorders.
Note: This insufficiency often causes speech problems by allowing air to escape through the nose instead of the mouth.

vena cava
Large vein returning deoxygenated blood to the right heart.
Note: The vena cava has two branches in humans, the inferior vena cava (carrying blood from the lower body) and the superior vena cava (carrying blood from the head, arms, and upper body).

venous shunt
See *arteriovenous shunt*.

ventral
Situated to the anterior side of the trunk; in humans, to the front of the body.
Opposite term: *dorsal*.

ventral thalamus
See *subthalamus*.

ventricular septum
Dividing wall between the two lower chambers (*ventricle*s) of the heart.

ventricular septal defect (VSD)
Congenital defect with an opening in the wall separating the right and left *ventricle*s of the heart (see *ventricular septum*).
Note: This cardiac anomaly allows reflux of blood back to the right ventricle during left ventricular contraction, producing varying degrees of cyanosis.

vertebral arch
See *neural arch*.

vertebra (n)/**vertebral** (adj)
One of the bony segments that together make up the bony column surrounding the *spinal cord*.

vertebrate
Denoting an animal that has as part of its nervous system a *spinal cord* that is surrounded by a bony *vertebral* column.

vesicle (n)/**vesicular** (adj)
Small fluid-filled sac, bladder-like structure, or blister.
Note: This term may refer to an anatomic structure, a subcellular organelle, or a liposome-related particle.

vestigial
In anatomy, pertaining to a remnant of an *embryonic* or *fetal* structure persisting in the *adult*.

viability
Ability to continue living.
Note: Fetal viability refers to the ability of the *fetus* to survive outside the *uterus*.

villus
1. Projection from the surface, typically of a *mucous membrane*.
2. Elongated projection of the dermis into an epidermal space.
After [5]

vimentin
Intermediate filament protein that is expressed in *mesenchymal* cells, e.g., fibroblasts, leukocytes, and blood vessel *endothelial* cells.
Note: Vimentin filaments support cell *membranes*, keep some organelles in a fixed

place within the cytoplasm, and transmit *membrane receptor* signals to the nucleus.

virilization
Possession or acquisition of characteristics of a male body, especially by a female or *prepubescent* male.
After [5]

viscera (n)/**visceral** (adj)
Soft and hollow organs of the body, in *vertebrates* particularly those found in the thoracic and *abdominal cavities*.
Note: This gives rise to the distinction of the visceral and *parietal serous membranes*, located respectively closest to the organ or to the body wall. For examples, see *pericardium*, *peritoneal cavity* and *pleura*.

vitellogenin (VTG)
Protein that forms part of the yolk of egg-laying *vertebrates*.
Note: Its expression in male fish is used in ecotoxicology as an indicator of exposure to environmental *estrogenic endocrine disruptors*.

vulva
External *genitalia* of the female.

wean
Accustomize a young mammal to independence from its mother's milk as a source of nutrition.

web (in anatomy)
webbing
Tissue or *membrane* present between adjacent structures where it is not usually found, e.g., between fingers or toes, or between the neck and shoulder, representing a *congenital abnormaility*.

Wharton's jelly
Gelatinous substance that embeds the vessels of the *umbilical cord*.
Note: The jelly consists mainly of hydrated glycosaminoglycans such as hyaluronic acid and chondroitin sulfate.

white matter
substantia alba
Portion of the brain and *spinal cord* consisting mainly of myelinated axons (see *myelination*) and glial cells.
Note: Neurons of the white matter transmit signals between areas of *grey matter* within the cerebrum, to lower brain centers, and up and down the superficial aspect of the spinal cord.

whole embryo culture
Technique, used prior to embryo transfer during *in vitro fertilization*, in which *embryos* undergoing *organogenesis* are maintained in formulated medium outside the body.
Note: Whole embryo culture is a useful procedure for testing the *teratogenic* effects of a substance on organogenesis in rodent or chick embryos.

wild type
Of an *allele* or *phenotype*, the naturally occurring, unaltered, or most frequent; if several alleles occur, the most frequent one is considered to be the wild type.

Williams syndrome
elfin facies syndrome
Congenital disorder with characteristic *facies* (described as elf-like), short stature, outgoing personality and mild mental retardation; associated with contiguous *gene deletion*s on *chromosome* 7.

Wnt
Family of *gene*s important in development, the proteins they encode, or the *signal transduction* pathways they determine.
Note 1: Wnt pathways are involved throughout *embryonic* development, regulating such processes as cytoskeletal dynamics, cell polarity, proliferation, migration, and body axis patterning.
Note 2: The proteins signal by binding to cell-surface G-protein coupled receptors of the Frizzled family that signal to members of the Dishevelled (Dsh) family of cytoplasmic phosphoproteins.
Note 3: Wnt is derived from Wingless-related integration site, originally identified in Drosophila.

Wolffian duct
See *mesonephric duct*.

womb
See *uterus*.

X chromosome
Chromosome determining female sex in the absence of a *Y chromosome.*
See also *sex chromosome*.

X-linked
Carried by a *gene* located on the *X chromosome*.

Y chromosome
Chromosome determining male sex.
See also *sex chromosome*.

yolk

vitellus
Nutritive material stored in the *ovum* for the nourishment of the *embryo*.

yolk sac
Fluid-filled, *membrane*-bound pouch on the *ventral* side of the early *embryo* that provides nourishment until the circulatory system develops.

yolk stalk
Narrow *tubular* support that connects the *yolk sac* to the middle of the digestive tract of an *embryo*.

zinc finger
Small tertiary protein structure in which parts of the protein, typically with cysteine and histidine residues, link to a divalent zinc ion, forming a loop or "finger" that attaches proteins to DNA.

Note: A zinc finger is present in many proteins, such as nucleases or *transcription factor*s that regulate expression of eukaryotic *genes*.

zona pellucida
Acellular glycoprotein-rich *membrane* surrounding the mature *ovum*.

zygosis
Sexual union of two cells with fusion of their nuclei.

zygote
1. Cell such as a fertilized *egg* (*ovum* after *fertilization*) resulting from the fusion of two *gametes*.
2. Cell obtained as a result of complete or partial fusion of cells produced by *meiosis*.
[1]

zygote intrafallopian transfer (ZIFT)
tubal embryo transfer
Introduction of a *zygote fertilized* in vitro into one of the *Fallopian tubes*.
See also *in vitro fertilization.*
Compare *gamete intrafallopian transfer.*

References:

1. Duffus, J.H., Nordberg, M. and Templeton, D.M., Glossary of terms used in toxicology, 2nd ed. Pure Appl. Chem. **79**, 1153-1341 (2007).
2. Nordberg, M., Templeton, D.M., Andersen, O. and Duffus, J.H., Glossary of terms used in ecotoxicology. Pure Appl. Chem. **81**, 829-970 (2009).
3. Templeton, D.M., Schwenk, M., Klein, R. and Duffus, J.H. Glossary of terms used in immunotoxicology, Pure Appl. Chem. **84**, 1113-1295 (2012).
4. Templeton, D.M., Schwenk, M. and Duffus, J.H. Glossary of terms used in neurotoxicology, Pure Appl. Chem. **87**, 841-927 (2015).
5. Stedman's Medical Dictionary, 27th ed., Senior Managing Editor M.B. Pugh, Lippincott Williams and Wilkins, Baltimore (2000).
6. Dorland's Illustrated Medical Dictionary, 32nd ed., Editor W.A.N. Dorland, W.B.Saunders, Philadelphia (2011).
7. Slack, J.M.W. Essential Developmental Biology, 3rd Edition. Pub. Wiley-Blackwell, Chichester (2012)
8. Mosby's Dictionary of Medicine, Nursing & Health Professions, 8th ed., Editor D.M. Anderson, Elsevier, Philadelphia (2009).
9. Saunders Comprehensive Veterinary Dictionary, 3rd ed., Editors Blood, D.C., Studdert, V.P. and Gay, C.C., Elsevier, Philadelphia (2007)
10. The American Heritage Medical Dictionary, Senior Editor S. Spitz, Houghton Mifflin, Boston, (2008)
11. Mosby's Dental Dictionary, 2nd ed., Editors D.W. Nunez, M.J. Ferenbach, M. Emmons, Elsevier, Philadelphia (2008).
12. Scientific Frontiers in Developmental Toxicology and Risk Assessment, Committee on Developmental Toxicology, Board on Environmental Studies and Toxicology, National Research Council, Washington DC (2000).
13. Hales, B., Scialli, A., and Tassinari, M.S., eds., Teratology Primer, 2nd ed., The Teratology Society (2010).
14. The Gale Encyclopedia of Medicine. Editor, Longe, J.L., The Gale Group Inc., Farmington Hills (2006).
15. The New Encyclopedia Britannica, 15th Edition. Encyclopedia Britannica Inc., Chicago (2010).
16. IUPAC Compendium of Chemical Terminology – the Gold Book (2005-2014). http://goldbook.iupac.org/
17. Drozdowsky, S.L. and Whittaker, S.G., Workplace Hazards to Reproduction and Development: A Resource for Workers, Employers, Health Care Providers, and Health & Safety Personnel, Washington State Department of Labor and Industries, Olympia, WA (1999).

Annex I - Abbreviations

ACE – angiotensin converting enzyme
ACTH – adrenocortocotropic hormone
Ad4BP – adrenal 4 binding protein
AFP – alpha-fetoprotein
AGD – anogenital distance
AGM region – aorta-gonad-mesonephros region
AHR – aryl hydrocarbon receptor
AIF – apoptosis-inducing factor
AMH – anti-Müllerian hormone
AR – androgen receptor
ARND – alcohol-related neurodevelopmental disabilities
ARNT – aryl hydrocarbon receptor translocator protein
ASD – atrial-septal defect
AV – arteriovenous
BMP – bone morphogenetic protein
CNS – central nervous system
CSF – cerebrospinal fluid
CTEV – congenital talipes equinovarus
DES – diethylstilbestrol
DGS – Di George syndrome
DME – drug metabolizing enzyme
ECM – extracellular matrix
ELS test – early life stage test
EMT – epithelial-to-mesenchymal transition
ES cell – embryonic stem cell
EST – expressed sequence tag
FACB – Fertility Assessment by Continuous Breeding
FAS – fetal alcohol syndrome
FASD – fetal alcohol spectrum disorder
FET – fish embryo test
FETAX – frog embryo teratogenesis assay Xenopus
FND – frontonasal dysplasia
FSH – follicle-stimulating hormone
FSH-RH – follicle-stimulating hormone releasing hormone
FGF – fibroblast growth factor
GH – growth hormone
GHRF – growth hormone releasing factor
GIFT – gamete intrafallopian transfer
GnRH – gonadotropin-releasing hormone
GRH – gonadotropin-releasing hormone
HCG – human chorionic gonadotropin
hGH – human growth hormone
hPL – human placental lactogen
HGP – Human Genome Project

ICSI – intracytoplasmic sperm injection
IF – intermediate filament
IUGR – intrauterine growth restriction (retardation)
IVF – in vitro fertilization
iPS – induced pluripotent stem cell
LC50 – median lethal concentration
LD50 – median lethal dose
LH – luteinizing hormone
LHRH – luteinizing hormone-releasing hormone
LOD score – logarithm (base 10) of odds score
MET – mesenchymal-to-epithelial transition
MIF – Müllerian inhibiting factor
MIH – Müllerian-inhibiting hormone
MIS – Müllerian-inhibiting substance
mRNA – messenger RNA
miRNA – microRNA
MSAFP – maternal serum alpha-fetoprotein
NOG – noggin
ORF – open reading frame
PKU – phenylketonuria
RACB – Reproductive Assessment by Continuous Breeding
RAR – retinoic acid receptor
RFLP – restriction fragment length polymorphism
Rh factor – rhesus factor
RNAi – RNA interference
RXR – retinoid X receptor
SCE – sister chromatid exchange
SDN – sexually dimorphic nucleus
SHM – somatic hypermutation
shRNA – short hairpin RNA
siRNA – small interfering RNA
SNP – single-nucleotide polymorphism
SRY protein – sex-determining region Y protein
STH – somatotropic hormone
STR – short tandem repeat
T3 – triiodothyronine
T4 – thyroxin
TBTO – tributyltin oxide
TC – median teratogenic concentration
TDF – testis-determining factor
TEL-ARNT – translocated ETS leukemia-ARNT fusion protein (where ARNT is defined above and ETS refers to the E twenty-six transformation-specific family of transcription factors)
TGF-β – transforming growth factor β
TI – teratogenic index
VNTR – variable number tandem repeat

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VSD – ventricular septal defect
VTG – vitellogenin
ZIFT – zygote intrafallopian transfer

Annex II – List of some chemicals with important adverse effects on the reproductive system, embryo, and fetus
IUPAC names of substances are included in {brackets}.

Substance	Occurence, use	Reprotoxic and fetotoxic effects
N-Acetoxy-2-acetylaminofluorene (2-AAF)	DNA-adduct forming agent	Teratogenic in various laboratory studies.
Acrylamide	Industrial monomer and cooking byproduct	Affects male and female fertility in experimental animals. Fetotoxic but not teratogenic in experimental animals.
Alcohol (see Ethanol)		
Aldrin {1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4:5,8-dimethanonaphthalene}	Organochlorine pesticide (widely banned)	Fetotoxic and teratogenic in experimental animals. Affects fertility in multiple experimental animal species.
Aminoglycosides	Antibiotic drugs	Deafness
Aminopterin (4-aminopteroic acid) {2-[[4-{[(2,4-diaminopteridin-6-yl)methyl]amino}benzoyl]amino]pentanedioic acid}	Folic acid analog and antagonist	Abortion, CNS- and craniofacial defects, growth retardation, and immunosuppressive effects.
Angiotensin converting enzyme (ACE) inhibitors	Hypotensive drugs	Various fetal organ failures associated with hypotensive effect.
Aniline	Solvent and intermediate	May induce methemoglobinemia in the fetus.
Anti-androgens	Drugs, endocrine disrupters	Disruption of sexual differentiation in various species.
Anticonvulsants	Antiepileptic drugs	Agents belonging to different chemical groups, associated with risks of mental retardation and other growth abnormalities.
Anti-HIV drugs	Therapeutic drugs	Interaction with cell cycle; effects ill-defined.
Antineoplastics	Anticancer and antitumor drugs	Agents interfering with DNA and the cell cycle, possibly producing various reprotoxic effects.
Arsenic (inorganic ions)	Semimetallic chemical species contaminating water	Spontaneous abortion, stillbirth.
Busulfan {butane-1,4-diyl dimethanesulfonate}	Alkylating chemotherapeutic drug	Teratogenic, embryotoxic and fetotoxic.
Cadmium (elemental and compounds)	Industrially in dust and fumes, contaminating food and water	Placental necrosis, zinc antagonist, calcium mimic.

Caffeine {1,3,7-trimethylpurine-2,6-dione}	Consumer products	Non-human teratogen only.
Carbamazepine {5*H*-dibenzo[*b*,*f*]azepine-5-carboxamide}	Antiepileptic drug	Associated with developmental disorders and risk of spina bifida.
Carbimazole {1-ethoxycarbonyl-3-methyl-2-thio-4-imidazoline}	Thyroxin antagonistic drug	Associated with risk of fetal hypothyroidism.
Carbon dioxide	Gas from fermentations and burning fossil fuels	Malformations in the offspring of experimental animals. Male reproductive effects in experimental animals.
Carbon disulfide	Industrial organic solvent	Spontaneous abortion, premature birth.
Carbon monoxide	Gas from incomplete combustion of fossil fuels	Possible neuropathological effects in offspring.
Carbon tetrachloride	Organic solvent	Embryotoxic and fetotoxic.
Chlorambucil {4-[4-(bis(2-chlorethyl)amino)phenyl]butanoic acid}	Alkylating chemotherapeutic drug	Various types of malformation and birth defects.
Chloroform	Organic solvent	Placental necrosis in experimental animals.
α-Chlorohydrin {3-chloropropane-1,2-diol}	Industrial intermediate, food contaminant	Adverse effects on male sperm production, potential chemosterilizant. May be genotoxic.
Choline acetyltransferase inhibitor	Pesticide	Deterioration of male reproductive organs.
Chromium [chromous(II)chloride, chromic(III)chloride, chromic(VI)trioxide]	Inorganic compounds, industrial exposures and environmental pollutants	Birth defects and fertility problems in experimental animals.
Cocaine {methyl(1*R*,2*R*,3*S*,5*S*)-3-(benzoyloxy)-8-methyl-8-azabicyclo[3.2.1]octane-2-carboxylate}	Drug of abuse	Cerebral infarcts, mental retardation, withdrawal symptoms after birth.
Colchicine {*N*-[(7*S*)-1,2,3,10-tetramethoxy-9-oxo-5,6,7,9-tetrahydrobenzo[*a*]heptalen-7-yl]acetamide}	Anti-gout drug	Teratogenic in mice. Modulation of fertility.
Corticoids	Hormones and therapeutic drugs	Support for maturation of lungs in fetus.
Coumarin derivatives (see Warfarin)		
Cyclophosphamide	Alkylating anticancer	Malformations and birth defects, experimental

{(*RS*)-2-[bis(2-chloroethyl)amino]tetrahydro-2*H*-1,3,2-oxazaphosphorine 2-oxide}	drug	teratogen.
Deoxycoformycin (Pentostatin) {(8*R*)-3-(2-deoxy-D-erythro-pentofuranosyl)-3,4,7,8-tetrahydroimidazo[4,5-*d*][1,3]diazepin-8-ol}	adenosine deaminase-inhibiting drug	Reproductive and teratogenic effects.
Diazepam (Valium) {7-chloro-1-methyl-5-phenyl-3*H*-1,4-benzodiazepin-2-one}	Sedative drug	Cleft lip and (or) cleft palate.
Dibromochloropropane {1,2-dibromo-3-chloropropane}	Soil fumigant	Testicular toxicant.
Dichlorodiphenyltrichloroethane (DDT) {1,1'-(2,2,2-trichloro-1,1-ethanediyl)bis(4-chlorobenzene)}	Insecticide (widely banned)	Thinning of eggshells of predator birds along with altered behavior, leading to reproductive failure. Found in human milk.
Dichlorvos {2,2-dichlorovinyl dimethyl phosphate}	Organophosphorus insecticide	Teratogenic in swine.
Dieldrin {(1*R*,2*S*,3*S*,6*R*,7*R*,8*S*,9*S*,11*R*)-3,4,5,6,13,13-hyexachloro-10-oxapentacyclo[6.3.1.1^{3,6}.0^{2,7}.0^{9,11}]tridec-4-ene}	Organochlorine insecticide	Reproductive and developmental effects in experimental animals.
Diethylstilbestrol (DES) {4,4'-[(3*E*)-hex-3-ene-3,4-diyl]diphenol}	Synthetic estrogen	Clear cell adenocarcinoma of the vagina associated with treatment of the patient's mother during first trimester.
Dinitrotoluene	Organic chemical	Methemoglobinemia in the fetus, male reproductive effects
Dinoseb {(*RS*)-2-*sec*-butyl-4,6-dinitrophenol}	Herbicide	Embryotoxic, may induce methemoglobinemia in experimental animals.
Diphenylhydantoin (see phenytoin)		
Drugs of abuse	Addictive drugs	Multiple effects on sexual behaviour and reproduction.
Enalapril (see Angiotensin converting enzyme inhibitors)		
Endosulfan	Organochlorine	Effects on the reproductive systems of

{1,9,10,11,12,12-hexachloro-4,6-dioxa-5-thiatricyclo[7.2.1.0^{2,8}]dodec-10-ene 5-oxide}	pesticide	experimental animals.
Epichlorohydrin {2-(chloromethyl)oxirane}	Industrial chemical	Male reproductive toxicity seen in experimental animals.
Ethanol	Drug of addiction	Fetal alcohol syndrome associated with birth defects and cognitive deficits by oral consumption.
Ethylene thiourea {1,3-ethylene-2-thiourea}	Industrial chemical	Teratogenic in rats.
di(2-Ethyhexyl)phthalate (see Phthalates)		
Ethylnitrosourea {1-ethyl-1-nitrosourea}	Alkylating mutagen	Fetotoxic, teratogenic effects.
Etretinate {ethyl 9-(4-methoxy-2,3,6-trimethyl-phenyl)-3,7-dimethyl-nona-2,4,6,8-tetraenoate}	Anti-psoriasis drug	Teratogenic (see also Vitamin A)
5-Fluorouracil	Chemotherapeutic drug, experimental teratogen	Embryotoxic, teratogenic
Folic acid (see also Aminopterin)	Essential nutrient	Deficiency leads to various types of malformations, neural tube defects. Possible effects on sperm.
Halothane {2-bromo-2-chloro-1,1,1-trifluoroethane}	Inhalation anaethetic	Developmental delay and behaviorial abnormalities in offspring.
Hydralazine {(1*E*)-1-hydrazono-1,2-dihydrophthalazine}	Antihypertensive drug	Teratogenic in mice.
Indomethacin {2-{1-[(4-chlorophenyl)carbonyl]-5-methoxy-2-methyl-1*H*-indol-3-yl}acetic acid}	Nonsteroidal anti-inflammatory drug (NSAID)	Risk of premature closure of ductus arteriosus, malformations and neonatal complications.
Iodide	Essential nutrient	Deficiency leads to goiter and cretinism.
Isotretinoin (13-cis-retinoic acid)	Drug used in treating acne	Craniofacial, ear and cardiovascular malformations, intellectual deficits.
Kepone (chlordecone) {decachloropentacyclo[5.3.0.0$^{2.6}$.0$^{3.9}$.0$^{4.8}$]decan-5-one}	Organochlorine insecticide (widely banned)	Depressed sperm count and motility, found in milk.
Lead (ions and organic lead)	Industrial and environmental contaminants of air, water and food	Abortion, growth retardation, and neurobehavioral deficits.
Lithium salts	Antidepressant drugs	Associated with risk of malformations notably of

		the heart (Epstein anomaly)
Malathion {diethyl 2-[(dimethoxyphosphorothioyl)sulfanyl]succinate}	Organophosphate pesticide	Effects on development and reproduction in several species of experimental animals
Mercury (elemental, inorganic mercury compounds, and organomercury)	Element used in gold refining, industrial and environmental pollutants	Teratogenic, embryotoxic and a disruptor of brain development, especially in the form of methylmercury.
Methimazole {1-methyl-3*H*-imidazole-2-thione}	Antithyroid drugs	Prematurity, intrauterine growth retardation, craniostenosis, cardiac failure, fetal hydrops, and intrauterine death
Methotrexate {4-amino-*N*10-methylfolic acid}	Antineoplastic drug, abortifacient	Teratogen, also adversely affects male and female fertility.
Methoxychlor {1,1'-(2,2,2-trichloro-1,1-ethanediyl)bis(4-methoxybenzene)}	Organochlorine insecticide	Male and female reproductive toxicity and developmental toxicity demonstrated in experimental animals.
Methoxyethanol	Organic solvent	Low sperm count (oligospermia), teratogenic.
Methylene blue {3,7-bis(dimethylamino)-phenothiazin-5-ium chloride}	Dye, various applications	Teratogenic.
Methylene chloride	Organic solvent	Spontaneous abortion, low birth weight.
Methylformamide	Chemical intermediate	Teratogenic in several animal species.
Methylmercury	see mercury	
Methylpyrrolidone {*N*-methyl-2-pyrrolidone}	Solvent	Fetotoxic and teratogenic in mice and rats at high doses.
Misoprostol {methyl (11α,13*E*)-11,16-dihydroxy-16-methyl-9-oxoprost-13-en-1-oate}	Synthetic prostaglandin	Abortifacient, limb and neural tube defects
Narcotics	Sedative and anaesthetic drugs	Substance-dependent effects on fetal brain. Potential withdrawal symptoms in the neonate.
Nickel compounds	Industrial and environmental pollutants from extraction and refining of nickel	Species-dependent embryotoxicity and teratogenicity.
Oral contraceptives	Contraceptive drugs	Decreased fertility in female. *Note:* Possible association with developmental deficits of fetus is a matter of debate.
Parathion {*O*,*O*-diethyl *O*-(4-nitrophenyl) phosphorothioate}	Organophosphate insecticide	May reduce fertility in experimental animals. Embryotoxic and fetotoxic.
Penicillamine	Metal-chelating and	Connective tissue defects.

{(2*S*)-2-amino-3-methyl-3-sulfanylbutanoic acid}	antirheumatic drug	
Phenol	Industrial chemical	Embryotoxic and fetotoxic in experimental animals.
Phenylalanine in maternal hyperphenylalaninemia (PKU)	Phenylalanine substitution in PKU-patients	Possible mental retardation if maternal phenylalanine substitution is too high.
Phenytoin (diphenylhydantoin) {5,5-diphenylimidazolidine-2,4-dione}	Anticonvulsant drug	Craniofacial, limb, and cerebrovascular defects, growth and mental retardation, fetal loss.
Phorbol {1,1a,1b,4,4a,7a,7b,8,9,9a-decahydro-4a,7b,9,9a-tetrahydroxy-3-(hydroxymethyl)-1,1,6,8-tetramethyl-5*H*-cyclopropa[3,4]benz[1,2-*e*]azulen-5-one}	Cellular research agent, kinase activator	Various teratogenic effects.
Phthalates	Plasticiser	Teratogenic, fetotoxic, testicular toxicant in several animal species.
Polychlorinated biphenyls (PCB)	Environmental pollutants (widely banned)	Growth retardation, hyperpigmentation and neurobehavioral deficit.
Polycyclic aromatic hydrocarbons (PAH)	Incomplete combustion	Associated with reproductive disturbances, birth defects and cancer in laboratory animals.
Progesterone	Female hormone	Possible masculinization of female fetus
Psychoactive drugs	Therapeutic and addictive drugs	Various substance-dependent effects on fetal neurological function. Possible withdrawal phenomena in the newborn.
Retinoids	Natural and synthetic (therapeutic) derivatives of Vitamin A	Substance-dependent teratogenic effects.
13-*cis*-Retinoic acid (see Isotretinoin)		
Sucrose	Nutrient	Potentially diabetogenic in predisposed women, increasing risk of birth defects and prenatal imprinting.
Suramin {8,8'-{carbonylbis[imino-3,1-phenylenecarbonylimino(4-methyl-3,1-phenylene)carbonylimino]}di(1,3,5-naphthalenetrisulfonic acid)}	Anti-protozoal drug	Reduced placental blood flow, fetal growth retardation.

Tetracycline {(4*S*,4a*S*,5a*S*,6*S*,12a*S*)-4-(dimethylamino)-3,6,10,12,12a-pentahydroxy-6-methyl-1,11-dioxo-1,4,4a,5,5a,6,11,12a-octahydro-2-tetracenecarboxamide}	Antibiotic drug	Discoloured (yellow, brownish or grey), defective teeth. May affect bone growth.
Thalidomide {(*RS*)-2-(2,6-dioxopiperidin-3-yl)-1*H*-isoindole-1,3(2*H*)-dione}	Treatment of certain cancers (multiple myeloma) and of leprosy	Teratogenic, particularly reduction defects of the limbs (phocomelia) and ears when mothers are treated on days 21-26 of pregnancy.
Tobacco smoke	Nicotine, addictive agent	Intrauterine growth retardation, low birth weight, prematurity.
Toluene	Industrial chemical	Toluene sniffing results in "Toluene embryopathy" with mainly neurological anomalies in the fetus.
Toxaphene (chlorinated camphene) {1,2,2,3,3,4,7,7-octachloro-5,5-dimethyl-6-methylenebicyclo[2.2.1]heptane}	Organochlorine insecticide	Multiple reproductive and developmental effects in laboratory animals.
Trifluoperazine {10-[3-(4-methylpiperazin-1-yl)propyl]-2-(trifluoromethyl)-10*H*-phenothiazine}	Antipsychotic drug	Teratogenic.
Trimethadione {3,5,5-trimethyl-1,3-oxazolidine-2,4-dione}	Anticonvulsant drug	Craniofacial and cardiovascular defects, mental retardation.
Trypan blue	Dye	Experimental teratogen when injected in frogs.
Valproic acid {2-propylpentanoic acid}	Anticonvulsant drug	Neural tube closure defects, mental retardation.
Vinclozolin {(*RS*)-3-(3,5-dichlorophenyl)-5-methyl- 5-vinyloxazolidine-2,4-dione}	Fungicide, endocrine disruptor	Multigenerational epigenetic effects on the male reproductive system.
Vismodegib {2-chloro-*N*-(4-chloro-3-pyridin-2-ylphenyl)-4-methylsulfonylbenzamide}	Basal cell carcinoma therapy	Teratogenic, enters the semen.
Vitamin A	Essential human nutrient, including retinol, retinoic acid and β-carotene	Excessive supplementation with liver-derived retinoids (not carotenes) is teratogenic.
Vitamin E	Essential human	Deficiency associated with infertility.

	nutrient	
Warfarin, coumadin {(*RS*)-4-hydroxy-3-(3-oxo-1-phenylbutyl)-2*H*-chromen-2-one}	Anti-clotting drug, rodenticide	Craniofacial defects, intrauterine growth retardation, central nervous system malformation, and stillbirth.
Zinc ions	Metallic elemental species in food and water, essential human nutrient	Deficiency may cause birth defects.