

FROG LABORATORY (ABLE 2025 mini workshop)

Below is the assignment that students complete in class.

I. Plaster models: The plaster models are of frog species, *Rana pipiens* (commonly known as Northern Leopard frog). In the lectures, we looked at embryonic stages of another frog species, *Xenopus laevis*. The animal hemisphere in *Rana pipiens* is much larger than in *Xenopus laevis*.

(A) 14 Brown models of unfertilized egg, 1-cell stage, 2-cell stage, 4-cell stage, morula, blastula, gastrula, neurula and tailbud stages.

(i) Examine the models and list the embryo model numbers along a timeline from youngest to the oldest.

(ii) How did you distinguish between the unfertilized egg and 1-cell stage embryo? Describe any visible asymmetry you noticed and explain how it forms? What is the developmental significance of this asymmetry?

(iii) Draw an outline sketch of first cleavage, second cleavage, and third cleavage stages. Label the animal-vegetal and dorsal-ventral axis. For each stage, indicate the orientation of the cleavage plane relative to the embryo's axes, and briefly describe how each cleavage contributes to establishing the body plan.

(iv) Match the alphabet labels (A, B, C, D and E on non-yellow circular labels) to the following structures in cases where applicable: blastomere, grey crescent, blastopore, yolk plug, and neural plate.

(v) Using the blastula stage fate map plaster model as your guide, draw an outline sketch of a lateral view of the fate map and label the following prospective fates: epidermis, neural, notochord, somites, blood, and kidney. Label the animal-vegetal axis, dorsal-ventral axis, and the germ layers.

(B) Brightly painted models (cross-sections only): The cross-sections are helpful for looking "inside" the embryo.

(i) Identify the following stages: late blastula, early gastrula, mid-late gastrula and tailbud. Write the corresponding model numbers for each stage. How did you distinguish between the above stages?

(ii) Draw an outline sketch of early gastrula, mid-late gastrula and tailbud stages [see (i)]. In your drawings, label the following:

(a) Label the visible structures such as blastocoel, archenteron, dorsal blastopore lip, neural tube, and endoderm.

(b) Label the following fates: epidermis, neural, notochord, ventral mesoderm, and endoderm.

(c) Label the animal-vegetal axis, anterior-posterior axis, and dorsal-ventral axis in cases where applicable.

(d) Indicate the orientation of the section for Neurula and Tailbud stage embryos: is it a transverse section or a longitudinal section?

2. Guided activity: Histological sections of embryos from the leopard frog allow you to study the organization of cells and tissues at various stages of development in more detail. Look at sections of embryos of the following stages using your **compound microscope**: cleavage, blastula, gastrula, neurula, and tailbud (4 mm):

(A) Late-Cleavage:

(i) On the slide, you will find several sections of late-cleavage stage embryos. Draw an outline sketch of any section. Label the animal pole, vegetal pole, and animal and vegetal blastomeres. How did you distinguish between the animal and vegetal blastomere? *Hint: Examine the relative size of the blastomeres.* Briefly describe what causes the size difference between the animal and vegetal blastomeres?

(ii) From the slide, identify a section where the blastocoel is clearly visible. Draw an outline sketch of the section. Label the animal pole, vegetal pole, blastocoel, and animal and vegetal blastomeres. What role does the blastocoel play during development?

(B) Blastula:

From the slide, identify a section where the blastocoel is clearly visible. Draw an outline sketch of the section. Label the animal pole, vegetal pole, blastocoel, and animal and vegetal blastomeres. What role does the blastocoel play during development?

(C) Early gastrula:

From the slide, identify a section where the dorsal blastopore lip is clearly visible. Draw an outline sketch of the section. Do NOT draw individual blastomeres. Label the blastocoel and dorsal blastopore lip. Label the animal-vegetal and dorsal-ventral axis. Why is the dorsal blastopore lip considered a critical organizer in development? What might happen if cells in this region were transplanted to another part of the embryo?

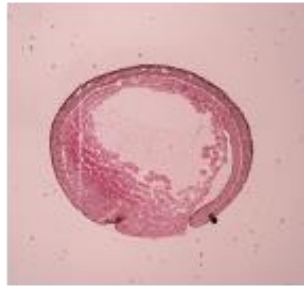
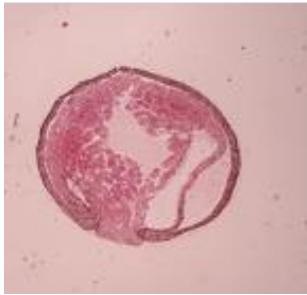
(D) Mid-late gastrula (slide labelled “gastrulation”):

A few select sections from the slide are shown below. The sections are from ‘early-mid gastrula’, ‘mid-late gastrula’ and ‘late gastrula’ stage embryos but not shown in this order.

(i) Specify the stage of the embryos corresponding to the sections in the boxes provided below each image.

(ii) For each section, label the visible structures such as blastocoel, archenteron, dorsal blastopore lip and ventral blastopore lip, in cases where applicable.

(iii) For each section, label the animal-vegetal axis and dorsal-ventral axis.



(E) Neurula (slide labelled ‘frog neurulation’): A few select sections from the slide are shown on the next page. The sections are from ‘early neurula’, ‘mid neurula’ and ‘late neurula’ stage embryos but not shown in this order. (0.75 points)

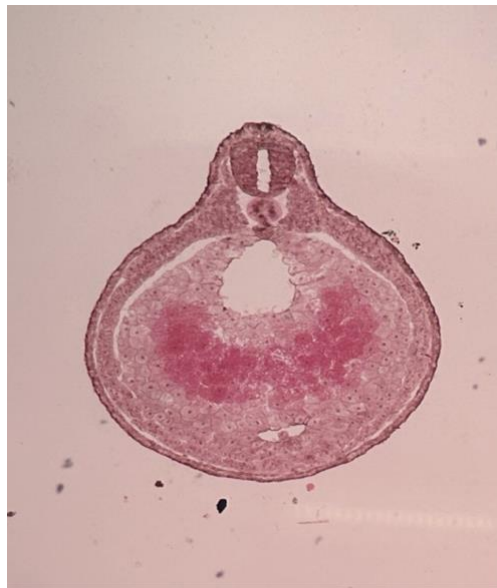
(i) Specify the stage of the embryos corresponding to the sections in the boxes provided before each image. Indicate the orientation of the section i.e., whether it is a transverse section or a longitudinal section?

(ii) For each section, label the visible structures such as gut cavity, neural plate, neural fold, neural tube, somites, and notochord, in cases where applicable.

(iii) For each section, label the dorsal-ventral axis.

(iv) How does the formation of the neural tube illustrate the process of induction in development? Which tissues are interacting, and what are the consequences if this process is disrupted?





(F). Tailbud (slide labelled '4mm embryo'): In the section below of a tailbud stage embryo, (1 point)

(i) Label the anterior-posterior axis and the dorsal-ventral axis.

(ii) Label the visible structures such as brain and somites.

(iii) In the box below the image, indicate the orientation of the section i.e., whether it is a transverse section or a longitudinal section?

