LABORATORY #11,12,13,14,17,18 BIOLOGY 441
CHICK DEVELOPMENT

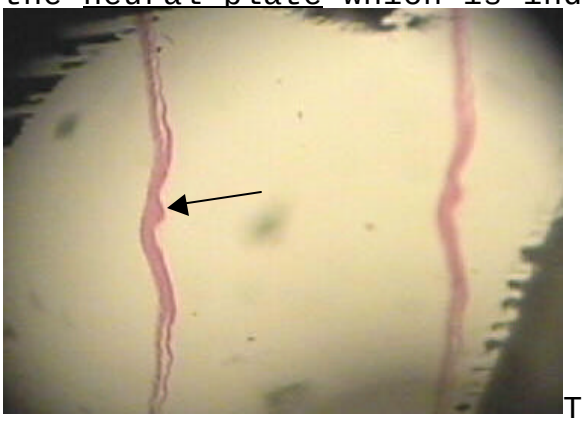
THIS INVESTIGATION REQUIRES: primitive streak stage (18 hr) x-section, 24 hr sagital, 33 hr serial x-sections, 48 or 56 hr x-sections and whole mounts, 72 hr whole mounts and x-sections, and sagital sections, 96 hr whole mounts.
DIAGRAMS: seven drawing of the chick whole mounts and sections to be made or labeled.
REFERENCE: Patten, Embryology of the chick.

PRELAB: BRING BOOKS WITH LABELED DIAGRAMS TO CLASS
OBJECTIVES: To learn to envision a 3D embryo from 2D cross sections; to see the changes from the flat streak stages to the rounded older stages. To learn how the extraembryonic membranes develop and are related and how to tell them apart. To follow the development of the organ systems.

STUDENTS TO WORK INDIVIDUALLY AND TURN IN COMPLETED LAB SHEET AT THE END OF EACH LAB.

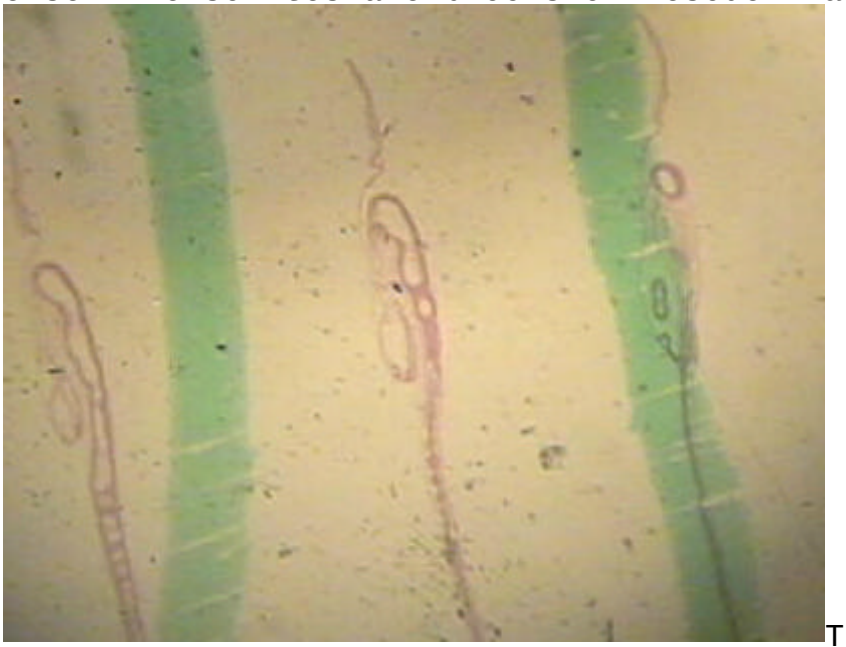
CHICK WHOLE MOUNTS; notice the wall charts which can help you, as well as the stereoptican cards which are labelled to tell you which structures are which.

18 hr. Find the primitive streak, Henson's node, area pellucia and area opaca. X-Sections:Hensen's node is a dark area in the middle of the blastodisc. Behind it is the primitive streak extending posteriorly in the blastodisc. In front of it is the head process, with the notochord underlying the neural plate which is induced by the chordamesoderm.



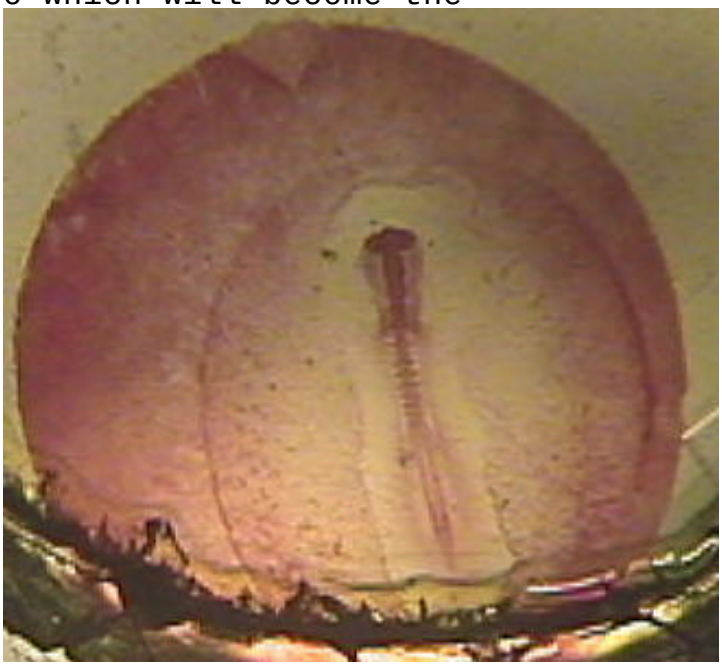
The mammal embryo looks like this at this stage, but is smaller, and covered over by the amnion and trophoblast. The embryo will arise from only a small part of the blastodisc, and the extraembryonic membranes arise from the rest. The area right around where the embryo will be is lighter and called the area pellucida, but the extraembryonic part is the area opaca which is as the name suggests, thicker and less transparent.

24hr. The new thing to notice on this slide is the presence of neural folds and somites.

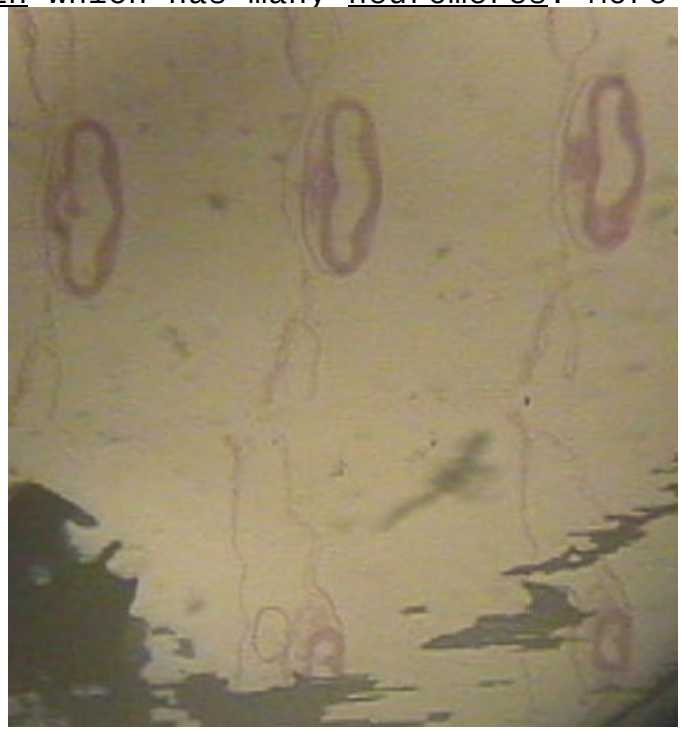

The neural folds are closing at the midbrain region, but open everywhere else. The somites are blocks of mesoderm along the notochord. 
Turn the slide over and look at the underneath part. The embryo is folding up off the rest of the blastodisc, as the gut closes

off from the yolk sac. The primitve streak has regressed to the posterior end of the embryo.

33 hr. The neural folds have closed in the front of the embryo which will become the



head. The optic vesicles which will give rise to the eyes are growing out from the forebrain, the brain is divided into forebrain, midbrain, and hindbrain which has many neuromeres. More somites are



visible. The heart has started to fuse from two lateral heart fields and the ventricle is in plain view on the right side of the embryo, with the large vitelline veins extending out to the yolk sac

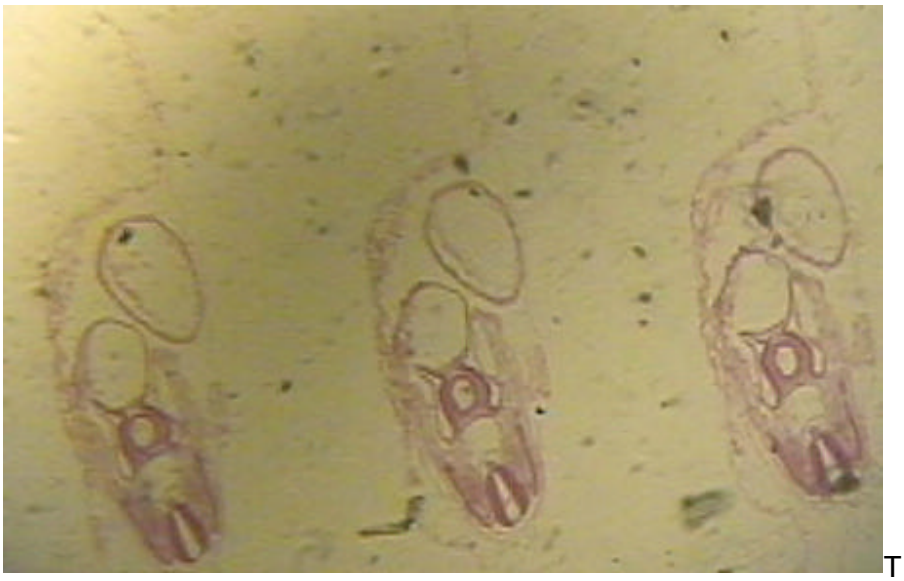
from the heart.

Later development 48 hr. You can see that the embryo has started to twist due to torsion, and the brain has started to be flexed by the cephalic and cervical flexures. The embryo lies on its left side on the yolk sac, and the amnion has started to cover it over. The amnion in mammals is there very early by forming a cavity in the inner cell mass, but it is formed by folding in the chick. Notice that the eyes have formed, with the optic vesicles invaginating to form a cup, and the lens placode invaginating to form a round lens which fits into the front of the optic cup. The brain divisions are more obvious; find fore-,mid-, and hind-brain. Look for the landmarks we used in the frog:epiphysis, optic chiasma, tuberculum posterius, neuromeres.

The heart has formed an s-shaped tube, see the models to see how the four chambers are

situated. The sinus venosus is the most posterior end of the heart where the veins enter, it is also dorsal and right in front of the developing

liver. The atrium comes next after the sinus venosus and it is also dorsal, but anterior to the SV. Then the ventricle curves ventrally and anteriorly and to the right.



The bulbus extends anteriorly from the ventricle to the underneath side of the pharynx where it breaks up into aortic arches which go around the pharnyx to the dorsal aorta. Look for the vitelline arteries coming off the dorsal aorta.

In this section you will determine the relationship between the heart and the bulbus as they become compartmented into right and left sides which are systemic and pulmonary; the development of the vena cavae, vitelline and umbillical derivatives; the

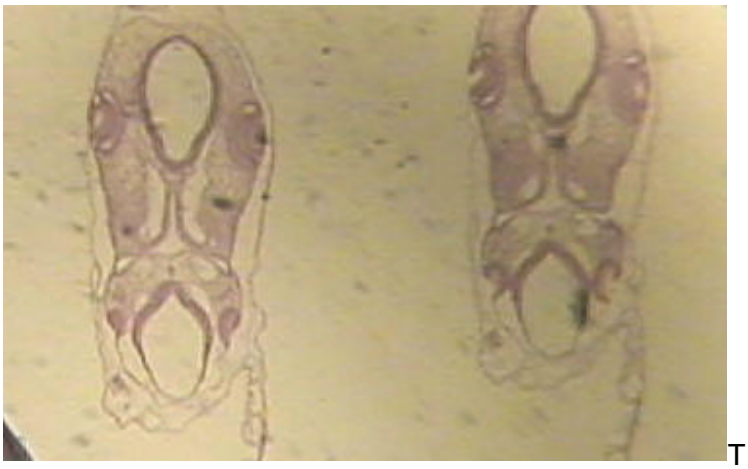
regions of the brain, and the cranial nerves; the various evaginating organs of the digestive system; the urogenital system; and somite division.

Great use can be made of the steroptican cards which show

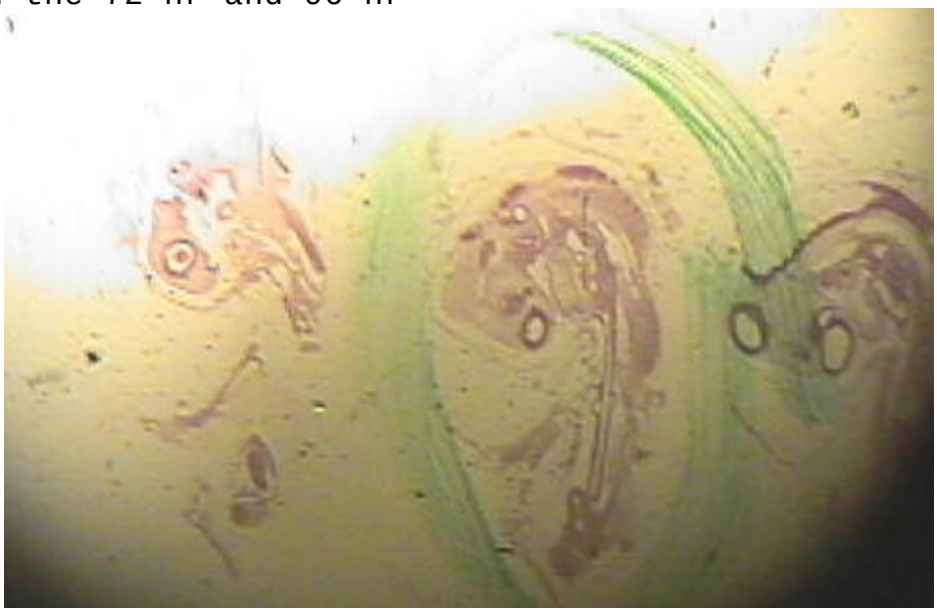
labeled dissection of chick embryos in 3D. The chick embryo models are also useful with digestive system in yellow, heart in red, nervous system in blue. This will help correlate external appearance which we have become familiar with to the internal structures you must find in the slides.

Notice the visceral arches in the region of the head, with the first one giving rise to the jaws. In the sections, the visceral arches look like blocks with holes in the center which are the aortic arches. Between the visceral arches are the visceral pouches of the pharynx which extend outward to the ectoderm. The first pouch gives rise to the middle ear cavity and the eardrum. The ventral part will give rise to the thyroid.

Notice what the brain looks like in section. The shape of the section of the brain varies according to what part of the brain you are in, so you can tell where you are from landmarks much the same as in the frog.

 The fore-brain is divided into three parts; the two anterior telencephalic bulbs which will gice rise to the cerebral cortex and the single diencephalon region behind that to which the optic stalks, the pituitary (made of infundulum and Rathke's pouch) are attached. The midbrain is the large round bulb which is the top of the head in the embryo. The hindbrain is the thin roofed part behind that and will give rise to the cerebellum, pons from the metencephalon and the medulla from the myelencephalon.

The cranial nerves are nerves coming to or from the brain. The sensory ones often go to organs of special sense such as eyes, ears, nose, and taste buds. They can best be seen in the 72 hr and 96 hr

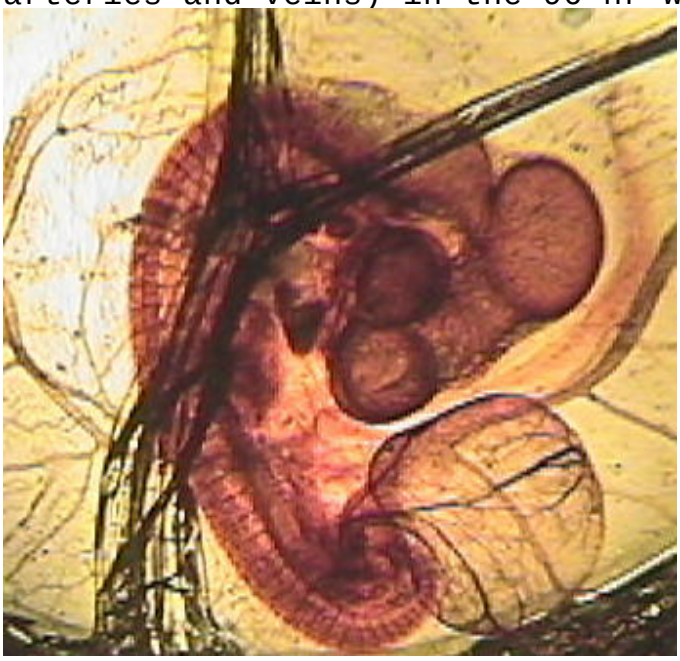
 stages. Find nerves 3,5,7,8,9, and 10. Nerve three is a motor nerve going to the eye muscles, and therefore comes out of the ventral part of the brain, in the mesencephalon region. Nerve 5 is just behind the eyes next to the midbrain-hindbrain transition. The sensory part of it is in a ganglion next to the first neuromere of the metencephalon. Nerves 7 and 8 are

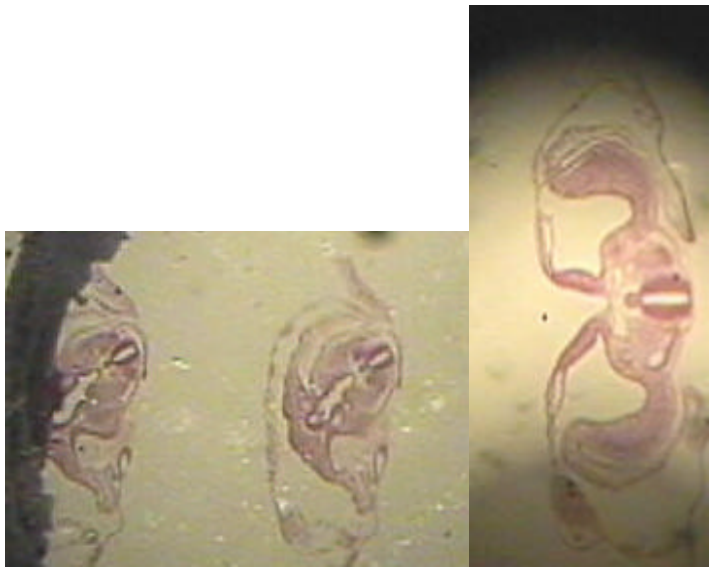
just in front of the ear vesicles, 9 just behind the ear vesicles. The ear vesicle becomes the inner ear and the endolymphatic ducts and the semicircular canals can be seen as knobs on it. There is one large nerve of the parasympathetic nervous system (cranial and caudal nerves), the vagus, nerve 10 which goes to all the viscera (the soft digestive and reproductive organs and the heart and lungs). Nerve 10 is just behind nerve 9. Use the chick models to see the placement of the nerves, then try to find them in the sections.

DIGESTIVE SYSTEM. Examine the pharynx. Find the visceral pouches, arches, grooves. The pharynx extends back to the laryngotraceal groove where the trachea separates off and ultimately gives off the lung buds. Find the esophagus, and the trachea and lung buds. Notice the pleural cavities, the pericardial cavity, and the peritoneal cavity. The esophagus leads to the thicker walled stomach.

HEART. Compare the 33 hr, 48 hr, and 72 hr slides in the heart region. The heart has become twisted and separated into right and left sides in this period of development. Draw the section including heart of the 72 hr chick on the lab sheet to be turned in. Label as many structures as possible for you at this time. The sinus venosus is being incorporated into the right atrium, and the valves are still plainly visible, at the junction. The SV will become the pacemaker of the heart since its cells have the fastest intrinsic beat. Find the interatrial and interventricular foramena. Look at the aortic arches and find which ones are present. Find the internal carotid artery. Find the large anterior cardinal vein which becomes the superior vena cava and takes blood to the SV from the brain.

Now look for the allantoic circulation (umbilical arteries and veins) in the 96 hr whole mount.





EXTRAEMBRYONIC MEMBRANES. The amnion surrounds the embryo and is continuous with its somatopleure and you will be able to see the amniotic folds closing over the embryo after the 48 hr. As the amniotic folds close the outer membrane becomes the chorion and the inner the amnion. Neither has blood vessels since they are somatopleure.

The yolk sac in continuous with the gut as the embryo is separated from the yolk sac by lateral folding. The allantois develops by outpocketing from the hindgut. So both of these membranes are splanchnopleure and contain blood vessels. This is an important way to tell membranes apart.