

NAME _____ Exam Key _____

BIO 32

EXAM # 3

May 6, 2003

SCORE:

Section

I. Practical _____ /62

II. Fill-ins _____ /28

III. Origins match _____ /20

IV. Failures _____ /21

V. Essay _____ /8

TOTAL _____ /135 (= _____ %)

I. Laboratory Practicum (60 points)

Instructions:

a. Make sure you have all the necessary slides.

b. When identifying a structure on a slide, be sure the **tip** of the pointer is positioned on the structure, not merely pointing toward it from a distance. Raise your hand to request that an instructor come over to check your identification.

c. If the instructor grades you "wrong" and you are convinced you are right, you can appeal for a second opinion. This must be done **immediately**, *not* 5 or 10 minutes later!

FIG: 42 points

Structure (2 pts each):

its name(one pt each):

- | | |
|--|-------------------------------|
| 1. Sites where PGCs will eventually mature | gonad (rudiment) |
| 2. Structure that suspends large intestine from dorsal body wall | dorsal mesogaster (mesentery) |
| 3. Region which if removed, would result in cessation of limb growth | AER (tip of limb bud) |
| 4. Area of interatrial communication | Foramen ovale |
| 5. Vessel that brings oxygenated blood directly from placenta to fetus | Umbilical vein |
| 6. A fetal vascular shunt through the liver | ductus venosus |
| 7. The embryo's functional kidney | mesonephros |
| 8. Site where embryonic blood is filtered into nephric tubules | glomeruli |
| 9. Structure through which food will be transported from pharynx to stomach | esophagus |
| 10. Derivative of Aortic Arch # 6 | pulmonary arteries |
| 11. Highly branched endodermal diverticulum that produces MANY digestive enzymes | pancreas |
| 12. Gland that represents one of the four basic chordate characteristics | thyroid |
| 13. Region that pumps blood into the systemic circulation | L. ventricle |
| 14. Structure that will later replace placenta for gas exchange function | Lung |

72 hour chick (2 pts each): (Use cross sections, please)

1. _____ allantois
2. _____ dorsal pancreatic rudiment
3. _____ cloaca
4. _____ area responsible for proximal/ distal outgrowth of forelimb bud
5. _____ pleural cavity
6. _____ trigeminal nerve
7. _____ Endoderm of a pharyngeal pouch
8. _____ infundibulum
9. _____ mandibular arch
10. _____ structure to be imbued with crystallin

II. FILL INS (28 points)

1. Secretion of _____ AMH _____ by _____ Sertoli _____ promotes the disintegration of the paramesonephric ducts.
(substance) (cells)
2. Production of _____ Testosterone _____ by cells in the _____ testis _____ promote the formation of the male genital duct system.
(substance) (organ)
3. Complete fusion of the distal portions of the paramesonephric ducts with the dorsal surface of the urogenital sinus, results in a _____ uterus _____.
(structure)
4. The genital tubercle, when exposed to androgens, forms a _____ penis _____, in males, and a _____ clitoris _____, in females.
(structure) (structure)
5. Two of the four basic chordate characteristics have their origins in the embryonic foregut region; their **primordia** are:
 - _____ thyroid rudiment (or foramen cecum) _____and
 - _____ closing plates at Branchial groove/ Pharyngeal pouch junctions _____
6. Rathke's pouch derives from _____ ectoderm _____ and forms the _____ pituitary gland _____.
(germ layer) (structure)
7. The urorectal shelf divides the _____ urinary bladder or urogenital sinus _____ from the _____ rectum _____.
(space) (space)
8. A pseudohermaphrodite may be phenotypically _____ xx _____ but genotypically _____ male _____.
OR _____ xy _____
(gender) (gender)

9. The septum primum divides the right from the left atrium
(space).
10. The transverse septum contributes tissue to the diaphragm, which subdivides the Coelom.
(structure) (space)
11. When the sex cords of the indifferent gonad form tubules, the gender is Female.
12. The Progress Zone is an area of mesoderm, that influences structures that form in the limb.
(germ layer) (structure)
13. The ureteric buds are diverticula from the Wolffian (mesonephric) duct / OR urogenital sinus.
14. The nitrogenous waste product that is processed through bird kidneys is Uric acid.
15. Endoderm of Pouches III and IV gives rise to the thymus and the parathyroids.
16. The skeletal primordium of Arch IV, in mammals, becomes the Larynx.
17. The muscles that make us smile are derived from the (be specific) myotomes (or Somite or somatic mesoderm).
18. If the urorectal fold failed to form completely, a mammal would have an area similar to the bird's:
cloaca.

III. ORIGINS MATCH (20 points)

Indicate the germ layer origin of the 20 items. For each response, use the number of the correct one, of the following choices in italics .

- 1) neural crest
- 2) skin ectoderm
- 3) neural tube ectoderm
- 4) endoderm
- 5) intermediate mesoderm
- 6) somatic mesoderm
- 7) splanchnic mesoderm
- 8) somitic mesoderm (i.e., somite)
- 9) cardiac mesoderm

ITEMS:

1. Osteocyte in finger bone 6
2. Gall bladder lining 4
3. infundibulum 3
4. thyroid rudiment 4
5. primordium of chordate subpharyngeal gland 4
6. cloacal lining 4
7. ureteric bud 4 or 5
8. metanephric blastema 5
9. lining of tube that carries sperm from testis to urethra 5
10. lining of site where blastocyst implants 5
11. cells that line hepatic duct 4
12. Mullerian ducts 5
13. Tracheal lining 4
14. Muscle of the back (mid-dorsal area) 8
15. Muscle from the arm 8
16. Muscle of facial expression 8
17. Left ventricular muscle 9
18. Ciliary muscle 1
19. Muscle responsible for peristalsis 7

IV. FAILURE COMPLEX: (21 points)

What developmental failures could generate the following malformations or defects Explain.

(Model responses below)

An individual has genotype XY, but exhibits female phenotype. Testes are formed. What could explain all this? Would the individual have Mullerian ducts or would these have regressed? Why?

One explanation of this would be a syndrome called testicular feminization. In this syndrome, the individual has the correct genotype to become male. The SRY gene produces testis determining factor (TDF), which stimulates the gertoli cells to produce anti-mullerian hormone, which would result in the formation of testes and the regression of the Mullerian duct. However, because of a problem in the enzymatic pathway of testosterone formation, or because of a problem with androgen receptors, spermatopenosis and the exhibition of secondary male sex characteristics will not occur, and the individual will appear femail (although infertile).

Persistent cervical fistula

The cervical sinus is formed by the fusion of branchial arches two and four to form an enclosed space. Failure of this fusion to occur will result in a persistent cervical fistula, which will cause external leakage of internal body fluids.

Cryptorchidism

Cryptorchidism is a syndrome that results when the testes of the male do not successfully descend into the scrotal pouches. This could result from a defect with the inguinal ligament, that is responsible for pulling down the testes. Also, if the testes did not move high enough at first, their path might be blocked by the kidneys or ureters.

Cleft Lip

The philtrum of the upper lib is formed from the fusion of the medical nasal process (which comes down from the nose area) and the maxillary process (which moves medially from either side). If there is a defect with the fusion, a cleft lip will result. This gives an individual a central gap in the upper lip where the tissues have failed to fuse.

Gut is strangulated by a persistent pancreatic rudiment. What happened?

The dorsal pancreatic rudiment forms from the duodenum, separate from other midgut diverticula. The ventral pancreatic rudiment, however, forms from the hepatic diverticulum on the other side of the gut. It then swings around to join the ventral part. However, in doing so, it must cross the gut. If it does not swing around in the right direction, its stalk can catch around the gut tube, strangulating it.

An individual has a female phenotype, lacks a Y chromosome, and is sterile with rudimentary gonads. What kind of gonads would these be, and what syndrome would account for the results?

This individual seems to have Turner's syndrome. This is caused by an XO phenotype – deletion of one X chromosome. It results in the incomplete development of female sex characteristics, so the individual is phenotypically female but is sterile and has incomplete female gonads and secondary sex characteristics.

An individual has gonads of the "tubular" vs follicular format, and has a deficiency in the enzyme 5 alpha reductase. What syndrome could explain this? And what is the genotype of the person?

5 α -reductase is an enzyme important in the formation of testosterone. This causes testicular feminization. The individual's normal male genotype XY results in the formation of testes, but because, in this case, testosterone cannot be produced, spermatogenesis and the appearance of male secondary sex characteristics do not occur. The individual will therefore appear phenotypically female, but sterile and with internal testes.

V. Essay: Choose one of the following and answer (8 points)

I. Cells of muscle become organized as syncytia.

- What is meant by “syncytium”
- Which kind of muscle forms a true syncytium? How does this happen?
- How does cardiac muscle form a functional syncytium?
- What kind of muscle is derived from splanchnic mesoderm? What to what systems does it thereby contribute?

II. It is said that the punishment should fit the crime. Or, stated more biologically, the development of a system should meet the functional demands that it will encounter. How does this assertion reflect the development of the kidney?

i.e., What is the rationale for kidney organization, and how does it improve upon itself as development proceeds?

Essay Number _____

Model Response #I: (some of the words were most likely misread by the typeset and are not correct, so hopefully you can figure it out)

A “syncytium” is a tissue which functions as a whole mass. A “syncytium” occurs when the cytoplasm of cells fuses together to form a multi-nucleated whole, which, therefore, moves as a whole. This is important in skeletal muscle (which forms a little syncytium) where, for the whole muscle to contract the muscle fibers must work dependently. Skeletal muscle is formed when myoblasts (from myotomes of somites) fuse to form a myotube, a syncytium. The myotube becomes a myofiber when it is imbued with sarcomeres, the smallest functional unit of contractile muscle tubes, which because of the syncytium affects the whole muscle. Similar functionally, is the cardiac muscle where the cells do not completely fuse but still act as a whole because of their intercolated, intimate guarantee, unlike synapses, electrical continuity, i.e., the muscle working as a whole. This get-up is convenient because cardiac muscle does not have time to form a complete syncytium, as it must function and grow at the same time.

Splanchnic mesoderm forms a different kind of muscle when cells are skinny, attenuated and lived up end-to-end. This muscle is called smooth muscle and while skeletal muscle is innervated by somatic (voluntary nerves), it is innervated by automatic nerves, which make it contract involuntary. This muscle type is found in the digestive system where through peristalsis it carries food from the esophagus, to the stomach, then to the intestines. In general, smooth muscle is formed from mesoderm local to the organ into which it is incorporated.

Model Response #II:

During early development, the pronephros develops to satisfy the basic requirement of removing nitrogenous wastes from the body. It can be removed in three forms: ammonia, uric acid, and urea. Since ammonia is toxic, that type of excretion typically occurs in fish who can release it into the water and avoid the toxic build up of wastes. Because of this, fish excretory organs don't develop much further than this stage, where the excretory tubules simply abut the capillaries.

The mesonephric kidneys are a more efficient development of the kidneys of an embryo. They accomplish this extra efficiency by increasing the surface area over which filtration of the blood occurs. This happens through induction of the mesonephric tubules to form cups (the precursors of the Bowman's capsule) into which a ball of knotted capillaries grow called glomeruli. The tightly bound capillaries and the inducted tubule increase surface area greatly.

The embryo still lives in an aqueous environment at this stage and doesn't need to worry about conservation of fluids. However, once it is born and exits the watery womb, it must conserve water just like all other terrestrial animals. Conserving water necessitates the production of concentrated urine. This is accomplished in the final development of the kidney, the metanephric kidney. By

establishing a concentration gradient in the renal pelvis into which the loop of Heale projects and by establishing selective permeability of the tubule, urine can be concentrated to reduce water loss finalizing development of the kidneys.