Developmental Biology
3090-01
Week 6, Thursday
10/02/14

Lecture 11) C. Elegans

These notes begin with the C. elegans life cycle slide from the lecture 10 notes.

Slide 15: These nematodes eat bacteria and are not parasitic (although some other nematodes are). They take 12-15 hours to hatch, and the whole life cycle is about 3 days. They reproduce very quickly and its easy to produce many organisms. The adult c. elegans is only about 1 mm in length. Quick reproduction and short life cycle makes them good candidates for working with genetics.

Slide 16: C. elegans is transparent, which means that cell division and development can be observed (through a microscope). They have simple anatomy. Interestingly, they don't have a heart (or kidneys).

(missing) Early larval stages can be frozen and later revived. This is extremely useful because it can't be done with something like drosophila or xenopus.

The image on this slide is actually a video of a specimen moving. It almost looks similar to the way we expect a snake to move. Also, watching this closely we can see the intestines (gut), developing eggs, and (towards the head) the pharynx.

Slide 17: Just a diagram of their anatomy. They only have about 302 neurons, showing that they are relatively simple creatures.

Now starts notes from lecture 11!

Slide 1: (C. elegans embryogenesis). This video shows development, occurring over about 14 hours and compressed into about one minute.

Slide 2: This slide shows a very precise fate map for c. elegans. It shows the lineage for forming major structures, such as the vulva and gonad. We can see that these structures actually come from multiple lineages.

(missing) lineage is variant.

Clicker Question!

Since the C. elegans lineage map is invariant there must not be any inductive signaling events during C. elegans development.

a) true

b) false

Answer is false! That the lineage map is invariant is not proof that there is no inductive signaling. The inductive signaling could also be invariant.

Slide 3: Here, hypodermis means epidermis. This image shows us that the germ line is very early differentiated. P1-P4 acts like a stem cell lineage in its progression. P4 gives rise to the germ cells. The E lineage, which forms the gut, is the only compartment in c. elegans.

Slide 4: Wherever the sperm enters the egg determines the posterior side for the A/P axis. These PAR proteins are part of a complex.

(missing) PARS establish cell polarity in many cell types in many organisms.

C. elegans use these PAR proteins early, while mammals use them later.

Slide 5: This differentiation in cell division here to form a AB and a P1 cell is caused by differentiation of PAR protein.

Slide 6: P-granules are required for germ cell lineage. It is not a C. elegans specific thing.

(missing) **Not** the determinants of polarization! These granules do not determine polarization. They just show it. It can be seen in the right hand side images, how the granules become segregated to one side of the cell. The PAR proteins determine cell polarization.

Slide 7: ABa = anterior; ABp = posterior. On the right side of the diagram, if we flip the positions of the four cells (switching around ABa and ABp) we still get normal development (even though the axis is basically reversed). This tells us that ABa and ABp are not determined yet. There must still be some induction that needs to happen.

Slide 8:

(missing) ABa develops as ABp and vice versa.

Slide 9: These next four slides are important to know for the exam!! These are signaling pathways. This slide is for signaling between P2 and ABp. P2 signals ABp to develop as ABp. If we take away P2, ABp will just develop as ABa.

(missing) GLP-1 (notch) and APX-1 (delta). APX stands for anterior pharynx excess.

Slide 10:

(missing) used for cell fate determination.

Slide 11: This slide shows signaling between P2 and EMS. P2 also signals E from EMS to give rise to the gut. If there is no E, no gut develops. If P2 is absent, no gut develops.

Specifically, the signaling between P2 and EMS is between MOM-2 and MOM-5.

(missing) A Wnt protein is P2 signal: MOM-2 = Wnt; MOM-5 = frizzled.

Slide 12: We want little POP-1 for gut development. Too much, or none, means no gut develops.

Slide 13:

(incomplete) Canonical signaling: B-catenin converts TCF into an activator.

Gut genes are repressed by POP-1. There are transcribed and expressed when the pathway is active.

On a side note, one nice advantage to working with c. elegans is that it is easier. No one really cares about freeing nematodes for ethical reasons (as they might with something like mice, or especially with monkeys and apes). It is also easier because with something like chimps, there are very strict regulations. With C. elegans, it is far more lenient.

Clicker Question!

Watching embryonic development after manipulating the position of AB daughter cells tells us

a) nothing
b) C. elegans undergoes mosaic development
c) C. elegans undergoes regulative development
d) Cell-cell interactions are not important for C. elegans development
e) C and D

Answer is C.

Slide 14: This is also an important slide to know. Antisense RNA is complementary to mRNA. It was first thought that it hybridized and inhibited gene expression, but it is actually more complicated than that, as shown by the pathway here.

(missing) Biological process where RNA molecules inhibit gene expression.

(incomplete) Thought to exist to help defend cells against viruses.