Cell Division in Reproduction, Growth & Development

Online Exploration of Cell Division in *C. elegans*

You probably already know something about the relationship between genes and traits, including how to distinguish genotype (something specified in DNA) from phenotype (the expression of a genotype within an environment). Further insight can be gained by exploring some of what is known about the microscopic, free-living nematode, *C. elegans* (its full name is *Caenorhabditis elegans* but who wants to say that very often?). *C. elegans* is one of the most studied species of animals, partly because it is small, cheap and easy to keep and culture, and has the character typical of nematodes called eutely.

Direct your internet browser to http://www.wormclassroom.org/Modules/GenoPhenotype/ and consider the following questions. Answer them in your lab notebook in statements that can stand alone as useful observations even if you don't remember what the question was. You could repeat the question if that would provide sufficient context. Be sure to record the URL. Using the bold face words below as subheadings may assist you in maintaining some sense and continuity among your responses. The questions are intended as minimal prompts; be sure to include any other observations and insights you develop as you visit the WormClassroom.

Within the **Background** page what features can you identify that are distinctly different from yourself and most of the other animals you are already familiar with?

When you observe the **Animation** page's Cell Division movies and animations it might be the first time you have studied cell division in action, as opposed to a series of photos or cartoons in a textbook. Did you see anything about cell division that isn't apparent in how it's shown in books? Are the movies made in real time or have they be sped up or slowed down to make them easier to follow? Are the speed changes uniform from one movie to another?

If answers to some of the previous questions was not obvious, consult the **Movie Info** page.

Consider the Size information provided. How does the size of a WT (wild type = normal) embryo compare the size of other small objects of known dimensions?

How much **Time** in hours does it take for a normal worm embryo to go from fertilized egg to hatchling? What is the **Cell Number** of the worm at that time?

Under **Growth Conditions** you can see that after hatching the worm must go through several stages before becoming an adult. The transition from each stage to the next requires that the worm shed its cuticle which is a non-living, non-growing, skin-like covering. How many molts are required? What makes an adult an adult?

The **Protein Info** page details precise how amino acids are sequenced to make particular proteins extracted from the Wild Type worms and the mutant worms. To save space the amino acids have been abbreviated; methionine, for example, is sometimes abbreviated as Met but here simply as M. Some other amino acids are also shortened to their first letter, (like glycine, alanine, valine, leucine, isoleucine, serine, threonine, cysteine, methionine, proline and histidine but glutamine uses Q and glutamic acid E since G is for glycine. For similar reasons R is for arginine and N for asparagine and D for aspartic acid. F is for phenylalanine, W for tryptophane, K for lysine, and Y for tyrosine. A clever set of mnemonics to learn them all (and who wouldn't want to impress their friends with such command?) is at http://wwwchem.csustan.edu/chem4400/code.htm. You won't be asked to know the code for this class. At the bottom of the page you can find links to online tools that will quickly take sequences (you can copy-and-paste them) and compare them, something you can do by eye if you are really into tedious tasks. How many different letters are used in the 1-letter amino acid code system?

Compare the **Spliced Genome** version of the Wild Type zyg-1 gene with the **Unspliced Genome** version of the same gene. What's the most obvious difference between them? One of them actually represents the sequence of subunits within a very long molecule (DNA); the other represents what that sequence would look like if the so-called "junk" regions were removed and the rest tied back together to make one long molecule again. If you compare the **Protein Info** page with the two **Genome** pages, you will notice that, although there are a large number of different letters used to encode the amino acids by people studying bioinformatics, there are only four letters used in the genome. What do those letters represent in real life?

In terms of the embryonic development of *C. elegans* from a single cell to stage one larva what do genotype and phenotype mean to you now?

Exploration of Cell Division in *Allium cepa & Leuchichthyes* in Lab

Having seen examples of cells at different stages of the "cell cycle," both as animations and in photographs, you will now examine preserved specimens of both an animal and a plant species undergoing mitosis.

You should be able to locate a very large number of cells in Interphase because it requires the longest time within the cell cycle to accomplish cell growth, replication of DNA, and production of materials needed before mitosis can begin. At any given moment more cells will be in Interphase than any of the briefer stages of mitosis. The shortest stage will be the rarest since very few cells will have been "caught" in that phase when the onion root or the blastodisc was preserved.

In your lab notebook make a sketch of each phase (arranged in the order they occur) for both the whitefish embryo (blastodisc) and the onion root tip. Which did you find easier to work with: the plant or the animal?

Using either organism, count 60 mitotic figures (cells that are in some stage of mitosis—not Interphase) and enter your tally into a table. Compute the portion of mitosis (as a percentage of the total number of mitotic figures counted) spent in Prophase, Metaphase, Anaphase and Telophase. If computers are available, use an electronic spreadsheet to make a pie chart showing the relative length of each phase of mitosis. If you assumed that mitosis in an given organism took an hour and the entire cell cycle took 24 hours, you could also use a spreadsheet to represent the cell cycle in a 24-hour clock.

A table something like the following should be recorded in your lab notebook.

Interphase	Prophase	Metaphase	Anaphase	Telophase
	cells	cells	cells	cells
1380 minutes	minutes	minutes	minutes	minutes
Accomplishes:	Accomplishes:	Accomplishes:	Accomplishes:	Accomplishes: