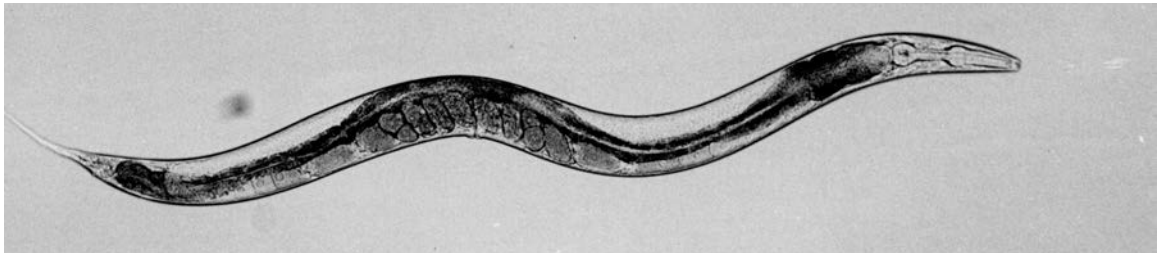
BIOL 322 INTRODUCTION TO *THE WORM*

Over the past few decades, the free-living roundworm *Caenorhabditis elegans* has become a favorite model organism for the genetic analysis of biological processes.



photomicrograph of an adult *Caenorhabditis elegans* hermaphrodite (body is compressed to flatten the animal)

C. elegans is an excellent model organism:

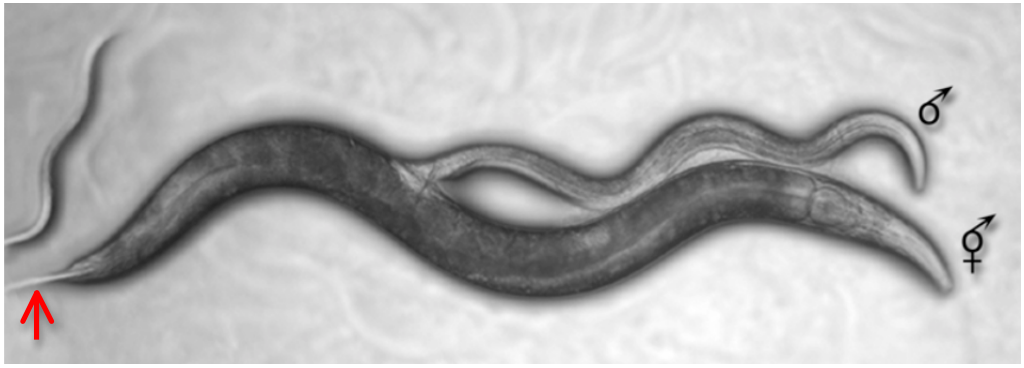
(i) It has a very short generation time of 2.5 days at 25ºC. The life cycle includes a period of embryogenesis and four larval stages.

(ii) *C.elegans* adults are only about 1mm in length. Hundreds or thousands of them can be grown up on a single small Petri dish. (Their food source in the laboratory is the bacterium *Escherichia coli*.)

(iii) *C. elegans* has a male sex and a hermaphrodite sex (above). The *C.elegans* hermaphrodite is essential a female animal that also has the capability to make sperm and to fertilize its own eggs. Thus reproduction can occur by hermaprodite self-fertilization (called self-progeny) or hermaphrodite-male mating (called cross-progeny). Mutant strains are easily be propagated by culturing hermaphrodites. Genetic crosses and experiments are performed by mating males and hermphrodites.

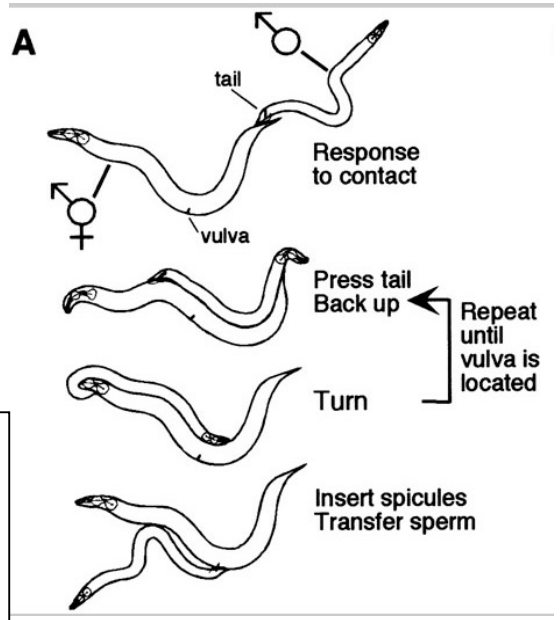
(iv) *C. elegans* as a small genome size ***of 100,000 kb (10^8 base pairs per genome copy).*** *and* ***about 20,000*** *genes*.

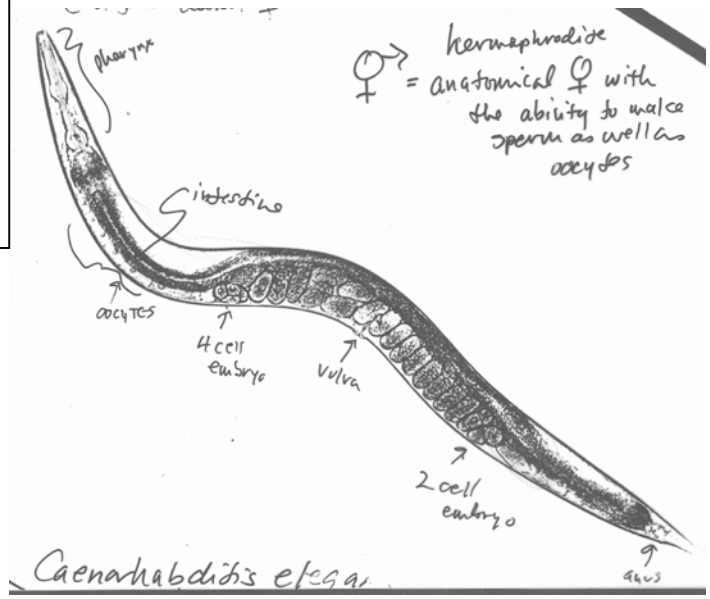
(v) These organisms are transparent and every cell in the body can be visualized with DIC (differential interference contrast) optics. The complete cell lineage has been determined.



http://broncnotes.utpa.edu/displayBulletin.aspx?bulletinID=3304

Above: Adult and larval animals as viewed with a stereomicroscope. The adult *C. elegans* hermphrodite will be the largest animal on the worm plate and will be full of brownish-colored eggs (shown in the micrograph on the bottom right). Note she has a tapered whip-like tail (red arrow). Adult males are thinner than hermaphrodites and have a very elaborate fan-like tail which functions in mating. One easy way to differentiate the two sexes as adults is to look at their behavior. *C. elegans* males show a very distinctive mating behavior (above and upper right):
http://post.queensu.ca/~chinsang/photos-and-movies/c-elegans-movies-album/





Right: Live adult hermaphrodite as visualized with a compound microscope. Note that she is transparent.

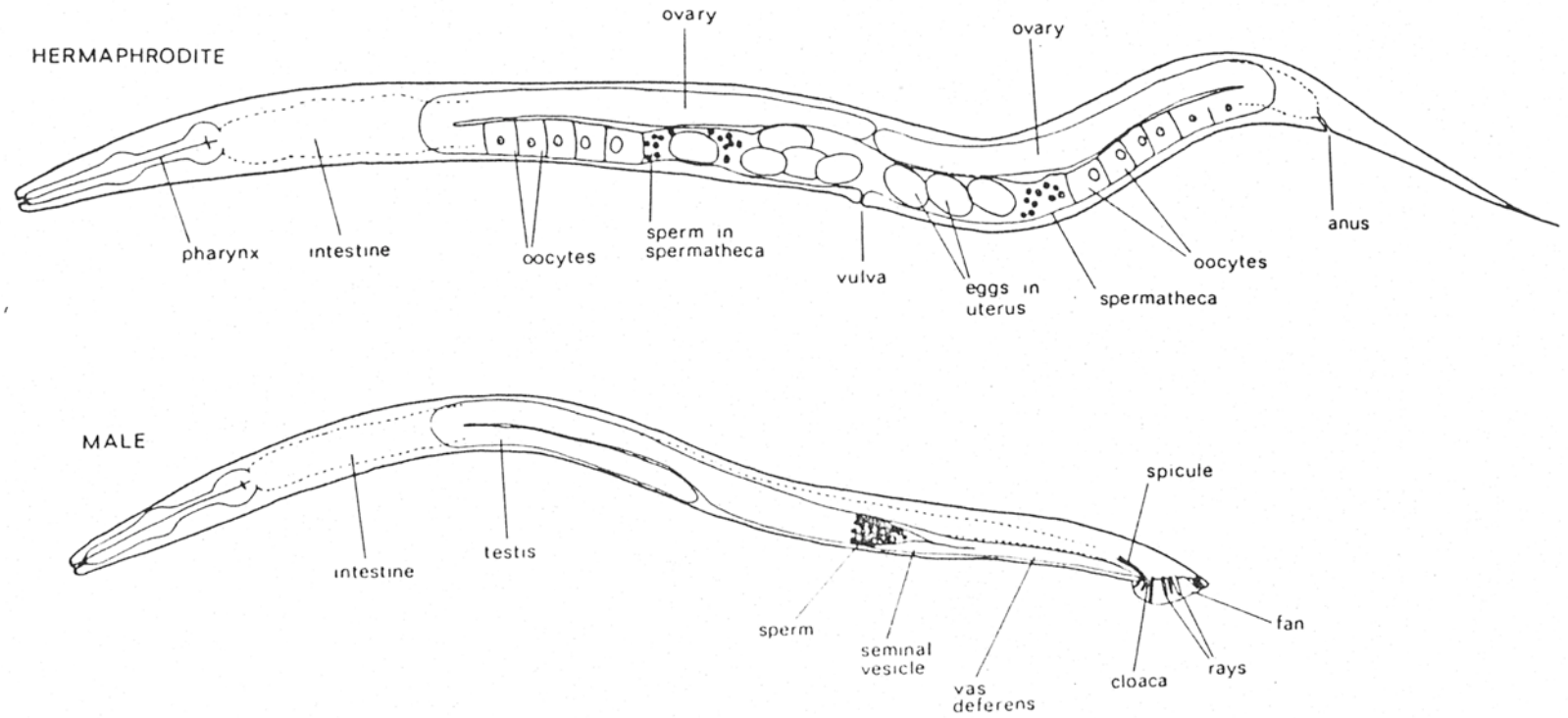


Figure 1. Major anatomical differences between hermaphrodite and male. The intestine of the adult hermaphrodite is specialized for the synthesis of large amounts of yolk proteins.

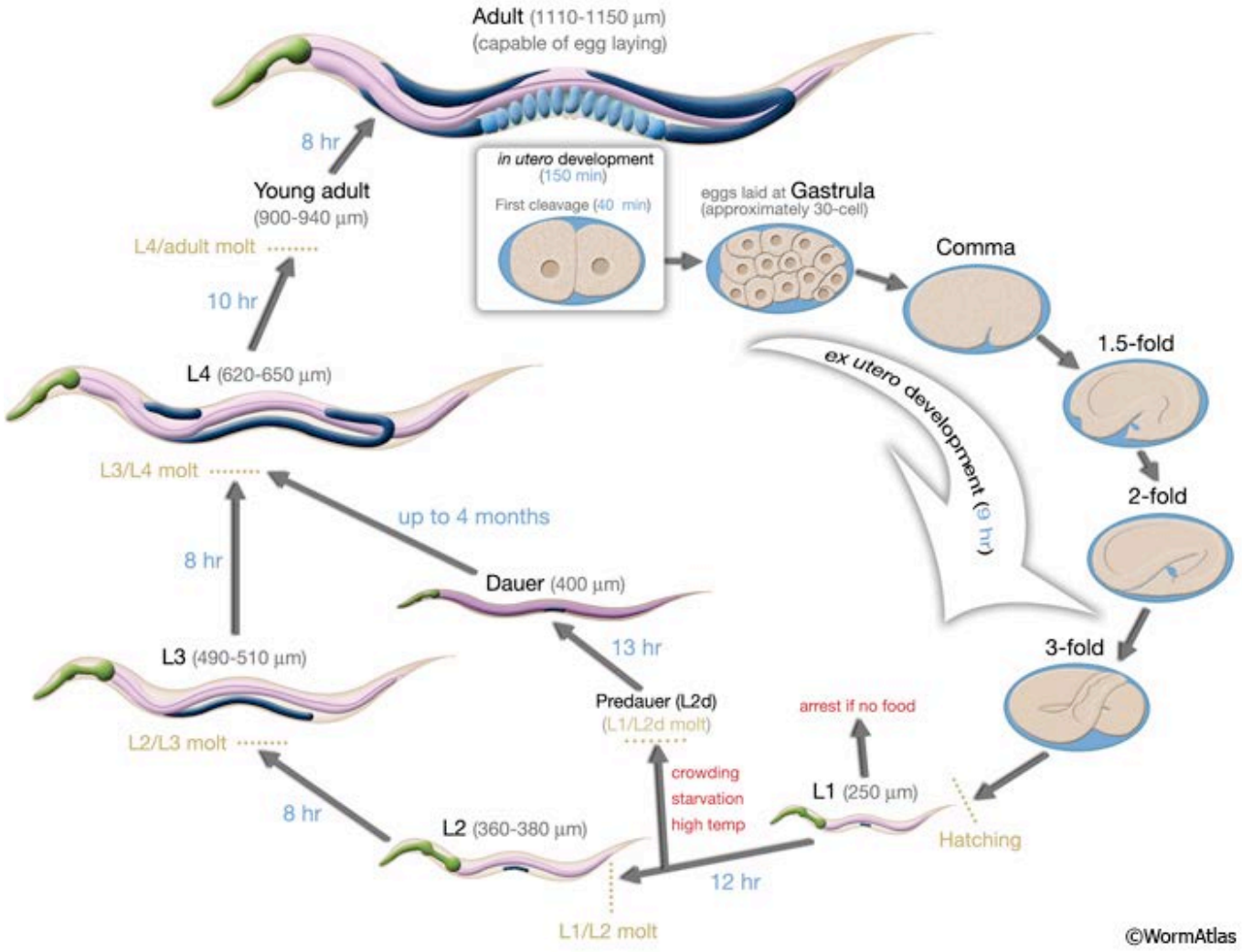
Top panel: wild-type hermaphrodite = female + sperm (XX = 2X chromosomes)
Bottom panel: wild-type male (XO = single X chromosome but no Y)
http://www.wormatlas.org/ver1/maleHandbook/GenIntroMalePartI.htm

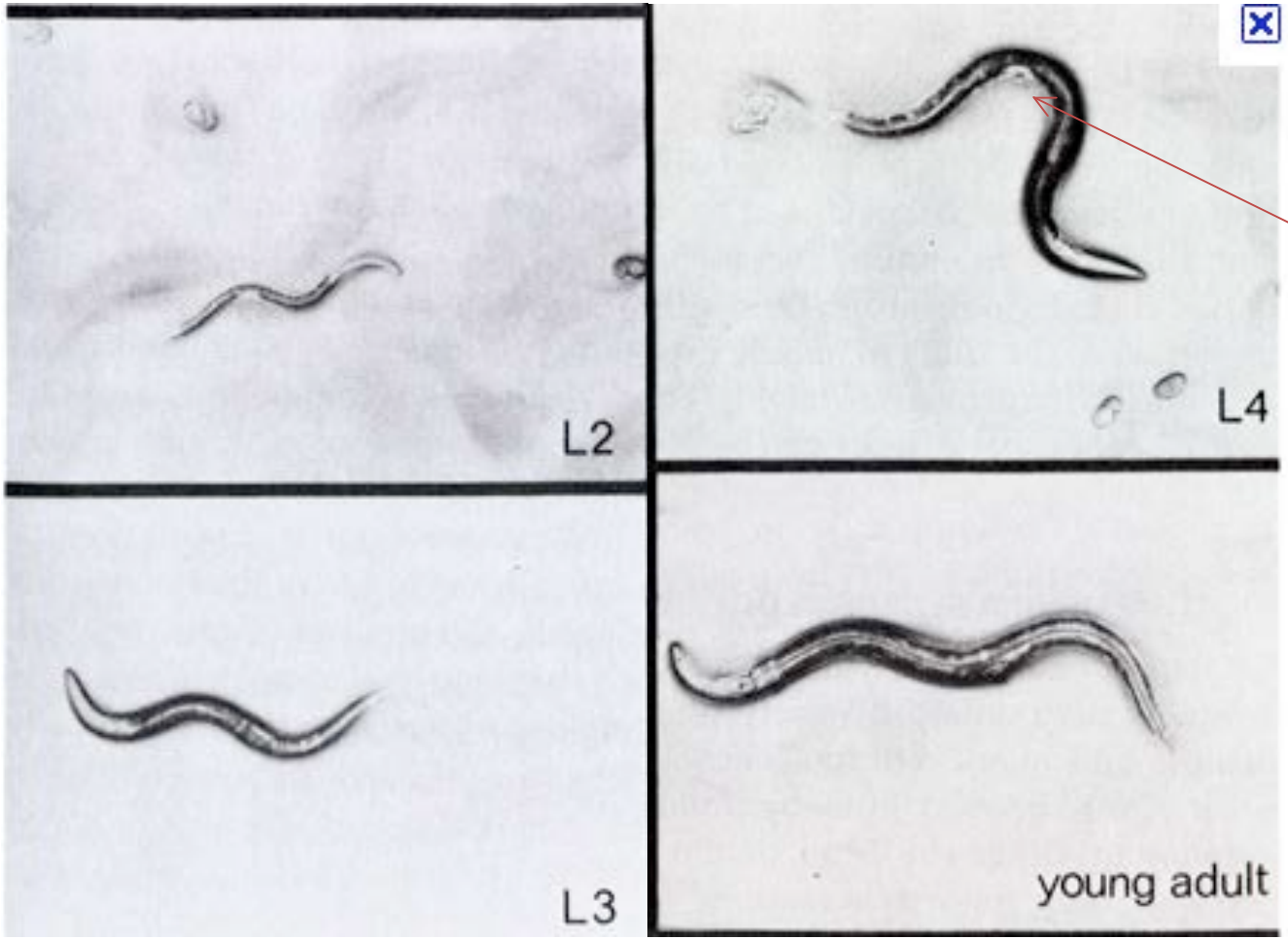
Live animals as visualized with a stereomicroscope

The binocular eyepieces of a stereomicroscope (aka dissecting scope) provide the stereoscopic effect of depth and distance. This type of microscope differs from a compound microscope in the following ways:

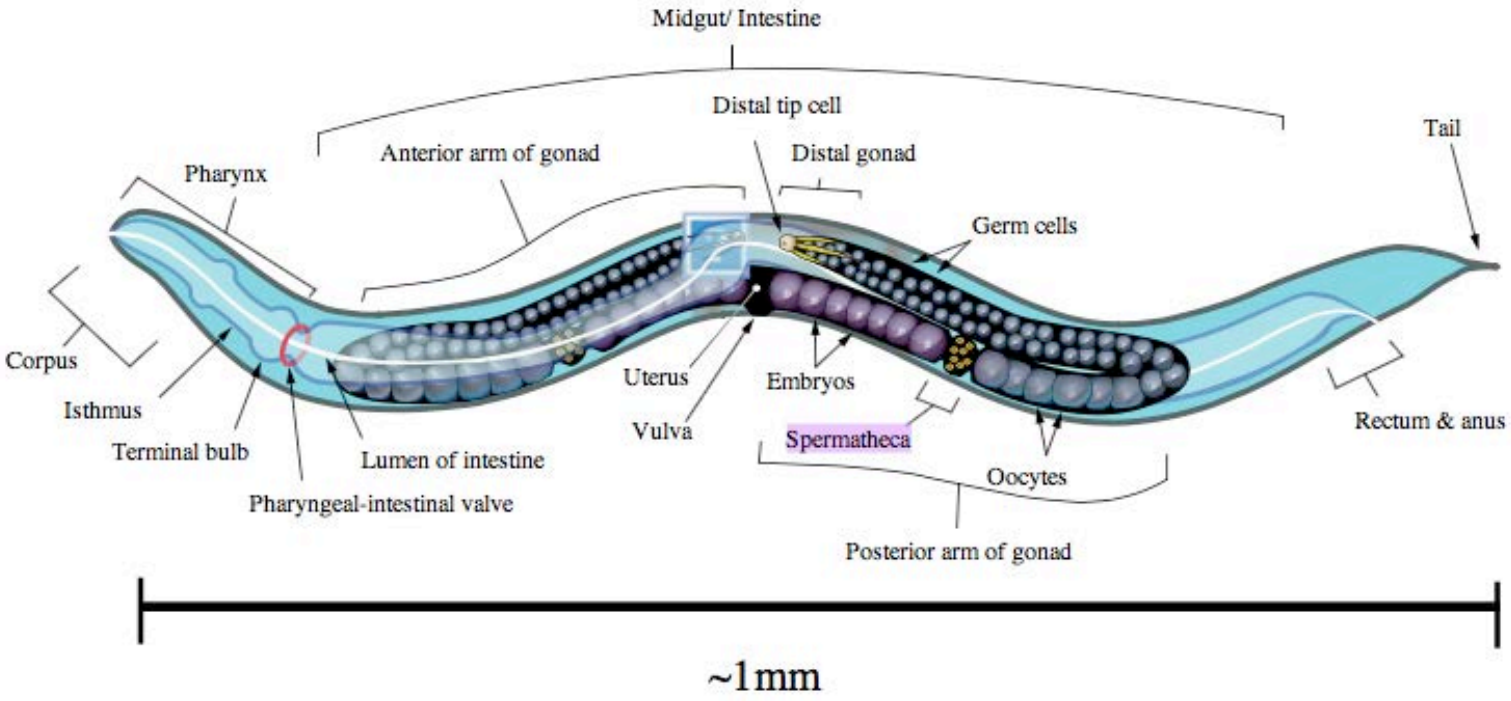
- depth of field (the thickness of the specimen that is in focus at any one time) is greater in a stereoscope
- left/right and up/down orientation of the specimen corresponds to what is viewed in the stereomicroscope
- a light source can be directed down onto an object as well as up through the specimen (*ie* transmitted) so specimens too thick to transmit light can be viewed (see wasp lab later this quarter)

Life cycle of C. elegans at 22°C. 0 min is fertilization. Numbers in blue along the arrows indicate the length of time the animal spends at a certain stage. First cleavage occurs at about 40 min. post-fertilization. Eggs are laid outside at about 150 min. post-fertilization and during the gastrula stage. The length of the animal at each stage is marked next to the stage name in micrometers (µm).





Hermaphrodites at various stages of development as visualized with a stereomicroscope



The general body plan of the nematode is in the form of two concentric tubes separated by a space called the pseudocoelom. The inner tube is the intestine; the outer tube consists of cuticle, hypodermis (essentially equivalent to epidermis), musculature and nerve cells. In the adult, the pseudocoelomic space also contains the tubular gonad. The shape of the worm is maintained by internal hydrostatic pressure controlled by an osmoregulatory system. *C. elegans* feeds through a muscular bilobed pharynx, which pumps fluid into the intestine and crushes ingested bacterial cells as they pass through the second lobe.