

Glossary

In insects the body is divided into three distinct parts, the head at the anterior end, followed by the thorax and the posterior abdomen.

Abembryonic pole *see* embryonic-abembryonic axis.

The acron is a specialized structure associated with the most anterior region of the *Drosophila* embryo.

The acrosomal reaction is the release of enzymes and other proteins from the acrosomal vesicle of the sperm head that occurs once a sperm has bound to the outer surface of the egg. It helps the sperm to penetrate the outer layers of the egg.

Actin filaments or **microfilaments** are one of the three principal protein filaments of the cytoskeleton. They are involved in cell movement and changes in cell shape. Actin filaments are also part of the contractile apparatus of muscle cells.

Gene-regulatory proteins that turn genes on are known as **activators**.

Actomyosin is an assembly of actin filaments and the motor protein myosin that can undergo contraction.

In plants, the **adaxial—abaxial axis** runs from the center of the stem to the circumference. In plant leaves it runs from the upper surface to the lower surface (dorsal to ventral).

Adherens junctions are a type of adhesive cell junction in which the adhesion molecules linking the two cells together are cadherins that are linked intracellularly to the actin cytoskeleton.

The **allantois** is a set of extra-embryonic membranes that develops in some vertebrate embryos. In bird and reptile embryos it acts as a respiratory surface, while in mammals its blood vessels carry blood to and from the placenta.

An **allele** is a particular version of a gene. In diploid organisms two alleles of each gene are present, which may or may not be the same.

The **amnion** is an extra-embryonic membrane in birds, reptiles, and mammals, which forms a fluid-filled sac that encloses and protects the embryo. It is derived from extra-embryonic ectoderm and mesoderm.

The **amnioserosa** of the *Drosophila* embryo is an extra-embryonic membrane on the dorsal side of the embryo.

An **androgonetic embryo** is an embryo in which the two sets of homologous chromosomes are both paternal in origin.

Angioblasts are the mesodermal precursor cells that will give rise to blood vessels.

Angiogenesis is the process by which small blood vessels sprout from the larger vessels.

The **animal region** of an egg is the end of the egg where the nucleus resides, usually away from the yolk. The most terminal part of this region is the **animal pole**, which is directly opposite the vegetal pole at the other end of the egg. In *Xenopus* the pigmented animal half is called the **animal cap**.

The **animal-vegetal axis** runs from the animal pole to the vegetal pole in an egg or early embryo.

The **anterior visceral ectoderm (AVE)** is an extra-embryonic tissue in the early mouse embryo that is involved in inducing anterior regions of the embryo.

The **antero-posterior axis** defines which is the 'head' end and which is the 'tail' end of an animal. The head is anterior and the tail posterior. In the vertebrate limb, this axis runs from the thumb to little finger.

Anticlinal cell divisions are divisions in planes at right angles to the outer surface of a tissue.

Antisense RNA is an RNA complementary in sequence to an mRNA or gene coding sequence and is used to block the expression of a protein by binding to its mRNA.

The **apical-basal axis** of a plant is the axis running from shoot tip to root tip.

The **apical ectodermal ridge** or **apical ridge** is a thickening of the ectoderm at the distal end of the developing chick and mammalian limb bud. Signals from the ridge specify the progress zone in the underlying mesoderm.

An **apical meristem** is the region of dividing cells at the tip of a growing shoot or root.

Apoptosis or **programmed cell death** is a type of cell death that occurs widely during development. In programmed cell death, a cell is induced to commit 'suicide', which involves fragmentation of the DNA and shrinkage of the cell. These apoptotic cells are removed by the body's scavenger cells and, unlike necrosis, their death does not cause damage to surrounding cells.

The **archenteron** is the cavity formed inside the embryo when the endoderm and mesoderm invaginate during gastrulation. It forms the gut.

The **area opaca** is the outer dark area of the chick blastoderm.

The **area pellucida** is the central clear area of the chick blastoderm.

Asymmetric cell division or **asymmetric division** are cell divisions in which the daughter cells are different from each other because some cytoplasmic determinant(s) have been distributed unequally between them.

A developmental process is said to be proceeding **autonomously** when it can continue without a requirement for extracellular signals to be continuously present. *See also* **cell autonomous**.

AVE *see* **anterior visceral endoderm**.

Axial structures are those that form along the main axis of the body, such as the notochord, vertebral column, and neural tube in vertebrates.

Axons are long cell processes of neurons that conduct nerve impulses away from the cell body. The end of an axon, the **axon terminal**, forms contacts (synapses) with other neurons, muscle cells, or glandular cells.

The protein **β -catenin** functions both as a transcription factor and as one of the proteins present at cell junctions. In its role as a transcription factor it is activated in early development in many vertebrates as the end result of a Wnt signaling pathway.

The **basal lamina** is a sheet of extracellular matrix that separates an epithelial layer from the underlying tissues. For example, the epidermis of the skin is separated from the dermis by a basal lamina.

Animals in which the only axis of symmetry is the central axis running from head to tail are said to possess **bilateral symmetry**. The two sides of the body are mirror images of each other.

In amphibian limb regeneration, a **blastema** is formed from the dedifferentiation and proliferation of cells beneath the wound epidermis, and gives rise to the regenerated limb.

The **blastocoel** is the fluid-filled cavity that develops in the interior of a blastula.

The **blastocyst** stage of a mammalian embryo corresponds in form to the blastula stage of other animal embryos, and is the stage at which the embryo implants in the uterine wall.

A **blastoderm** is a post-cleavage embryo composed of a solid layer of cells rather than a spherical blastula, as in early chick and *Drosophila* embryos. The chick blastoderm is also known as the **blastodisc**.

Blastomeres are the cells derived from cleavage of the early embryo.

The **blastopore** is the slit-like or circular invagination on the surface of amphibian and sea urchin embryos where the mesoderm and endoderm move inside the embryo at gastrulation.

The **blastula** stage in animal development is the outcome of cleavage. The blastula is a hollow ball of cells, composed of an epithelial layer of small cells enclosing a fluid-filled cavity—the blastocoel.

The **body plan** describes the overall organization of an organism, for example the position of the head and tail, and the plane of bilateral symmetry, where it exists. The body plan of most animals is organized around two main axes, the antero-posterior axis and the dorso-ventral axis.

The **brachial** region of a vertebrate embryo is the region that includes the forelimb or that gives rise to the structures of the forelimb.

The **cadherins** are a family of cell-adhesion molecules with important roles in development.

The **cambium** in plants is a ring of meristem in the stem that gives rise to new stem tissue that increases the diameter of the stem.

The **canonical Wnt pathway** is an intracellular signaling pathway stimulated by members of the Wnt family of signal proteins that leads to the stabilization of β -catenin and its entry into nuclei, where it acts as a transcription factor.

The functional maturation of sperm after they have been deposited in the female reproductive tract is known as **capacitation**.

Caspases are intracellular proteases, some of which are involved in apoptosis.

Cell-adhesion molecules bind cells to each other and to the extracellular matrix. The main classes of adhesion molecules important in development are the cadherins, the immunoglobulin superfamily, and the integrins.

The effects of a gene are **cell autonomous** if they only affect the cell the gene is expressed in.

The **cell body** is the part of a neuron that contains the nucleus, and from which the axon and dendrites extend.

Cell-cell interaction and **cell-cell signaling** are general terms to describe many different types of intercellular communication by which one cell influences the behavior of another cell. Cells can communicate with each other via cell contact or by the secretion of signaling molecules that influence the behavior of other cells nearby or at a distance.

The **cell cycle** is the sequence of events by which a cell duplicates itself and divides in two.

During **cell differentiation**, cells become functionally and structurally different from one another and become distinct cell types, such as muscle or blood cells.

Cell-lineage restriction occurs when all the descendants of a particular group of cells remain within a 'boundary' and never mix with an adjacent group of cells. Compartment boundaries in insect development are boundaries of lineage restriction.

Cell senescence *see* **senescence**.

The **chemoaffinity hypothesis** proposes that each retinal neuron carries a chemical label that enables it to connect reliably with an appropriately labeled cell in the optic tectum.

A **chemoattractant** is a molecule that attracts cells to move towards it.

A **chemorepellant** is a molecule that repels cells, causing them to move away from it.

A **chimeric** organism or tissue (a chimera) is made up of cells from two or more different sources, and thus of different genetic constitutions.

Chondrocytes are differentiated cartilage cells.

The **chorion** is the outermost of the extra-embryonic membranes in birds, reptiles, and mammals. It is involved in respiratory gas exchange. In birds and reptiles it lies just beneath the shell. In mammals it is part of the placenta and is also involved in nutrition and waste removal. The chorion of insect eggs has a different structure.

Chromatin is the material of which chromosomes are made. It is composed of DNA and protein. Enzyme complexes called **chromatin-remodeling complexes** can act on chromatin to modify it and alter the ability of the DNA to be transcribed.

The **circadian clock** is an internal 24-hour timer present in living organisms that causes many metabolic and physiological processes, including the expression of some genes, to vary in a regular manner throughout the day.

The **cis-regulatory control region** of a gene comprises the sequences flanking the gene and containing sites at which the expression of that gene can be controlled. Many control regions contain a variety of different **cis-regulatory modules**, which are short regions containing multiple binding sites for different transcription factors; the combination of factors bound determines whether the gene is switched on or off.

Cleavage occurs after fertilization and is a series of rapid cell divisions without growth that divides the embryo up into a number of small cells.

A **clone** is a collection of genetically identical cells derived from a single cell by repeated cell division, or the genetically identical offspring of a single individual produced by asexual reproduction or artificial cloning techniques.

Cloning is the procedure by which an individual genetically identical to a 'parent' is produced by transplantation of a parental somatic cell nucleus into an unfertilized oocyte.

The **coding region** of a gene is that part of the DNA that encodes a polypeptide or functional RNA.

The correspondence between the order of Hox genes on a chromosome and their temporal and spatial order of expression in the embryo is known as **co-linearity**.

Induction of cell differentiation in some tissues depends on a **community effect**, in that there have to be a sufficient number of responding cells present for differentiation to occur.

Compaction of the mouse embryo occurs during early cleavage. The blastomeres flatten against each other and microvilli become confined to the outer surface of the ball of cells.

Compartments are discrete areas of an embryo that contain all the descendants of a small group of founder cells and which show cell-lineage restriction. Cells in compartments respect the compartment boundary and do not cross over into an adjacent compartment. Compartments tend to act as discrete developmental units.

Competence is the ability of a tissue to respond to an inducing signal. Embryonic tissues only remain **competent** to respond to a particular signal for a limited period of time.

The **control region** of a gene is the region to which regulatory proteins bind and so determine whether or not the gene is transcribed.

Convergent extension is the process by which a sheet of cells changes shape by extending in one direction and narrowing—converging—in a direction at right angles to the extension.

Cortical rotation occurs immediately after an amphibian egg is fertilized. The egg **cortex**, an actin-rich layer of cytoplasm lying immediately

below the surface, rotates with respect to the underlying cytoplasm, toward the point of sperm entry.

A **cotyledon** is the part of the plant embryo that acts as a food storage organ.

Cyclins are proteins that periodically rise and fall in concentration during the cell cycle and are involved in controlling progression through the cycle. They act by binding to and activating **cyclin-dependent kinases (CDKs)**.

Cytoplasmic localization is the non-uniform distribution of some factor or determinant in a cell's cytoplasm, so that when the cell divides, the determinant is unequally distributed to the daughter cells.

The long-lived **dauer** larvae of *C. elegans* are a response to starvation conditions and neither eat nor grow until food is again available.

Redifferentiation is loss of the structural characteristics of a differentiated cell, which may result in the cell then differentiating into a new cell type.

Delamination is the process in which epithelial cells leave an epithelium as individual cells. It occurs, for example, in the primitive streak and in the movement of neural crest cells out of the neural tube.

Dendrites are extensions from the body of a nerve cell that receive stimuli from other nerve cells.

Denticles are small tooth-like outgrowths of the cuticle on insect larvae.

The **dermatome** is the region of the somite that will give rise to the dermis.

The **dermis** of the skin is the connective tissue beneath the epidermis, from which it is separated by a basal lamina.

The **dermomyotome** is the region of the somite that will give rise to both muscle and dermis.

Determinants are cytoplasmic factors (e.g. proteins and RNAs) in the egg and in embryonic cells that can be asymmetrically distributed at cell division and so influence how the daughter cells develop.

Determination implies a stable change in the internal state of a cell such that its fate is now fixed, or **determined**. A determined cell will follow that fate when grafted into other regions of the embryo.

Deuterostomes are those animals, such as chordates and echinoderms, that have radial cleavage of the egg, and in which the primary invagination of the gut at gastrulation forms the anus, with the mouth developing independently.

Genes that specifically control a developmental process are known as **developmental genes**.

Diploblasts are animals with two germ layers (endoderm and ectoderm) only and include coelenterates such as *Hydra* and jellyfish.

Diploid cells contain two sets of homologous chromosomes, one from each parent, and thus two copies of each gene.

Directed dilation is the extension of a tube-like structure at each end due to hydrostatic pressure, the direction of extension reflecting greater circumferential resistance to expansion.

The **distal end** of a structure such as a limb is the end furthest away from the point of attachment to the body.

DNA microarrays, also known as **DNA chips**, are arrays of oligonucleotides that are used to detect and measure the expression of large numbers of genes simultaneously, by hybridization of cellular RNA or cDNA.

A **dominant allele** is one that determines the phenotype even when present in only a single copy.

A **dominant-negative mutation** inactivates a particular cellular function by the production of a defective RNA or protein molecule that blocks the normal function of the gene product.

Dorsalized embryos develop greatly increased dorsal regions at the expense of ventral regions.

Dorsalizing factors in vertebrate embryos are proteins that promote the formation of dorsal structures.

The **dorso-ventral axis** defines the relation of the upper surface or back (dorsal) to the under surface (ventral) of an organism or structure. The mouth is always on the ventral side.

Dosage compensation is the mechanism that ensures that although the number of X chromosomes in males and females is different, the level of expression of X-chromosome genes is the same in both sexes. Mammals, insects, and nematodes all have different dosage compensation mechanisms.

Ecdysis is a type of molting in arthropods in which the external cuticle is shed to allow for growth.

The **ectoderm** is the germ layer that gives rise to the epidermis and the nervous system.

The **egg cylinder** in early post-implantation mouse embryogenesis is the cylindrical structure comprising the epiblast covered by visceral endoderm.

Embryogenesis is the process of development of the embryo from the fertilized egg.

Embryology is the study of the development of an embryo.

The **embryonic-abembryonic axis** in the mammalian blastocyst runs from the site of attachment of the inner cell mass—the **embryonic pole**—to the opposite pole, the **abembryonic pole**.

The **embryonic ectoderm** is the name given to the mouse epiblast once it has developed into an epithelial sheet.

Embryonic stem cells (ES cells) are derived from the inner cell mass of a mammalian embryo, usually mouse, and can be indefinitely maintained in culture. When injected into another blastocyst, they combine with the inner cell mass and can potentially contribute to all the tissues of the embryo.

In the chick embryo, the **hypoblast** underlying the epiblast is replaced by a layer of cells called the **endoblast** that grows out from the posterior marginal zone prior to primitive streak formation.

The **endocardium** is the inner endothelial layer of the developing heart.

Endochondral ossification is the replacement of cartilage with bone in the growth plate of vertebrate embryonic skeletal elements, such as those that give rise to the long bones of the limbs.

The **endoderm** is the germ layer that gives rise to the gut and associated organs, such as the lungs and liver in vertebrates.

The **endodermis** is a tissue layer in plant roots interior to the cortex and outside the vascular tissue.

Endomesoderm is a tissue that can give rise to both mesoderm and endoderm.

The **endosperm** in higher plant seeds is a nutritive tissue that serves as a source of food for the embryo.

The **enhancer-trap technique** is used in *Drosophila* to turn on the expression of a specific gene in a particular tissue or stage in development.

Ephrins and their receptors, **Eph receptors**, are cell-surface molecules involved in delimiting compartments in rhombomeres and in axonal guidance.

The **epiblast** of mouse and chick embryos is a group of cells within the blastocyst or blastoderm, respectively, that gives rise to the embryo proper. In the mouse, it develops from cells of the inner cell mass.

Epiboly is the process during gastrulation in which the ectoderm extends to cover the whole of the embryo.

The **epidermis** in vertebrates, insects, and plants is the outer layer of cells that forms the interface between the organism and its environment. Its structure is quite different in the different organisms.

Epimorphosis is a type of regeneration in which the regenerated structures are formed by new growth.

ES cells *see* **embryonic stem cells**.

An **epithelium** is said to **evaginate** when it forms a tubular outgrowth from the surface.

Extra-embryonic ectoderm in mammals contributes to the formation of the placenta.

Extra-embryonic membranes are membranes external to the embryo proper that are involved in the protection and nutrition of the embryo.

The **fate of cells** describes what they will normally develop into. By marking cells in the embryo, a **fate map** of embryonic regions can be constructed. Having a particular normal fate does not, however, imply that a cell could not develop differently if placed in a different environment.

Fertilization is the fusion of sperm and egg to form the zygote.

A **file of cells** in a plant root is a vertical column of cells that originates from a single initial in the root meristem.

The **floor plate** is a small region of the developing neural tube at the ventral midline that is composed of non-neural cells. It is involved in patterning the ventral part of the neural tube.

A **floral meristem** is a region of dividing cells at the tip of a shoot that gives rise to a flower.

The individual parts of a flower develop from **floral organ primordia** generated by the floral meristem and are given their individual identities by the expression of **floral organ identity genes**.

Follicle cells are somatic cells that surround the oocyte and nurse cells during egg development in *Drosophila*.

Plant organs such as flowers and leaves each develop from a small number of **founder cells** that derive from the apical meristem.

The **gametes** are the cells that carry the genes to the next generation—in animals they are the eggs and sperm.

A **ganglion mother cell** is formed by division of a neuroblast in *Drosophila* and gives rise to neurons.

Gap genes are zygotic genes coding for transcription factors expressed in early *Drosophila* development that subdivide the embryo into regions along the antero-posterior axis.

The **gastrula** is the stage in animal development when the endoderm and mesoderm of the blastula move inside the embryo.

Gastrulation is the process in animal embryos in which the endoderm and mesoderm move from the outer surface of the embryo to the inside, where they give rise to internal organs.

Gene knock-out refers to the complete inactivation of a particular gene in an organism by means of genetic manipulation.

Gene-regulatory proteins are proteins that bind to control regions in DNA and help to switch genes on and off.

When genes are switched off by microRNAs, RNA interference, or changes to chromatin this is known as **gene silencing**.

General transcription factors are ubiquitous transcription factors that form a complex with sites in the gene promoter and with the RNA polymerase to enable the polymerase to start transcription.

The **genital ridge** in vertebrates is the region of mesoderm lining the abdominal cavity from which the gonads develop.

The **genotype** is a description of the exact genetic constitution of a cell or organism in terms of the alleles it possesses for any given gene.

The **germarium** in female *Drosophila* contains stem cells that give rise to a succession of egg chambers, each containing an oocyte.

The **germ band** is the name given to the ventral blastoderm of the early *Drosophila* embryo, from which most of the embryo will eventually develop.

Germ cells are those cells that give rise to eggs and sperm.

The **germ layers** refer to the regions of the early animal embryo that will give rise to distinct types of tissue. Most animals have three germ layers—ectoderm, mesoderm, and endoderm.

The **germline cells** give rise to the gametes.

Germplasm is the special cytoplasm in some animal eggs, such as those of *Drosophila*, that is involved in the specification of germ cells.

Glia are supporting cells of the nervous system, such as Schwann cells.

The **globular stage** of a plant embryo is a ball of around 32 cells.

The **gonads** are the reproductive organs of animals.

Growth is an increase in size, which occurs by cell multiplication, increase in cell size and deposition of extracellular material.

Axons of developing neurons extend by means of a **growth cone** at their tip. The growth cone both crawls forward on the substrate and senses its environment by means of filopodia.

Growth hormone is a protein hormone produced by the pituitary gland that is essential for the post-embryonic growth of humans and other mammals.

Growth of vertebrate long bones occurs at the cartilaginous **growth plates**. The cartilage grows and is eventually replaced by bone by the process of endochondral ossification.

A **gynogenetic embryo** is one in which the two sets of homologous chromosomes are both maternal in origin.

Haploid cells are derived from diploid cells by meiosis and contain only one set of chromosomes (half the diploid number of chromosomes), and thus contain only one copy of each gene. In most animals the only haploid cells are the gametes—the sperm or egg.

The **heart stage** is a stage in embryogenesis in dicotyledonous plants in which the cotyledons and embryonic root are starting to form, giving a heart-shaped embryo.

The **Hedgehog** signaling protein of *Drosophila* is a member of an important family of developmental signaling proteins that includes Sonic hedgehog in vertebrates.

Hematopoiesis is the process by which all the blood cells are derived from a pluripotent stem cell. This occurs mainly in the bone marrow.

A **hemisegment** in *Drosophila* is the lateral half of a segment, one on each side of the midline, and is the developmental unit for the nervous system.

Hensen's node is a condensation of cells at the anterior end of the primitive streak in chick and mouse embryos. Cells from the node give rise to the notochord. It corresponds to the Spemann organizer in amphibians.

A **hermaphrodite** is an organism that possesses both male and female gonads and produces both male and female gametes.

Heterochromatin is the state of chromatin in regions of the chromosome that are so condensed that transcription is not possible.

Heterochrony is an evolutionary change in the timing of developmental events. A mutation that changes the timing of a developmental event is called a **heterochronic** mutation.

A diploid individual is **heterozygous** for a given gene when it carries two different alleles of that gene.

The **homeobox** is a region of DNA in homeotic genes that encodes a DNA-binding domain called the **homeodomain**. Genes containing this motif are known generally as **homeobox genes**. The homeodomain is present in a large number of transcription factors that are important in development, such as the products of the Hox genes and the Pax genes.

Homeosis is the phenomenon in which one structure is transformed into another, homologous, structure. An example of a **homeotic transformation** is the development of legs in place of antennae in *Drosophila* as a result of mutation in a **homeotic gene**.

Homeotic selector genes in *Drosophila* are genes that specify the identity and developmental pathway of a group of cells. They encode homeo-domain transcription factors and act by controlling the expression of other genes. Their expression is required throughout development. The *Drosophila* gene *engrailed* is an example of a homeotic selector gene.

Homologous genes share significant similarity in their nucleotide sequence and are derived from a common ancestral gene.

Homologous recombination is the recombination of two DNA molecules at a specific site of sequence similarity.

Homology refers to morphological or structural similarity due to common ancestry.

A diploid individual is **homozygous** for a given gene when it carries two identical alleles of that gene.

Hox genes are a particular family of homeobox-containing genes that are present in all animals (as far as is known) and are involved in patterning the antero-posterior axis. They are clustered on the chromosomes in one or more gene complexes.

The **hypoblast** in the early chick embryo is a sheet of cells that covers the yolk and gives rise to extra-embryonic structures such as the stalk of the yolk sac.

The **hypocotyl** is the seedling stem that develops from the region between the embryonic root and the future shoot.

The **hypophysis** is a cell in some plant embryos that is recruited from the suspensor and contributes to the embryonic root meristem and root cap.

IGF see **insulin-like growth factor**.

Imaginal discs are small sacs of epithelium present in the larva of *Drosophila* and other insects, which at metamorphosis give rise to adult structures such as wings, legs, antennae, eyes, and genitalia.

Some cell-adhesion molecules, such as N-CAM, are members of the **immunoglobulin superfamily** (which also contains many proteins that are not cell-adhesion molecules).

A gene is said to be **imprinted** when it is expressed differently (either active or inactive) in the embryo depending on whether it is derived from the mother or father. This genomic **imprinting** occurs during gamete formation.

Plants with **indeterminate** growth do not make a fixed number of leaves or flowers.

Induction is the process whereby one group of cells signals to another group of cells in the embryo and so affects how they will develop.

An **inflorescence** in plants is a flowerhead—a flowering shoot. Shoots that can bear flowers develop as a result of the conversion of a vegetative apical meristem into an **inflorescence meristem**.

Ingression is the movement of individual cells from the outside of the embryo into the blastocoel.

Initials are cells in the meristems of plants that are able to divide continuously, giving rise both to dividing cells that stay within the meristem and to cells that leave the meristem and go on to differentiate.

The **inner cell mass** of the early mammalian embryo is derived from the inner cells of the morula, which form a discrete mass of cells in the blastocyst. Some of the cells of the inner cell mass give rise to the embryo proper.

In situ hybridization is a technique used to detect where in the embryo particular genes are being expressed. The mRNA that is being transcribed is detected by its hybridization to a labeled single-stranded complementary DNA probe.

In animals in which the larva goes through successive phases of growth and molting before developing into an adult, the phase between each molt is known as an **instar**.

In an **instructive induction**, the cells respond differently to different concentrations of the inducing signal.

Insulin-like growth factors (IGF) are polypeptide growth factors that mediate many of the effects of growth hormone and are essential for post-natal growth in mammals.

Integrins are a class of cell-adhesion molecules by which cells attach to the extracellular matrix.

Intercalary growth can occur in animals capable of epimorphic regeneration when two pieces of tissue with different positional values are placed next to each other. The intercalary growth replaces the intermediate positional values.

Intermediate filaments are one of the three principal protein filaments of the cytoskeleton. They are involved in strengthening tissues such as epithelia.

An **internode** is that portion of a plant stem between two nodes (sites at which a leaf or leaves form).

Invagination is the local inward deformation of a sheet of embryonic epithelial cells to form a bulge-like structure, as in early gastrulation in the sea urchin embryo.

Involution is a type of cell movement that occurs at the beginning of amphibian gastrulation, when a sheet of cells enters the interior of the embryo by rolling in under itself.

Keratinocytes are differentiated epidermal skin cells that produce keratin, eventually die, and are shed from the skin surface.

Knock-out see **gene knock-out**.

Koller's sickle is a crescent-shaped region of small cells lying at the front of the posterior marginal zone.

The **lateral geniculate nucleus** is the main region of the brain in mammals where the axons from the retina terminate.

Lateral inhibition is the mechanism by which cells inhibit neighboring cells from developing in a similar way to themselves.

The **lateral plate mesoderm** in vertebrate embryos lies lateral and ventral to the somites and gives rise to the tissues of the heart, kidney, gonads, and blood.

Lateral shoot meristems arise from the apical shoot meristem and give rise to lateral shoots.

A plant leaf develops from a small set of cells called a **leaf primordium** at the edge of the apical meristem.

The bilateral asymmetry of the arrangement and structure of most internal organs in vertebrates is known as **left-right asymmetry**. In mice and humans, for example, the heart is on the left side, the right lung has more lobes than the left, and the stomach and spleen lie to the left.

The **life history** of an organism or species is its life cycle viewed in terms of its reproductive strategy and its unique ecology or interaction with the environment.

The small embryonic structures that give rise to the limbs of vertebrates are called **limb buds**.

A cell's **lineage** is the sequence of cell divisions that give rise to that cell.

Lineage restriction see **cell-lineage restriction**.

In **long-germ development** the blastoderm gives rise to the whole of the future embryo, as in *Drosophila*.

Macromeres are the larger of the cells that result from unequal cleavage in certain embryos, such as those of sea urchins.

The **marginal zone** of an amphibian embryo is the belt-like region of presumptive mesoderm at the equator of the late blastula.

Maternal-effect mutations are mutations in genes of the mother that affect the development of the egg and later the embryo. Genes affected by such mutations are called maternal-effect genes.

Maternal factors are proteins and RNAs that are deposited in the egg by the mother during oogenesis. The production of these maternal proteins and RNAs is under the control of so-called **maternal genes**.

The **medio-lateral axis** in vertebrates runs from the midline to the periphery.

Medio-lateral intercalation of cells occurs during convergent extension in amphibian gastrulation. The sheet of cells narrows and elongates by cells pushing in sideways between their neighbors.

Meiosis is a special type of cell division that occurs during formation of sperm and eggs, and in which the number of chromosomes is halved from diploid to haploid.

In **meridinal chimeras** a genetically marked cell gives rise to a sector of an organ or of a whole plant.

Meristems are groups of undifferentiated, dividing cells that persist at the growing tips of plants. They give rise to all the adult structures—shoots, leaves, flowers, and roots. The **meristem identity genes** specify whether a meristem is a vegetative or an inflorescence meristem.

Mesectoderm is composed of cells that may give rise to both ectoderm and mesoderm.

Mesenchyme describes loose connective tissue, usually of mesodermal origin, whose cells are capable of migration; some epithelia of ectodermal origin, such as the neural crest, undergo an epithelial to mesenchymal transition.

A **mesenchyme-to-epithelium transition** occurs when loose mesenchyme cells aggregate and then form an epithelium like a tube, as in kidney development.

Mesendoderm is composed of cells that may give rise to both endoderm and mesoderm.

The **mesoderm** is the germ layer that gives rise to the skeleto-muscular system, connective tissues, the blood, and internal organs such as the kidney and heart.

The **mesonephros** in mammals is an embryonic kidney that contributes to the male and female reproductive organs.

Messenger RNA (mRNA) is the RNA molecule that specifies the sequence of amino acids in a protein. It is produced by transcription from DNA.

Metamorphosis is the process by which a larva is transformed into an adult. It often involves a radical change in form, and the development of new organs, such as wings in butterflies and limbs in frogs.

Metastasis is the movement of cancer cells from their site of origin to invade underlying tissues and to spread to other parts of the body. Such cells are said to **metastasize**.

Microfilaments see **actin filaments**.

Micromeres are small cells that result from unequal cleavage during early animal development.

MicroRNAs (miRNAs) are small RNAs that suppress the expression of specific genes.

Microtubules are one of the three principal protein filaments of the cytoskeleton. They are involved in the transport of proteins and RNAs within cells.

The **mid-blastula transition** in amphibian embryos is when the embryo's own genes begin to be transcribed, cleavages become asynchronous, and the cells of the blastula become motile.

miRNAs see **microRNAs**.

Mitosis is the nuclear division that occurs during the proliferation of somatic diploid cells and results in both daughter cells having the same diploid complement of chromosomes as the parent cell.

The small number of species that are commonly studied in developmental biology are known as **model organisms**.

Molting is the shedding of an external cuticle when arthropods grow, and its replacement with a new one.

Morphallaxis is a type of regeneration that involves repatterning of existing tissues without growth.

A **morphogen** is any substance active in pattern formation whose spatial concentration varies and to which cells respond differently at different threshold concentrations.

Morphogenesis refers to the processes involved in bringing about changes in form in the developing embryo.

The **morphogenetic furrow** in *Drosophila* eye development moves across the eye disc and initiates the development of the ommatidia.

A **morula** is the very early stage in a mammalian embryo when cleavage has resulted in a solid ball of cells.

Mosaic development was a term used historically to describe the development of organisms that appeared to develop mainly by distribution of localized cytoplasmic determinants.

The **Müllerian duct** runs adjacent to the Wolffian duct in the mammalian embryo and becomes the oviduct in females.

Müllerian-inhibiting substance is secreted by the developing testis and induces regression of the Müllerian ducts in males.

A **multipotent cell** is one that can give rise to many different types of differentiated cell.

A **myoblast** is a committed but undifferentiated muscle cell. In developing skeletal muscle, it will first develop into a multinucleate **myotube** and then into a fully differentiated **muscle fiber**.

The **myocardium** is the outer contractile layer of the developing heart.

Myoplasm is special cytoplasm in ascidian eggs involved in the specification of muscle cells.

The **myotome** is that part of the somite that gives rise to muscle.

Necrosis is a type of cell death due to pathological damage in which cells break up, releasing their contents.

Negative feedback is a type of regulation in which the end-product of a pathway or process inhibits an earlier stage.

Neoteny is the phenomenon in which an animal acquires sexual maturity while still in larval form.

The **neural crest cells** in vertebrates are derived from the edge of the neural plate. They migrate to different regions of the body and give rise to a wide variety of tissues, including the autonomic nervous system, the sensory nervous system, pigment cells, and some cartilage of the head.

Neural folds, neural plate, neural tube, see **neurulation**.

The **neurectoderm** is embryonic ectoderm with the potential to form neural cells and epidermis.

A **neuroblast** is an embryonic cell that will give rise to neural tissue (neurons and glia).

The **neuromuscular junction** is the specialized area of contact between a motor neuron and a muscle fiber, where the neuron can stimulate muscle activity.

Neurons or nerve cells are the electrically excitable cells of the nervous system, which convey information in the form of electrical signals.

Neurotrophins are proteins that are necessary for neuronal survival, such as nerve growth factor.

A **neurula** is the stage of vertebrate development at the end of gastrulation when the neural tube is forming.

Neurulation in vertebrates is the process in which the ectoderm of the future brain and spinal cord—the **neural plate**—develops folds (**neural folds**) and forms the **neural tube**.

The **Nieuwkoop center** is a signaling center on the dorsal side of the early *Xenopus* embryo. It forms in the vegetal region as a result of cortical rotation.

Nodal and Nodal-related proteins comprise a subfamily of the TGF- β family of signaling proteins of vertebrates. They are involved in all stages of development, but particularly in early mesoderm induction and patterning.

A **node** in a plant is that part of the stem at which leaves and lateral buds form. In avian and mammalian embryos the term usually refers to Hensen's node or its equivalent.

The effects of a gene are **non cell autonomous** or non-autonomous if they affect cells other than the cell in which the gene is expressed.

The **notochord** in vertebrate embryos is a rod-like cellular structure that runs from head to tail and lies centrally beneath the future central nervous system. It is derived from mesoderm.

Nurse cells surround the developing oocyte in *Drosophila* and synthesize proteins and RNAs that are to be deposited in it.

The eight-cell stage of a plant embryo is called the **octant stage**.

Alternate ocular dominance columns in the visual cortex respond to the same visual stimulus from either the left or right eye.

Insect compound eyes are composed of hundreds of individual photoreceptor organs, the **ommatidia** (singular **ommatidium**).

Many of the genes involved in cell regulation can be mutated into **oncogenes**, which cause cells to become cancerous.

Ontogeny refers to the development of an individual organism.

An **oocyte** is an immature egg.

Oogenesis is the process of egg formation in the female.

The **optic tectum** is the region of the brain in amphibians and birds where the axons from the retina terminate.

The **oral-aboral axis** in sea urchins and other radially symmetrical organisms runs from the centrally situated mouth to the opposite side of the body.

An **organizer**, organizing region or organizing center is a signaling center that directs the development of the whole embryo or of part of the embryo, such as a limb. In amphibians, the organizer usually refers to the Spemann organizer.

Organogenesis is the development of specific organs such as limbs, eyes, and heart.

Osteoblasts are the precursors from which differentiated bone cells are formed.

The **oviduct** in female birds and mammals transports the eggs from the ovaries to the uterus.

An **ovule** is the structure in plants that contains an egg cell.

The **pair-rule genes** in *Drosophila* are involved in delimiting parasegments. They are expressed in transverse stripes in the blastoderm, each pair-rule gene being expressed in alternate parasegments.

Genes within a species that have arisen by duplication and divergence are called **paralogs**. Examples are the Hox genes in vertebrates, which comprise several **paralogous subgroups** made up of **paralogous genes**.

Parasegments in the developing *Drosophila* embryo are independent developmental units that give rise to the segments of the larva and adult.

The mesoderm lying on either side of the midline and forming the somites is sometimes called the **paraxial mesoderm**.

Pattern formation is the process by which cells in a developing embryo acquire identities that lead to a well ordered spatial pattern of cell activities.

Pax genes encode transcriptional regulatory proteins that contain both a homeodomain and another protein motif, the paired motif.

P elements are transposable DNA elements found in *Drosophila*. They are short sequences of DNA that can become inserted in different positions within a chromosome and can also move to other chromosomes. This property is exploited in the technique of P-element-mediated transformation for making transgenic flies.

Periclinal cell divisions are divisions in a plane parallel to the surface of the tissue.

In **periclinal chimeras** in plants, one of the three meristem layers has a genetic marker which distinguishes it from the other two.

Permissive inductions occur when a cell makes only one kind of response to an inducing signal, and makes it when a given level of signal is reached.

P granules are granules that become localized to the posterior end of the fertilized egg of *C. elegans*.

The **phenotype** is the observable or measurable characters and features of a cell or an organism.

The response of an organism to relative day length is known as **photoperiodism**, and in plants is responsible for promoting flowering as days become longer.

Phyllotaxy is the way the leaves are arranged along a shoot.

Phylogeny is the evolutionary history of a species or group.

Vertebrate embryos pass through a developmental stage known as the **phylotypic stage** at which the embryos of the different vertebrate groups closely resemble each other. This is the stage at which the embryo possesses a distinct head, a neural tube, and somites.

Planar cell polarity is the situation in which cells are polarized in the plane of the tissue, as in the epidermis of insect wings, in which wing hairs all point in the same direction.

Plasmodesmata (singular **plasmodesma**) are the threads of cytoplasm that run through the cell wall and interconnect adjacent plant cells.

A **pluripotent** stem cell is one that can give rise to many different types of differentiated cell.

The **pluteus** is the larval stage of the sea urchin.

Polar bodies are formed during meiosis in the developing egg. They are small cells containing a haploid nucleus and take no part in embryonic development.

When one end of a cell, structure, or organism is different from the other end it is said to have **polarity** or to be **polarized**.

In the developing chick and mouse limb buds, the **polarizing region** at the posterior margin of the bud produces a signal specifying position along the antero-posterior axis.

Pole cells give rise to the germ cells in *Drosophila* and are formed at the posterior end of the blastoderm.

Pole plasm is the cytoplasm at the posterior end of the *Drosophila* egg that is involved in specifying germ cells.

Polydactyly is the occurrence of extra digits on hands or feet.

Polyspermy is the entry of more than one sperm into the egg.

Positional information in the form, for example, of a gradient of an extracellular signaling molecule, can provide the basis for pattern formation. Cells acquire a **positional value** that is related to their position with respect to the boundaries of the given field of positional information. The cells then interpret this positional value according to their genetic constitution and developmental history, and develop accordingly.

Positive feedback is a type of regulation in which the end-product of a pathway or process can activate an earlier stage.

Posterior dominance or **posterior prevalence** is the process whereby the more posteriorly expressed Hox genes can inhibit the action of more anteriorly expressed Hox genes when they are expressed in the same region.

The **posterior marginal zone** of the chick embryo is a dense region of cells at the edge of the blastoderm that will give rise to the primitive streak.

Most neurons do not divide further once they are formed, when they are known as **post-mitotic neurons**.

The **post-synaptic** side of a synapse is the part that receives the signal.

Post-translational modification of a protein involves changes in the protein after it has been synthesized. The protein can, for example, be enzymatically cleaved, glycosylated, or acetylated.

A basic pattern generated automatically in a structure is known as a **prepattern**. It may subsequently be modified during development.

The **pre-somitic mesoderm** is the unsegmented mesoderm between the node (in chick and mouse) and the already formed somites. It will form somites from its anterior end.

The **pre-synaptic** side of a synapse is the part that generates the signal.

Primary embryonic induction is the induction of the whole body axis, as demonstrated by transplantation of the Spemann organizer in amphibians.

The **primitive ectoderm** or epiblast is the part of the inner cell mass in the mammalian blastocyst that gives rise to the embryo proper.

The **primitive endoderm** in mammalian embryos is that part of the inner cell mass that contributes to extra-embryonic membranes.

The **primitive streak** of the chick embryo is a strip of cells that extends inward from the posterior marginal zone and is the forerunner of the antero-posterior axis. During gastrulation, cells move through the streak into the interior of the blastoderm. The primitive streak in the mouse embryo has a similar function to that in the chick.

Minute undifferentiated outgrowths that will give rise to a structure such as a tooth, leaf, flower or floral organ are known as **primordia** (singular **primordium**).

The two-celled stage in plants is called the **proembryo**.

Programmed cell death see **apoptosis**.

In chick and mouse limb buds the cells in the **progress zone** at the tip of the bud proliferate and acquire positional values.

The **promeristem** is the central region of the meristem that contains cells capable of continued division—the initials.

The **promoter** is a region of DNA close to the coding sequence to which RNA polymerase binds to begin transcription of a gene.

Proneural clusters are small clusters of cells within the neurectoderm in which one cell will eventually become a neuroblast.

Genes that promote a neural fate in neurectoderm cells are called **proneural genes**.

A **pronucleus** is the haploid nucleus of sperm or egg after fertilization but before nuclear fusion and the first mitotic division.

A **proto-oncogene** is a gene that is involved in regulation of cell proliferation and that can cause cancer when mutated into an oncogene or expressed under abnormal control.

Protostomes are those animals, such as insects, in which cleavage of the zygote is not radial and in which gastrulation primarily forms the mouth.

The **proximo-distal axis** of a limb or other appendage runs from the point of attachment to the body (proximal) to the tip of the limb (distal).

The **pupa** in *Drosophila* and similar insects is a stage following the larval stages in which the organism can remain dormant for long periods and in which metamorphosis occurs.

The **quiescent center** in a plant root tip meristem is a central group of cells that divide rarely but are essential for meristem function.

The **radial axis** of a structure is the axis running from the center to the circumference. Cylindrical structures such as plant stems and roots that are completely symmetrical around a central axis are said to have **radial symmetry**.

Radial intercalation occurs in a multilayered ectoderm of an amphibian gastrula when cells intercalate in a direction perpendicular to the surface, so thinning and extending the cell sheet.

Reaction-diffusion mechanisms produce self-organizing patterns of chemical concentrations which could underlie periodic patterns.

A **recessive mutation** is a mutation in a gene that only changes the phenotype when both copies of the gene carry the mutation.

Redundancy refers to an apparent absence of an effect when a gene that is normally active during development is inactivated. It is assumed that other pathways exist which can substitute for the missing gene action.

Regeneration is the ability of a fully developed organism to replace lost parts.

Regulation is the ability of the embryo to develop normally even when parts are removed or rearranged. Embryos that can regulate are called **regulative**.

The **rhombomeres** are a sequence of compartments of cell-lineage restriction in the hindbrain of chick and mice embryos.

RNA interference (RNAi) is a means of suppressing gene expression by promoting the destruction of a specific mRNA by targeting them with short complementary RNAs called **short interfering RNAs (siRNAs)**.

RNA processing is the process in eukaryotic cells in which newly transcribed RNAs are modified in various ways to make a functional messenger RNA or structural RNA. It includes **RNA splicing**, which removes introns from the transcript to leave a continuous coding messenger RNA or a functional structural RNA.

The **roof plate** of the developing neural tube is composed of non-neural cells and is involved in patterning the dorsal part of the tube.

Skeletal muscle can be renewed from undifferentiated stem cells called **satellite cells**.

The **sclerotome** is that part of a somite that will give rise to the cartilage of the vertebrae.

Segmentation is the division of the body of an organism into a series of morphologically similar units or **segments**.

Segmentation genes in *Drosophila* are involved in patterning the parasegments and segments.

Selector genes in *Drosophila* determine the activity of a group of cells, and their continued expression is required to maintain that activity.

A **semi-dominant** mutation is a mutation that affects the phenotype when just one allele carries the mutation but where the effect on the phenotype is much greater when both alleles carry the mutation.

Senescence is the impairment of function associated with aging.

A **sensory organ precursor** is an ectodermal cell that will give rise to a sensory bristle in the adult *Drosophila* epidermis.

Sex determination is the genetic and developmental process by which an organism's sex is specified. In many organisms, sexual phenotype is determined by specific chromosomes called **sex chromosomes**.

The **sex-determining region of the Y chromosome (SRY)** determines maleness by specifying the gonad as a testis.

The **shield stage** in zebrafish embryos is the stage in which the organizer, known as the shield, has been formed.

Short-germ development characterizes those insects in which most of the segments are formed sequentially by growth. The blastoderm itself only gives rise to the anterior segments of the embryo.

short interfering RNA (siRNA) *see* RNA interference.

A **signaling center** is a localized region of the embryo that exerts a special influence on surrounding cells and thus determines how they develop.

Signal transduction is the process by which a cell converts an extracellular signal, usually at the cell membrane, into a response, which is often a change in gene expression.

In the rare condition **situs inversus** in humans there is complete mirror-image reversal of the position of the internal organs.

Somatic cells are any cells other than germ cells. In most animals, the somatic cells are diploid.

Somites in vertebrate embryos are segmented blocks of mesoderm lying on either side of the notochord. They give rise to body and limb muscles, the vertebral column, and the dermis.

A **specification map** shows how the tissues of an embryo will develop when placed in a simple culture medium.

A group of cells is called **specified** if when isolated and cultured in a neutral medium they develop according to their normal fate.

The **Spemann organizer** or **Spemann–Mangold organizer** is a signaling center on the dorsal side of the amphibian embryo that acts as the main embryonic organizer. Signals from this center can organize new antero-posterior and dorso-ventral axes.

The **sphere stage** in zebrafish embryos comprises a blastoderm of around 1000 cells lying over a spherical yolk.

Spermatogenesis is the production of sperm.

A **stem cell** is a type of undifferentiated cell that is both self renewing and also gives rise to differentiated cell types. They are found in some adult tissues. They are maintained in microenvironments known as **stem-cell niches**. *See also* embryonic stem cells.

The **subgerminal space** is the cavity that develops under the **area pellucida** in the early chick blastoderm.

The **superior colliculus** in mammals is a region of the brain to which some retinal neurons project. It corresponds to the optic tectum of amphibians and birds.

The **suspensor** attaches the embryo to maternal tissue and is a source of nutrients.

A **synapse** is the specialized point of contact where a neuron communicates with another neuron or a muscle cell. Neurotransmitter is produced in **synaptic vesicles** in the presynaptic neuron and is released into the **synaptic cleft** separating the two cells.

A **syncytium** is a cell with many nuclei in a common cytoplasm. Cell walls do not develop during nuclear division within the very early *Drosophila* embryo. This gives rise to the **syncytial blastoderm** in which the nuclei are arranged around the periphery of the embryo.

The **tailbud** is the structure at the posterior end of vertebrate embryos that gives rise to the post-anal tail.

The **telson** is a distinctive structure at the posterior end of the *Drosophila* embryo.

Teratocarcinomas are solid tumors that arise from germ cells and which can contain a mixture of differentiated cell types.

A **tetraploid cell** is one that contains four sets of chromosomes.

Therapeutic cloning is the potential use of somatic cell transfer to alleviate disease, without affecting the germline.

In insects the body is divided into three distinct parts, the head at the anterior end, followed by the **thorax** and the posterior abdomen. The thoracic segments of *Drosophila* are the segments that carry the legs and wings in the adult. In vertebrates, the thorax is the chest region.

A **threshold concentration** is that concentration of a chemical signal or morphogen that can elicit a particular response from a cell. A specific response to a chemical signal that only occurs above or below a particular threshold concentration of the signal is known as a **threshold effect**.

Totipotency is the capacity of a cell to develop into any of the cell types found in that particular organism. Such a cell is called **totipotent**.

The **tracheal system** of insects is a system of fine tubules that deliver air (and thus oxygen) to the tissues.

When a gene is active its DNA sequence is copied, or **transcribed**, into a complementary RNA sequence, a process known as **transcription**.

A **transcription factor** is a regulatory protein required to initiate or regulate the transcription of a gene into RNA. Transcription factors act within the nucleus of a cell by binding to specific regulatory regions in the DNA.

Transdifferentiation is the process by which a differentiated cell can differentiate into a different cell type, such as pigment cell to lens.

Transfection is the technique by which mammalian and other animal cells are induced to take up foreign DNA molecules. The introduced DNA sometimes becomes inserted permanently into the host cell's DNA.

The process by which messenger RNA directs the order of amino acids in a protein during protein synthesis at ribosomes is known as **translation**. The messenger RNA is said to be **translated** into protein.

A **transposon** is a DNA sequence that can become inserted into a different site on the chromosome, either by the insertion of a copy of the original sequence or by excision and reinsertion of the original sequence.

A **trichome** is a hair-bearing cell in plant epidermis.

A **triploblast** is an animal with three germ layers—endoderm, mesoderm, and ectoderm.

The **trophectoderm** is the outer layer of cells of the early mammalian embryo. It gives rise to extra-embryonic structures such as the placenta.

Tumor suppressor genes are genes that can cause a cell to become cancerous when both copies of the gene have been inactivated.

Vasculogenesis is the formation of blood vessels.

The **vegetal region** of an amphibian egg is the most yolky region, and is the region from which the endoderm will develop. The most terminal part of this region is called the **vegetal pole**, and is directly opposite the animal pole.

Embryos that are **ventralized** are deficient in dorsal regions and have much increased ventral regions.

The **ventricular zone** is a layer of proliferating cells lining the lumen of the vertebrate neural tube, from which neurons and glia are formed.

The phenomenon by which flowering is accelerated after the plant has been exposed to a long period of cold temperature is known as **vernalization**.

The **vertebral column** is the backbone or spine of vertebrates, composed of a succession of vertebrae.

The **visceral endoderm** is derived from the primitive endoderm that develops on the surface of the egg cylinder in the mammalian blastocyst.

The **vitelline membrane** is an extracellular layer surrounding the eggs of the sea urchin and other animals. In the sea urchin it gives rise to the fertilization membrane.

The **Wnt family** of secreted signaling proteins are important in many aspects of development. It includes the Wingless protein in *Drosophila*. See also **canonical Wnt pathway** and **planar cell polarity**.

Wolffian ducts are ducts associated with the mesonephros in mammalian embryos. They become the vas deferens in males.

The **yolk sac** is an extra-embryonic membrane in birds and mammals. In the chick embryo it surrounds the yolk.

The **yolk syncytial layer** in zebrafish forms a continuous layer of multinucleate non-yolky cytoplasm underlying the blastoderm.

The **zona pellucida** is a layer of glycoprotein surrounding the mammalian egg that serves to prevent polyspermy.

The **zone of polarizing activity** is another name for the polarizing region at the posterior margin of the limb bud.

The **zootype** refers to a pattern of expression of Hox genes and certain other genes along the antero-posterior axis of the embryo that is characteristic of all animal embryos.

The **zygote** is the fertilized egg. It is diploid and contains the chromosomes of both the male and female parents.

Zygotic genes are those present in the fertilized egg and which are expressed in the embryo itself.