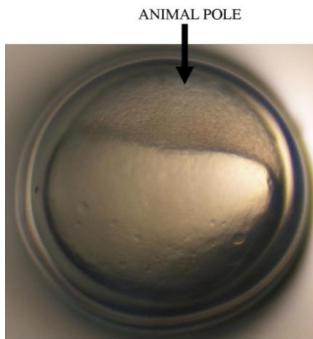


## Glossary

**Allele-** An allele is an alternative form of a gene (one member of a pair) that is located at a specific position on a specific chromosome.

**Aneuploidy-** The state of having chromosomes in a quantity not a multiple of the haploid number. Conditions caused by having one or more extra duplicates of a particular chromosome, or the lack of a duplicate include Down syndrome, which is a trisomy of the twenty first chromosome.

**Animal Pole-** Region of the zebrafish embryo, opposite the yolk, where cells divide and undergo cleavage during zygote, cleavage, and blastula stages.



**Antagonist-** A type of inhibitor. For example, an artificial ligand that competes with the normal ligand for binding to a receptor is an antagonist.

**Asynchronous-** Things occurring at different periods of time rather than occurring simultaneously.

**Autosome-** An autosome is a chromosome that is not a sex chromosome. Zebrafish only have autosomes, no sex chromosomes have been identified.

## **B**

**Base Analog-** A molecule with similar structure to a pyrimidine or a purine, which has the ability to replace a nucleotide within a DNA molecule.

Example: 5-Bromouracil (Often Abbreviated 5BU).

**Blastodisc-** The embryo-forming portion of an egg with discoidal cleavage. In zebrafish, the blastodisc is a small disc of yolk-free cytoplasm that is located at the animal pole.

**Blastomere /blas-to-mere (bläs'-to-mîr')**- Cell produced from the cleaving of a single-celled zygote by mitotic cell division during early embryonic development. In zebrafish, blastomeres are produced by division of the blastodisc after fertilization.

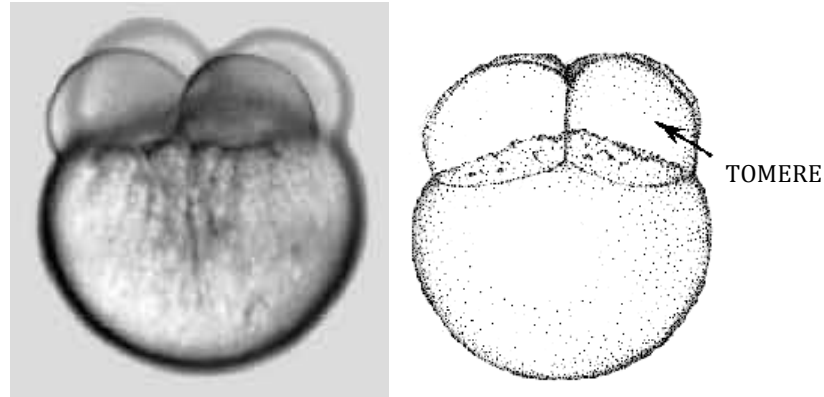


Image from Gilbert, 2006

**BMP-inhibitors**- prevent the binding of BMP's to certain embryonic cells. In the zebrafish, this allows the formation of neural tissue from ectoderm versus epidermal tissue and is important for formation of the dorsal-ventral axis.

**Bone Morphogenetic Protein (BMP)**- directs the ectoderm to become epidermal tissue rather than neural tissue and induces tissues to have a ventral fate.

**Brightfield Microscopy**- A type of microscopy which creates contrast between the object and the surrounding field by having a light positioned under the stage of the microscope, creating a bright background relative to the object.

**Brine Shrimp**- Food for older baby or adult zebra fish, also called “sea monkeys” in the backs of comic books.

## C

**Cell cycle**- stages through which a cell passes through during cell division. The stages of the cell cycle are  $G_1$ , S,  $G_2$ , and mitosis.

**Chi-squared analysis**– a statistical test used to evaluate how well a set of observed values fit the expected values. The resulting probability is the probability that the hypothesis that the observed values match the expected values is correct.

**Chordin**- A BMP inhibitor found in the organizer responsible for inducing the ectoderm to form neural tissue and involved in the formation of the dorsal ventral axis of the embryo.

**Chorion** - The translucent outer membrane that encloses the zebrafish embryo and egg.

**Chromosome** - A single (before replication) or double (after replication) strand of DNA with only a single centromere. Chromosomes contain the loci for alleles of different genes.

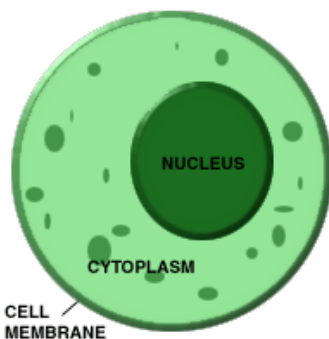
**Cleavage Period** – The period of development where the cells in an embryo undergo repeated division. The period ends when the embryo is in the form of a blastula.

**Codominance**- A mixed phenotypic expression where two alleles are both dominantly expressed throughout different regions of the organism or specific area of expression, creating a mosaic like result. For example, some cats possess multiple genes coding for fur color, which results in patches of different color throughout the fur.

**Convergent Extension**- Process by which tissues changes shape. For example, during the gastrula stage, cells extend along the anterior-posterior axis and migrate toward the dorsal side of the embryo.

**Crossing Over**- The exchange of DNA of non sister chromatids between a homologous pair that happens during prophase of meiosis I.

**Cytoplasm/ cy-to-plasm (sī-to-plaz'm)**- the substance surrounding the nucleus in a cell that contains the organelles of that cell.



[http://www.daylilies.org/ahs\\_dictionary/cytoplasm.gif](http://www.daylilies.org/ahs_dictionary/cytoplasm.gif)

## D

**Dechorionate**- Remove the outer membrane (chorion) enclosing the embryo.

**Differentiation-** Process in which cells become functionally and structurally different from one another and become distinct cell types.

**Diploid** - A condition in which each chromosome exists in pairs; having two of each chromosome.

**Discoidal cleavage-** Cleavage that does not divide the entire egg, but only the blastodisc of the embryo.

**Dominant allele**— An allele that is the only allele expressed phenotypically in both homozygous and heterozygous genotypes. If “M” is used to denote the dominant allele, and “m” is used to denote a recessive allele, then both the MM and Mm genotypes will have the phenotype of the “M” allele.

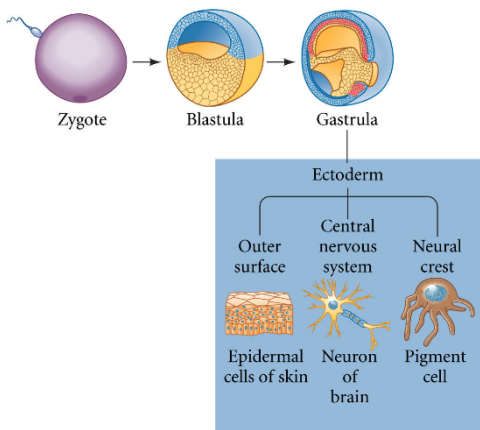
**Dorsal-** The “back side” of an animal. Ex. The top of a shark (where the dorsal fin is located) or in humans the back.

## E

**Early Pressure Screen-** Type of genetic screen that uses gynogenetic diploids that are produced through inhibition of the second meiotic division.

**Embryo Loop-** Tool used for maneuvering zebra fish embryos made from capillary tubes & fishing line.

**Ectoderm-** One of the three primary germ layers in a developing zebrafish embryo; forms the epidermis, nervous tissue, and sense organs develop. Also called ectoblast.



**Embryonic shield-** A thickening at the leading edge of the dorsal blastoderm during the formation of the germ ring. Equivalent to the organizer in frogs or the node in mammals. The embryonic shield cells eventually become the prechordal plate and chordamesoderm. Like the organizer and node, the embryonic shield is essential for gastrulation and axis formation.

**Endoderm-** One of the three primary germ layers in a developing embryo; forms gastrointestinal tract, gills, and other associated structures.

**ENU-** Also known by its IUPAC (International Union of Pure and Applied Chemistry) name “N-methyl-N-nitrosourea (chemical formula, C<sub>3</sub>H<sub>6</sub>N<sub>3</sub>O<sub>2</sub>) is a highly potent Mutagen. The chemical is an alkylating agent, and acts by transferring the ethyl group of ENU to nucleobases (usually thymine) in nucleic acids. ENU is used in zebrafish genetic screens to cause mutations in the spermatogonial stem cells, from which mature sperm is derived.

**Epiboly-** Process in which cells extend to cover the whole embryo, including the yolk. All germ layers in a zebrafish undergo epiboly.

**Eukaryote-** Organism whose cells have a nucleus, for examples eubacteria and archaea (multicellular organisms) such as humans and plants.

## **F**

**F1 Generation-** Offspring of the initial parents in a genetic cross. (“F” stands for filial).

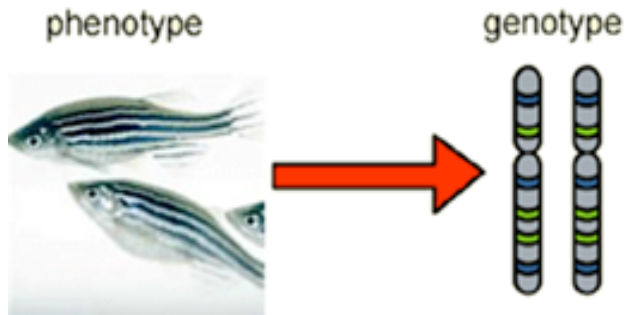
**F2 Generation-** Offspring of the F1 generation in a genetic cross. (“F” stands for filial).

**F3 Genetic Screen-** A type of genetic screen commonly used in zebrafish where the male from the parent generation undergoes a mutagenic treatment of their sperm which produces heterozygous mutants in both the F1 and F2 generations. Intercrossing of the heterozygous fish from the F2 generation produces an F3 generation that should be approximately  $\frac{1}{4}$  homozygous mutants,  $\frac{1}{2}$  heterozygous mutants, and  $\frac{1}{4}$  homozygous wild type. (“F” stands for filial).

**Fertilization** – The fusion of two gametes resulting in a zygote.

**Flake Food-** Non-living food for baby or adult zebrafish.

**Forward Genetics-**A classical research approach which begins with the study of a phenotype and then progresses to identify the corresponding mutated gene.



<http://groups.exeter.ac.uk/eabrg/images/zebrafish3sm.jpg>

<http://www.bbc.co.uk/schools/gcsebitesize/science/images/bigenopheno.gif>

## G

**Gamma Radiation-** A type of radiation caused by rays with a frequency of  $10^{20}$  Hz or higher. Gamma radiation is a type of high energy radiation known for causing mutations. In zebrafish, gamma radiation typically induces large deletions or inversions.

**Gastrulation-** Phase in development of embryos in which morphology is restructured by cell migration and the three main germ layers of the embryo (endoderm, mesoderm, and ectoderm) develop. A gastrula is formed from a blastula by inward migration of cells.

**Genome-** Complete set of genetic instructions for an organism.

**Genotype-** The genetic makeup, as distinguished from the physical appearance, of an organism or a group of organisms. The set of genes possessed by an individual organism.

## H

**Homeotic Genes-** Genes that control body development. More specifically these genes determine which parts of the body develop into which body parts. A common example of a mutation in homeotic genes is *antennapedia* in *Drosophila melanogaster* (fruit fly), where legs grow out of the head instead of the antennae.

**Homologous pair-** Two chromosomes that are alike in structure and size and that carry specific genetic information for the same set of hereditary characteristics. Humans carry 23 homologous pairs.

**Hypoblast-** The inner layer of the zebrafish embryo that contains both endodermal and mesodermal precursors.

## I

**Incomplete (Partial) Dominance-** A mixed phenotypic expression when two alleles are “incompletely dominant” that causes an expression of some sort of intermediate phenotype. For example, a cross between a pure red snapdragon (R/R) and a pure white snapdragon (r/r) produces a pink snapdragon (R/r).

**Involution-** Type of cell movement where a sheet of cells rolls under itself, which results in entering the interior of the embryo.

## L

**Larva-** The developmental stage in some animals that occurs after hatching or birth typically preceding metamorphosis and the adult form. In zebrafish, the larval stage begins at about 3 days post-fertilization, when the fish emerges from the chorion.

## M

**Meiosis-** Process in which chromosomes of the Eukaryotic cell divide to give rise to haploid reproductive cells. The stages of meiosis are prophase I, metaphase I, anaphase I, cytokinesis, prophase II, metaphase II, anaphase II, and telophase.

**Mesoderm-** One of three primary germ layers. The mesoderm is located between the ectoderm and the endoderm and gives rise to the blood, heart, kidneys, gonads, bones, muscles and connective tissues.

**Mesenchyme-** A type of loose connective tissue.

**Microinjection-** A method for physically introducing molecules into an organism in order to alter gene expression or to label cells.

**Midblastual transition-** The stage in embryonic development where zygotic gene transcription begins, cell divisions become asynchronous (in zebrafish), and cell movements start. In zebrafish, the MBT occurs around the tenth cell division.

**Mitosis-** Process by which the nucleus of a eukaryotic cell divides. The stages of mitosis are prophase, metaphase, anaphase, and telophase.

**Morpholino antisense oligomer-** An artificial molecule that binds to RNA to prevent splicing or protein translation.

**Mutagenesis-** Process by which the genetic information of an organism is changed in a stable manner, either in nature or experimentally by use of chemicals or radiation. Creation of a mutation.

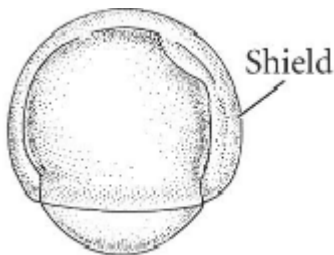
**Mutation-** A change in the DNA or RNA of an organism.

## N

**Nondisjunction-** An error happening in mitosis or meiosis where the chromosomes fail to separate during metaphase causing one cell to receive two chromosomes and the other to receive no copies.

## O

**Organizer-** In zebrafish, also referred to as the shield. The organizer expresses Nodal and BMP inhibitors (Noggin, Chordin, Follistatin). The organizer establishing the dorsal-ventral axis of the embryo and is necessary and sufficient for the process of gastrulation.



Gilbert, S. F. (2006). Developmental Biology. Sinauer Associates Inc.

## P

**Parafomaldehyde (PFA)-** A fixative used for studying zebra fish embryos, typically used to prepare the fish for molecular techniques such as antibody staining or whole mount RNA in situ hybridization.



**Paramecium-** One-celled organisms fed to baby zebra fish.

**Pericardial Edema**– The accumulation of fluid within the pericardial sac that encases the heart. Pericardial edema results in impaired diastolic filling of the heart and is usually fatal if the volume of liquid is large and remains unabsorbed.

**P Generation-** The P generation is the parental generation that produces offspring that will be analyzed in a genetic screen. The P generation is followed by the F1, F2, F3 etc generations.

**Phenotype /phe-no-type (fé nō-tīp’)**- The observable, expressed genetic traits or characteristics of an organism. The phenotype of an organism is the result of the interaction between its inherited genetic code (genotype) and non-heritable environmental factors. Examples: blood type, hair and eye color, and stature (height, weight, body structure, etc.), wing shape, body size, number of appendages, etc..



<http://groups.exeter.ac.uk/eabrg/images/zebrafish3sm.jpg>

<http://www.bbc.co.uk/schools/gcsebitesize/science/images/bigenopheno.gif>

**Point Mutation-** A mutation affecting only one or very few nucleotides in a gene sequence.

**Prokaryote-** Unicellular organism with simple cell structure that lacks a nucleus, such as bacterial cells.

**Protein-** A molecule composed of one or more amino acid polypeptide chains, the order and composition of which is dictated by the DNA sequence that coded for it.

## **R**

**Recessive allele**– An allele that is expressed phenotypically when it is homozygous but not when heterozygous.

**Reverse genetics-** Beginning with an unknown gene and using a molecular analysis to determine the function of that gene. This differs from forward genetics in which the phenotype is observed first and the genotype determined.

## **S**

**Shield-** See “Embryonic Shield”

**Somites-** Mesodermal structures formed during embryonic development that give rise to segmented body parts. Somites form adjacent to the notochord and are specified along the anterior-posterior axis by the Hox genes they express. Somites develop into dermis, vertebrae, and skeletal muscle.

## **T**

**Telolecital egg/ tel-o-c-i-thal (těl’a-lēs’-thal)-** Eggs with a large amount of yolk concentrated in one hemisphere. This hemisphere is referred to as the vegetal pole. Zebrafish have telolecital eggs.

**Totipotency** – The potential of a cell to divide and produce any of the differentiated cells found in an adult form of the organism.

**Transcription-** The process by which messenger RNA is synthesized from a DNA template strand; resulting in the transfer of genetic information from the DNA molecule to messenger RNA.

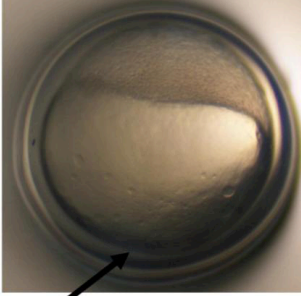
**Transgenic Organism-** An organism whose genome has been genetically modified using genetic engineering techniques.

## **W**

**Wild type–** The trait or allele that is most commonly found in natural populations.

## V

**Vegetal Pole-** Region of the zebrafish embryo or egg that contains the yolk, opposite the animal pole.

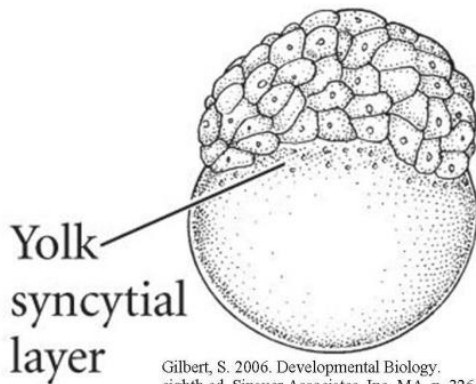


VEGETAL POLE

**Ventral-** The front of the animal. Ex. The chest is on the ventral side of a human and the belly is on the ventral side of a fish.

## Y

**Yolk Syncytial Layer (YSL) -** Region in zebrafish where a continuous layer of multinucleate, non-yolk containing cytoplasm forms at the interface between the animal and vegetal poles.



Gilbert, S. 2006. Developmental Biology. eighth ed. Sinauer Associates, Inc. MA. p. 326

**Yolk Cell-** A large cell at the vegetal pole of the embryo that contains yolk and does not divide.

## **Z**

**Zygote period-** The stage of an organism when it consists of just a single cell after fertilization.

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