Experiment

Wilhem Roux' embryos

Week 1: Intro

Experiment

Hans Drierich Sea Urchins

Week 1: Intro

Definition

Pattern formation

Week 1: Intro

Definition

Types of regulatory signalling and their range

Week 1: Intro

Definition

Maternal factors

Week 1: Intro

Definition

Mosaic vs regulatory development

Week 1: Intro

Definition

Cell fate, specification and determination

Week 1: Intro

Definition

Gastrulation

Week 1: Intro

Definition

Cleavage

Week 1: Intro

Definition

Blastula and blastocyst

Week 1: Intro

Hans Drierich showed that 4 Sea Urchin embryo cells could grow into separate organisms **IF** they were separated, contradicting Roux' experiment where he punctured one of two cells.	Wilhem Roux showed that if one of two embryonic frog cells were killed, the result would be a half-complete frog. However, he did not detach the dead cell, which would have resulted in a normal frog.
Gap junctions, only between adjacent cells Surface protein interactions, adjacent cells Diffusion of ligands, any two cells	One or multi-dimensional gradients of extracellular ligands, that cause cell differentiation depending on concentration.
Mosaic: two cells contain different growth factors (proteins, RNA) and thus take different paths **Regulatory**: two cells are identical, but receive different extracellular signalling and thus take different paths	Proteins and mRNA supplied by the mother to the zygote.
The process in which germ layers are formed. Organism starts to resemble itself.	**Fate**: normal developmental path for cell, either differentiation or apoptosis **Specification**: a specified cell has been given instructions, but can change path unless determined **Determination**: a determined cell cannot change its fate
Occurs after cleavage, and consists of a single, hollowed layer of cells. Called blastocysts in vertebrates.	When the zygote divides without increasing the size of cells, resulting in a blastula.

Germ layers *Ectoderm* Week 1: Intro	Germ layers *Mesoderm* Week 1: Intro
Germ layers *Endoderm* Week 1: Intro	Cell lineages *Number of somatic and germ cells* Week 2: *C. elegans*
Cell lineages *Number of C, D and E cells, PCD count* Week 2: *C. elegans*	Cell lineages *Number of AB and MS cells, PCD count* Week 2: *C. elegans*
Cell lineages *AB_a cells form..* Week 2: *C. elegans*	Cell lineages *AB_p cells form..* Week 2: *C. elegans*
Cell lineages ***MS** cells form..* Week 2: *C. elegans*	Cell lineages ***E** cells form..* Week 2: *C. elegans*

Middle layer - muscle, heart, blood. In vertebrates also skeleton and kidney	Outer layer - skin (or cuticle in insects) and nervous system
959 somatic cells, around 2000 germ cells; invariant	Inner layer - epithelial layer of gut. In vertebrates also liver and lungs
606 AB cells, an additional 116 undergo PCD. 252 MS cells, additional 14 undergo PCD.	47 C-cells, 20 D-cells, 34 E-cells. 1 C-cell undergoes PCD.
Neurons, skin, specialised cells.	Neurons, skin, anterior mesodermal pharynx.
Gut cells (only one cell type)	Muscle cells, nerve cells, posterior mesodermal pharynx

Cell lineages

C *cells form..*

Week 2: *C. elegans*

Cell lineages

D *cells form..*

Week 2: *C. elegans*

Cell lineages

P *cells form.. due to the presence of ..*

Week 2: *C. elegans*

Definition

Use P_1 and AB as examples of autonomous and conditional modes of specification

Week 2: *C. elegans*

Early cell fates

SKN-1 does .. is inhibited by..

Week 2: *C. elegans*

Maternal genes

Role of PIE-1

Week 2: *C. elegans*

Maternal genes

Role of MEX-1

Week 2: *C. elegans*

Induction events

The role of APX-1 and GLP-1

Week 2: *C. elegans*

Induction events

Equivalents of APX-1 and GLP-1 in Drosophila

Week 2: *C. elegans*

Induction events

Descendants of ABa are specified as pharyngeal precursor cells through...

Week 2: *C. elegans*

Muscle cells (only one cell type)	Skin cells, nerve cells and muscle cells
The AB cell requires the P_1 to develop, and is therefore undergoes conditional specification. P_1 cell can develop on its own, autonomous.	Germ line cells, presence of P-granules
Pharynx and **I**ntestinal **E**xcess. Inhibits the activity of SKN-1 in the P2-cell, preventing it from adopting EMS fate.	SKN-1 specifies the EMS cell. If not present, the EMS cell becomes a P2-like cell. Inhibited by PIE-1.
Required to give ABp its cell identity. GLP-1 is activated in ABp because the cell is in contact with P2; if ABp and ABa are swapped, ABa will be induced instead.	**M**uscle **Ex**cess. Prevents SKN-1 from entering ABa and ABp, which prevents them adopting the EMS fate. If mutated, they develop into muscle cells.
Activation of the transcription factor PHA-4. The receptor is GLP-1, but the ligand is *not* APX-1	Delta (ligand) and Notch (receptor)

Induction events

Activation of PHA-4 is caused by...

Week 2: *C. elegans*

Induction events

The specification of gut (E) cells is induced through...

Week 2: *C. elegans*

Induction events

Consequences of high vs low amounts of pop-1

Week 2: *C. elegans*

Genes

The molecules involved in inhibiting POP-1 are...

Week 2: *C. elegans*

Vulva formation

Vulva cell names,, ancestor cell, total cells in developed vulva

Week 2: *C. elegans*

Vulva formation

Determinant for primary cell fate, fate if mutated

Week 2: *C. elegans*

Vulva formation

Determinant for secondary cell fate, fate if mutated

Week 2: *C. elegans*

Vulva formation

Determinant for tertiary cell fate

Week 2: *C. elegans*

Partition genes

*Par-**1** mutant distribution of SKN-1, MEX-3 and GLP-1 at four cell stage...*

Week 2: *C. elegans*

Partition genes

*Par-**2** mutant distribution of SKN-1, MEX-3 and GLP-1 at four cell stage...*

Week 2: *C. elegans*

Cell-cell interactions between EMS and P2. The molecule mom-2 is released from P2 and activates the mom-5 receptor in EMS, which downregulates pop-1 so that the E cell is formed.	GLP-1 is the receptor, but the ligand in this case is **not** APX-1
mom-2, mom-5, mom-4, wrm-1, lit-1	Active: MS cells, as pop-1 specifies MS fate Inactive: E cells
LIN-3 from the anchor cell, which binds to LET-23 receptor. Results in repressing the LIN-12 receptor, which determines secondary cell fate. If mutated, all cells become tertiary, vulvaless.	Anchor cell, P3-P8 (not the same as germ line), descends from the ABp cell. Mature vulva contains 22 cells.
LIN-15 from the epidermis inhibits the formation of primary cell fates if the signal is weak. Thus P3, P4 and P8 adopts tertiary cell fate. If mutated, all cells become secondary or primary, multivulva.	LIN-12 activated by ligands from the primary cell. Signal represses primary fate. If mutated, the two secondary cells become primary, multivulva?
GLP-1 is found in all four cells.	All three determinants are found in all four cells.

Partition genes

*Par-**3** mutant distribution of SKN-1, MEX-3 and GLP-1 at four cell stage...*

Week 2: *C. elegans*

Apoptosis

How many cells undergo programmed cell death? How many of them are in the nervous sytem?

Week 3: *C. elegans*

Background strains used by Horvitz et al

nuc-1 mutants

Week 3: *C. elegans*

Background strains used by Horvitz et al

ced-1/ced-2 mutants

Week 3: *C. elegans*

Background strains used by Horvitz et al

eg11 (gof) mutants

Week 3: *C. elegans*

Background strains used by Horvitz et al

Wild type

Week 3: *C. elegans*

C. elegans PCD pathway

ced-9

Week 3: *C. elegans*

C. elegans PCD pathway

egl-1

Week 3: *C. elegans*

C. elegans PCD pathway

ced-4

Week 3: *C. elegans*

C. elegans PCD pathway

ced-3

Week 3: *C. elegans*

131/105	SKN-1 and GLP-1 are found in all four cells.
No phagocytosis; apoptotic cells do not disappear. Discovered the killer gene *ced3* (less cell death in mutants)	*Nuc*lease abnormal; no DNA destruction during apoptosis. Unsuccesful
Genes discovered: • *ced-9* (gof) - NSM sister cell which usually dies survives. *ced-9* functions unlike *ced-3* and *ced-4* in that it protects against cell death • *nuc-1* • *ced-1* • *egl1* (gof)	Cannot lay eggs becuase nerve cell (HSN neuron) connected to vulva dies. Discovered a new killer gene, *ced4* (can lay eggs because cell death suppressed, meaning HSN neuron does not die)
Egg laying deficient. Hermaphrodite specifying neuron (HSN) dies if egl-1 has gof mutation. Cell death activator. Represses the PCD repressor *ced-9*, by forcing it to release *ced-4* and starting PCD.	Cell death repressor. Binds *ced-4*, preventing it from cleaving *ced-3* which initiates PCD. Repressed by *egl-1*
Cell death activator. Last part of the central pathway, activated by *ced-4*	Cell death activator. Prepares *ced-3* by cleaving it, initiating PCD. Released from *ced-9* after binding *egl-1*

Fly facts

No. of genes in Drosophila and C. elegans, no. lethal genes in Drosophila

Week 4: *Drosophila melanogaster*

Oogenesis

Oogenesis, follicle cells, oocyte

Week 4: *Drosophila melanogaster*

Oogenesis

Nurse cells

Week 4: *Drosophila melanogaster*

Oogenesis

Syncytial specification

Week 4: *Drosophila melanogaster*

Embryo structures

Cephalic furrow, ventral furrow

Week 4: *Drosophila melanogaster*

Embryo structures

Segment names (head, thorax, abdomen)

Week 4: *Drosophila melanogaster*

Maternal factors

Anterior posterior axis specification

Week 4: *Drosophila melanogaster*

Maternal factors

Bicoid is a ... and is assisted to the anterior by ...

Week 4: *Drosophila melanogaster*

Maternal factors

Nanos is a ... and is assisted to the posterior by ...

Week 4: *Drosophila melanogaster*

Maternal factors

Bicoid/nanos effects on hunchback/caudal

Week 4: *Drosophila melanogaster*

Oogenesis is the creation of the **oocyte**, the unfertilized, haploid egg cell. Follicle cells are somatic cells - the "shell"of the oocyte.	13600 genes in Drosophila vs 19000 in C. elegans. 5000 lethal genes.
Syn-cytial, same-cell. Control of individual cell specification in a cell with many nuclei, but no membranes. Occurs varying concentrations of maternal factors (e.g. bicoid) throughout the cytoplasm.	Nurse cells are **germ line** cells. 15 nurse cells are created from one stem cell after 4 divisions, in addition to oocyte.
Mx, Ma, Lb, T1-T3, A1-A8.	Cephalic furrow is ridge in embryo that separates head from thorax. Ventral furrow eventually invaginates and creates mesoderm layer.
Transcription factor, assisted by exuperantia, swallow	First, nucleus localizes to posterior and releases Gurken mRNA close to the posterior follicle cells. Gurken protein binds to the torpedo receptor. Now bicoid and nanos can separate.
Nanos-pumilio complex —— hunchback Bicoid —— caudal Bicoid –¿ hunchback	Translational repressor (hunchback). Assisted by Oskar, tudor, vasa and valois

Maternal factors

Torso does ... and is activated by

Week 4: *Drosophila melanogaster*

Maternal factors

Hunchback mRNA stems from...

Week 4: *Drosophila melanogaster*

Maternal factors

Overexpressed bicoid results in ...
No bicoid results in ...
Inserted bicoid results in ...

Week 4: *Drosophila melanogaster*

Maternal factors

No nanos results in ...
No torso results in ...

Week 4: *Drosophila melanogaster*

Gap genes, anterior-posterior

The three important anterior-posterior gap genes are ..., and they are repressed by ...

Week 5: *Drosophila melanogaster II, gap genes*

Gap genes, anterior-posterior

If an anterior-posterior gap gene is deleted ...

Week 5: *Drosophila melanogaster II, gap genes*

Gap genes, anterior-posterior

Gap genes ... of type ... are required for acron and activated by ...

Week 5: *Drosophila melanogaster II, gap genes*

Gap genes, dorsal-ventral

The dorsal side is initially specified by ...

Week 5: *Drosophila melanogaster II, gap genes*

Gap genes, dorsal-ventral

The ventral side reaction chain involves the proteins..

Week 5: *Drosophila melanogaster II, gap genes*

Gap genes, dorsal-ventral

A fly is ventralised in the case of a LOF in proteins..

Week 5: *Drosophila melanogaster II, gap genes*

Both a maternal factor and transcription/translation in the zygote.	Torso represses groucho, a repressor of acron/telson proteins huckebein (hkb) and tailless (tll). Activated by trunk, which is activated by torso-like protein. Torso-like only located on extremities.
No abdomen. No acron or telson.	Larger head and thorax region. No head, thorax or acron. Head, thorax and maybe acron region at insertion.
The region normally specified is deleted.	Krüppel, repressed by all except bicoid (knirps, giant, hunchback, tailless, etc.) knirps, repressed by all except bicoid giant, repressed by all except bicoid **and hunchback** **All transcription factors.**
After anterior-posterior specification, nucleus releases Gurken mRNA at random side - **dorsal side**. Gurken activates torpedo, which inhibits pipe, which is used in the ventral side.	Bicoid actiavtes otd, ems and btd, **only** required for acron, while tailless and huckebein from torso are required for acron and telson. They are all **transcription factors**
Cactus, as it inhibits dorsal. Gurken and torpedo, as they inhibit pipe	Nudel and pipe activate proteases Gd –¿ Snake –¿ Easter. Easter activates ligand Spätzle, which binds to membrane receptor Toll. Toll releases Cactus from Dorsal, allowing Dorsal into the nucleus, specifying ventral side.

Gap genes, dorsal-ventral

A fly is dorsalised in the case of a LOF in proteins..

Week 5: *Drosophila melanogaster II, gap genes*

Dorsal concentration gradient

Highest concentrations of dorsal activate ... which specify the ...

Week 5: *Drosophila melanogaster II, gap genes*

Dorsal concentration gradient

Low concentrations of dorsal activate ... (top to bottom)

Week 5: *Drosophila melanogaster II, gap genes*

Dorsal concentration gradient

Dorsal represses ... (top to bottom)

Week 5: *Drosophila melanogaster II, gap genes*

Dorsal concentration gradient

Snail and twist are not activated at low dorsal concentrations due to ...

Week 5: *Drosophila melanogaster II, gap genes*

Segment polarity genes

Segment polarity genes are activated by ... and the involved genes are ...

Week 5: *Drosophila melanogaster II, gap genes*

Pair rule genes

The pair rule genes are initially in the ... and move to the ... in the segments

Week 5: *Drosophila melanogaster II, gap genes*

RNAi vs genetic screening

The benefits of RNAi over genetic screening and vice versa are...

Week 5: *Drosophila melanogaster II, gap genes*

Pair rule genes

Even-skipped stripe two is activated by ... and repressed by ...

Week 5: *Drosophila melanogaster II, gap genes*

Homeotic genes

Homeotic genes and segment polarity genes appear after ...

Week 5: *Drosophila melanogaster II, gap genes*

Proteins twist and snail, specifies the mesoderm (e.g. gut)	Pipe, Nudel, Gd, Snake, Easter, Spätzle, Toll and Dorsal.
zerknüllt, tolloid, decapentaplegic.	rhomboid, short gastrulation and single-minded (lowest affinity for dorsal of the three)
Engrailed activated by even skipped and fushi taratzu. Involved genes: Engrailed –¿ hedgehog —— patched —— smoothened –¿ Cubitus Interruptus –¿ wingless –¿ frizzled —— zeste white 3 —— armadillo –¿ engrailed Engrailed and cubitus interruptus are TFs.	Low activator site affinity for dorsal. Harder to bind long enough for transcription to start.
Genetic screening: Can discover tissue-specific promotorers by non-coding DNA mutations. Can discover gain of function mutations, though lethal genes hard to mutate **RNAi** Much cheaper, bypasses lethal gene limits, discovers redundant genes.	anterior –¿ posterior.
The cellular blastoderm (individual cells) has formed.	Activated by hunchback and bicoid. Repressed to the anterior by giant, to the posterior by Krüppel.

Homeotic genes

Homeotic genes do ...

Week 5: *Drosophila melanogaster II, gap genes*

Homeotic genes

Antennapedia LOF causes...
GOF causes...

Week 5: *Drosophila melanogaster II, gap genes*

Homeotic genes

Homeotic genes resemble the ... genes in humans

Week 5: *Drosophila melanogaster II, gap genes*

Homeotic genes

In homeotic genes, LOF causes ... while GOF causes ...

Week 5: *Drosophila melanogaster II, gap genes*

Homeotic genes

Antennapedia GOF replaces antennae with legs due to ...

Week 5: *Drosophila melanogaster II, gap genes*

Homeotic genes

The three last homeotic genes are ... and they are each necessary for ..

Week 5: *Drosophila melanogaster II, gap genes*

Experiment

Hans Spemanns experiments

Week 6: *Xenopus*

General terms

Blastula, blastocoel, blastomere

Week 6: *Xenopus*

General terms

Gastrula(tion), Neurula(tion)

Week 6: *Xenopus*

General terms

Invagination, involution, epiboly

Week 6: *Xenopus*

LOF causes antennae to appear at 2nd legs, along with other thorax modifications GOF causes antennae to be replaced by legs.	Homeotic genes are localized genes that activate realizator genes, leading to the local development of appendages, etc.
LOF causes anteriorizations, GOF causes posteriorizations due to posterior dominance. Posterization = anterior part gets posterior elements, e.g. legs instead of antennae.	HOX-genes.
Ultrabitthorax, abdominal A and abdominal B. Ubx controls T3-A1, abdA A2-A4 and abdB A5-A8. Each required for their part, posterior genes take precedence.	Antennapedia represses the antennae-related genes and activates leg-related genes.
Blastula is the embryo after cleavage, but before gastrulation. Blastocoel is the empty area inside the embryo on the animal side. Blastomere is a cell in a blastula.	Hans Spemann showed that by transplanting the organizer region from a frog embryo to another, a second body w. spinal column and CNS formed.
Invagination is the creation of a slit (dorsal lip), involution is the movement of cells through the slit (endoderm/mesoderm layer), epiboly is the spreading of the ectoderm (skin) around the embryo as the rest of the cells move inside.	Gastrulation means that the germ layers have started to form (cells move inside). Neurulation means that the spinal column has started to form.

General terms

No knock-out in Xenopus due to.. but an alternative is...

Week 6: *Xenopus*

General terms

Put the elements in order:

Grey crescent *Corsical rotation*
Gastrulation *Organizer*
Nieuwkoop center *Fertilization*

Week 6: *Xenopus*

Early development

Mid-blastula transition (MBT) is ... and occurs at...

Week 6: *Xenopus*

Early development

First three cell divisions, axis

Week 6: *Xenopus*

Gastrulation

Archenteron

Week 6: *Xenopus*

The dorso-ventral axis

How is the dorsal region specified?

Week 6: *Xenopus*

The dorso-ventral axis

Cortical rotation can be inhibited through...

Week 6: *Xenopus*

The dorso-ventral axis

How to rescue a dorsalized embryo?

Week 6: *Xenopus*

The dorso-ventral axis

Belly pieces are the result of..

Week 6: *Xenopus*

The dorso-ventral axis

The Nieuwkoop center eventually becomes

Week 6: *Xenopus*

Fertilization, corsical rotation, grey crescent, Nieuwkoop center, Organizer, gastrulation.	Tetraploid genes makes it very difficult. Antisense oligos can be injected instead in case of mRNA.
First division divides left/right (both halves can form embryo) second division divides dorsal/ventral, third is animal/vegetal.	Zygotic genes are expressed. 12th cell cycle division.
Point of sperm entry specifies the ventral side. Dsh protein moves to the opposite side by cortical rotation. This becomes the Nieuwkoop center.	Empty space inside the embryo created during gastrulation. Eventually becomes gut.
Injection of any of the molecules found on the dorsal side: Dsh, betacatenin, simois, noggin, chordin, goosecoid... or lithium, which will inhibit GSK-3, just like Dsh. Centrifugation experiments can also work.	The chemical nocodazole, or UV-radiation, which inhibits the actin filaments. Both give a dorsalized embryo/'belly piece'.
Endoderm tissue.	A ventralized embryo, which is missing the organizer.

THE DORSO-VENTRAL AXIS

The organizer can not form at the bottom due to...

WEEK 6: *Xenopus*

THE DORSO-VENTRAL AXIS

Name the proteins in the pathway resulting in the organizer, along with their function.

WEEK 6: *Xenopus*

THE DORSO-VENTRAL AXIS

Goosecoid protein causes...

WEEK 6: *Xenopus*

INDUCTION OF THE MESODERM

Mesoderm cells are the result of ...

WEEK 6: *Xenopus*

INDUCTION OF THE MESODERM

Maternal factors in the vegetal pole

WEEK 6: *Xenopus*

INDUCTION OF THE MESODERM

VegT activates...

WEEK 6: *Xenopus*

INDUCTION OF THE MESODERM

Function of Vg-1, Derriere, Xnrf

WEEK 6: *Xenopus*

ORGANISER

What's required for siamois to activate goosecoid and form the organiser?

WEEK 6: *Xenopus*

ORGANISER

Which gene indicates the presence of the organiser?

WEEK 6: *Xenopus*

ORGANISER

For dorsal mesoderm specification, you need...

WEEK 6: *Xenopus*

Dsh -I GSK-3 -I B-catenin -¿ siamois (TF) -¿ goosecoid	The organizer is made from marginal zone ectoderm cells.
Endoderm cells inducing ectoderm cells at the marginal zone by releasing Vg-1.	Movement of dorsal lip cells, induces dorsal mesodermal fate in cells, recruits nearby cells to lip
Derriere, Xnrf, Vg-1	VegT, Vg1.
High levels of Xnrf released from the Nieuwkoop center, meaning only ectodermal cells can form dorsal mesoderm/organiser.	Transforms ectoderm cells to mesoderm cells when received, by activating Xbra in mesoderm cells, determining their fate.
B-catenin. Usually depleted by GSK-3, but Dsh protein, which is found in the dorsal region, inhibits GSK-3, allowing Betacatenin to bind to Tcf-3 and transform it from a repressor to an activator of simois.	Goosecoid.

BMP-4 in mesodermal differentiaion

High levels of BMP specify...

Week 6: *Xenopus*

BMP-4 in mesodermal differentiaion

Intermediate levels of BMP specify...

Week 6: *Xenopus*

BMP4 in mesodermal differentiaion

Low levels of BMP4 specify...

Week 6: *Xenopus*

BMP4 in mesodermal differentiaion

BMP4 is inhibited by...

Week 6: *Xenopus*

Neurulation

Paraxial mesoderm essentially means

Week 7: *Xenopus*

Neurulation

The notochord is responsible for...

Week 7: *Xenopus*

Neurulation

The neural plate becomes the neural tube by..

Week 7: *Xenopus*

Neurulation

The part of the ectoderm that forms neurons is ..

Week 7: *Xenopus*

Neurulation

Ectodermic cells isolated form ... due to ..

Week 7: *Xenopus*

General

Embryos look similar at the ... stage

Week 7: *Xenopus*

Kidneys, muscle, heart.	Blood.
Noggin, chordin (and frizzzzzzbee) from the organiser.	Notochord.
Forming the neural plate, eventually becomes spine, brain and CNS.	Cells that form somites, which forms trunk and limb muscles, and ribcage.
The part closest to the organizer after gastrulation.	Neural folds folding over, ”zipping”the neural plate up.
Phylotypic stage, late part of organogenesis.	Neurons, as the community effect with BMP is necessary for epidermis to form.

AP axis in Neurulation

Neural tissue is induced by ... and differentiated by ...

Week 7: *Xenopus*

AP axis in Neurulation

Posterior ectoderm is induced by high amounts of

Week 7: *Xenopus*

AP axis in Neurulation

Trunk is induced by high amounts of

Week 7: *Xenopus*

AP axis in Neurulation

Head is induced by high amounts of

Week 7: *Xenopus*

AP axis in Neurulation

High amounts of retinoic acid causes...

Week 7: *Xenopus*

General terms

Morula, Zona Pellucida, Trophoblast

Week 8: *Stem cells*

General terms

When cells move through the primitive streak/node...

Week 8: *Stem cells*

General terms

Totipotent, pluripotent, multipotent, unipotent

Week 8: *Stem cells*

Experiment

John B. Gurdon and Yamanaka showed that..

Week 8: *Stem cells*

Wnt, FGF, retinoic acid (RA).	planar signals (along the surface), lateral signals (from the notochord).
Wnt inhibitors Cerberus, frizzbee, dickkopf plus IGF (insulin growth factor).	Inhibitors of BMP chordin, noggin and follistatin
The morula is a solid ball opposed to the blastula, which is hollowed. The morula is inside the zona pellucida until blastulation occurs. Trophoblast is the extraembryonic tissue in the blastula.	Posteriorization of embryo.
Cells that can make respectively all cells (including extraembryonic), all cells (excluding extraembryonic), some types of cells, one type of cell.	When cells move through the primitive streak in a mouse, they develop into mesoderm cells. Notochord if moving through node.
	Normal cells can be induced to become pluripotent stem cells by subjecting them to specific transcription factors. Impossible with mechanical or chemical stress.