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Human Development

Questions

1) Please list the four stages of the sexual response cycle:

2) Name the recovery phase after orgasm during which it is physiologically impossible for an individual to have additional orgasms:

3) What is the most noticeable difference between the male and female sexual response cycle?

4) The labia in the female are the developmental equivalent to what part of the male anatomy?

5) Please select the appropriate progression of an embryo after fertilization:
Blastocyst > Morula > Pronuclear stage
Pronuclear stage > Morula > Blastocyst
Pronuclear stage > Blastocyst > Morula
Morula > Blastocyst > Pronuclear stage

6) The brain, nervous system and skin all evolve from which embryonic layer?
Mesoderm
Endoderm
Ectoderm

7) True or False: During the first 3 days after fertilization, an embryo is developing in the endometrium of the uterus:

8) Please match the following weeks after conception with the appropriate stages of embryonic development:

3rd	All essential internal and external organs are present
4th	Heart begins to beat and limb buds form
5th	Nose becomes distinct
6th	Neural tube forms
7th	Lens pits and optic cups form
8th	Oral and nasal cavities become confluent

9) What are the two primary concerns of the fetus during the fetal period of development?

10) At what age can a fetus become viable (albeit with significant health risks)?

11) What are the three main groups of tetralogy?

12) At what gestation time point does sexual differentiation typically take place?
4-5 weeks
6-7 week
8-9 weeks
10-12 weeks

13) True or false: In a developing fetus, the lungs are the primary organs responsible for oxygenating the blood?

14) Why could the umbilical vein be considered in a way a misnomer?

15) Name three structures present in the fetal circulatory system that are absent in adults:

16) True or false: The ductus venosus is important to insure the developing liver is supplied with enough oxygen and nutrient-rich blood.

17) Why is it important that fetal hemoglobin have a higher affinity for oxygen than maternal hemoglobin?

18) Why are C-section babies often at higher risk for transient tachypnea than those delivered vaginally?

19) Name two (of the several) functions the stress hormones cortisol and epinephrine play in helping newborns adjust to extrauterine life?

20) True or false: A female has the most possibly viable eggs at birth?

21) If ovulation typically occurs around day 14-16 of a menstrual cycle, why is it recommended that intercourse occur as early as day 12 when couples are trying to get pregnant?

22) What is the main function of progesterone during pregnancy?

23) What is the structural predecessor to the placenta that plays a crucial role in embryo implantation?

24) Pregnancy tests test for what hormone in the urine?

25) Because pregnancy requires an increase in metabolic rate, beta-HCG which is released during pregnancy mimics the hormone _____ which stimulates the _____ gland.

26) All of the following changes occur in the mother directly preceding delivery except:
Decreased GFR
Increased cardiac output
"Thinning" of the blood
Increased blood volume

27) List the three main function of the placenta:

28) True or false: A mom who has had prior pregnancies is likely to dilate (her cervix) more quickly during labor?

29) Define effacement:

30) Briefly describe the Apgar Scale:

31) What nutrient is regularly given to newborns almost immediately after birth?

32) An ABR is used as a basic test to look for what abnormality in newborns?

33) True or false: Mothers with hepatitis (A, B, or C) can breastfeed, but those with HIV cannot.

34) Upon delivery, if ultrasounds or the date of a mother's first missed period are unknown, the _____ _____ is used to estimate gestational age.

35) In addition to "weight vs age" and "height vs age" growth charts, physicians often plot "weight vs height". Why is this a useful measure?

36) True or false: The growth charts for girls and boys are identical, except that it is shifted down slightly for girls (they have a lower weight and length/height at a given age).

37) List one change made to the revised growth charts that came out in 2000?

38) True or False: A BMI of 23 is considered normal for a child from ages 2 to 18.

39) If a newborn comes into your office one week after delivery and is found to have lost weight since delivery, should this be a cause for concern?

40) What was the main initiative of the Back to Sleep Campaign?

41) What is the leading cause of death in children age 1-6?

42) When do we expect to see the first teeth emerging in infants?
At birth
0-5 months
6-10 months
11-18 months

43) What term is used to describe when children have both primary and permanent teeth at the same time?
44) By what age do we expect the last of the primary teeth to be lost?
10 years
12 years
14 years
16 years

45) Why do we expect to see a thinning of the hymen and labia majora after birth?

46) In males, we expect the testes to descend?

Prior to birth
Immediately after birth
0-4 months after birth

47) List the four main domains of development:

48) Briefly describe the moro reflex:

49) At what age (in months) should a child be able to sit independently?

50) What is the correct progression for fine motor control in infants?
Pincer grasp > Radial Palmar Rake > Radial Digital Grasp
Radial Digital Grasp > Radial Palmar Rake > Pincer Grasp
Radial Palmar Rake > Radial Digital Grasp > Pincer Grasp

51) By what age (in months) do we expect children to be able to put together 2 word sentences?
12 months
18 months
24 months
36 months

52) Is a HR of 140 bpm in a 6 month old child cause for concern?

53) Which of these vital signs do we expect to decrease as a child ages?
Blood pressure
Heart rate
Respiratory rate
54) According to Piaget, what cognitive development stage follows the Sensorimotor Stage, and what ages does it apply to?

55) According to Freud, someone suffering from OCD underwent a problem during which psychosexual stage?

56) At what ages do girls and boys, respectively, go through their growth spurts?

57) True or false: BY the end of puberty we expect the hemoglobin level to increase more in males than females since females need to compensate for blood lost during menstruation?

58) At what Tanner stage do we expect to see menstruation begin in females?

59) Name at least 4 of the categories analyzed in the HEADDSSS assessment acronym:

60) What are two questions you might ask to assess an adolescent's sexual history?

61) According to Piaget, at what age does abstract thinking and deductive reasoning being to evolve? To which stage of cognitive development does this correspond?

62) According to Erikson, in which stage of cognitive development is identity crisis most likely to occur?

Answers

1) Please list the four stages of the sexual response cycle:
1) Excitement
2) Plateau
3) Orgasm
4) Resolution
You should also be able to describe these stages and the anatomical changes that occur during them in both males and females.

2) Name the recovery phase after (normally male) orgasm during which it is physiologically impossible for an individual to have additional orgasms:
Refractory period

3) What is the most noticeable difference between the male and female sexual response cycle?
Females lack a refractory period

4) The labia in the female are the developmental equivalent to what part of the male anatomy?
Scrotum

5) Please select the appropriate progression of an embryo after fertilization:
Blastocyst > Morula > Pronuclear stage
* Pronuclear stage > Morula > Blastocyst
Pronuclear stage > Blastocyst > Morula
Morula > Blastcyst > Pronuclear stage

6) The brain, nervous system and skin all evolve from which embryonic layer?
Mesoderm
Endoderm
* Ectoderm

7) True or False: During the first 3 days after fertilization, an embryo is developing in the endometrium of the uterus:
False- in the fallopian tubes

8) Please match the following weeks after conception with the appropriate stages of embryonic development:

3rd	Neural tube forms
4th	Heart begins to beat and limb buds form
5th	Lens pits and optic cups form
6th	Oral and nasal cavities become confluent
7th	Nose becomes distinct
8th	All essential internal and external organs form

9) What are the two primary concerns of the fetus during the fetal period of development?

During this time the main concern is one of growth and differentiation of tissues and organs that started to develop during the embryonic period

10) At what age can a fetus become viable (albeit with significant health risks)?
22-23 weeks

11) What are the three main groups of tetralogy?
1) Malformation
2) Deformation
3) Disruption
You should also be able to explain the differences between these causes of structural abnormalities

12) At what gestation timepoint does sexual differentiation typically take place?
4-5 weeks
*6-7 week
8-9 weeks
10-12 weeks

13) True or false: In a developing fetus, the lungs are the primary organs responsible for oxygenating the blood?
False, the placenta fills this role. At this time the main requirement of the lungs are to grow.

14) Why could the umbilical vein be considered in a way a misnomer?
It carries oxygenated blood, whereas we typically this of veins carries deoxygenated blood.

15) Name three structures present in the fetal circulatory system that are absent in adults:
Ductus Venosus
Foramen Ovale
Ductus Arteriosus
You should also know the function of these structures

16) True or false: The ductus venosus is important to ensure the developing liver is supplied with enough oxygen and nutrient-rich blood.
False, the ductus venosus actually shunts blood away from the liver.

17) Why is it important that fetal hemoglobin have a higher affinity for oxygen than maternal hemoglobin?
The fetus is receiving “used” blood from the mother that already has a lower oxygen saturation than maternal arterial blood. For efficient oxygen transfer to occur in the placenta, the fetal hemoglobin must act like a “magnet” for oxygen.

18) Why are C-section babies often at higher risk for transient tachypnea than those delivered vaginally?

In C-sections, the newborns don't have the benefit of the "thoracic squeeze" – the pressure upon the chest wall of the infant during delivery which is a minor contributor to alveolar fluid clearance.

19) Name two (of the several) functions the stress hormones cortisol and epinephrine play in helping newborns adjust to extrauterine life?
Glucose production
Fetal lung fluid clearance
Using brown fat to keep infant warm
Improving blood pressure
Closing the ductus arteriosus

20) True or false: A female has the most possibly viable eggs at birth?
False, by birth many of the eggs formed by the fetus in utero will have already died. 6 million eggs are initially formed, and by birth only 1 million remain.

21) If ovulation typically occurs around day 14-16 of a menstrual cycle, why is it recommended that intercourse occur as early as day 12 when couples are trying to get pregnant?
Because sperm can survive in the female reproductive tract for 3-5 days.; "you want that sperm there- ready- waiting for an ambush"

22) What is the main function of progesterone during pregnancy?
It maintains the endometrium in which the fertilized egg implants itself.

23) What is the structural predecessor to the placenta that plays a crucial role in embryo implantation?
The trophoblast.

24) Pregnancy tests test for what hormone in the urine?
Beta-HCG

25) Because pregnancy requires an increase in metabolic rate, beta-HCG which is released during pregnancy mimicks the hormone _____TSH_____ which stimulates the _____thyroid_____ gland.

26) All of the following changes occur in the mother directly preceding delivery except:
*Decreased GFR
Increased cardiac output
"Thinning" of the blood
Increased blood volume

27) List the three main function of the placenta:
Oxygen supply
Filtrate system
Protective barrier

28) True or false: A mom who has had prior pregnancies is likely to dilate (her cervix) more quickly during labor?

True

29) Define effacement:
The thinning of the cervix. In addition to dilating, the cervix must also thin to prepare for delivery.

30) *Briefly* describe the Apgar Scale:
A simple and repeatable method to quickly and summarily assess the health of newborn children immediately after birth. Measures 5 parameters of health: heart rate, respiration, muscle tone, reflex irritability, and color.

31) What nutrient is regularly given to newborns almost immediately after birth?
Vitamin K.

32) An ABR is used as a basic test to look for what abnormality in newborns?
Hearing loss.

33) True or false: Mothers with hepatitis (A, B, or C) can breastfeed, but those with HIV cannot.
True

34) Upon delivery, if ultrasounds or the date of a mother's first missed period are unknown, the _____Ballard_____ _____Score_____ is used to estimate gestational age.

35) In addition to "weight vs age" and "height vs age" growth charts, physicians often plot "weight vs height". Why is this a useful measure?
"This is a good measure for kids who are poor at gaining weight or not gaining weight as appropriately as we would think or those who are gaining too much weight"

36) True or false: The growth charts for girls and boys are identical, except that it is shifted down slightly for girls (they have a lower weight and length/height at a given age).
False, the slope of the curve is also different. In the first months of life, boys tend to gain weight faster than girls.
37) List one change made to the revised growth charts that came out in 2000?
Includes breast-fed babies
Excludes very low-birth weight babies

38) True or False: A BMI of 23 is considered normal for a child from ages 2 to 18.
False, while a BMI of 23 is normal for an adult, the "normal" BMI actually changes with age in children (see BMI curve)

39) If a newborn comes into your office one week after delivery and is found to have lost weight since delivery, should this be a cause for concern?
No, newborns will actually lose weight immediately following birth.

40) What was the main initiative of the Back to Sleep Campaign?

To encourage parents to have their infants sleep on their backs (supine position) to reduce the risk of Sudden Infant Death Syndrome, or SIDS

41) What is the leading cause of death in children age 1-6?
Unintentional injury

42) When do we expect to see the first teeth emerging in infants?
At birth
0-5 months
* 6-10 months
11-18 months

43) What term is used to describe when children have both primary and permanent teeth at the same time?
Mixed dentition

44) By what age do we expect the last of the primary teeth to be lost?
10 years
* 12 years
14 years
16 years

45) Why do we expect to see a thinning of the hymen and labia majora after birth?
Estrogen is responsible for the "thickening" of the labia and hymen. After birth, the baby is no longer being supplied with estrogen from maternal blood.

46) In males, we expect the testes to descend?
*Prior to birth
Immediately after birth
0-4 months after birth

47) List the four main domains of development:
Motor
Language
Social
Cognitive

48) Briefly describe the moro reflex:
1) the reflex is initiated by pulling the infant up from the floor and then releasing him ; 2) he spreads his arms 3) he pulls his arms in. If this reflex is lacking or the infant moves asymmetrically it indicates a disorder of the motor system. Reflex usually gone by 6-12 months.

49) At what age (in months) should a child be able to sit independently?
6 months

50) What is the correct progression for fine motor control in infants?

Pincer grasp > Radial Palmar Rake > Radial Digital Grasp
Radial Digital Grasp > Radial Palmar Rake > Pincer Grasp
*Radial Palmar Rake > Radial Digital Grasp > Pincer Grasp

51) By what age (in months) do we expect children to be able to put together 2 word sentences?
12 months
18 months
*24 months
36 months

52) Is a HR of 140 bpm in a 6 month old child cause for concern?
No, the normal range for this age is 110-180bpm.

53) Which of these vital signs **do** we expect to decrease as a child ages?
Blood pressure
Heart rate
Repiratory rate
*HR and RR decrease over time.

54) According to Piaget, what cognitive development stage follows the Sensorimotor Stage, and what ages does it apply to?
Preoperational Stage; ages 2-7 years.

55) According to Freud, someone suffering from OCD suffered a problem during which psychosexual stage?
The Anal Stage (as opposed to the Oral or Phallic Stage).

56) At what ages do girls and boys, respectively, go through their growth spurts?
10 and 12 years.
57) True or false: BY the end of puberty we expect the hemoglobin level to increase more in males than females since females need to compensate for blood lost during menstruation?
False, hemoglobin levels increases from mean of 12g/DL in 6 yr olds to a mean of 16g/DL in males and only 14g/DL in females.

58) At what Tanner stage do we expect to see menstruation begin in females?
SM4

59) Name at least 4 of the categories assessed in the HEADSSS acronym:
H: Home environment
E: Education and employment
A: Activities
D: Drugs/Diet
S: Sexual activity/sexuality
S: Suicide/depression
S: Safety

60) What are two questions you might ask to assess an adolescent's sexual history?

Do you have a boyfriend/girlfriend?
How long have you been going out?
Are you getting along?
Have you ever had sex?
When you have sex, is it with men, women or both?
How many partners have you had?
Do you know how to protect yourself from pregnancy, STIs, and AIDS?

61) According to Piaget, at what age does abstract thinking and deductive reasoning being to evolve? To which stage of cognitive development does this correspond?
11 years; Formal Operations.

62) According to Erikson, in which stage of cognitive development is identity crisis most likely to occur?
Identity vs. Role Confusion/Diffusion

Embryos, Tissues, and Cells

Questions

Week One

**The test questions with an asterisk were marked as relevant for last year's class. They may or may not be the relevant questions for ours.*

1. The medulla oblongata derives from the
    A. Telencephalon
    B. metencephalon
    C. diencephalon
    D. myelencephalon
    E. none of the above

2. Atresia refers to
    A. obstruction of a tube
    B. pinching in of a tube
    C. overgrowth of a tube
    D. narrowing of a tube
    E. none of the above

3. The rostral and caudal neuropores usually close during the _____ week.
    A. third
    B. fourth
    C. fifth
    D. sixth
    E. seventh

*4. Gastrulation begins during
    A. week 1
    B. week 2
    C. week 3
    D. week 4
    E. at fertilization

5. Defects in which organ system represent the greatest frequency of major congenital anomalies?
    A. brain
    B. heart
    C. kidneys
    D. limbs
    E. lungs

6. Oligohydramnios is associated with all of the following except:
    A. esophageal atresia
    B. low volume of amniotic fluid
    C. renal agenesis
    D. urinary tract obstructions

E. retardation of lung development

*7. Limb development involves all of the following except:
A. Wnt signaling
B. sonic hedgehog signaling
C. WT1 (Wilms tumor) signaling
D. cells from the paraxial mesoderm
E. cells from the lateral plate mesoderm

8. What is referred to as “a progressive disorder in signal transduction?”
A. renal agenesis
B. transposition of the great vessels
C. spina bifida
D. cancer
E. epispadias

*9. Failure of fusion of the halves of the vertebral arches results in:
A. hydrocephalus
B. acrania
C. only minor problems
D. lethal consequences
E. spina bifida

10. Congenital hypertrophic pyloric stenosis:
A. involves an hypertrophy of the ileum
B. involves an enlargement of the pyloris
C. results from excessive recanalization of the pyloris
D. is not associated with projectile vomiting
E. is the most common anomaly of the stomach

11. Gastroschisis:
A. permits extrusion of the abdominal viscera without involving the umbilical cord
B. cannot be distinguished from an omphalocele
C. is incompatible with life
D. is also referred to as “left-sided” colon
E. is an extremely common malformation

*12. Limb bud formation begins towards the end of which week?
A. week 2
B. week 3
C. week 4
D. week 5
E. week 6

13. Sclerotomes:
A. give rise to somites

B. form the vertebrae
C. are the only adult remnant of the notochord
D. arise during the second week after fertilization
E. give rise to the muscles of the face

*14. Neural crest cells give rise to all of the following except:
A. melanocytes
B. suprarenal medulla
C. Schwann cells
D. peripheral ganglion cells
E. corpus callosum cells

*15. The foregut gives rise to all of the following except:
A. liver
B. spleen
C. pharynx
D. esophagus
E. pancreas

16. When chorionic villi become vascularized, they are referred to as primary villi.
A. True
B. False

17. Hypoplasia is a term used to indicate an increase in cell size.
A. True
B. False

18. Pulmonary valve stenosis is associated with Tetralogy of Fallot.
A. True
B. False

*19. According to recent statistics, approximately what percentage of pregnancies end in spontaneous abortion:
A. 10%
B. 20%
C. 30%
D. 40%
E. 50%

*20. A secondary oocyte finishes meiosis II:
A. at the time of ovulation
B. after pronuclear fusion
C. while in a primordial follicle
D. at fertilization
E. after release from nurse cells

21. Which of the following can derive from defects in the maternal chromosome set?
    A. Hydatidaform moles and Prader-Willi syndrome
    B. Teratomas and Angelmann syndrome
    C. Teratomas and Prader-Willi syndrome
    D. Hydatidaform moles and Angelmann syndrome
    E. none of the above

22. The salamander experiments of Towne and Holtfreter demonstrated that
    A. embryonic cells are not adherent
    B. embryonic cells cannot independently orient themselves in the correct location
    C. embryonic cells are totipotent
    D. embryonic cells quickly change their fate
    E. embryonic cells can recognize "self"

23. A male infant with hypospadias was referred to the urologist. This developmental anomaly:
    A. occurs in about 1:400 male infants
    B. is associated with extrophy of the bladder
    C. involves the scrotum in most cases
    D. results from defected fusion of the urogenital folds
    E. is almost never associated with chordee

*24. The SRY gene
    A. regulates gamete proliferation
    B. encodes a cell surface receptor
    C. is located on human chromosome 22
    D. is the master regulatory gene in testes development
    E. encodes a growth factor

*25. Wnt and TGF-β family members are:
    A. thalidomide derivatives
    B. extracellular signaling molecules
    C. transcription factors
    D. kinases
    E. none of the above

*26. The zona pellucida serves as a barrier that normally allows only sperm of the same species access to the egg.
    A. True
    B. False

27. The anterior pituitary gland is derived from neural ectoderm.
    A. True
    B. False

28. Hydrocephalus in an infant is synonymous with an enlarged head.

A. True
B. False

*29. Maternal alcohol syndrome (fetal alcohol syndrome) is the single most common cause of mental retardation.
A. True
B. False

30. Tumor suppressor genes are characterized by requiring both copies of the gene to be mutant to induce tumor formation.
A. True
B. False

31. Microcephaly is the result of abnormal development of the central nervous system in which the brain and, consequently, the cranium fail to grow.
A. True
B. False

32. Chondroblasts differentiate into osteoblasts.
A. True
B. False

*33. Hyperplasia involves an increase in the volume of cells.
A. True
B. False

34. The AER plays an important role in determining the proximal/distal axis of the limbs.
A. True
B. False

*35. Which is the gene for male sex determination in humans?
A. TDF
B. SXF
C. SRY
D. ZFY
E. WNT

36. An increased incidence of what condition is strongly associated with advanced maternal age?
A. ambiguous genitalia
B. Trisomy 21
C. Trisomy 18
D. anencephaly
E. Tetralogy of Fallot

*37. A child is born with a neural tube defect and a ventricular septal defect, but has normal development of the genitalia as well as palate and teeth. If an environmental insult is responsible for these defects, during what period after fertilization was the insult most likely to occur?

A. less than 1 week
B. 3-5 weeks
C. 7-9 weeks
D. 12-14 weeks
E. 21-24 weeks

38. Nucleated erythrocytes circulating in the embryo during the first 6 weeks are produced in the:

A. liver
B. bone marrow
C. yolk sac
D. spleen
E. endocardium

39. Blood vessels associated with which structure enter the fetal component of the placenta?

A. allantois
B. decidual parietalis
C. amnion
D. yolk sac
E. decidual basalis

40. The physiological herniation of the intestines begins during:

A. week 4
B. week 5
C. week 6
D. week 7
E. week 8

*41. Neural crest cells arise from:

A. Somites
B. Dorsal nonneural ectoderm
C. Neural tube
D. splachnic lateral plate mesoderm
E. somatic lateral plate mesoderm

*42. Neural crest contributes to the structure of which of the following?

A. Truncus Arteriosus
B. Pulmonary Trunk
C. Ascending Aorta
D. none of the above

E. all of the above

*43. What molecule produced by the notochord is instrumental in inducing the floor plate of the neural tube?

A. HOXA-5
B. Retinoic Acid
C. L-Selectin
D. PAX-3
E. Sonic Hedgehog

*44. When during normal development a cell begins to be restricted in its ability to produce all the future parts of the embryo, that cell is said to be:

A. a blastocoel
B. pluripotent
C. compacted
D. a primordial germ cell
E. immortal

*45. The proliferative cells of a stratified squamous epithelia are located primarily in the:

A. basal layer
B. suprabasal layers
C. sub-basement membrane zone
D. outer-most layer

*46. Desmosomes and hemidesmosomes:

A. are structurally similar and biochemically identical in composition.
B. mediate attachments of microtubules to the plasma membrane.
C. are critical for cell adhesion and resisting mechanical stress.
D. mediate cell-cell communication and ion transfer.

*47. These surface specializations are often disrupted during gastrointestinal infections, contributing to diarrhea and fluid loss:

A. gap junctions
B. tight junctions
C. microvillae and cilia
D. hemidesmosomes

*48. Which of the following influence the final destination of a polypeptide?

A. the length of the transmembrane domain
B. its primary amino acid sequence
C. carbohydrate modifications
D. fatty acid modifications
E. All of the above are true.

*49. Which of the following statements is TRUE for proteins destined for secretion?

A. They are always translated on free ribosomes in the cytosol.
B. They have signal sequences that target them to the endoplasmic reticulum.
C. They contain sequences recognized by signal peptidase.
D. Both A and B are correct.
E. Both B and C are correct.

*50. Which of the following statements concerning cell adhesion molecules is FALSE:

A. They are peripherally associated with the plasma membrane (not integral membrane proteins).

B. They can mediate attachment to the extracellular matrix.

C. They are able to induce intracellular signal cascades.

D. They mediate adhesion between cells.

E. Different classes of cell adhesion molecules often act in concert to carry out a biological process.

*51. Cells of higher eukaryotes are characterized by:

A. the packaging of many metabolic pathways into membrane enclosed organelles to increase metabolic efficiency.

B. cytoskeletal networks that contribute to communication between organelles and to the control of cell shape.

C. cell surface receptors that receive and transmit signals from the extracellular environment.

D. a nuclear envelope.

E. All of the above are correct.

*52. Elaboration of a mannose-6-phosphate recognition motif is characteristic of:

A. proteins destined for secretion.

B. integral membrane proteins.

C. proteins targeted to the endoplasmic reticulum.

D. proteins targeted to the lysosome.

E. All of the above are correct.

*53. Which of the following processes occur in the Golgi complex?

A. The initiation of N-linked glycosylation.

B. Oligosaccharide chains are fully elongated.

C. Proteins acquire their biologically appropriate conformation (folding).

D. Translation of proteins destined for the secretory pathway.

E. Both C and D are true.

*54. Which of the following statements concerning biological membranes is TRUE?

A. The two leaflets of phospholipid bilayers have symmetrical phospholipids composition.

B. Cholesterol decreases the mobility of integral membrane proteins.

C. Increasing the concentration of phospholipids with saturated fatty acid chains increases membrane fluidity.

D. Glycolipids are predominantly localized to the nuclear membrane.

E. Both A and C are true.

*55. Which of the following statements concerning the process of transport between membrane compartments is FALSE?

A. Vesicles formation (i.e., budding) occurs spontaneously from planar lipid bilayers

B. Vesicles are targeted to their proper destination by molecular interactions between SNAREs.

C. Transport vesicles are characterized by a single lipid bilayer.

D. Coating proteins (e.g, clathrin) are required to form vesicles.

E. GTPases are required for the proper docking and fusion of membrane vesicles to their target compartments.

*56. Sweat glands and hair follicles originate from:
A. neural crest cells that migrate into the dermis in response to growth factors.
B. skin fibroblasts that are induced to differentiate by epidermal cells.
C. epidermal invaginations into the dermis in response to developmental cues.
D. differentiation of macrophage-related cells in the epidermis.

*57. Which structure integrates the basal layer of keratinocytes with the underlying dermis, and is compromised in several congenital and acquired disorders that cause skin blistering?
A. the desmosome
B. the hemidesmosome
C. the adherens junction
D. gap junctions
E. None of the above are correct.

*58. Fluidity is important for numerous membrane functions. Addition of cholesterol or saturated fatty acids results in:
A. Increased membrane fluidity
B. Decreased membrane fluidity
C. No effect on membrane fluidity
D. Either increase or decrease in fluidity dependent on the temperature of the organism

*59. Proteins enter mitochondria by:
A. transport vesicle fusion
B. mSNARE mechanism
C. active transport mediated by protein translocators
D. None of the above is correct

*60. A plasma membrane protein was found to have a cleavable N-terminal signal sequence followed by a stop-transfer sequence. The N-terminus of this plasma membrane protein is located:
A. in the cytoplasm
B. on the extra cellular surface of the plasma membrane
C. on neither surface; rather it will be a secreted protein
D. None of the above is correct

*61. Receptor-mediated endocytosis is characterized by all of the following EXCEPT:
A. receptor-ligand binding and receptor aggregation
B. clathrin coat formation and membrane budding
C. disassembly of the coat proteins before fusion to target membranes
D. lamin de-phosphorylation and assembly
E. endosome fusion and protein sorting

*62. Which of the following word associations is INAPPROPRIATE?
A. junctional complex/ zonula occludens/ zonula adherens
B. intermediate filaments/ cytokeratins
C. desmosome/ macula adherens

D. zonula occludens/ tight junction
E. desmosome/ microvilli

*63. Cilia
A. are modified microvilli which are non-motile
B. have no known function
C. are usually significantly smaller in height and diameter than microvilli
D. move material in the lumen of several different organs

*64. All cellular membranes have a bilayer organization. The assembly of the bilayer is driven by:
A. flippase enzymes of the membrane
B. self-assembly of amphipathic phospholipids
C. proteoglycans
D. carbohydrates

*65. Integral membrane proteins include
A. insulin
B. ion channels
C. EGF receptors
D. all of the above are correct
E. only B and C are correct

*66. Import of proteins into mitochondria involves
A. appropriate transport vesicle fusion
B. appropriate vSNARE and tSNARE interactions
C. unfolding, translocation, and subsequent refolding of the proteins
D. all of the above are correct

*67. Select the correct statement(s):
A. Adaptins are responsible for selecting specific cargo in transport vesicles
B. Docking of vesicles to target membranes is mediated by vSNAREs and tSNAREs
C. Nuclear transport of proteins involves and requires unfolding, translocation, and subsequent refolding
D. All of the above are correct
E. Only A and B are correct.

*68. Epithelial tissue is classified on the basis of the:
A. shape of the cells
B. number of cell layers
C. presence of cell specializations
D. All of the above are correct

*69. The zonula occludens is characterized most accurately by which of the following terms?
A. intercellular canaliculus
B. hemi-desmosome
C. gap junction
D. tight junction
E. desmosome

*70. Import of the proteins into the lumen of the endoplasmic reticulum involves:
A. transport vesicle fusion
B. vSNARE and tSNARE interactions
C. unfolding, translocation, and subsequent refolding of the proteins
D. co-translational import through a protein translocation channel

*71. Export of proteins from the lumen of the endoplasmic reticulum to the Golgi apparatus involves
A. formation of a COP-coated vesicle
B. transport and vesicle fusion
C. vSNARE and tSNARE interactions
D. specialized membrane fusion proteins
E. All of the above are true

*72. Self-assembly of amphipathic phospholipids is a fundamental mechanism for assembly of:
A. the plasma membrane bilayer
B. the mitochondrial membrane bilayer
C. the ER membrane bilayer
D. all cellular membrane bilayers

*73. Basal bodies are the apical plasma membrane anchoring site for the cytoskeletal network present in this cell surface specialization:
A. desmosomes
B. cilia
C. microvilli
D. intermediate filaments

*74. All of the following cell junctions play a direct role in adhesion EXCEPT:
A. adherens junctions
B. desmosomes
C. gap junctions
D. hemidesmosomes

*75. This intercellular junction plays a critical role in maintaining a barrier between the luminal and interstitial space of a tissue:
A. desmosome
B. keratin filaments
C. adherens junction
D. tight junction

*76. Proteins destined for insertion into the plasma membrane or for secretion:
A. possess a signal sequence peptide recognized by the signal recognition particle.

B. Are translated on a free ribosome in the cytoplasm
C. Are targeted to the endoplasmic reticulum for membrane insertion
D. All of the above are correct
E. Only A and C are correct

*77. Proteins can be stably associated with the lipid bilayer by a:
A. Hydrophobic transmembrane domain
B. Covalently associated fatty acid moiety that inserts into the inner lipid leaflet
C. Covalently associated glycosylphosphatidylinositol (GPI) linkage that inserts into the outer lipid leaflet.
D. All of the above are correct

*78. Which one of the following protein modifications occurs in the endoplasmic reticulum
A. Addition of the core N-linked oligosaccharide chain
B. Addition of a fatty acid tail for insertion into the cytosolic face of the plasma membrane
C. Proper protein folding
D. final maturation of the oligosaccharide chain
E. Only A and C are correct

*79. Which of the following statement(s) about the Golgi complex is/are true?
A. final maturation of the oligosaccharide chains occurs in the Golgi.
B. Posttranslational modifications occur that influence protein sorting to their final destination.
C. Enzymes involved in the oligosaccharide synthesis are segregated into membrane stacks or cisternae
D. All of the above are true
E. None of the above are true

*80. Which of the following protein families and/or sequences are directly involved in the formation of membrane vesicles from lipid bilayers?
A. KDEL sequences
B. SNAREs
C. Coatomers (i.e. coating proteins)
D. Glycosyl transferases
E. All of the above are correct

*81. A newly formed membrane vesicle is targeted to its proper membrane compartment in the cytoplasm using
A. Coatomers (i.e. coating proteins)
B. Rab GTPases
C. SNAREs
D. Specific oligosaccharide sequences
E. Only B and C are correct

*82. Which of the following statements about the use of sorting motifs is/are true?
A. The signal sequence motif targets proteins to the nucleus
B. An exposed mannose-6-phosphate residue is required to target proteins to the lysosome
C. The KDEL amino acid sequence is used to recycle proteins back to the trans-Golgi network

D. All of the above are true

*83. A primary function of the keratinized layer of a stratified epithelial sheet is to:
A. control water loss.
B. Mediate attachment to the basement membrane
C. Generate directed movement of fluid.
D. None of the above

*84. Which of the following structures are designed for intermediate filament attachment to the plasma membrane?
A. Adherens junction and tight junction
B. Adherens junction and hemidesmosomes
C. Desmosome and hemidesmosome
D. Desmosome and gap junction

*85. Which of the following protein modifications occur in the Golgi complex?
A. protein translation
B. addition of the core N-linked oligosaccharide chain
C. initial protein folding
D. final maturation of oligosaccharide chains
E. All of the above are true.

*86. Lipid bilayers are induced to form vesicles due to the action of _____.
A. glycosyltransferases
B. coatamers (i.e., coating proteins)
C. integrins
D. SNAREs

*87. All of the following statements about the process of transport between membrane compartments are true EXCEPT:
A. Budding transport vesicles have a distinct protein coat.
B. Transport vesicles loose the protein coat before fusion with target membranes.
C. Transport vesicles are characterized by a triple layered lipid bilayer.
D. vSNAREs and tSNAREs mediate specificity of docking between membranes.

*88. Epithelial sheets are anchored to the basement membrane by_____.
A. hemi-desmosomes.
B. adherens junctions.
C. desmosomes.
D. basal bodies.
E. hummus.

*89. Paracellular permeability to NaCl is controlled by _____:
A. adherens junctions.
B. tight junctions.
C. gap junctions.
D. proton- K^+ ATPases.
E. goblet cells.

*90. Stereocilia are _____:

A. motile structures designed for absorption.
B. microtubule containing structures that move fluid.
C. basal structures designed for adhesion to collagen.

D. actin containing structures much larger than brush border microvilli.

Week Two

* relevant to class of 2015's lectures
** appears more than once (extra important)

*1. Which protein is NOT found in the extracellular matrix of cartilage?
   A. elastin
   B. collagen II
   C. laminin
   D. the proteoglycan aggrecan

*2. All of the following statements describe properties of the basement membrane (basal lamina) EXCEPT:
   A. The basement membrane is rich in associative glycoproteins therefore is an adhesive substrate for epithelial cells.
   B. The basement membrane induces the differentiation of osteoblasts into osteocytes.
   C. The basement membrane is formed by a meshwork of collagen IV and proteoglycans.
   D. The basement membrane serves as a polarity cue for epithelial cells.

3. Your patient presents clinical signs consistent with Ehlers-Danlos Syndrome. To confirm your diagnosis, you decide to determine how much collagen can be synthesized by fibroblasts from a skin biopsy. Which one of the following options would be the best choice to assess collagen synthesis?
   A. Incubate biopsy fibroblasts with labeled hydroxyproline and measure the label incorporation into collagen I molecules.
   B. Measure lysil oxidase activity.
   C. Determine free N-terminus peptides of alpha 1 collagen content.
   D. Measure glycosaminoglycan content of the sample.

*4. An osteocyte is:
   A. the precursor of an osteon.
   B. the main cell type found in the periosteum.
   C. an osteoclast precursor.
   D. a mature osteoblast that has been surrounded by bone matrix.
   E. the progenitor cell of all bone cells.

5. Which of the following processes occurring in the epiphyseal plate contributes the most to longitudinal bone growth?
   A. differentiation of perichondrium into periosteum.
   B. blood vessel invasion.
   C. osteoblast deposition of bone matrix on calcified cartilage matrix.
   D. chondrocyte apoptosis.
   E. chondrocyte hypertrophy.

*6. Which of the following statements about bone modeling and remodeling is FALSE?
   A. Bone shape is maintained during growth by modeling.
   B. Bone remodeling requires the coupled activity of osteoclasts and osteoblasts to ensure complete restitution of bone mass.
   C. Osteoclasts and osteoblasts are responsible for osteon remodeling.
   D. Only osteoclast activity is required for bone modeling.
   E. Imbalanced activity of osteoclasts and osteoblast during remodeling contributes to osteoporosis.

*7. All of the following are features that distinguish between unilocular and multilocular adipocytes, EXCEPT:

A. shape and localization of the nucleus
B. triglyceride content
C. lipid droplet organization
D. color of the tissue due to capillary abundance and mitochondria content

**8. Which statement about clinical aspects of muscular dystrophies is FALSE?

A. Emery-Dreifuss patients display slowly progressive muscle wasting, contractures of elbows, neck and Achilles tendons, and high risk of sudden cardiac arrest and death.
B. Myotonic dystrophy is the most common muscular dystrophy in adults.
C. It is extremely rare to have Duchenne's without a family history.
D. Most patients with Duchenne's are confined to a wheelchair by age 12 and die in their early 20s.

**9. Which of the following statements about myotonic dystrophy is FALSE?

A. Most cases are caused by expansion of a CTG repeat in the 3'UTR of a gene.
B. There is a correlation between the number of CTG repeats and disease severity.
C. "Genetic anticipation" means that with each generation, disease severity decreases and age of onset increases.
D. Myotonia is delayed muscle relaxation after contraction; it can be detected by shaking a patient's hand.
E. A "pathogenic RNA" model best explains the pathogenesis of both forms of myotonic dystrophy.

*10. Which of the following statements about muscle thin filaments is FALSE?

A. Major components include actin, tropomyosin and the troponins.
B. Thin filaments are elastic and during muscle contraction undergo extensive lengthening.
C. The F-actin is polar with the plus (or barbed) end located at the Z-lines.
D. Thin filaments are the site of calcium regulation in striated muscle.

*

12. Which of the following matrix components confer the functional properties to loose connective tissue?

A. ground substance and collagen I fibers
B. mineralized collagen I
C. elastin and reticular fibers
D. only collagen I bundles

*13. You suspect that one of your patients may have cutis laxa, a disorder characterized by thin and loose skin, but without joint laxity. To confirm your diagnosis as an elastic fiber deficiency, the most appropriate analysis for a skin biopsy would be to measure the content of:

A. hydroxyproline
B. isodesmosine-desmosine
C. collagen III
D. chondroitin and dermatansulfates

*14. Which of the following statements about cartilage is correct?

A. Elastin, proteoglycans and collagen III are components of the extracellular matrix of cartilage.
B. Chondrocytes reside in lacunae interconnected by canaliculi.
C. Regeneration is very efficient.

D. The high negative charge of proteoglycans confers resilience and shock absorbing properties to the tissue.

*15. Which of the following cell types is NOT part of an osteon?
A. osteoclast
B. osteoblast
C. endothelial cell
D. osteocyte

16. The epiphyseal plate:
A. is located between the primary and secondary ossification sites.
B. forms after intramembranous ossification has started to build bone in the medullary cavity.
C. is a determinant in remodeling of mature bones.
D. participates in the ossification of all bone types.

*17. Which of the following statements about bone dynamics is FALSE?
A. Modeling is responsible for increased shaft width.
B. Trabecullae are remodeled by the bone multicellular unit (BMU).
C. The epiphyseal plate is responsible for growth of long bone length.
D. Remodeling renovates the complete skeleton several times over a lifetime.

**18. Regarding clinical aspects of muscular dystrophies, which statement is NOT TRUE?
A. The cartoonist who first drew Popeye may have been thinking of a patient with FSH (facial-scapulo-humoral) muscular dystrophy.
B. Duchenne's is the most frequent lethal heritable childhood illness.
C. It is extremely rare to have Duchenne's without a family history.
D. If a patient has difficulty releasing a handshake, he/she might have myotonic dystrophy.

*19. Which of the following statements about muscle thick filaments is FALSE?
A. The major component of the thick filament is myosin.
B. Thick filaments are elastic and during muscle contraction undergo extensive lengthening to become thin filaments.
C. The shaft of the thick filament consists of an assembly of myosin rods and the myosin heads project from the surface of the shaft.
D. The myosin rod consists of two myosin heavy chains in an alpha-helical coiled-coil structure.

*20. Chondroblasts develop into osteoblasts.
A. True.
B. False.

*21. Splanchnic mesoderm acts as an inducer of all of the following EXCEPT:
A. trachea
B. teeth
C. pancreas
D. lungs
E. none of the above

*22. The humerus develops from which of the following?

A. somite mesoderm
B. lateral plate mesoderm
C. intermediate mesoderm
D. extraembryonic mesoderm
E. sclerotome mesoderm

*23. Limb development involves all of the following except:

A. Wnt signaling
B. sonic hedgehog signaling
C. WT1 (Wilms tumor) signaling
D. cells from the paraxial mesoderm
E. cells from the lateral plate mesoderm

*24. Sclerotomes:

A. give rise to somites
B. form the vertebrae
C. are the only adult remnant of the notochord
D. arise during the second week after fertilization
E. give rise to the muscles of the face

*25. Which of the following features contribute to collagen tensile strength?

I. triple helix association of the alpha peptidic chains
II high levels of glycosylation
III intermolecular covalent cross linking mediated by lysyl oxidase

A. Both I and III are correct.
B. I, II and III are all correct.
C. Only I is correct.
D. Only III is correct.

*26. Which of the following does not belong to an osteon:

A. Volksmann's canal
B. Haversian canal
C. osteocyte
D. canaliculi
E. lacuna

*27. Which of the following sequences of events represents the normal process of during ossification?

A. Chondrocyte proliferation – chondrocyte hypertrophy – chondrocyte apoptosis – osteocyte – osteoblasts.
B. Cartilage template – primary ossification center – epiphyseal plate closure, secondary ossification center.
C. Mesenchymal cells – mesenchymal collagen - osteoblasts – osteoid (prebone) - bone
D. None of the above is correct.

*28. Which of the following statements about the basal lamina is INCORRECT?

A. found beneath every type of epithelium
B. rich in collagen IV and proteoglycans
C. surrounds chondrocytes and osteocytes
D. contains abundant associative glycoproteins

*29. Which of the following statements about cartilage is FALSE?
A. Cartilage is avascular tissue.
B. Chondrocytes lie in lacuna.
C. Interstitial growth is due to extracellular matrix accumulation and limited cell proliferation.
D. The extracellular matrix is rich in proteoglycans and collagen III.

*30. Which filaments in muscle are known to be elastic?
A. thick filaments
B. thin filaments
C. intermediate filaments composed of desmin
D. titin filaments

*31. Which of the following statements about muscle sarcomeres is FALSE?
A. They are the fundamental repeating unit of myofibrils, extending from one Z-disc to the next Z-disc.
B. During muscle contraction, both the I-band and the H-zone narrows.
C. single molecules of the giant polypeptide titin span half a sarcomere from M-line to Z-disc.
D. The giant polypeptide obscurin may serve to link sarcomeres to the sarcoplasmic reticulum.
E. Thick filaments are attached to Z-discs.

*32. Cardiac muscle is characterized by all of the following EXCEPT:
A. Intercalated disks provide linkage between adjacent cells.
B. Contraction is regulated by MLCK phosphorylation of myosin.
C. Contain myofibrils similar to those found in skeletal muscle.
D. Cardiac muscle cells contain 1-2 nuclei and the cells are often branched.
E. Gap junctions lie primarily along lateral contact surfaces of the intercalated disc and provide electrical connection between cells.

**33. All of the following statements about myotonic dystrophy are true <u>EXCEPT:</u>
A. Myotonic dystrophy is the most common muscular dystrophy in adults.
B. Patients with myotonic dystrophy exhibit myotonia, a delay in muscle relaxation.
C. In myotonic dystrophy, nearly every organ system is affected.
D. Myotonic dystrophy exhibits genetic anticipation: with each generation, disease severity decreases and age of onset increases.

*34. Which of the following statements about myotonic dystrophy is <u>NOT TRUE</u>?
A. The genetic defect is an expansion of a tri-nucleotide repeat in the 3'UTR of the DMPK (myotonic dystrophy protein kinase) gene.
B. The severity of the disease is proportional to number of tri-nucleotide repeats.
C. The genetic anticipation results from expansion of the number of trinucleotide repeats with each generation.
D. A single mechanism can explain the myotonia, heart arrythmias and cataracts.

*35. All of the following statements about Duchenne's/Becker's or the dystrophin glycoprotein complex (DGC) are true <u>EXCEPT</u>:
A. Most Duchenne's patients have out-of-frame deletions that produce mRNA with premature stop codons.
B. Most Becker's patients have in-frame deletions that produce smaller, abundant and largely functional dystrophin.

C. The DGC is likely to provide structural reinforcement to the muscle cell membrane to protect it from mechanical stress produced by repeated muscle activity.
D. To date, with the exception of dystrophin, no other components of the DGC are implicated in muscular dystrophies.
E. Anti-sense induced exon skipping is a promising approach for treating Duchenne's.

**36. Which of the following statements about muscle thin filaments is FALSE?
A. Thin filaments are unipolar.
B. During muscle contraction, thin filaments undergo shortening.
C. Thin filaments are the sites of calcium regulation in striated muscle.
D. The major components of thin filaments are F-actin, tropomyosin and the troponins.
E. Thin filament length is proportional to the size of nebulin.

**37. The radius develops from which of the following?
A. sclerotome mesoderm
B. somite mesoderm
C. intermediate mesoderm
D. extraembryonic mesoderm
E. lateral plate mesoderm

*38. Smooth muscle is characterized by all the following EXCEPT?
A. Intercalated disks provide linkage between adjacent cells.
B. Contraction is regulated by MLCK phosphorylation of myosin.
C. Thin filaments and intermediate filaments are attached to dense bodies.
D. Smooth muscle contains bipolar myosin filaments.
E. Smooth muscle fibers are relatively small muscle cells with single nuclei.

*39. Which of the following components can be found in the extracellular matrix of cartilage?
A. collagen I, aggrecan, elastin
B. fibronectin, collagen II, osteonectin
C. proteoglycans, laminin, collagen IV
D. elastin, collagen II, aggrecan

*40. All of the following statements characterize calcium regulation of muscle contraction **EXCEPT:**
A. In striated muscle, calcium regulation occurs through the troponin-tropomyosin complex.
B. In cardiac muscle, calcium regulation occurs through intermediate filaments.
C. In smooth muscle, calcium regulation occurs through the calcium/calmodulin activation of myosin light chain kinase.
D. Sarcoplasmic reticulum is a primary calcium storage and release depot.

41. Which of the following statements about muscle thick filaments is **FALSE?
A. The major component of thick filaments is myosin.
B. Thick filaments are elastic and during muscle contraction undergo extensive lengthening.
C. Thick filaments are bipolar.
D. The shaft of the thick filament consists of an assembly of myosin rods and the myosin heads project from the surface of the shaft.

*42. If a patient has a difficulty releasing a handshake, he/she is most likely to have:

A. Duchenne's muscular dystrophy.
B. Emery-Dreyfus muscular dystrophy
C. FSH (facial-scapulo-humoral) muscular dystrophy
D. Myotonic dystrophy
E. Tibial muscular dystrophy

*43. The side chains of which of the following components are involved directly in the formation of covalent cross links between adjacent alpha chains and collagen molecules in collagen microfibrils?
A. glycine
B. allysine
C. mannose
D. hydroxyproline

44. Which of the following IS NOT an important factor in facilitating adequate bone growth and maintenance of bone mass?
A. osteoblast deposition of prebone collagen
B. Regular exercise
C. Vitamin C
D. Osteoblast production of hyaluronic acid
E. An integral vascular supply

*45. Which of the following statements about adipocytes is true?
A. are derived from fibroblasts
B. can synthesize intracellular triglyceride using fatty acids released from chylomicrons
C. have no ER or mitochondria
D. possess no cell surface receptors

46. Vitamin C deficiency normally leads to all of the following defects in collagen production EXCEPT:
A. synthesis of pro-alpha chains with an altered Gly-X-Y pattern
B. reduced hydroxylation of prolines in pro-alpha chains
C. reduced hydroxylation of lysines in pro-alpha chains
D. inhibition of superhelix formation of pro-alpha chains

*47. Which of the following statement about fibroblasts is INCORRECT?
A. they are capable of proteoglycans biosynthesis
B. they routinely perform glycosylation of proteins destined for expert
C. they can respond to antigens by producing immunoglobulins
D. they are the primary cellular components of tendons

*48. Which of the following is NOT a characteristic of osteons?
A. Osteons can develop in bones derived from both intramembranous and endochondral ossification.
B. Osteocytes maintain cell surface contact and gap junctions within canaliculi in the matrix lamellae of osteons.
C. Blood vessels, nerves, and osteogenic cells can be found at the center of the osteon.
D. Once formed, all osteons are maintained throughout the life of an individual.

**49. Which of the following statements about thin filaments in muscle is FALSE?
A. the major components are F-actin, tropomyosin, and the troponins
B. they are unipolar
C. they are the site of Ca^{2+} regulation in striated muscle

D. during muscle contractions, they undergo extensive shortening

*50. Which of the following statements about Emery-Dreifuss syndrome is NOT TRUE?
A. cardiac conduction block with high risk of sudden death
B. X-linked cases are due to mutation in a gene encoding an inner nuclear membrane protein (emerin)
C. autosomal dominant cases are due to mutation in a gene encoding lamins A and C
D. emerin and lamins A and C are expressed only in striated muscle

*51. Which of the following is NOT a characteristic of compact bone?
A. it is a highly vascular tissue
B. cells within the matrix maintain contact via gap junctions between cytoplasmic processes that occupy canaliculi in bone lamellae
C. cells within the matrix can contribute to interstitial growth by cell division
D. bone matrix is hard and resists bending because of its inorganic material content

*52. Which of the following is NOT a characteristic of intramembranous bone formation?
A. vascular invasion precedes initiation of osteoblastic activity
B. hydroxyapatite deposition occurs within and around collagen microfibrils
C. osteoblasts deposit prebone on calcified cartilage matrix
D. it occurs primarily in skull bones
E. osteons form in areas which develop into compact bone

*53. Which of the following is NOT a characteristic of chondrocytes?
A. respire primarily by glycolysis
B. synthesize and secrete Type II collagen
C. are actively motile, migrating to multiple new positions
D. synthesize and secrete sulfated proteoglycans
E. can divide in cartilage matrix giving rise to interstitial growth

*54. In considering the differences and similarities between skeletal, cardiac, and smooth muscles, which of the following is INCORRECT?
A. Skeletal muscle has evolved for rapid contractions, whereas smooth muscle has evolved for slow, sustained contractions.
B. Calcium regulation is mediated by the troponins and tropomyosin in smooth muscle, whereas calcium regulation is mediated by the regulatory myosin light chains in skeletal muscle (myosin- or thick filament-based).
C. Cardiac muscle consists of short cells (fibers) that are often branched, contain single centrally placed nuclei and are linked to other cells by intercalated disks.
D. Smooth muscle consists of sheets of long, spindle shaped cells containing centrally placed nuclei.

*55. All of the following characterize Emery-Dreifuss EXCEPT:
A. A clinical picture of slowly progressive muscle weakness, contracture of elbows, and cardiomyopathy with a high risk of sudden death.
B. Most cases are X-linked and contain mutations in the gene for "emerin," but some cases are autosomal dominant and contain mutations in the gene for lamins A and C.
C. Both emerin and the lamins are localized to the inner mitochondrial membrane.
D. Emerin is one of at least 6 integral membrane proteins embedded in the inner nuclear membrane and interacts with the nuclear lamina composed primarily of lamins.

*56. Which of the following statements about osteoclasts is INCORECT?

A. exhibit parathyroid hormone receptors on the plasma membrane opposite the ruffled border

B. are derived from a coalescence of monocytes

C. can mediate dissolution of hydroxyapatite by releasing carbonic acid

D. are present in bone throughout life

*57. Canaliculi in living bone:

A. contain cellular processes of osteocytes

B. form "lifelines" between osteocytes and the nearest blood supply

C. are formed as a result of osteoblasts being trapped in freshly deposited prebone

D. are the sites where intercellular communication between osteocytes takes place via gap junctions

E. all of the above are correct

*58. Antibodies to _____ have proven very useful as markers in identifying the tissue of origin of a particular tumor.

A. keratins
B. actin and tubulin
C. dynein and kinesin
D. intermediate filament proteins
E. Both A and D are correct

*59. Movement of organelles throughout the cell and along microtubules occurs via the action of:

A. actin and α-actinin
B. dynein and kinesin
C. myosin I and calmodulin
D. spectrin and myosin II
E. keratin and dystrophin

*60. The centrosome of mammalian cells:

A. is the assembly of proteins located at the centromere called the kinetochore.
B. is a microtubule structure identical in for to the basal body.
C. contains multiple ring-like structures that contain γ-tubulin and nucleate microtubule assembly.
D. is responsible for capture and regulation of microtubule plus (+) ends in the mitotic spindle.
E. duplicates numerous times (~23 times) during S-phase of the cell cycle.

Week Three

ETC Week 3 Quiz Questions

1. Which of the following is NOT a characteristic of a tumor cell?
   A. growth in the absence of growth factors
   B. diploid karyotype
   C. immortality
   D. lobate nucleus
   E. uncontrolled cell growth

2. Cancers derived from epithelial cells are termed
   A. melanomas
   B. carcinomas
   C. teratomas
   D. sarcomas
   E. gliomas

3. Wnt and TGF-beta family members are:
   A. thalidomide derivatives
   B. extracellular signaling molecules
   C. transcription factors
   D. kinases
   E. none of the above

4. The mechanism of movement of chromosomes during anaphase A directly involves _____:
   A. rapid, controlled loss of tubulin subunits at the plus (+) end of kinetochore microtubules and continued, relatively slow loss of tubulin subunits at the minus (-) of the kinetochore microtubules.
   B. activation of a minus (-) end molecular motor localized at the kinetochore.
   C. myosin and actin mediated contraction of the contractile ring.
   D. concurrent nuclear lamin phosphorylation and disassembly.
   E. Only A and B are correct.

5. The Cdks are central regulators of the cell cycle that are controlled by _____:
   A. binding of cyclin.
   B. binding of Cdk inhibitor proteins.
   C. degradation of cyclin by ubiquitin mediated proteolysis.
   D. phosphorylation of regulatory residues in the Cdks.
   E. All of the above are true.

6. Apoptosis is characterized by _____:
   A. programmed cell death.
   B. cleavage of nuclear lamina components.
   C. activation of caspase proteases.
   D. condensation and degradation of DNA and formation of apoptotic bodies.
   E. All of the above are correct.

7. Antibodies to which of the following proteins are useful in identifying cells in a tumor derived from epithelia?

A. laminin
B. tubulin
C. keratin
D. actin
E. myosin

8. The anti-tumor drug taxol (paclitaxel), and related compounds, operate by directly _____:
A. inhibiting origins of replication during S-phase.
B. blocking actin assembly.
C. inhibiting normal microtubule dynamics, blocking the cells in mitosis.
D. activating the G2 proofreading checkpoint.
E. stabilization of nuclear lamins preventing nuclear envelope breakdown

9. Cancers derived from connective tissue cells are termed
A. melanomas
B. carcinomas
C. teratomas
D. sarcomas
E. gliomas

10. Cancerous cells have all of the following characteristics except:
A. unstable karyotype
B. immortality
C. minimal extracellular matrix
D. reduced cell division rate
E. growth factor-independent growth

11. The process of Anaphase A is characterized by:
A. movement of sister chromatids toward the mitotic spindle poles
B. shortening of kinetochore microtubules
C. movement of kinetochores from the metaphase plate toward the mitotic spindle poles
D. all of the above are correct

12. The microtubule organizing center (MTOC) in animal cells:
A. nucleates and anchors cellular microtubules at microtubules minus ends
B. plays a central role in organizing the Golgi
C. duplicates during the cell division cycle
D. contains gamma-tubulin, the key initiator of microtubule assembly
E. all of the above are correct

13. The chemical taxol acts as an anti-tumor drug by:
A. blocking cells in S-phase
B. activation of p53
C. dissociation of the contractile ring, preventing cell division
D. blocking cells in M-phase by microtubule stabilization

14. Which of the following characterize the process of transport between membrane components?
A. Budding transport vesicles have a distinct protein coat
B. Transport vesicles lose the protein coat before fusion with target membranes
C. A “fusion complex”-catalyzed fusion of vesicles and target membranes
D. vSNAREs and tSNAREs mediate specificity of docking between membranes

E. All of the above are correct

15. p53 is involved in:
A. the DNA damage checkpoint pathway
B. transcriptional activation of the Cdk inhibitor, p21
C. vesicular sorting
D. cytoplasmic motility mechanisms
E. only A and B are correct

16. All of the following statements about apoptosis are correct EXCEPT:
A. Apoptosis can be activated by extracellular death signals.
B. The "execution" phase of apoptosis is carried out by a family of proteases, the caspases.
C. Apoptosis is designed to trigger an inflammatory response from the immune system.
D. The intrinsic or intracellular initiated apoptotic pathway requires mitochondria.
E. All of the above are correct.

17. The phosphorylation of retinoblastoma protein is involved in:
A. activating a transcription factor
B. driving separation of chromosomes during mitosis
C. mitosis sorting
D. cytoplasmic motility mechanisms
E. both A and C are correct

18. Oncogenes may encode:
A. a growth factor receptor
B. an inhibitor of the cell cycle
C. an activator of the cell cycle
D. all of the above are correct
E. only A and C are correct

19. Caspases are cellular enzymes involved in:
A. successive activation of cyclin proteins
B. triggering programmed cell death
C. cleavage of proinsulin into insulin
D. all of the above are correct

20. Injection of cytoplasm from an M-phase cell into a cell that is in the S-phase of the cell cycle would result in the injected cell:
A. readily entering mitosis
B. never exiting the S-phase
C. entering and arresting in G2 phase of the cell cycle
D. reverting back to the G1 phase of the cell cycle
E. all of the above are correct

21. Actin filaments are polarized structures with distinct plus and minus ends. The polarity of the thin filaments plays a central role in the organization of the cell and directs myosin-based cell movement. The plus end of an actin filament is:
A. located at the "barbed-end" of the filament
B. the primary site of addition of new actin subunits during filament growth
C. the direction toward which myosin II moves during muscle contraction
D. All of the above are true

22. Nuclear lamins are skeletal components of the nuclear matrix. All of the following are

characteristics of lamins EXCEPT:

A. Lamins are members of the fibronectin/laminin/desmoplakin family of proteins
B. Lamin disassembly is regulated by cyclin-dependent kinases
C. Lamins are members of the intermediate filament family of proteins
D. Lamins support the nuclear envelope

23. All of the following are characteristic of the centrosome EXCEPT:

A. the centrosome is the primary microtubule organizing center of human cells
B. the centrosome contains gamma-tubulin ring structures that nucleate microtubule assembly.
C. the centrosome duplicates during anaphase of mitosis
D. centrosomes in humans contain microtubule-based structures called centrioles
E. cellular microtubules minus-ends are located at the centrosome

24. All of the following are characteristic of mitosis EXCEPT:

A. during anaphase A in human cells, kinetochore microtubules shorten primarily by loss of subunits at their plus ends.
B. separation of chromosomes cannot begin until all chromosomes are properly aligned on the metaphase mitotic spindle due to the mitotic spindle checkpoint mechanism
C. myosin is responsible for movement of chromosomes toward the spindle poles during anaphase
D. the kinetochore is responsible for multiple functions include capture of microtubule plus ends and control of kinetochore microtubule elongation and shortening

25. Anti-tumor drugs such as vinchristine and taxol affect tumor growth by:

A. inducing actin filament disassembly, blocking cytokinesis
B. blocking myosin ATPase activity during mitosis
C. interfering with microtubule function during mitosis
D. interrupting nuclear lamin disassembly

26. Programmed cell death is:

A. called apoptosis
B. necrosis
C. always bad for CNS development
D. the name of a punk rock band

27. Retinoblastoma is a good example of a:

A. a growth factor receptor
B. an oncogene
C. a tumor suppressor
D. only A and C are correct

28. Activation of cyclin-dependent kinases, CDKs, involves:

A. ubiquitination and degradation of cyclins
B. accumulation of cyclins
C. phosphorylation and dephosphorylation of specific residues in CDKs
D. only B and C are correct

29. Apoptosis is characterized by:

A. plasma membrane blebbing
B. formation of apoptotic bodies
C. activation of a cascade of proteases
D. all of the above are correct

30. Basal bodies are the apical plasma membrane anchoring site for the cytoskeletal network

present in this cell surface specialization:

A. desmosomes
B. cilia
C. microvilli
D. intermediate filaments

31. Anaphase A of mitosis is characterized by all of the following EXCEPT:

A. actin microfilaments at the contractile ring designed to pull sister chromatids apart
B. shortening of kinetochore microtubules by loss of tubulin subunits predominantly at the microtubule plus end
C. activation of minus end directed molecular motors located at the kinetochore
D. sister chromatid separation and movement toward the poles

32. The microtubule organizing center (MTOC) of human cells is typically characterized by all of the following EXCEPT:

A. contains g-tubulin
B. nucleation and anchoring of microtubule minus ends
C. duplicates in S-phase of the cell cycle of the dividing cells
D. is only required for cell division
E. is usually called the centrosome

33. The anti-tumor drug taxol operates by:

A. disruption of the acto-myosin contractile ring blocking cell division
B. stabilization of the mitotic microtubules, blocking mitosis
C. binding to the tumor suppressor p53
D. stabilization of nuclear lamins preventing nuclear envelope breakdown

34. All of the following are characteristic of Anaphase A **EXCEPT:**

A. Activation of a minus (-) end molecular motor localized in the kinetochore
B. Rapid, controlled loss of tubulin subunitsat the (+) end of kinetochore subunits
C. Continued, relatively slow loss of tubulin subunits at the minus (-) end of the kinetochore microtubules
D. Nuclear lamin phosphorylation and disassembly

35. The kinetochore is characterized by all of the following **EXCEPT:**

A. A complex of proteins organized on a paired structure located on the sister chromatids
B. Gamma-tubulin containing structures that nucleate interphase and mitotic microtubule assembly
C. Specialized for capture and control of spindle microtubule plus (+) ends
D. Designed to control the addition and loss of tubulin as kinetochore microtubules grow and shorten

36. The Cdks are central regulators of the cell cycle that are controlled by:

A. Binding of cyclin.
B. Binding of Cdk inhibitor proteins.
C. Degradation cyclin by ubiquitin mediated proteolysis
D. Phosphorylation of regulatory residues in the Cdks
E. All of the above are true.

38. Which of the following perform as microtubule organizing centers (MTOCs) at the apical

surface of certain columnar epithelial cell types?

A. Connexons
B. Basal bodies
C. Brush border
D. Terminal web
E. Striated border

39. Movement of organelles throughout the cell and along microtubules occurs via the action of:

A. actin and α-actinin
B. dynein and kinesin
C. myosin I and calmodulin
D. spectrin and myosin II
E. keratin and dystrophin

40. The centrosome of mammalian cells:

A. is the assembly of proteins located at the centromere called the kinetochore.
B. is a microtubule structure identical in for to the basal body.
C. contains multiple ring-like structures that contain γ-tubulin and nucleate microtubule assembly.
D. is responsible for capture and regulation of microtubule plus (+) ends in the mitotic spindle.
E. duplicates numerous times (~23 times) during S-phase of the cell cycle.

41. Inhibition of cyclin dependent kinases, Cdks, involves each of the following EXCEPT:

A. the ubiquitination and proteolysis of cyclins
B. the activity of CKI's (cyclin dependent kinase inhibitor proteins) including certain tumor suppressors.
C. Phosphorylation and dephosphorylation of specific residues in catalytic subunit of Cdks
D. Synthesis of cyclins

42. The drug taxol acts to:

A. promote microtubule stabilization and block cell division.
B. promote microtubule disassembly and block cell division.
C. promote cell division, the cell cycle and tissue growth.
D. sever microtubules and block metaphase.
E. inhibit kinesin and dynein motor activity.

43. You are:

A. a glazed doughnut.
B. a doughnut.
C. a jelly-filled doughnut.
D. a bagel.
E. all of the above

Vascular

Vascular system practice questions *(written by Claire Hailey- not from old tests!!)*

1. The internal cellular lining of the cardiovascular system is the _____.

2. Arteries are (low or high) pressure vessels with (thinner or thicker) walls.

3. Veins are (low or high) pressure vessels with (thinner or thicker) walls.

4. Endothelial cell functions include:
    a. Selective permeability barrier
    b. Synthesize basement membrane components
    c. Provide a non-thrombogenic surface
    d. Prevent blood clotting
    e. All of the above

5. The endocardium is made of _____ on a thin layer of connective tissue and smooth muscle cells.
    a. Simple squamous epithelium
    b. Simple cuboidal epithelium
    c. Simple columnar epithelium
    d. Stratified squamous epithelium

6. The epicardium is lined by mesothelial cells that secrete the _____ fluid.

7. The above fluid serves what purpose?

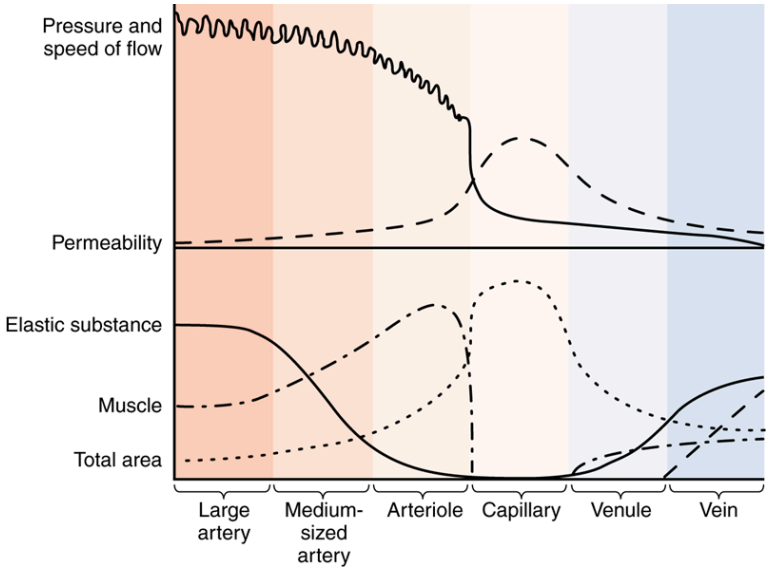
8. Which vessel regulates blood pressure the most?
    a. Capillaries
    b. Postcapillary venule
    c. Arteriole
    d. Veins

9. Which vessel is most likely to contain leukocytes?
    a. Capillaries
    b. Postcapillary venule
    c. Arteriole
    d. Veins

10. Capillary beds can be bypassed by the _____.

11. An example where capillary beds would be bypassed is: _____

12. Understand this chart (slide 15) as there could be many related questions:



13. What are the three main components of large vessels?

14. What are the three main components of capillaries and postcapillary venules?

15. Vessel type is determined by:
    a. Location in body
    b. Circumference
    c. Thickness and composition of layers
    d. Direction of flow

16. The internal elastic membrane is composed primarily of _____.

17. The internal elastic membrane separates the _____ from the _____.

18. The external elastic membrane separates the _____ from the _____.

19. Where is vaso vasorum located?
    a. Intima
    b. Media
    c. Adventitia
    d. Heart

20. The _____ arteries absorb impact of ventricular contraction and rebound during diastole.

21. The artery in question 20 has a very (thin or thick) media.

22. Marfan syndrome has a gene defect in _____.
23. Marfan syndrome can lead to _____.

24. Most of the "named" arteries are _____ arteries.

25. _____ is the hardening and narrowing of the arteries.

26. Mesenchymal cells that support small vessels are _____.

27. Fenestrated capillaries are prominent in tissues requiring _____.

28. _____ is when WBCs leave and enter circulation.

29. Capillaries drain into thin-walled vessels of increasing diameter called _____.

30. Valves _____ during systole and _____ during diastole.

31. Large veins have a (thin or thick) adventitia.

32. Rapid increases in capillary permeability can lead to edema in the skin known as _____.

33. Vasculogenesis includes all the following processes except:
    a. Angioblast differentiation
    b. Angioblast migration to site of vessel formation
    c. Intussusception
    d. Endothelialization

34. Angiogenesis includes the processes of:
    a. Sprouting angiogenesis
    b. Intussusception
    c. Both A and B
    d. Neither A nor B

35. The first organ system to develop is the _____.

36. The placenta does all the following except:
    a. Form from the fusion of the allantois with the chorion
    b. Connect the fetal urine to the mother's urinary tract
    c. Connect the vasculature of the mother and embryo
    d. Provide supply of oxygen and nutrients to the embryo

37. The _____ _____ serves the young embryo with nutrient absorption and a source of blood cells.

38. _____ vessels develop between somites.

39. Sprouting angiogenesis is initiated by:
    a. Stock cells
    b. Tip cells
    c. Doughnuts
    d. None of the above

40. What is the result of VEGF-A knock out mice?

a. Defective vascular development
b. Embryonic lethal
c. No effect
d. A and B

41. What are the molecular activities of VEGFR?
    a. Vascular permeability
    b. Cell migration
    c. Cell survival
    d. Actin remodeling
    e. All of the above plus many more

42. Too much angiogenesis may lead to:
    a. Psoriasis
    b. Obesity
    c. IBS
    d. Endometriosis
    e. All of the above

43. Too little angiogenesis may lead to:
    a. All of the below
    b. Ischemia
    c. Alzheimer's
    d. Atherosclerosis
    e. Chronic wounds

44. The point when dormant tumors acquire the ability to induce angiogenesis is known as _____.

VAnswers

Week One

1. The medulla oblongata derives from the
    A. Telencephalon
    B. metencephalon
    C. diencephalon
    *D. myelencephalon
    E. none of the above

2. Atresia refers to
    *A. obstruction of a tube
    B. pinching in of a tube
    C. overgrowth of a tube
    D. narrowing of a tube
    E. none of the above

3. The rostral and caudal neuropores usually close during the _____ week.
    A. third
    *B. fourth
    C. fifth
    D. sixth
    E. seventh

*4. Gastrulation begins during
    A. week 1
    B. week 2
    *C. week 3
    D. week 4
    E. at fertilization

5. Defects in which organ system represent the greatest frequency of major congential anomlies?
    *A. brain
    B. heart
    C. kidneys
    D. limbs
    E. lungs

6. Oligohydramnios is associated with all of the following except:
    *A. esophageal atresia
    B. low volume of amniotic fluid
    C. renal agenesis
    D. urinary tract obstructions
    E. retardation of lung development

* 7. Limb development involves all of the following except:
    A. Wnt signaling
    B. sonic hedgehog signaling
    *C. WT1 (Wilms tumor) signaling
    D. cells from the paraxial mesoderm
    E. cells from the lateral plate mesoderm

8. What is referred to as "a progressive disorder in signal transduction?"
    A. renal agenesis
    B. transposition of the great vessels
    C. spina bifida
    *D. cancer
    E. epispadias

*9. Failure of fusion of the halves of the vertebral arches results in:
    A. hydrocephalus
    B. acrania
    C. only minor problems
    D. lethal consequences
    *E. spina bifida

10. Congenital hypertrophic pyloic stenosis:
    A. involves an hypertrophy of the ileum
    *B. involves an enlargement of the pyloris
    C. results from excessive recanalization of the pyloris
    D. is not associated with projectile vomiting
    E. is the most common anomaly of the stomach

11. Gastroschisis:
    *A. permits extrusion of the abdominal viscera without involving the umbilical cord
    B. cannot be distinguished from an omphalocele
    C. is incompatible with life
    D. is also referred to as "left-sided" colon
    E. is an extremely common malformation

*12. Limb bud formation begins towards the end of which week?
    A. week 2
    B. week 3
    *C. week 4
    D. week 5
    E. week 6

13. Sclerotomes:
    A. give rise to somites
    *B. form the vertebrae

C. are the only adult remnant of the notochord
D. arise during the second week after fertilization
E. give rise to the muscles of the face

*14. Neural crest cells give rise to all of the following except:
A. melanocytes
B. suprarenal medulla
C. Schwann cells
D. peripheral ganglion cells
*E. corpus callosum cells

*15. The foregut gives rise to all of the following except:
A. liver
*B. spleen
C. pharynx
D. esophagus
E. pancreas

16. When chorionic villi become vascularized, they are referred to as primary villi.
A. True
*B. False
@ When chorionic villi become vascularized, they are referred to as tertiary villi

17. Hypoplasia is a term used to indicate an increase in cell size.
A. True
*B. False
@ Hypertrophy is a term used to indicate an increase in cell size

18. Pulmonary valve stenosis is associated with Tetralogy of Fallot.
*A. True
B. False

*19. According to recent statistics, approximately what percentage of pregnancies end in spontaneous abortion:
A. 10%
B. 20%
C. 30%
*D. 40%
E. 50%

*20. A secondary oocyte finishes meiosis II:
A. at the time of ovulation
B. after pronuclear fusion
C. while in a primordial follicle
*D. at fertilization
E. after release from nurse cells

21. Which of the following can derive from defects in the maternal chromosome set?

A. Hydatidaform moles and Prader-Willi syndrome
*B. Teratomas and Angelmann syndrome
C. Teratomas and Prader-Willi syndrome
D. Hydatidaform moles and Angelmann syndrome
E. none of the above

22. The salamander experiments of Towne and Holtfreter demonstrated that
A. embryonic cells are not adherent
B. embryonic cells cannot independently orient themselves in the correct location
C. embryonic cells are totipotent
D. embryonic cells quickly change their fate
*E. embryonic cells can recognize "self"

23. A male infant with hypospadias was referred to the urologist. This developmental anomaly:
A. occurs in about 1:400 male infants
B. is associated with extrophy of the bladder
C. involves the scrotum in most cases
*D. results from defected fusion of the urogential folds
E. is almost never associated with chordee

*24. The SRY gene
A. regulates gamete proliferation
B. encodes a cell surface receptor
C. is located on human chromosome 22
*D. is the master regulatory gene in testes development
E. encodes a growth factor

*25. Wnt and TGF-β family members are:
A. thalidomide derivatives
*B. extracellular signaling molecules
C. transcription factors
D. kinases
E. none of the above

*26. The zona pellucida serves as a barrier that normally allows only sperm of the same species access to the egg.
*A. True
B. False
~ The interaction between the sperm and zona pellucida is species-specific due to the "sperm receptors" of the ZP3 glycoprotein. Sperm are able to recognize and bind to the receptor by a specific O-linked oligosaccharide on the ZP3.

27. The anterior pituitary gland is derived from neural ectoderm.
A. True

*B. False

~ The anterior pituitary gland is derived from the hypophysial diverticulum from the stomodeum, or primordial oral cavity. This tissue is derived from surface ectoderm. The *posterior* pituitary gland is derived from neural ectoderm.

28. Hydrocephalus in an infant is synonymous with an enlarged head.
A. True
*B. False

*29. Maternal alcohol syndrome (fetal alcohol syndrome) is the single most common cause of mental retardation.
*A. True
B. False

~ Fetal Alcohol Syndrome is the most common cause of mental retardation for a few reasons: even moderate drinking can produce FAS affects, 2% of all women of childbearing age are alcoholics, and lastly, the critical period for brain development is the longest of any organ system, making the brain highly susceptible to defects for a long period.

30. Tumor suppressor genes are characterized by requiring both copies of the gene to be mutant to induce tumor formation.
*A. True
B. False

~ A tumor suppressor gene is a gene that reduces the probability that a cell in a multicellular organism will turn into a tumor cell. A mutation or deletion of such a gene will increase the probability of the formation of a tumor. If only one allele for the gene is damaged, the second can still produce the correct protein.

31. Microcephaly is the result of abnormal development of the central nervous system in which the brain and, consequently, the cranium fail to grow.
*A. True
B. False

32. Chondroblasts differentiate into osteoblasts.
A. True
*B. False

~ Chondroblasts are cartilage-forming cells that develop at chondrification centers in condensed mesenchyme. Chondroblasts form three kinds of cartilage. Osteoblasts are bone forming-cells that also develop from condensation of mesenchyme. Cartilage does not turn into bone-forming substances

*33. Hyperplasia involves an increase in the volume of cells.
A. True
*B. False

~ Hyperplasia is an abnormal increase in the number of cells. Hypertrophy is an abnormal increase in cell size.

34. The AER plays an important role in determining the proximal/distal axis of the limbs.

*A. True
B. False

~ AER (apical ectodermal ridge) is the multilayered epithelial structure at the apex of each limb bud that interacts with mesenchyme to promote outgrowth and development of the bud in a proximal-distal axis.

*35. Which is the gene for male sex determination in humans?

A. TDF
B. SXF
*C. SRY
D. ZFY
E. WNT

36. An increased incidence of what condition is strongly associated with advanced maternal age?

A. ambiguous genitalia
*B. Trisomy 21
C. Trisomy 18
D. anencephaly
E. Tetralogy of Fallot

*37. A child is born with a neural tube defect and a ventricular septal defect, but has normal development of the genitalia as well as palate and teeth. If an environmental insult is responsible for these defects, during what period after fertilization was the insult most likely to occur?

A. less than 1 week
*B. 3-5 weeks
C. 7-9 weeks
D. 12-14 weeks
E. 21-24 weeks

@ If the insult had occurred between the 7-9th weeks, then you are less likely to have the heart defect, and more likely to see defects in the palate, teeth, and genitalia. By the 12-14 weeks, the only organ systems still within the timeframe of their most sensitive periods are the brain and possibly the external genitalia, but the period in which a CHD is mostly likely to occur is long past.

38. Nucleated erythrocytes circulating in the embryo during the first 6 weeks are produced in the:

A. liver
B. bone marrow
*C. yolk sac

D. spleen
E. endocardium

~ The blood islands of the yolk sac will be the source of blood cells during the first 5 weeks.

@ The liver will take up blood cell formation around week 5 or 6, and the bone marrow will be the site of blood cell production by month 5. The spleen has a short stint of fairly insignificant blood cell production around the 6^{th} or 7^{th} week.

39. Blood vessels associated with which structure enter the fetal component of the placenta?
*A. allantois
B. decidual parietalis
C. amnion
D. yolk sac
E. decidual basalis

~ The allantois is associated with the connecting stalk through which blood vessels travel from embryo to placenta.
@ The decidua parietalis and basalis are maternally derived. The amnion and yolk sac do not participate in the placenta.

40. The physiological herniation of the intestines begins during:
A. week 4
B. week 5
*C. week 6
D. week 7
E. week 8

*41. Neural crest cells arise from:
A. Somites
B. Dorsal nonneural ectoderm
*C. Neural tube
D. splachnic lateral plate mesoderm
E. somatic lateral plate mesoderm

~ As the neural tube separates from the surface ectoderm, neural crest cells migrate off to either side of it.
@ Somites form from paraxial mesoderm on either side of the notochord. Neural crest cells derive from dorsal neuroectodermal cells, making dorsal nonneural ectoderm an incorrect answer. The neural crest cells develop from medial ectoderm, so the lateral plate mesoderm options are also incorrect.

*42. Neural crest contributes to the structure of which of the following?
A. Truncus Arteriosus
B. Pulmonary Trunk
C. Ascending Aorta
D. none of the above
*E. all of the above

~ Neural crest cells participate in the separation and spiraling of the bulbar and truncal ridges, which form the aorta and pulmonary trunk.

*43. What molecule produced by the notochord is instrumental in inducing the floor plate of the neural tube?

A. HOXA-5
B. Retinoic Acid
C. L-Selectin
D. PAX-3
*E. Sonic Hedgehog

~ The notochord induces the neural plate (and later the ventral part of the neural tube) to begin formation of the neural tube through secretion of the ligand Shh.
@ PAX 3 is involved in neural tube folding. L-Selectin is involved in sycytiotroph attachment and embedding into the endometrium. Retinioc Acid is a teratogen, and not involved in neurulation. HOX genes are involved in segment specification.

*44. When during normal development a cell begins to be restricted in its ability to produce all the future parts of the embryo, that cell is said to be:

A. a blastocoel
*B. pluripotent
C. compacted
D. a primordial germ cell
E. immortal

~ Totipotency is descriptive of the ability of a cell to produce anything and everything needed to from an embryo. Pluripotent reflects a decrease in potency, such that the cell still has the ability to become certain, but not all, parts of an embryo.
@ The terms blastocoel, compacted, and immortal have nothing to do with the ability of a cell to become different parts of the embryo. A primordial germ cell is restricted in its ability to produce all tissue-types, however, not all cells

*45. The proliferative cells of a stratified squamous epithelia are located primarily in the:

*A. basal layer
B. suprabasal layers
C. sub-basement membrane zone
D. outer-most layer

*46. Desmosomes and hemidesmosomes:

A. are structurally similar and biochemically identical in composition.
B. mediate attachments of microtubules to the plasma membrane.
*C. are critical for cell adhesion and resisting mechanical stress.
D. mediate cell-cell communication and ion transfer.

~ Desmosomes are adhesive intercellular junctions that link intermediate filaments through cadherin. Hemidesmosomes anchor cells to the basement membrane. These junctions allow resistance against mechanical stress, which is why they are abundant in cells in the heart.
@ desmosomes are on the lateral membrane of cells while hemidesmosomes are on the basal membrane of cells. Also, desmosomes are comprised of cadherin anchors, while hemidesmosomes are anchored using integrins. Both desmosomes and hemidesmosomes link intermediate filaments, not microtubules. Gap junctions mediate ion transfer and cell-cell communications.

*47. These surface specializations are often disrupted during gastrointestinal infections, contributing to diarrhea and fluid loss:

A. gap junctions
*B. tight junctions
C. microvillae and cilia
D. hemidesmosomes

~ Tight junctions act as fences which separate the apical side of the cell from the basolateral side which allows the maintenance of a water gradient from the lumen of the gut.

@ Gap junctions facilitate transport, they don't limit it. Even though microvillae aid in the absorption of nutrients, failure of these structures would not cause fluid loss, also cilia do not play a part in the GI tract but instead in the reproductive and respiratory tract. Hemidesmosomes anchor cells, they do not act as barriers between environments.

*48. Which of the following influence the final destination of a polypeptide?
A. the length of the transmembrane domain
B. its primary amino acid sequence
C. carbohydrate modifications
D. fatty acid modifications
*E. All of the above are true.

@ The length of the transmembrane domain exerts its influence in whether it will be within a membrane or not. Its primary amino acid sequence dictates whether it will be targeted toward the ER due to signal sequences in the first ~20 AAs. Carbohydrate modifications help signal chaperone molecules that direct it to its next location. Fatty acid modifications are important, such as with the glycosylphosphatidylinositol anchor that replaces the proteinaceous signal sequence (and is always on the outside of the cell

*49. Which of the following statements is TRUE for proteins destined for secretion?
A. They are always translated on free ribosomes in the cytosol.
B. They have signal sequences that target them to the endoplasmic reticulum.
C. They contain sequences recognized by signal peptidase.
D. Both A and B are correct.
*E. Both B and C are correct.

~ Proteins destined for secretion have signal sequences to target them to the ER as well as sequences recognized by signal peptidase (without that signal being cleaved, it becomes a transmembrane domain, which is not very good for secreting).

@ secreted proteins are translated in the ER.

*50. Which of the following statements concerning cell adhesion molecules is FALSE:
*A. They are peripherally associated with the plasma membrane (not integral membrane proteins).
B. They can mediate attachment to the extracellular matrix.
C. They are able to induce intracellular signal cascades.
D. They mediate adhesion between cells.
E. Different classes of cell adhesion molecules often act in concert to carry out a biological process.

@ CAMs are integral proteins, not peripheral proteins

*51. Cells of higher eukaryotes are characterized by:

A. the packaging of many metabolic pathways into membrane enclosed organelles to increase metabolic efficiency.
B. cytoskeletal networks that contribute to communication between organelles and to the control of cell shape.
C. cell surface receptors that receive and transmit signals from the extracellular environment.
D. a nuclear envelope.
*E. All of the above are correct.

~ metabolic pathways are localized for maximal efficiency, the cytoskeleton aids in communication and stability of form, cell surface receptors receive information for the external environment, and a nuclear envelope is present

*52. Elaboration of a mannose-6-phosphate recognition motif is characteristic of:
A. proteins destined for secretion.
B. integral membrane proteins.
C. proteins targeted to the endoplasmic reticulum.
*D. proteins targeted to the lysosome.
E. All of the above are correct.

@ Secreted proteins require the clipping of the signal sequence, with no anchors holding it still, with no requirement of mannose-6-phosphate. Integral membrane proteins have no need for mannose-6-phosphate to be integral, just a transmembrane sequence. The glycosylation begins in the ER, so the addition of a sugar isn't necessary to target to the ER.

*53. Which of the following processes occur in the Golgi complex?
A. The initiation of N-linked glycosylation.
*B. Oligosaccharade chains are fully elongated.
C. Proteins acquire their biologically appropriate conformation (folding).
D. Translation of proteins destined for the secretory pathway.
E. Both C and D are true.

~ Glycosylation is completed in the golgi

@ Glycosylation is initiated in the ER. Folding occurs in the ER. Translation of proteins destined for secretion occurs at the ER.

*54. Which of the following statements concerning biological membranes is TRUE?
A. The two leaflets of phospholipid bilayers have symmetrical phospholipids composition.
*B. S of integral membrane proteins.
C. Increasing the concentration of phospholipids with saturated fatty acid chains increases membrane fluidity.
D. Glycolipids are predominantly localized to the nuclear membrane.
E. Both A and C are true.

~ Cholesterol can help stiffen a plasma membrane and thus decrease mobility of integral membrane proteins

@ Lipid membranes are transversely asymmetrical. Saturated fatty acids inhibit fluidity since they pack tighter, as opposed to unsaturated. Glycolipids are found in plasma membranes.

*55. Which of the following statements concerning the process of transport between membrane compartments is FALSE?

*A. Vesicles formation (i.e., budding) occurs spontaneously from planar lipid bilayers

B. Vesicles are targeted to their proper destination by molecular interactions between SNAREs.

C. Transport vesicles are characterized by a single lipid bilayer.

D. Coating proteins (e.g, clathrin) are required to form vesicles.

E. GTPases are required for the proper docking and fusion of membrane vesicles to their target compartments.

@ Budding formation requires curvature, which require coatamers and adapters (both proteins), therefore it isn't spontaneous

*56. Sweat glands and hair follicles originate from:

A. neural crest cells that migrate into the dermis in response to growth factors.

B. skin fibroblasts that are induced to differentiate by epidermal cells.

*C. epidermal invaginations into the dermis in response to developmental cues.

D. differentiation of macrophage-related cells in the epidermis.

~ Sweat glands and hair follicles are skin appendages located in the dermis but derived from epidermis.

@ During development, the dermal papillae secrete signals that cue epidermal invaginations into the dermis; hence, it is the dermis and not the epidermis that induces this process (choice B). Melanocytes, not sweat glands nor hair follicles, are derived from neural crest cells. Langerhans cells are derived from the monocyte/macrophage system

*57. Which structure integrates the basal layer of keratinocytes with the underlying dermis, and is compromised in several congenital and acquired disorders that cause skin blistering?

A. the desmosome

*B. the hemidesmosome

C. the adherens junction

D. gap junctions

E. None of the above are correct.

~ Skin blistering problems can be caused by defects in the keratin itself; in the desmosomes responsible for cell-cell adhesions between cells of the basal layer of epidermis (choice A); and in the hemidesmosomes responsible for binding the basal layer, the basement membrane, and the underlying dermis.

@ Adherens junctions do bind keratinocytes to each other, but are not critical to the skin's ability to withstand mechanical stress (choice C). Similarly, gap junctions do not contribute to elasticity

*58. Fluidity is important for numerous membrane functions. Addition of cholesterol or saturated fatty acids results in:

A. Increased membrane fluidity

*B. Decreased membrane fluidity

C. No effect on membrane fluidity

D. Either increase or decrease in fluidity dependent on the temperature of the organism

~ Cholesterol addition decreases membrane fluidity by intercalating between neighboring phospholipid molecules. Saturated fatty acids decrease fluidity because the phospholipid tails pack tightly together

@ A and C directly oppose the correct statement. D is wrong because the cell can maintain desired fluidity by adjusting the saturation and length of the phospholipid tails, but the effects of these changes are the same for any temperature

*59. Proteins enter mitochondria by:

A. transport vesicle fusion
B. mSNARE mechanism
*C. active transport mediated by protein translocators
D. None of the above is correct

~ Proteins enter mitochondria by unfolding and being passed through both membranes via a protein translocator
@ A and B are wrong because neither vesicles nor SNAREs are involved.

*60. A plasma membrane protein was found to have a cleavable N-terminal signal sequence followed by a stop-transfer sequence. The N-terminus of this plasma membrane protein is located:

A. in the cytoplasm
B. on the extra cellular surface of the plasma membrane
C. on neither surface; rather it will be a secreted protein
*D. None of the above is correct

~ None of the above are correct because they do not apply to a Type I integral membrane protein, which the question describes. The N-terminus will bind to the translocator protein and remain in the membrane.

*61. Receptor-mediated endocytosis is characterized by all of the following EXCEPT:

A. receptor-ligand binding and receptor aggregation
B. clathrin coat formation and membrane budding
C. disassembly of the coat proteins before fusion to target membranes
*D. lamin de-phosphorylation and assembly
E. endosome fusion and protein sorting

@ All other choices are involved in receptor-mediated endocytosis. Lamin de-phosphorylation and assembly is a nuclear event that is unrelated to endocytosis

*62. Which of the following word associations is INAPPROPRIATE?

A. junctional complex/ zonula occludens/ zonula adherens
B. intermediate filaments/ cytokeratins
C. desmosome/ macula adherens
D. zonula occludens/ tight junction
*E. desmosome/ microvilli

~ desmosome anchors the intermediate filaments in neighboring cells on the lateral membranes, and are not related to microvilli
@ Zonula occludens and adherens are both types of junctional complexes. Cytokeratins are types of intermediate filaments. Desmosomes are also known as macula adherens. Zonula occludens are types of tight junction

*63. Cilia

A. are modified microvilli which are non-motile
B. have no known function

C. are usually significantly smaller in height and diameter than microvilli
*D. move material in the lumen of several different organs

@ Cilia are motile structures that propel fluid along the apical (luminal surface) of several different organs. They are larger than microvilli. Cilia are composed of microtubules, while microvilli are made of actin filaments

*64. All cellular membranes have a bilayer organization. The assembly of the bilayer is driven by:
A. flippase enzymes of the membrane
*B. self-assembly of amphipathic phospholipids
C. proteoglycans
D. carbohydrates

~ The characteristics of the ampthipathic phospholipids drive the assembly of the bilayer as hydrophobic tails shun water and seek to aggregate with other hydrophobic molecules and the hydrophilic head is attracted to water extracellularly and cytoplasmically
@ Flippases are involved in the specific placement of phospholipid molecules on one side of the bilayer. Proteoglycans and carbohydrates are attached to proteins within the membrane to form a coat, but do not play a role in its organization

*65. Integral membrane proteins include
A. insulin
B. ion channels
C. EGF receptors
D. all of the above are correct
*E. only B and C are correct

@ Ion channels and EGF receptors are integral membrane proteins because they reside within the plasma membrane in order to function

*66. Import of proteins into mitochondria involves
A. appropriate transport vesicle fusion
B. appropriate vSNARE and tSNARE interactions
*C. unfolding, translocation, and subsequent refolding of the proteins
D. all of the above are correct

@ Protein import into mitochondria is different than the usual transport pathway of budding and fusing and uses a chaperone for the protein to move to the mitochondria

*67. Select the correct statement(s):
A. Adaptins are responsible for selecting specific cargo in transport vesicles
B. Docking of vesicles to target membranes is mediated by vSNAREs and tSNAREs
C. Nuclear transport of proteins involves and requires unfolding, translocation, and subsequent refolding
D. All of the above are correct
*E. Only A and B are correct.

@ Adaptin binds to specific cargo receptors as well as bind the clathrin coat to the vesicle membrane. Interactions between specifically complementary v- and t-SNAREs guide vesicles to their appropriate targets. C is incorrect because nuclear pores transport proteins in their fully folded conformation

*68. Epithelial tissue is classified on the basis of the:
A. shape of the cells
B. number of cell layers
C. presence of cell specializations
*D. All of the above are correct

*69. The zonula occludens is characterized most accurately by which of the following terms?
A. intercellular canaliculus
B. hemi-desmosome
C. gap junction
*D. tight junction
E. desmosome

*70. Import of the proteins into the lumen of the endoplasmic reticulum involves:
A. transport vesicle fusion
B. vSNARE and tSNARE interactions
C. unfolding, translocation, and subsequent refolding of the proteins
*D. co-translational import through a protein translocation channel
~ Most of the proteins that enter the ER begin to be threaded across the ER membrane before the polypeptide chain is completely synthesized, so import through the translocator is co-translational
@ No vesicles are involved, and thus, no SNARE interactions are involved. Unfolding and refolding during translocation are specific to mitochondria and chloroplasts

*71. Export of proteins from the lumen of the endoplasmic reticulum to the Golgi apparatus involves
A. formation of a COP-coated vesicle
B. transport and vesicle fusion
C. vSNARE and tSNARE interactions
D. specialized membrane fusion proteins
*E. All of the above are true

*72. Self-assembly of amphipathic phospholipids is a fundamental mechanism for assembly of:
A. the plasma membrane bilayer
B. the mitochondrial membrane bilayer
C. the ER membrane bilayer
*D. all cellular membrane bilayers

*73. Basal bodies are the apical plasma membrane anchoring site for the cytoskeletal network present in this cell surface specialization:
A. desmosomes
*B. cilia
C. microvilli
D. intermediate filaments
~ Cilia are inserted into basal bodies on the apical plasma membrane
@ C is wrong because the actin filaments that make up microvilli are anchored into the terminal web. A and D are also wrong since neither desmosomes nor intermediate filaments make up apical surface specializations

*74. All of the following cell junctions play a direct role in adhesion EXCEPT:
A. adherens junctions
B. desmosomes
*C. gap junctions
D. hemidesmosomes
~ Gap junctions are involved in passage of small water-soluble ions and molecules between neighboring cells, while adherens junctions, desmosomes, and hemidesmosomes are involved in directly attaching neighboring cells

*75. This intercellular junction plays a critical role in maintaining a barrier between the luminal and interstitial space of a tissue:
A. desmosome
B. keratin filaments
C. adherens junction
*D. tight junction
~ Tight junctions are the most apical junctions between cells and effectively seal off the luminal and interstitial environments on each side of the cells, thereby preventing flow from basal to apical sides
@ Desmosomes attach lateral membranes as well, but are located more basally. Keratin filaments are intracellular intermediate filaments that attach to desmosomes. Adherens junctions function similarly to desmosomes, but have actin filaments attached intracellularly.

*76. Proteins destined for insertion into the plasma membrane or for secretion:
A. possess a signal sequence peptide recognized by the signal recognition particle.
B. Are translated on a free ribosome in the cytoplasm
C. Are targeted to the endoplasmic reticulum for membrane insertion
*D. All of the above are correct
E. Only A and C are correct

*77. Proteins can be stably associated with the lipid bilayer by a:
A. Hydrophobic transmembrane domain
B. Covalently associated fatty acid moiety that inserts into the inner lipid leaflet
C. Covalently associated glycosylphosphatidylinositol (GPI) linkage that inserts into the outer lipid leaflet.
*D. All of the above are correct

*78. Which one of the following protein modifications occurs in the endoplasmic reticulum?
A. Addition of the core N-linked oligosaccharide chain
B. Addition of a fatty acid tail for insertion into the cytosolic face of the plasma membrane
C. Proper protein folding
D. Final maturation of the oligosaccharide chain
*E. Only A and C are correct
~ a preformed N-linked oligosaccharide is added to many proteins in the ER. The N-linked oligosaccharide is formed on the outside of the ER and then flipped inside of the ER where it is added to the protein. Protein folding occurs in the ER and is facilitated by: disulfide isomerase (PDI) which rearranges disulfides; calnexin and calreticulin. Folding will not occur without the glycosylation which occurs in the ER.
@ Since whatever proteins are anchored to the ER membrane inside the lumen of the ER and are destined to the plasma membrane end up on the outer leaflet of the plasma membrane, the proteins that are destined to the inner leaflet should be lipid anchored to the ER membrane

outside of the ER. Final maturation of the oligosaccharide chain occurs in the Golgi.

*79. Which of the following statement(s) about the Golgi complex is/are true?
A. final maturation of the oligosaccharide chains occurs in the Golgi.
B. Posttranslational modifications occur that influence protein sorting to their final destination.
C. Enzymes involved in the oligosaccharide synthesis are segregated into membrane stacks or cisternae
*D. All of the above are true
E. None of the above are true
~ Golgi is the site for: protein sorting via post translational modification; final maturation of the oligosaccharide chains. In the cis golgi there are specific glycosyl transferases, in the medial golgi there are other glycosyl transferases, and in the trans golgi there are a different set of glycosyl transferases. They belong in those compartments because they have to add the sugars in a very sequential sequence.

*80. Which of the following protein families and/or sequences are directly involved in the formation of membrane vesicles from lipid bilayers?
A. KDEL sequences
B. SNAREs
*C. Coatomers (i.e. coating proteins)
D. Glycosyl transferases
E. All of the above are correct
~ Membranes require coating proteins to bud and form vesicles. Three types of coating proteins: Clathrin, COP II coatamer, COP I coatamer.
@ KDEL sequences are signal sequence that direct ER destined proteins from the Golgi back to the ER – A is wrong. SNAREs define proper vesicle targeting– B is wrong. Glycosyl transferases add oligosaccharide residues to proteins in the Golgi and the ER for the purpose of sorting and folding D is wrong.

*81. A newly formed membrane vesicle is targeted to its proper membrane compartment in the cytoplasm using
A. Coatomers (i.e. coating proteins)
B. Rab GTPases
C. SNAREs
D. Specific olygosacharide sequences
*E. Only B and C are correct
@ Rab GTPases regulate SNARE docking. Specific oligosaccharide residues target proteins to different vesicle.
*In class Dr. Faundez also said coatomers influence vesicle targeting, so this answer may change for our test, but in this case E is the only possibility as no other choice is correct by itself.

*82. Which of the following statements about the use of sorting motifs is/are true?
A. The signal sequence motif targets proteins to the nucleus
*B. An exposed mannose-6-phosphate residue is required to target proteins to the lysosome
C. The KDEL amino acid sequence is used to recycle proteins back to the trans-Golgi network
D. All of the above are true

@ Membrane destined proteins have a signal sequence. Hence, the signal sequence motif targets proteins to the ER – A is wrong. KDEL sequence is used to recycle proteins back to the ER from Golgi – C is wrong. D is wrong

*83. A primary function of the keratinized layer of a stratified epithelial sheet is to:
*A. control water loss.
B. Mediate attachment to the basement membrane
C. Generate directed movement of fluid.
D. None of the above
~ The keratinized layer of a stratified epithelium provides a barrier against the outside world. Cells in the outer layer are non-living. This layer prevents water loss. Two main problems in burn patients are water loss and infection due to the loss of keratinized layer

*84. Which of the following structures are designed for intermediate filament attachment to the plasma membrane?
A. Adherens junction and tight junction
B. Adherens junction and hemidesmosomes
*C. Desmosome and hemidesmosome
D. Desmosome and gap junction
~ Desmosomes – cell-cell attachment sites for intermediate filaments. Hemidesmosomes are tightly bound to the basement membrane, even extending into the tissue in organs like the skin. Hemidesmosomes mediate interactions between intermediate filaments and the plasma membrane at the basal surface of the cell.
@ Adherens junction is an anchoring junction associated with actin filaments – A and B are wrong. Gap junctions are associated with cell-cell communication, the protein subunit associated with the gap junction is called connexin.

*85. Which of the following protein modifications occur in the Golgi complex?
A. protein translation
B. addition of the core N-linked oligosaccharide chain
C. initial protein folding
*D. final maturation of oligosaccharide chains
E. All of the above are true.
~ various levels of the golgi contain specific glycosyltransferasese to complete the oligosaccharide addition
@ A is incorrect because protein translation takes place in the cytosol and can later be transferred to the golgi via the ER. B is incorrect – the core oligosaccharide chain is added co-translationally in the ER lumen to facilitate proper folding. C is incorrect because initial protein folding occurs in the ER with help from the core oligosaccharide

*86. Lipid bilayers are induced to form vesicles due to the action of _____.
A. glycosyltransferases
*B. coatamers (i.e., coating proteins)
C. integrins
D. SNAREs
E. Only C and D are correct.
~ coatamers (Clathrin, COP I, COP II) attach to the cytosolic portion of the membrane to be pinched off to aid in vesicle formation
@ integrins are heterophillic CAMs that facilitate adhesion/migration. SNAREs are

responsible for the proper targeting of vesicles. Glycosyltransferases are used to modify the core oligosaccharide in the golgi.

*87. All of the following statements about the process of transport between membrane compartments are true EXCEPT:
A. Budding transport vesicles have a distinct protein coat.
B. Transport vesicles loose the protein coat before fusion with target membranes.
*C. Transport vesicles are characterized by a triple layered lipid bilayer.
D. vSNAREs and tSNAREs mediate specificity of docking between membranes.
~ like any other membrane in the cell the lipid bilayer is a double layer of lipids
@ A is true – budding transport vesicles are coated by a coatamer (clathrin, COPI, COPII) which helps the bud break off from the cytosolic portion of the membrane. B is true – after the vesicle has pinched off and completely formed it goes through an uncoating stage and loses that coatamers. D is correct – vSNAREs attach to budding/moving vesicles and tSNAREs are attached to the target membrane and recognize specific vSNAREs.

*88. Epithelial sheets are anchored to the basement membrane by_____.
*A. hemi-desmosomes.
B. adherens junctions.
C. desmosomes.
D. basal bodies.
E. hummus.
~ hemi-desmosomes anchors intermediate filaments, of the epithelial cells, to adhesion sites of the Basement Memebrane
@ B is incorrect – the adherens junctions provide adhesion between the actin cytoskeleton of adjacent cells. C is incorrect – desmosomes are attachment sites for intermediate filaments between adjacent cells and are important for cells with high mechanical stress: epidermis, heart. D is incorrect because basal bodies are the site of attachment for the microtubules in cilia

*89. Paracellular permeability to NaCl is controlled by _____:
A. adherens junctions.
*B. tight junctions.
C. gap junctions.
D. proton- K^+ ATPases.
E. goblet cells.
~ Tight junction act as a fence and restrict solutes as well as membrane proteins to the apical or basolateral membranes
@ A is incorrect - the adherens junctions provide adhesion between the actin cytoskeleton of adjacent cells and do not limit paracellular movement of small ions. C is incorrect – the gap junctions allow ion flow between adjacent cells, not around them. D is incorrect – these do not control paracellular permeability of anything. E is incorrect because goblet cells are secretory cells of the epithelium.

*90. Stereocilia are _____:
A. motile structures designed for absorption.
B. microtubule containing structures that move fluid.
C. basal structures designed for adhesion to collagen.
*D. actin containing structures much larger than brush border microvilli.

@ A is incorrect - stereocilia are non motile structures. B is incorrect – cilia are the microtubule containing structures that move fluid. C is incorrect – stereocilia are apical structures
~ the stereocilia are like large microvilli with an absorptive function

Week Two

1. Which protein is NOT found in the extracellular matrix of cartilage?
   A. elastin
   B. collagen II
   *C. laminin
   D. the proteoglycan aggrecan

2. All of the following statements describe properties of the basement membrane (basal lamina) EXCEPT:
   A. The basement membrane is rich in associative glycoproteins therefore is an adhesive substrate for epithelial cells.
   *B. The basement membrane induces the differentiation of osteoblasts into osteocytes.
   C. The basement membrane is formed by a meshwork of collagen IV and proteoglycans.
   D. The basement membrane serves as a polarity cue for epithelial cells.

3. Your patient presents clinical signs consistent with Ehlers-Danlos Syndrome. To confirm your diagnosis, you decide to determine how much collagen can be synthesized by fibroblasts from a skin biopsy. Which one of the following options would be the best choice to assess collagen synthesis?
   A. Incubate biopsy fibroblasts with labeled hydroxyproline and measure the label incorporation into collagen I molecules.
   B. Measure lysil oxidase activity.
   *C. Determine free N-terminus peptides of alpha 1 collagen content.
   D. Measure glycosaminoglycan content of the sample.

4. An osteocyte is:
   A. the precursor of an osteon.
   B. the main cell type found in the periosteum.
   C. an osteoclast precursor.
   *D. a mature osteoblast that has been surrounded by bone matrix.
   E. the progenitor cell of all bone cells.

5. Which of the following processes occurring in the epiphyseal plate contributes the most to longitudinal bone growth?
   A. differentiation of perichondrium into periosteum.
   B. blood vessel invasion.
   C. osteoblast deposition of bone matrix on calcified cartilage matrix.
   D. chondrocyte apoptosis.
   *E. chondrocyte hypertrophy.

6. Which of the following statements about bone modeling and remodeling is FALSE?
   A. Bone shape is maintained during growth by modeling.
   B. Bone remodeling requires the coupled activity of osteoclasts and osteoblasts to ensure complete restitution of bone mass.
   C. Osteoclasts and osteoblasts are responsible for osteon remodeling.
   *D. Only osteoclast activity is required for bone modeling.
   E. Imbalanced activity of osteoclasts and osteoblast during remodeling contributes to osteoporosis.

7. All of the following are features that distinguish between unilocular and multilocular adipocytes, EXCEPT:
   A. shape and localization of the nucleus

*B. triglyceride content
C. lipid droplet organization
D. color of the tissue due to capillary abundance and mitochondria content

8. Which statement about clinical aspects of muscular dystrophies is FALSE?
A. Emery-Dreifuss patients display slowly progressive muscle wasting, contractures of elbows, neck and Achilles tendons, and high risk of sudden cardiac arrest and death.
B. Myotonic dystrophy is the most common muscular dystrophy in adults.
*C. It is extremely rare to have Duchenne's without a family history.
D. Most patients with Duchenne's are confined to a wheelchair by age 12 and die in their early 20s.

9. Which of the following statements about myotonic dystrophy is FALSE?
A. Most cases are caused by expansion of a CTG repeat in the 3'UTR of a gene.
B. There is a correlation between the number of CTG repeats and disease severity.
*C. "Genetic anticipation" means that with each generation, disease severity decreases and age of onset increases.
D. Myotonia is delayed muscle relaxation after contraction; it can be detected by shaking a patient's hand.
E. A "pathogenic RNA" model best explains the pathogenesis of both forms of myotonic dystrophy.
~Genetic anticipation means that with each generation, disease severity increases and age of onset decreases.

10. Which of the following statements about muscle thin filaments is FALSE?
A. Major components include actin, tropomyosin and the troponins.
*B. Thin filaments are elastic and during muscle contraction undergo extensive lengthening.
C. The F-actin is polar with the plus (or barbed) end located at the Z-lines.
D. Thin filaments are the site of calcium regulation in striated muscle.
~Thin filaments do not lengthen (or shorten) during contraction.

12. Which of the following matrix components confer the functional properties to loose connective tissue?
*A. ground substance and collagen I fibers
B. mineralized collagen I
C. elastin and reticular fibers
D. only collagen I bundles
~ in loose connective tissue (as well as in all connective tissue) there is both a ground substance and fibers. The difficult part of this question is what confers the functional property, which is support in structures that are under pressure and low friction. Ground substance helps give volume to the tissue and collagen usually confers strength and rigidity. Loose connective tissue is filler tissue, which is why ground substance is needed.
@ B is wrong because mineralized collagen I is in bone, not in loose connective tissue. C is wrong because even though these are present in loose connective tissue, they do not confer the functional property of the tissue. Reticular fibers are functional in hematopoietic tissue and in parenchymal organs. Elastin is used properly in skin and other organs that need to stretch. These are not filler components. D is wrong because collagen I is not arranged in bundles in loose connective tissue, but it is in dense connective tissue

13. You suspect that one of your patients may have cutis laxa, a disorder characterized by thin and loose skin, but without joint laxity. To confirm your diagnosis as an elastic fiber deficiency, the most appropriate analysis for a skin biopsy would be to measure the content of:

A. hydroxyproline
*B. isodesmosine-desmosine
C. collagen III
D. chondroitin and dermatansulfates
~ desmosine and isodesmosine are amino acids that are distinct to elastin proteins that help the protein cross-link
@ A is wrong because hydroxyproline is critical to collagen, not elastin. C is wrong because collagen III forms reticular fibers, not elastin. D is wrong because these compounds are critical to cartilage, which is composed of collagen and proteoglycans.

14. Which of the following statements about cartilage is correct?
A. Elastin, proteoglycans and collagen III are components of the extracellular matrix of cartilage.
B. Chondrocytes reside in lacunae interconnected by canaliculi.
C. Regeneration is very efficient.
*D. The high negative charge of proteoglycans confers resilience and shock absorbing properties to the tissue.
~ the negatively charged proteoglycans within cartilage enable it to be very resilient due to the fact that water is bound to the proteoglycans and can act as a shock absorber
@ A is wrong because cartilage contains mostly collagen II, with traces of IX, X, and XI, but not type III which are found in reticular fibers. B is wrong because canaliculi are the thin, cylindrical spaces that perforate bone matrix, which allows osteocytes to exchange material with capillaries. C is wrong because generation is NOT very efficient since cartilage is avascular

15. Which of the following cell types is NOT part of an osteon?
*A. osteoclast
B. osteoblast
C. endothelial cell
D. osteocyte
~ osteoclasts are involved in the breakdown of bone, not as an organizational unit.
@ B is wrong because osteoblasts can be found within osteons since the newest lamella in a Haversian system is the innermost, which shows that osteoblasts have to be there to produce the matrix. C is wrong because endothelial cells make up the blood vessels that are in the very center of the osteon. D is wrong because osteocytes are in the lacunae of bone that make up the osteon

16. The epiphyseal plate:
*A. is located between the primary and secondary ossification sites.
B. forms after intramembranous ossification has started to build bone in the medullary cavity.
C. is a determinant in remodeling of mature bones.
D. participates in the ossification of all bone types.
~ the primary ossification site is within the shaft of the long bone, while the secondary ossification site is within the epiphysis with the epiphyseal plate in the middle.
@ B is wrong because the epiphyseal plate is a part of the endochondrial ossification, not intramembranous ossification. C is wrong because the epiphyseal plate is active during bone growth, not remodeling of mature bone. D is wrong because some bones ossify via intramembranous ossification

17. Which of the following statements about bone dynamics is FALSE?
A. Modeling is responsible for increased shaft width.
*B. Trabecullae are remodeled by the bone multicellular unit (BMU).
C. The epiphyseal plate is responsible for growth of long bone length.

D. Remodeling renovates the complete skeleton several times over a lifetime.
~ compact bone is replaced by BMU, not trabecullae or cancellous bone
@ A is wrong because modeling is responsible for increasing shaft width, which allows bones to grow and yet maintain the same overall shape. C is wrong because the epiphyseal plate is responsible for growth of long bone length. D is wrong because remodeling does renovate the skeleton several times

80. Which of the following statements concerning cell adhesion molecules is FALSE:

They are peripherally associated with the plasma membrane (not integral membrane proteins).
They can mediate attachment to the extracellular matrix.
They are able to induce intracellular signal cascades.
They mediate adhesion between cells.
Different classes of cell adhesion molecules often act in concert to carry out a biological process.

96. Cells of higher eukaryotes are characterized by:

the packaging of many metabolic pathways into membrane enclosed organelles to increase metabolic efficiency.
cytoskeletal networks that contribute to communication between organelles and to the control of cell shape.
cell surface receptors that receive and transmit signals from the extracellular environment.
a nuclear envelope.
All of the above are correct.

99. Which of the following statements concerning biological membranes is TRUE?

The two leaflets of phospholipid bilayers have symmetrical phospholipids composition.
Cholesterol decreases the mobility of integral membrane proteins.
Increasing the concentration of phospholipids with saturated fatty acid chains increases membrane fluidity.
Glycolipids are predominantly localized to the nuclear membrane.
Both A and C are tr

*18. Regarding clinical aspects of muscular dystrophies, which statement is NOT TRUE?
A. The cartoonist who first drew Popeye may have been thinking of a patient with FSH (facial-scapulo-humoral) muscular dystrophy.
B. Duchenne's is the most frequent lethal heritable childhood illness.
*C. It is extremely rare to have Duchenne's without a family history.
D. If a patient has difficulty releasing a handshake, he/she might have myotonic dystrophy.
~ the dystrophin gene, which is responsible for Duchenne's has one of the highest spontaneous mutation rates of all human genes
@ A is wrong because this idea was mentioned in the clinical correlation since FSH patients have large forearms relative to their arms. B is wrong because it is the most frequent lethal heritable childhood disease. D is wrong because myotonic dystrophy presents with difficulty relaxing muscles, such as in a handshake

19. Which of the following statements about muscle thick filaments is FALSE?
A. The major component of the thick filament is myosin.
*B. Thick filaments are elastic and during muscle contraction undergo extensive lengthening to become thin filaments.
C. The shaft of the thick filament consists of an assembly of myosin rods and the myosin heads project from the surface of the shaft.

D. The myosin rod consists of two myosin heavy chains in an alpha-helical coiled-coil structure.
~ thick filaments and thin filaments are totally different entities (thin being actin, thick being myosin), and neither thick nor thin filaments change in length during contraction
@ A is wrong because the major component of thick filament is myosin . C is wrong because myosin heads project from the surface of the shaft. D is wrong because the myosin rod is made up of 2 heavy chains in an alpha-helix coiled-coil structure.

20. Chondroblasts develop into osteoblasts.
A. True.
*B. False.
~ Chondroblasts are cartilage-forming cells that develop at chondrification centers in condensed mesenchyme. Chondroblasts form three kinds of cartilage. Osteoblasts are bone forming-cells that also develop from condensation of mesenchyme. Cartilage does not turn into bone-forming substances.

21. Splanchnic mesoderm acts as an inducer of all of the following EXCEPT:
A. trachea
*B. teeth
C. pancreas
D. lungs
E. none of the above
~ Teeth develop from three sources: oral ectoderm, mesoderm, and neural crest cells.
@ Splanchnic mesoderm is the tissue, derived from the split in the extraembryonic mesoderm upon the formation of the extraembryonic coelem, which surrounds the yolk sac.

22. The humerus develops from which of the following?
A. somite mesoderm
*B. lateral plate mesoderm
C. intermediate mesoderm
D. extraembryonic mesoderm
E. sclerotome mesoderm
~ The somatic lateral plate mesoderm gives rise to the endochondral limb skeleton, which is mostly associated with bones in the limbs
@ The somite mesoderm leads to the musculature of the limbs. Sclerotome mesoderm is the ventromedial part of the somite. Intermediate mesoderm is involved in the urogenital ridge. Extraembryonic mesoderm is not going to be involved at this point.

23. Limb development involves all of the following except:
A. Wnt signaling
B. sonic hedgehog signaling
*C. WT1 (Wilms tumor) signaling
D. cells from the paraxial mesoderm
E. cells from the lateral plate mesoderm
@WTI Signaling is important in kidney formation.

24. Sclerotomes:
A. give rise to somites
*B. form the vertebrae
C. are the only adult remnant of the notochord

D. arise during the second week after fertilization
E. give rise to the muscles of the face

25. Which of the following features contribute to collagen tensile strength?
I. triple helix association of the alpha peptidic chains
II high levels of glycosylation
III intermolecular covalent cross linking mediated by lysyl oxidase
*A. Both I and III are correct.
B. I, II and III are all correct.
C. Only I is correct.
D. Only III is correct.
~ Both I and III are correct. (I) Triple helix association of the alpha peptide chains and (III) intermolecular covalent cross linking mediated by lysyl oxidase are features that contribute to collagen tensile strength.
@ (II) is incorrect because high levels of glycosylation and hydroxylation are only post-translational modifications of procollagen (alpha chain) molecules that occur intracellularly – and does not contribute to the tensile strength which involves the aggregation of procollagen into collagen extracellularly (choices I and II).

26. Which of the following does not belong to an osteon:
*A. Volksmann's canal
B. Haversian canal
C. osteocyte
D. canaliculi
E. lacuna
~ The Volksmann's canal connects Haversian canals by perforating the concentric lamellae, but they are organized transversely and obliquely and do not arise with the concentric formation of the Haversian system
@ The osteon or Haversian system is a complex of concentric lamellae of bone surrounding a Haversian canal Haversian canal containing blood vessels, nerves, and loose connective tissue. Lacunae containing osteocytes, which are interconnected by canaliculi, are found between and occasionally within the lamellae

27. Which of the following sequences of events represents the normal process of during ossification?
A. Chondrocyte proliferation – chondrocyte hypertrophy – chondrocyte apoptosis – osteocyte – osteoblasts.
B. Cartilage template – primary ossification center – epiphyseal plate closure, secondary ossification center.
*C. Mesenchymal cells – mesenchymal collagen - osteoblasts – osteoid (prebone) - bone
D. None of the above is correct.
~ Bone arises from pre-existing connective tissue of either mesenchymal cell template (intramembranous ossification) or a cartilage template (endochondral ossification). Intramembranous ossification (within mesenchymal tissue): The starting point of condensation of the mesenchymal tissue is the primary ossification center. Here, the mesenchymal cells form a blastema (the mesenchymal collagen) from which osteoblasts differentiate. The osteoblasts deposit osteoid/prebone (uncalcified bone matrix= type I collagen and ground substance) between the osteoblast layer and the previously formed bone. This process of bone apposition is completed when the osteoid becomes calcified, creating new bone. The ossification center contains many islands of developing bone walls which form with elongating cavities that fill with capillaries and bone marrow cells (also has undifferentiated cells). These islands fuse, giving the spongy bone structure. Growing blood vessels penetrate the remaining connective tissue and

undifferentiated mesenchymal cells become bone marrow cells. The ossification centers grow radially and fuse together, replacing the original connective tissue. Connective tissue that does not undergo ossification becomes the osteum and periosteum of the intramembranous bone.

28. Which of the following statements about the basal lamina is INCORRECT?
    A. found beneath every type of epithelium
    B. rich in collagen IV and proteoglycans
    *C. surrounds chondrocytes and osteocytes
    D. contains abundant associative glycoproteins

@ The basal lamina (basement membrane) is rich in collagen IV and proteoglycans as well as associative glycoproteins and serves as the interface between connective tissue and every type of epithelium; functions: support, cell-bonding, and polarity cue for epithelia

29. Which of the following statements about cartilage is FALSE?
    A. Cartilage is avascular tissue.
    B. Chondrocytes lie in lacuna.
    C. Interstitial growth is due to extracellular matrix accumulation and limited cell proliferation.
    *D. The extracellular matrix is rich in proteoglycans and collagen III.

~ The extracellular matrix (ECM) of hyaline cartilage (the most common type) is transparent without apparent fibers, fibrocartilage ECM has a high concentration of collagen I fibers in a matrix of collagen II fibers. Elastic cartilage ECM has elastic fibers. Although all the ECM of these have ground substance which includes proteoglycans, none of have collagen III

@ Cartilage is an (A) avascular tissue and (B) the chondrocytes (cells of the cartilage) lie in lacuna and (C) interstitial growth is due limited cell proliferation enclosed in the matrix which lay down more ECM as they become separated leading to ECM accumulation.

30. Which filaments in muscle are known to be elastic?
    A. thick filaments
    B. thin filaments
    C. intermediate filaments composed of desmin
    *D. titin filaments

~ Titin filaments, specifically the I-band portion, in muscle are known to be *elastic which provides restoring force to allow the sarcomeres to maintain a set resting length*

@ The thick and thin filaments are not elastic; they never change their length even during contraction – during which they slide past one another during to shorten the sarcomere so (A) and (B) are incorrect. (C) is incorrect because intermediate filaments composed of desmin are also not elastic because they must mechanically link the contractile actions of myofibrils by forming a 3D lattice that connects them and all the organelles. Moreover if a mutation in desmin occurs, myopathy or cardiomyopathy (stretching of heart muscle) results which is also evidence that the intermediate filaments must not be elastic

31. Which of the following statements about muscle sarcomeres is FALSE?
    A. They are the fundamental repeating unit of myofibrils, extending from one Z-disc to the next Z-disc.
    B. During muscle contraction, both the I-band and the H-zone narrows.
    C. single molecules of the giant polypeptide titin span half a sarcomere from M-line to Z-disc.
    D. The giant polypeptide obscurin may serve to link sarcomeres to the sarcoplasmic reticulum.

*E. Thick filaments are attached to Z-discs.

~ *Thin filaments,* not thick filament*s*, are attached to Z-discs

@ The thick and thin filaments are not elastic; they never change their length even during contraction – during which they slide past one another during to shorten the sarcomere so (A) and (B) are incorrect. (C) is incorrect because intermediate filaments composed of desmin are also not elastic because they must mechanically link the contractile actions of myofibrils by forming a 3D lattice that connects them and all the organelles. Moreover if a mutation in desmin occurs, myopathy or cardiomyopathy (stretching of heart muscle) results which is also evidence that the intermediate filaments must not be elastic

32. Cardiac muscle is characterized by all of the following EXCEPT:

A. Intercalated disks provide linkage between adjacent cells.

*B. Contraction is regulated by MLCK phosphorylation of myosin.

C. Contain myofibrils similar to those found in skeletal muscle.

D. Cardiac muscle cells contain 1-2 nuclei and the cells are often branched.

E. Gap junctions lie primarily along lateral contact surfaces of the intercalated disc and provide electrical connection between cells.

~ Cardiac muscle contraction is regulated by *actin and troponin/tropomyosin interactions*, not by MLCK phosphorylation of myosin (regulatory myosin light chains) which is for smooth muscle and non-muscle cells. Yet, both are regulated by Ca^{+2} concentrations. For details of the actin-based regulation of striated muscle and the myosin-based regulation of smooth muscle/non-muscle cells–.

@ (A) Intercalated disks provide linkage between adjacent cells *and are where the thin filaments of adjacent I-bands are attached* (C) Contain myofibrils similar to those found in skeletal muscle (D) Cardiac muscle cells contain 1-2 *centrally placed* nuclei and the cells are often branched. (E) Gap junctions lie primarily along lateral contact surfaces of the intercalated disc and provide electrical connection between cells.

33. All of the following statements about myotonic dystrophy are true <u>EXCEPT:</u>

A. Myotonic dystrophy is the most common muscular dystrophy in adults.

B. Patients with myotonic dystrophy exhibit myotonia, a delay in muscle relaxation.

C. In myotonic dystrophy, nearly every organ system is affected.

*D. Myotonic dystrophy exhibits genetic anticipation: with each generation, disease severity decreases and age of onset increases.

~ severity always increases with age as the trinucleotide repeat that leads to disease is expanded

34. Which of the following statements about myotonic dystrophy is <u>NOT TRUE</u>?

A. The genetic defect is an expansion of a tri-nucleotide repeat in the 3'UTR of the DMPK (myotonic dystrophy protein kinase) gene.

B. The severity of the disease is proportional to number of tri-nucleotide repeats.

C. The genetic anticipation results from expansion of the number of trinucleotide repeats with each generation.

*D. A single mechanism can explain the myotonia, heart arrythmias and cataracts.

~ there are three mechanisms 1) altering expression of DMPK protein 2) interfering with expression of nearby genes 3) toxic gain-of-function effect on cell metabolism caused by the repeat expansion in the DMPK RNA

@ A is true – the expansion of this repeat causes successive generations to exhibit a more severe phenotype. B and C are true because as the promoter is pushed further from the gene as the repeat expands the phenotype worsens.

35. All of the following statements about Duchenne's/Becker's or the dystrophin glycoprotein complex (DGC) are true EXCEPT:

A. Most Duchenne's patients have out-of-frame deletions that produce mRNA with premature stop codons.
B. Most Becker's patients have in-frame deletions that produce smaller, abundant and largely functional dystrophin.
C. The DGC is likely to provide structural reinforcement to the muscle cell membrane to protect it from mechanical stress produced by repeated muscle activity.
*D. To date, with the exception of dystrophin, no other components of the DGC are implicated in muscular dystrophies.
E. Anti-sense induced exon skipping is a promising approach for treating Duchenne's.

~ sarcoglycans, a component of the DGC, is mutated in many forms of Limb-Girdle MD's
@ A is true – these polypeptides are unstable and dysfunctional. B is true – since some of the function is retained BMD is less severe than DMD .

36. Which of the following statements about muscle thin filaments is FALSE?

A. Thin filaments are unipolar.
*B. During muscle contraction, thin filaments undergo shortening.
C. Thin filaments are the sites of calcium regulation in striated muscle.
D. The major components of thin filaments are F-actin, tropomyosin and the troponins.
E. Thin filament length is proportional to the size of nebulin.

~ the thin filaments are pulled together, not shortened
@ A is true because the thin filaments are unipolar – determined by which end is fast-growing. C is true because the troponin portion of the troponin/tropomyosin complex are the sites of Ca regulation. D is true. E is true because nebulin is a template protein that stretches from the Z-disc to the minus end of each filament and helps maintain a constant thin filament length.

37. The radius develops from which of the following?

A. sclerotome mesoderm
B. somite mesoderm
C. intermediate mesoderm
D. extraembryonic mesoderm
*E. lateral plate mesoderm

38. Smooth muscle is characterized by all the following EXCEPT?

*A. Intercalated disks provide linkage between adjacent cells.
B. Contraction is regulated by MLCK phosphorylation of myosin.
C. Thin filaments and intermediate filaments are attached to dense bodies.
D. Smooth muscle contains bipolar myosin filaments.
E. Smooth muscle fibers are relatively small muscle cells with single nuclei.

~ intercalated discs are found only in cardiac and skeletal muscle
@ B is incorrect –MLCK phosphorylation does regulate contraction. C is incorrect – thin and intermediate filaments do attach to the dense bodies in an irregular fashion and smooth muscle does not exhibit striations. E is incorrect – smooth muscle fibers are smaller than cardiac and skeletal muscle fibers and smooth muscle has only 1 nucleus/fiber, cardiac has 1-2 and skeletal muscle is multinucleated.

39. Which of the following components can be found in the extracellular matrix of cartilage?
A. collagen I, aggrecan, elastin
B. fibronectin, collagen II, osteonectin
C. proteoglycans, laminin, collagen IV
*D. elastin, collagen II, aggrecan
~proteoglycan needed to maintain resiliency in the ground substance. Aggrecan is a proteoglycan
@ A is incorrect – collagen II not collagen I is found in cartilage. B is incorrect – osteonectin is abundant in bone and is important for osteoblast formation, maturation, and survival. C is incorrect – collagen IV is important for support and filtration in the basal lamins.

40. All of the following statements characterize calcium regulation of muscle contraction **EXCEPT:**
A. In striated muscle, calcium regulation occurs through the troponin-tropomyosin complex.
*B. In cardiac muscle, calcium regulation occurs through intermediate filaments.
C. In smooth muscle, calcium regulation occurs through the calcium/calmodulin activation of myosin light chain kinase.
D. Sarcoplasmic reticulum is a primary calcium storage and release depot.

41. Which of the following statements about muscle thick filaments is **FALSE**?
A. The major component of thick filaments is myosin.
*B. Thick filaments are elastic and during muscle contraction undergo extensive lengthening.
C. Thick filaments are bipolar.
D. The shaft of the thick filament consists of an assembly of myosin rods and the myosin heads project from the surface of the shaft.

42. If a patient has a difficulty releasing a handshake, he/she is most likely to have:
A. Duchenne's muscular dystrophy.
B. Emery-Dreyfus muscular dystrophy
C. FSH (facial-scapulo-humoral) muscular dystrophy
*D. Myotonic dystrophy
E. Tibial muscular dystrophy

43. The side chains of which of the following components are involved directly in the formation of covalent cross links between adjacent alpha chains and collagen molecules in collagen microfibrils?
A. glycine
*B. allysine
C. mannose
D. hydroxyproline

44. Which of the following IS NOT an important factor in facilitating adequate bone growth and maintenance of bone mass?
A. osteoblast deposition of prebone collagen
B. Regular exercise
C. Vitamin C
*D. Osteoblast production of hyaluronic acid
E. An integral vascular supply

45. Which of the following statements about adipocytes is true?
A. are derived from fibroblasts

*B. can synthesize intracellular triglyceride using fatty acids released from chylomicrons
C. have no ER or mitochondria
D. possess no cell surface receptors

~ Chylomicrons and VLDL are hydrolyzed at the luminal surfaces of blood capillaries of adipose tissue by lipoprotein lipase, an enzyme synthesized by the adipocyte. Free fatty acids enter the adipocytes by mechanisms not completely understood…Within the adipocyte the fatty acids combine with glycerol phosphate, an intermediate product of glucose metabolism, to form triglyceride molecules. Adipose cells develop from mesenchymally derived lipoblasts – they have the appearance of fibroblasts but are able to accumulate fat in the their cytoplasm (they are not derived from fibroblasts--their precursors just look like fibroblasts).

46. Vitamin C deficiency normally leads to all of the following defects in collagen production EXCEPT:
*A. synthesis of pro-alpha chains with an altered Gly-X-Y pattern
B. reduced hydroxylation of prolines in pro-alpha chains
C. reduced hydroxylation of lysines in pro-alpha chains
D. inhibition of superhelix formation of pro-alpha chains

47. Which of the following statement about fibroblasts is INCORRECT?
A. they are capable of proteoglycans biosynthesis
B. they routinely perform glycosylation of proteins destined for expert
*C. they can respond to antigens by producing immunoglobulins
D. they are the primary cellular components of tendons

~ Fibroblasts do not produce immunoglobulins. Immune functions in connective tissue are done by immigrant cells that migrate to injured sites as needed
@ A is true because proteoglycans are produced by fibroblasts. B is true because fibroblasts routinely perform glycosylation of proteins destined fro export as in the case of collagen. D is true because fibroblasts are the primary cellular component of tendons, as they are responsible for the dense, regular characteristic of collagen production and arrangement.

48. Which of the following is NOT a characteristic of osteons?
A. Osteons can develop in bones derived from both intramembranous and endochondral ossification.
B. Osteocytes maintain cell surface contact and gap junctions within canaliculi in the matrix lamellae of osteons.
C. Blood vessels, nerves, and osteogenic cells can be found at the center of the osteon.
*D. Once formed, all osteons are maintained throughout the life of an individual.

~ Once formed, all osteons are not maintained throughout an individuals life because if the bone is degraded, the enclosed osteons must likewise be degraded
@ A is true: since all bone cells need a blood supply, osteons develop in bones derived from both intramembranous and endochondral ossification. C is true since osteons are formed surrounding blood vessels.

49. Which of the following statements about thin filaments in muscle is FALSE?
A. the major components are F-actin, tropomyosin, and the troponins
B. they are unipolar
C. they are the site of Ca^{2+} regulation in striated muscle
*D. during muscle contractions, they undergo extensive shortening

~ The thin filaments remain the same length during contraction. The I band and H band shorten
@ B is true because all the monomers are pointed in one direction. C is true because the troponin and tropomyosin components are involved in calcium regulation in striated muscle.

50. Which of the following statements about Emery-Dreifuss syndrome is NOT TRUE?
    A. cardiac conduction block with high risk of sudden death
    B. X-linked cases are due to mutation in a gene encoding an inner nuclear membrane protein (emerin)
    C. autosomal dominant cases are due to mutation in a gene encoding lamins A and C
    *D. emerin and lamins A and C are expressed only in striated muscle

~Emerin and lamins A and C are expressed in most cell types, not just in striated muscle. The only cell types which emerin is not expressed in are leukocytes

@ B is true because X-linked cases are due to emerin mutations. C is true because autosomal dominant cases are due to mutations in the LNMA gene, which encodes lamins A and C.

51. Which of the following is NOT a characteristic of compact bone?
    A. it is a highly vascular tissue
    B. cells within the matrix maintain contact via gap junctions between cytoplasmic processes that occupy canaliculi in bone lamellae
    *C. cells within the matrix can contribute to interstitial growth by cell division
    D. bone matrix is hard and resists bending because of its inorganic material content

~ Cells within the matrix do NOT contribute to interstitial growth by cell division in compact bone (although they do in cartilage).

@ A is true because compact bone is highly vascularized with blood vessels in the osteons. B is true because osteocytes within the matrix retain cytoplasmic contact with osteoblasts via canaliculi within the gap junctions. D is true because the association of inorganic hydroxyapatite crystals with the collagen fibers confers the properties of hardness and resistance to bone matrix

52. Which of the following is NOT a characteristic of intramembranous bone formation?
    A. vascular invasion precedes initiation of osteoblastic activity
    B. hydroxyapatite deposition occurs within and around collagen microfibrils
    *C. osteoblasts deposit prebone on calcified cartilage matrix
    D. it occurs primarily in skull bones
    E. osteons form in areas which develop into compact bone

    ~ In intramembranous bone formation, osteoblasts do NOT deposit prebone on calcified cartilage matrix, as is done in endochondral bone formation. The starting material for intramembranous bone formation is primitive mesenchyme.

    @ A is true because vascular invasion always precedes initiation of osteoblastic activity because the blood brings in the osteoprogenitor cells for production of prebone. D is true because it occurs primarily is skull bones, whereas endochondral formation occurs in long bones. Osteons form in areas which develop into compact bone as the thickening bone matrix surrounds blood vessels, so E is true.

53. Which of the following is NOT a characteristic of chondrocytes?
    A. respire primarily by glycolysis
    B. synthesize and secrete Type II collagen
    *C. are actively motile, migrating to multiple new positions
    D. synthesize and secrete sulfated proteoglycans
    E. can divide in cartilage matrix giving rise to interstitial growth

~ Chondrocytes are not actively mobile cells that migrate to multiple new positions.

@ Chondrocytes metabolize glucose mainly by anaerobic glycolysis because cartilage is devoid of capillaries and thus must prosper with little oxygen. Chondrocytes produce Type II collagen and secrete it into the surrounding cartilage matrix. Cartilage proteoglycans contain chondroitin 4-sulfate,

chondroitin 6-sulfate, and keratan sulfate. Chondrocytes can divide in cartilage matrix, as is seen by isogenous groups, giving rise to interstitial growth.

54. In considering the differences and similarities between skeletal, cardiac, and smooth muscles, which of the following is INCORRECT?

A. Skeletal muscle has evolved for rapid contractions, whereas smooth muscle has evolved for slow, sustained contractions.

*B. Calcium regulation is mediated by the troponins and tropomyosin in smooth muscle, whereas calcium regulation is mediated by the regulatory myosin light chains in skeletal muscle (myosin- or thick filament-based).

C. Cardiac muscle consists of short cells (fibers) that are often branched, contain single centrally placed nuclei and are linked to other cells by intercalated disks.

D. Smooth muscle consists of sheets of long, spindle shaped cells containing centrally placed nuclei.

~ in skeletal muscle, calcium regulation is actin-based (tropomyosin and troponins), and in smooth muscle, calcium regulation is myosin-based.

55. All of the following characterize Emery-Dreifuss EXCEPT:

A. A clinical picture of slowly progressive muscle weakness, contracture of elbows, and cardiomyopathy with a high risk of sudden death.

B. Most cases are X-linked and contain mutations in the gene for "emerin," but some cases are autosomal dominant and contain mutations in the gene for lamins A and C.

*C. Both emerin and the lamins are localized to the inner mitochondrial membrane.

D. Emerin is one of at least 6 integral membrane proteins embedded in the inner nuclear membrane and interacts with the nuclear lamina composed primarily of lamins.

~ Emerin is localized to the inner nuclear membrane and the lamins compose the nuclear lamina and are bound to inner nuclear membrane proteins.

@ A is true because those are the clinical presentations of EDMD.

56. Which of the following statements about osteoclasts is INCORRECT?

*A. exhibit parathyroid hormone receptors on the plasma membrane opposite the ruffled border

B. are derived from a coalescence of monocytes

C. can mediate dissolution of hydroxyapatite by releasing carbonic acid

D. are present in bone throughout life

~ Osteoclasts do NOT have PTH receptors, while osteoblasts do

@ B, C, and D are all properties of osteoclasts because: they are derived from a coalescence of monocytes, which is why they are multinucleate cells; they cause bone resorption by the release of carbonic acid into the blood and hydrogen ions into the Howship's lacuna, which makes the bone matrix acidic for hydroxyapatite dissolution; and they are present in bone throughout life .

57. Canaliculi in living bone:

A. contain cellular processes of osteocytes

B. form "lifelines" between osteocytes and the nearest blood supply

C. are formed as a result of osteoblasts being trapped in freshly deposited prebone

D. are the sites where intercellular communication between osteocytes takes place via gap junctions

*E. all of the above are correct

58. Antibodies to _____ have proven very useful as markers in identifying the tissue of origin of a particular tumor.

A. keratins

B. actin and tubulin
C. dynein and kinesin
D. intermediate filament proteins
*E. Both A and D are correct

E is correct because both keratins and intermediate filaments are specific to their tissue type and have antibodies that can be used to identify them
B is wrong because even though there are various **forms** of actin, and it is present in some form in most cells it is not chemically distinct enough to use as a marker since in most cells they are "scattered in what appears to be an unorganized fashion
C is wrong because dynein and kinesin are wrong because there is not mention of differentiable forms of these motor proteins.

59. Movement of organelles throughout the cell and along microtubules occurs via the action of:

A. actin and α-actinin
B. *dynein and kinesin
C. myosin I and calmodulin
D. spectrin and myosin II
E. keratin and dystrophin

B is correct because dynein and kinesin are molecular motor proteins that use microtubules
A is wrong because actin and alpha-actinin are not involved in movement along microtubules. Actin pairs with myosin motors for transport, while alpha-actinin is though to anchor actin filament to the Z-line in skeletal muscle and as a different type of anchor in smooth muscle.
C and D are wrong because myosin motors are typically active in the movement of the whole cell, not in the movement of organelles within the cell. Also, instead of microtubules, myosin pairs with actin.
E is wrong because keratin is not involved with transport, but is a structural time of intermediate filament. Dystrophin is an actin-binding protein found in the sarcolemma which acts as a link between the cytoskeleton and the ECM

60. The centrosome of mammalian cells:

A. is the assembly of proteins located at the centromere called the kinetochore.
B. is a microtubule structure identical in for to the basal body.
C. *contains multiple ring-like structures that contain γ-tubulin and nucleate microtubule assembly.
D. is responsible for capture and regulation of microtubule plus (+) ends in the mitotic spindle.
E. duplicates numerous times (~23 times) during S-phase of the cell cycle.

A is wrong because the centrosome is located at the poles of the dividing cell, not near the centromere of the chromosome in the center of the cell. This is because the centrosome organizes the (-) end of the microtubules since nucleation occurs here, while the kinetochore interacts with the (+) end of the microtubules.
B is wrong because the centriole, which is within the centrosome, is what becomes a basal body (and occasional location of microtubule nucleation)
D is wrong because the centrosome is the site of nucleation, which corresponds with the (-) end of the microtubule, not the (+) end.

E is wrong because the centrosome is only present as a pair at the poles of the mitotic cell, there are not 23 of them (like the chromosomes)

Week Three

ETC Week 3 Quiz Answers

1. B
2. B
3. *B Both Wnt and TGF-beta are diffusible signaling molecules (See slide * of Mechanisms of Morphogenesis)*
4. E
   ~ A is true – the rapid loss at the + end is controlled by ATP driven motor proteins at the kinetochore and is responsible for pulling of the chromosome toward the spindle and subunits are removed more slowly from the – end: "The kinetochore microtubules shorten during anaphase by loss of subunits at both ends". B is correct
5. E
   ~ A is correct – cyclin dependent kinases (CDKs) are dependent on cyclin binding, and their activity cycles with the levels of cyclin . B is correct – these block the assembly or activity of cyclin-CDK complexes like active p53, indirect, and p21,direct. C is correct – APC adds a multiubiquitin chain to cyclin, targeting it for proteolysis. D is correct – various sites on the CDK can be phosphorylated, some that are inhibitory and others that are activating
6. E
   ~ A is correct – apoptosis is a mechanism that leads to programmed cell death. B is correct – the nuclear lamina is cleaved as the nuclear envelope disassembles. C is correct – the activation of the caspases, from inactive to active protease, is mediated by other caspases activating a cascade that engineers cell destruction. D is correct.
7. C
   ~ keratins are a diverse family with a distinct type found in various epithelial cells, one set for the gut distinct from the skin. So keratins would be a useful marker for epithelia and the type of epithelia.
   @ A is incorrect – laminin is a component of the Basal lamina outside of the epithelial cells. B is incorrect because tubulin is the building block for microtubules, which can be found in many cells, and is not characteristic of epithelial cells. D and E are incorrect because actin and myosin will be found in non-epithelial cell types – muscle.
8. C
   Taxol and similar Anti-microtubule drugs, Cholchicine, are analogs of tubulin, the building block of Microtubules. These drugs are then incorporated into the +, or fast-growing, terminal. This prevents the addition of further subunits and blocks cell proliferation/mitosis.
9. D
   Inappropriate proliferation of connective tissue can lead to sarcoma. Hyperplasia of melanocytes leads to melanomas. Hyperplasia of epithelial tissues leads to carcinomas. Teratomas results from development of independent germ lines. Neuroglial cells of the CNS will form gliomas.
10. D
    Cancer cells are characterized by uncontrolled hyperplasia and metastasis. These cells grow in the absence of growth factor induction and persist in spite of signals to die (immortality). These cells have minimal extracellular matrix because they need not attach to or communicate with other tissues.
11. D
12. E
    The minus end of each microtubules is embedded in the centrosome and growth occurs only at the plus end. The Golgi are arranged in a specific manner for secretion, and this polarity is a reflection of the polarized microtubules which direct and hold the Golgi and other organelles in place. The centrosome duplicates during the S phase. The g- tubulin

ring serves as the nucleation site for microtubules growth

13. D
    Taxol binds tightly to microtubules and prevents them from losing subunits, which inhibits the mitotic process. A is incorrect because taxol's affects the mitotic spindle which is not in place in S phase. B is incorrect because taxol does not function on p53. C is incorrect because taxol acts on microtubules, not actin filaments that form the contractile ring
14. E
    ~ A is correct; B is correct because vesicles lose their coat after budding is completed so that the vesicle can interact directly with the target membrane; C is correct because a fusion complex is formed with the vSNAREs, tSNAREs, and fusion proteins; D is correct because the budded vesicle carries a specific vSNARE that binds to a complementary tSNARE at the target membrane.
15. E
    ~ When active, the p53 protein stimulates transcription of p21, which inhibits activation of S-phase cyclins/CDKs until the cell has ensured that any damaged DNA is repaired before mitosis (A and B are correct)
    @ p53 is not involved with vesicular sorting or cytoplasmic motility
16. C
    ~Apoptosis, unlike necrosis, specifically does not trigger an inflammatory response.
17. A
    ~ When the retinoblastoma protein is phosphorylated, its conformation is altered so that it no longer binds to a particular transcription factor
    @ Rb is not involved in the processes listed in choices B, C, or D.
18. E
    ~ are mutant genes that cause excessive proliferation of cells . Encoding of a growth factor receptor or of a cell cycle activator would lead to over-stimulation of cell growth or proliferation. B is wrong because inhibiting the cell cycle would prohibit cell growth and division
19. B
    ~ Caspases are proteases activated for apoptosis; they cleave cytosolic proteins as well as nuclear lamin in order to stimulate suicide in a regulated manner. . It does not activate cyclin proteins, which are involved in the normal cell cycle, or in cleavage of insulin
20. A
    ~ MPF (M-phase promoting factor) found in cytoplasm selectively during the M phase will stimulate a cell in S phase to enter mitosis. Injection of M-phase cytoplasm will not induce any other phases, as in the other answer choices
21. D
22. A
    ~Nuclear lamins actually belong to the intermediate filament family. B is true because Cdks phosphorylate the lamins and cause them to dissociate to initiate M phase. D is also true.
23. *C*
    ~ The centrosome duplicates during the S phase of the cell cycle, well before the anaphase stage of mitosis. (see slide 11 of Cytoskeleton 2)
24. *C*
    The model of how chromosomes move towards the spindle poles is still not entirely understood. We know that there is disassembly of the microtubules at the + (kintochore-assosiated end) which is likely aided by the action of
    - end directed motor proteins (see slide 7 of Cytoskeleton 3). However, myosin is not responsible for this movement.
25. *C. Taxol binds the beta-tubulin subunits and prevents microtubles disassembly (slide 5 of Cytoskeleton 2)*

26. A
    @ B is wrong because necrosis refers to cell death as a result of acute injury and may cause an inflammatory response that may harm neighboring cells. C is wrong because programmed cell death in CNS development is necessary to match the number of developing cells to the correct number of target cells
27. C
    ~ Retinoblastoma protein is a nuclear tumor suppressor, which binds to a transcription factor, preventing it from stimulating cell proliferation . It is not a growth factor receptor. An oncogene is a mutant gene which, via hyperactivity, results in excessive cell proliferation (cancer); a functional retinoblastoma protein will prevent activation of an oncogene.
28. D
    ~ B is correct because CDKs are activated at the peak of cyclin accumulation. C is correct because CDK activity is controlled by phosphorylation and dephosphorylation.
    @ A is wrong because when cyclins are ubiquinated and degraded, CDK activity ceases abruptly.
29. D
    ~ In apoptosis, the cell surface (plasma membrane) is altered to signal phagocytosis of the dead cell (an apoptotic body). Also, a cascade of proteases is activated to break down the nuclear envelope and to cleave and inactivate intracellular proteins
30. B
    ~ Cilia are inserted into basal bodies on the apical plasma membrane
    @ C is wrong because the actin filaments that make up microvilli are anchored into the terminal web. A and D are also wrong since neither desmosomes nor intermediate filaments make up apical surface specializations
31. A
    ~ The contractile ring plays a role in cytokinesis, not in pulling the sister chromatids apart
32. D
    ~ The MTOC is required for more than just cell division. It also plays a role in guiding organelle movement and placement. All other statements regarding the MTOC are correct
33. B *Taxol binds the beta-tubulin subunits and prevents microtubles disassembly (slide 5 of Cytoskeleton 2)*
34. D
    ~ Phosphorylation and consequent disassembly of the intermediate filament proteins of the nuclear lamin occurs in prometaphase which takes place prior to anaphase
    @ During Anaphase A the following occurs: A relatively slow loss of subunits from the minus end and an increased loss of subunits from the plus end through kinetochore triggering. (-) end directed motors attached to the kinetochore are also in use
35. B
    ~ Gamma tubulin is located at the centrosome of the MTOC and not at the kinetochore
    @ The spindle microtubules bind the chromosomes through specialized protein complexes called kinetochores , which are formed on the chromosomes during late prophase. Each replicated chromosome consists of a two sister chromatids – A is true. Proteins at the centromere of the chromosomes (kinetochore forms at the centromere of the chromosomes) capture the plus ends of the kinetochore microtubules, the kinetochore proteins selectively stabilize the microtubules.
36. E
    ~ Cdks are regulated by the accumulation and degradation of cyclin. Experiments have been done to show that other regulatory kinases and phosphatases are also involved. Once Cdk binds cyclin the complex activates APC. cyclin/Cdk complex ensures its own destruction by activating this ubiquidating component that ubiquidates cyclin, and the cyclin is then targeted for degradation to an organelle called the proteosome.

37.
38. *B Cilia and flagella are organized by basal bodies (See slide 4 in Cytoskeleton 2)*
39. B

    ~ dynein and kinesin are molecular motor proteins that use microtubules

    @ A is wrong because actin and alpha-actinin are not involved in movement along microtubules. Actin pairs with myosin motors for transport, while alpha-actinin is though to anchor actin filament to the Z-line in skeletal muscle and as a different type of anchor in smooth muscle. C and D are wrong because myosin motors are typically active in the movement of the whole cell, not in the movement of organelles within the cell. Also, instead of microtubules, myosin pairs with actin. E is wrong because keratin is not involved with transport, but is a structural time of intermediate filament. Dystrophin is an actin-binding protein found in the sarcolemma which acts as a link between the cytoskeleton and the ECM
40. C

    @ A is wrong because the centrosome is located at the poles of the dividing cell, not near the centromere of the chromosome in the center of the cell. This is because the centrosome organizes the (-) end of the microtubules since nucleation occurs here, while the kinetochore interacts with the (+) end of the microtubules. B is wrong because the centriole, which is within the centrosome, is what becomes a basal body (and occasional location of microtubule nucleation). D is wrong because the centrosome is the site of nucleation, which corresponds with the (-) end of the microtubule, not the (+) end. E is wrong because the centrosome is only present as a pair at the poles of the mitotic cell, there are not 23 of them (like the chromosomes)
41. D

    @ A, B and C all are responsible for inhibition of Cdks and synthesis of cyclins would stimulate Cdks. A is wrong because ubiquitination and proteolysis are important for inhibition of Cdks. B is wrong because CdkIs are important for inhibition, and they include the tumor-suppressor family. C is wrong because phosphorylation and dephosphorylation play huge roles in regulation

42. A

    ~ taxol stabilizes microtubules

    @ B is wrong because colchicines acts to disassemble microtubules, not taxol. C is wrong because taxol counteracts all of these activities as a anti-tumor agent. D is wrong because taxol stabilizes the microtubules, it doesn't destroy them. E is wrong because there is not direct effect on motor activity, just an effect on the microtubules themselves

Vascular

1. endothelium
2. high; thicker
3. low; thinner
4. E
5. A
6. Serosal
7. Lubricates heart movements
8. C
9. B
10. Arteriovenous anastomosis
11. Temperature control in the skin
12.
13. Endothelium, smooth muscle, and connective tissue
14. Endothelium, basal lamina, and pericytes
15. C
16. Elastin
17. Intima; media
18. Media; adventitia
19. C
20. Large or elastic
21. Thick
22. Fibrillin-1
23. Abdominal aortic aneurysm
24. Muscular
25. Arteriosclerosis
26. Pericytes
27. Rapid exchange (ex. intestines and kidney)
28. Diapedesis
29. Postcapillary venules
30. Open; close
31. Thick
32. Hives

33. C
34. C
35. Vascular system
36. B
37. Yolk sac
38. Intersomitic
39. B
40. D
41. E
42. E
43. A
44. Angiogenic switch

Neural Function

Questions

Week One

Neuro Week 1 Questions
The numbering is out of order at places because last year's week 1 and 2 were a little different, but they match the numbering on the answer key. There are also a lot of repeated questions but I marked them and left them in because some of the answer explanations are more detailed. Good luck!

1. Which disease likely involves the basic protein of CNS myelin?
A. Alzheimer's disease
B. Guillain-Barré syndrome
C. AIDS
D. multiple sclerosis

2. Which of these organelles is NOT found in axons?
A. microtubules
B. dense-core vesicles
C. rough endoplasmic reticulum
D. mitochondria
E. synaptic vesicles

3. Which issue below represents a NEGATIVE influence on successful nerve regeneration in the CNS?
A. Damaged astrocytes can no longer re-myelinate axons.
B. The Schwann cells die.
C. The oligodendroglia are physically separated from the axons they myelinate.
D. none of the above

5. The electromyogram (EMG) measures:
A. the compound action potential originating from skeletal muscle.
B. the action potential in the axons of the nerve.
C. the postsynaptic potential at the endplate of skeletal muscle.
D. the force of muscle contraction.
E. the velocity of action potential propagation.

6. Which of the following is NOT true of endplate potentials, excitatory postsynaptic potentials (EPSPs) in muscle cells?
A. EPSPs are graded in amplitude depending on the amount of transmitter released.
B. EPSPs are local: the depolarization associated with them decays with distance from the synapse.
C. EPSPs usually are blocked by acetylcholinesterase inhibitors.
D. EPSPs exhibit spatial and temporal summation.
E. EPSPs can initiate action potentials if their amplitude is sufficiently large to reach threshold.

7. Small molecule neurotransmitters like ACh are:
A. synthesized in mitochondria in the cell soma.
B. synthesized in the cytoplasm of the presynaptic terminal and transported via a proton-dependent exchanger into the synaptic vesicle.
C. pumped into the synaptic cleft one molecule at a time in response to membrane depolarization by a Na-dependent exchanger.
D. released as single ACh molecules (quanta) by Ca-dependent exocytosis.
E. released in a Ca-independent fashion.

8. Which of the following is NOT true of ionotropic receptors?
A. They have binding sites for neurotransmitters.
B. They are ligand-gated ion channels.
C. They are coupled to adenylyl cyclase activation.
D. They mediate fast synaptic transmission.
E. They can mediate either EPSPs or IPSPs.

9. A presynaptic nerve is stimulated twice in close succession. The second EPSP recorded in the postsynaptic cell is larger than the first. This phenomenon is called:
A. facilitation.
B. posttetanic potentiation.
C. depression.
D. paired pulse depression.

10. Which of the following is NOT true of presynaptic inhibition?
A. Presynaptic inhibition can be mediated by GABA-A receptor mediated increases in Cl conductance and shunting of the presynaptic action potential.
B. Presynaptic inhibition can be mediated by alpha-adrenergic receptor activation of G-proteins that modulate voltage-gated Ca channel function.
C. The increase in cytosolic Ca concentration in the presynaptic terminal is reduced in presynaptic inhibition.
D. Presynaptic inhibition is caused by a prolongation of the presynaptic action potential.

11. Which of the following is NOT true of myasthenia gravis (MG)?
A. There is a decrease in the number of viable nicotinic ACh receptors at the neuromuscular junction.
B. Patients often produce an antibody directed against the nicotinic ACh receptor.
C. Treatments for MG include immunosuppressive therapy, acetylcholinesterase inhibitors, and sometimes thymectomy.
D. There is a decrease in EMG amplitude with repeated nerve activity.
E. Quantal content is greatly increased.

12. In Alzheimer's disease, which of the following is characteristic of the protein tau?
A. It no longer binds to MAP2
B. It shows decreased binding to tubulin
C. It binds tightly to microtubules and increases their stability
D. All of the above are correct
E. None of the above is correct

(repeat) 13. Which disease below likely involves the basic protein of CNS myelin (myelin basic protein)?
A. Alzheimer's disease
B. GUillain- Barre's disease
C. AIDS
D. multiple sclerosis

15. Which property of glia is an impediment to effective and successful nerve regeneration within the CNS?
A. inability of damaged astrocytes to remyelinate axons
B. premature death of Schwan cells
C. the physical separation of cell bodies from the axons they myelinate
D. migration of microglia from the site of injury
E. none of the above

16. Which of the following is (are) characteristic of microglia?

A. They harbor the HIV receptor
B. They are the primary antigen presenting cell in brain
C. They may secrete factors that cause astrocytes to hypertrophy
D. All of the above are correct
E. None of the above is correct

(repeat) 17. The electromyogram (EMG) measures
A. the compound action potential originating from skeletal muscle
B. the action potential in the axons of the medial nerve
C. the postsynaptic potential at the endplate of skeletal muscle
D. the force of muscle contraction
E. the velocity of action potential propagation

18. The EMG from patients with myasthenia gravis exhibits:
A. a decreased amplitude with repetitive stimulation at 3/sec
B. an increased amplitude with repetitive stimulation at 20/sec
C. no change with repeated stimulation at 3/sec for 10 min.
D. an oscillation in amplitude depending on the stimulation frequency
E. no response

19. Which of the following is NOT true of excitatory postsynaptic potentials (EPSPs)?
A. EPSPs are graded in amplitude depending on the amount of transmitter released
B. EPSPs are local: the depolarization associated with them decays with distance from the synapse
C. EPSPs are often hyperpolarizing
D. EPSPs exhibit spatial and temporal summation
E. EPSPs can initiate action potential if their amplitude is sufficiently large to reach threshold.

20. Which of the following is TRUE of electrical synapses?
A. They exhibit a long synaptic delay
B. They always transmit signals in one direction
C. They mediate slow postsynaptic potentials
D. They are formed by connexons of gap junctions
E. They use a chemical transmitter

(repeat) 21. Small molecule neurotransmitter, like Ach, are:
A. synthesized in mitochondria in the cell soma
B. synthesized in the cytoplasm of the presynaptic terminal and transported via proton- dependent exchanger into the synaptic vesicle.
C. pumped into the synaptic cleft one molecule at a time in response to membrane depolarization by a Na-dependent exchanger
D. released in a CA-independent fashion

22. Which of the following is NOT true of synaptic vesicles?
A. Docking involves the interaction of SNARE proteins on the vesicle and presynaptic membrane
B. Release is triggered by Ca influx through voltage-gated CA channels
C. Synaptic vesicle release can be blocked by botulinum toxins which cleave certain SNARE proteins
D. Synaptic vesicle proteins are recovered and recycled by formation of coated pits and vesicles
E. Synaptic vesicles have an alkaline pH in their lumen

23. A certain cell has typical mammalian ionic concentrations inside and outside. At rest, it has only K channels open. What is the approximate value of the resting potential of this cell and how will the membrane potential change if Na channels opens?

A. -90 mV, hyperpolarize
B. -50 mV, depolarize
C. -90 mV, depolarize
D. 50 mV, hyperolarize
E. -45 mV, depolarize

(repeat) 24. Which of the following is NOT true of myasthenia gravis?
A. There is a decrease in the number of nicotinic Ach receptors at the neuromuscular junction
B. Patients often produce an antibody directed against the nicotinic ACh receptor
C. Treatments for myasthenia gravis include immunosuppressive therapy, acetylecholinesterase inhibitors, and sometimes thymectomy
D. Quantal content is greatly increased

31. A patient has a lesion of sympathetic pathways on the right controlling pupil size. Which of the following is most likely to be true?
A. The pupils will be equal in size.
B. There will be a right relative afferent pupillary defect.
C. There will be a left relative afferent pupillary defect.
D. The right pupil will be larger than the left.
E. The left pupil will be larger than the right.

32. Lesions in which of the following brain regions would most likely result in seizures?
A. Cerebellum
B. Hypothalamus
C. Temporal lobe
D. Cavernous sinus
E. Cerebral peduncle

33. Which of the following would NOT increase risk for developing epilepsy?
A. Penetrating head wound
B. Stroke
C. Neonatal hypoxia
D. Family history

34. Presynaptic densities:
A. are the sole determinant of synaptic physiology
B. are arranged in a geometric pattern to facilitate synaptic vesicle/membrane fusion
C. nitiate and maintain retrograde transport
D. synthesize and package neurotransmitters

35. An early stage in the formation of paired helical filaments in Alzheimer's disease is likely to be:
A. phosphorylation of tubulin
B. phosphorylation of MAP2
C. phosphorylation of tau
D. phosphorylation of neurofilaments
E. phosphorylation of actin

37. An early change in the pathogenesis of multiple sclerosis is:
A. generation of myelin fragments in the CNS
B. generation of myelin fragments in the PNS
C. degeneration of peripheral neurons
D. degeneration of Schwann cells

38. Which of the following statements is most accurate about association cortex?
A. Unlike primary sensory cortex, association cortex has only three layers.
B. Unlike primary motor cortex, association cortex is found only in the temporal lobe.
C. Unlike primary sensory and motor cortices, association cortex is found only on the left side in about 90% of people, regardless of handedness.
D. Unlike primary sensory cortex, association cortex has no connections with the thalamus.
E. Unlike primary sensory cortex, all sensory inputs to association cortex come from other cortical regions.

39. The statement "acetylcholine (ACh) causes skeletal muscle to contract" is imprecise because
A. it is only true if ACh causes a depolarization that exceeds threshold for action potential generation in the muscle.
B. skeletal muscle does not contain ACh receptors.
C. ACh is an inhibitory transmitter.
D. muscle contraction is initiated by hyperpolarization.
E. none of the above.

40. Electrical synapses
A. are formed by gap junctions.
B. exhibit no synaptic delay.
C. can conduct bi-directionally.
D. have no synaptic cleft.
E. all of the above.

41. Release of neurotransmitter from the presynaptic terminal
A. requires extracellular Ca
B. requires Ca influx
C. is initiated by depolarization of the presynaptic terminal
D. occurs by exocytosis
E. all of the above.

42. Ion channels in the postsynaptic membrane may be opened by which of the following:
A. neurotransmitter binding to channels.
B. binding of G-protein subunits to channels.
C. binding of soluble second messengers like cAMP or Ca to channels.
D. Phosphorylation of channels.
E. all of the above.

43. Which of the following statements are true about a cell that has a resting membrane potential of 95 mV with normal mammalian intracellular and extracellular ionic compositions?
A. Only Na and Ca channels are open.
B. The cell has no K channels.
C. The membrane conductance is due mainly to K ions.
D. The membrane potential is near the Nernst potential for Na.
E. none of the above.

44. Which of the following types of synaptic modulation are NOT due to changes in the amount of transmitter released?
A. presynaptic inhibition produced by GABA.
B. paired pulse facilitation
C. post-tetanic potentiation
D. desensitization

45. Mechanisms of presynaptic inhibition theoretically could include all EXCEPT which of the following:
A. Inhibition of Ca channels
B. Activation of K channels
C. Activation of Cl channels
D. Inhibition of interaction of v-snares and t-snares.
E. Inhibition of acetylcholinesterase activity.

46. Cocaine and tricyclic antidepressants produce their effects by
A. enhancing catecholamine reuptake into the postsynaptic cell.
B. blocking postsynaptic 5-HT receptors
C. blocking catecholamine re-uptake into the presynaptic nerve terminal
D. stimulating catecholamine reuptake into mitochondria
E. inhibiting monoamine oxidase

47. Which of the following statements is NOT true about myasthenia gravis?
A. It is an autoimmune disease caused by antibodies against acetylcholinesterase.
B. The number of nicotinic ACh receptors at the neuromuscular junction is reduced.
C. It can be treated with inhibitors of acetylcholinesterase.
D. It can be treated by thymectomy or immunosuppressants.
E. All of the above statements are true.

54. Cerebrospinal fluid:
A. normally contains no red blood cells
B. is secreted at a rate of about 10 ml/day
C. normally contains only 1 microgram of protein per liter.
D. is secreted by the arachnoid membrane.
E. exists only within the brain ventricles and the central canal of the spinal cord.

55. Cerebrospinal fluid reenters the blood circulation via:
A. the lymphatic system.
B. the thoracic duct.
C. the superior cistern.
D. the cisterna magna.
E. the arachnoid granulations.

(repeat) 56. Which of the following is characteristic of the protein tau in Alzheimer's disease?
A. It no longer binds to MAP2.
B. It exhibits decreased binding to tubulin.
C. It binds tightly to microtubules and increases their stability.
D. A, B, and C
E. none of the above

(repeat) 57. Which disease likely involves the “basic protein” of CNS myelin?
A. Alzheimer's disease
B. Guillain-Barré disease
C. AIDS
D. multiple sclerosis

(repeat) 58. Which of these organelles is NOT found in axons?
A. microtubules
B. dense core vesicles
C. nissl bodies (rough endoplasmic reticulum)
D. mitochondria
E. synaptic vesicles

(repeat) 59. Which property is an impediment to successful nerve regeneration in the CNS?
A. Damaged astrocytes can no longer remyelinate axons.
B. The Schwann cell dies.
C. The oligodendroglia is physically separated from the axon it myelinates.
D. Microglia move away from the site of injury and atrophy.
E. none of the above

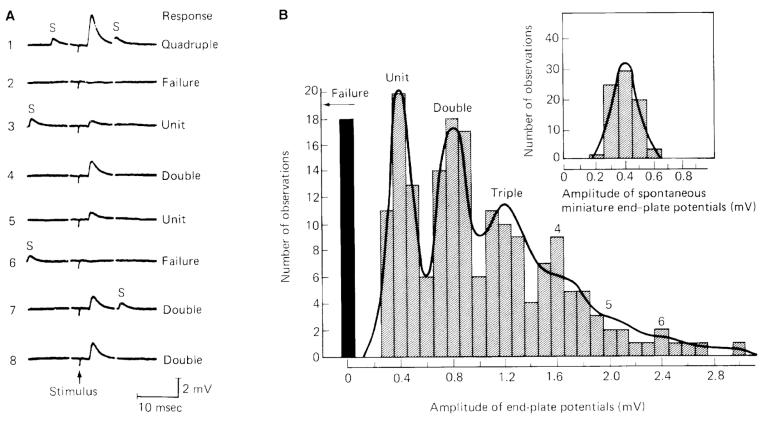
(repeat) 60. Which of the following are characteristic of microglia?
A. They harbor the HIV receptor.
B. They are the primary antigen presenting cell in brain.
C. They may secrete factors that cause astrocytes to hypertrophy.
D. all of the above
E. none of the above

61. Which of the following aids successful nerve regeneration in the PNS?
A. secreted glycosaminoglycans (GAGS)
B. the endoneurium
C. activated astrocytes
D. degeneration resistant pools of myelin
E. all of the above

62. Which of the following statements is NOT TRUE about electrical synapses?
A. Electrical synapses are composed of gap junction connexons.
B. Transmission at electrical synapses is very fast.
C. Electrical synapses can transmit in both directions.
D. Electrical synapses transduce electrical energy into chemical energy.
E. The extracellular space between cells at gap junctions is about 3.5 nm.

63. Which of the following statements is NOT TRUE about small molecule neurotransmitters?
A. They are packaged in small synaptic vesicles.
B. They are often synthesized in the nerve terminal and packaged in vesicles by a process that involves transport via a proton-transmitter exchanger.
C. They are released by exocytosis.
D. Their action at the postsynaptic membrane is terminated by hydrolysis, re-uptake, or diffusion away from the receptors.
E. They are synthesized on the rough endoplasmic reticulum in the cell body and packaged into vesicles in the Golgi apparatus.

64. Which of the following statements is NOT TRUE about calcium-mediated transmitter release?
A. Calcium enters the nerve terminal via ligand-gated Ca channels.
B. Calcium causes transmitter release by changing the conformation of the SNARE complex which stimulates vesicle fusion.
C. Transmitter release can be blocked by botulinum toxins.
D. Transmitter release requires influx of calcium from the extracellular space at the same time the nerve terminal is depolarized.
E. Calcium channels are located in the active zone.



65. Which of the statements below is NOT TRUE about the figure above?
A. In trace A1, the EPSP evoked by nerve stimulation is ~4 times larger than a spontaneous miniature EPSP.
B. The quantal content in trace A2 is 0.
C. The mean amplitude of the miniature endplate potential is ~0.4 mV.
D. Nerve stimulation often produces no postsynaptic response.
E. The depolarizations following the stimulus artifact are compound action potentials.

66. Which of the following is NOT TRUE about ionotropic receptors?
A. They often mediate fast synaptic transmission.
B. They are ligand gated ion channels.
C. They are often coupled to G proteins.
D. They have a selectivity filter in the pore.
E. They are transmembrane proteins.

67. Which of the following is NOT TRUE about metabotropic receptors?
A. They may be G-protein coupled receptors.
B. They may activate adenylyl cyclase or phospholipase C.
C. They may open an ion channel in the postsynaptic membrane by a pathway that involves phosphorylation.
D. They often mediate slow synaptic transmission.
E. They include nicotinic acetylcholine receptors and GABA-A receptors.

68. Many insecticides, like malathion, inhibit acetylcholinesterase. Which of the following statements is TRUE about these compounds?
A. These compounds increase the amount and lifetime of acetylcholine (ACh) at the postsynaptic membrane and have the same effect as Mestinon, used to treat myasthenia gravis.
B. These compounds increase the amount of ACh released.
C. These compounds increase the sensitivity of the postsynaptic membrane to ACh.
D. These compounds inhibit action potential generation.

69. $GABA_A$-receptor-mediated presynaptic inhibition involves
A. activation of Cl-selective channels.
B. activation of a G-protein
C. inhibition of α-adrenergic receptors
D. activation of nicotinic Ach receptors and Na influx.
E. decreases in the amount of transmitter per vesicle..

75. A localized lesion to the left medial longitudinal fasciculus (MLF) would cause which of the following ?
A. When the patient looks to the left, the right eye does not follow.
B. When the patient looks to the right, the left eye does not follow.
C. The patient cannot look up.
D. When the patient looks down, there is a pronounced vertical nystagmus.

76. Which of the following statements about epilepsy is (are) true?
A. Risk factors include trauma with bleeding into the brain, and stroke.
B. Pilocarpine injection produces a chronic rat model of epilepsy that involves a permanent change in brain circuitry leading to a hyperexcitable state.
C. Selective degeneration of certain neuron types following trauma can produce a reorganization of circuitry that produces an epileptic state.
D. Pharmacological strategies for epilepsy therapy include suppressing the ability of neurons to fire repetitively, and enhancing synaptic inhibition in cortical regions.
E. All four answers are correct.

(repeat) 77. The cerebrospinal fluid:
A. Is generated in the arachnoid granulations.
B. Circulates in the subdural space.
C. Normally contains very few red blood cells.
D. Has a protein concentration equal to that of blood.
E. Is secreted at a rate of 5 cc per day.

78. The longest cells in the nervous system:
A. Are no longer than 30 cm.
B. Extend from the precentral gyrus to a muscle in the foot.
C. Extend from the skin or muscle of the foot to the medulla.
D. Are unmyelinated.
E. Travel in the spinothalamic tract.

79. Which of these components is most critical for fast axonal transport?
A. Neurofilaments
B. ATP
C. Intermediate filaments
D. Actin filaments
E. Cyclic AMP

80. An early stage in the formation of paired helical filaments in Alzheimer's disease is likely to be:
A. Phosphorylation of tubulin.
B. Phosphorylation of MAP2.
C. Phosphorylation of tau.
D. Phosphorylation of neurofilaments.
E. Phosphorylation of actin.

(repeat) 81. Which property or event is a NEGATIVE influence on successful nerve regeneration in the CNS?
A. The oligodendroglia is in close apposition to the axon it myelinates.
B. The astrocytes hypertrophy and secrete glycosaminoglycans (GAGS).
C. The Schwann cell dies.
D. Microglia move away from the site of injury and atrophy.

(repeat) 82. An early change in the pathogenesis of multiple sclerosis is:
A. Generation of myelin fragments in the CNS.
B. Generatino of myelin fragments in the PNS.
C. Degeneration of neurons.
D. Degernation of Schwann cells.

83. Ligand gated and voltage gated channels share all the following features EXCEPT:
A. Both types of channel have a selectivity filter.
B. Both types of channel have one or more gates.
C. Both types of channel have a voltage sensor.
D. Both types of channel have hydrophobic domains that interact with the phospholipid bilayer.

(repeat) 84. Which of the following statements is NOT TRUE about small molecule neurotransmitters?
A. They are packaged in synaptic vesicles.
B. They are often synthesized in the nerve terminal and packaged in vesicles by a process that involves transport via a proton-tramsmitter exchanger.
C. They are released by exocytosis.
D. Their action at the postsynaptic membrane is terminated by hydrolysis, re-uptake, or diffusion away from the receptors.

E. They are synthesized on rough endoplasmic reticulum in the cell body and packaged into vesicles in the Golgi apparatus.

85. Which of the following statements is NOT TRUE about calcium-mediated transmitter release?
A. Calcium enters the nerve terminal via voltage-gated Ca channels.
B. Calcium causes transmitter release by changing the conformation of the SNARE complex which stimulates vesicle fusion.
C. Transmitter release requires that calcium stimulate a protein kinase.
D. Transmitter release requires influx of calcium from the extracellular space.
E. Calcium channels are located in the active zone.

87. An alpha-motor neuron has a resting membrane potential of -75 mV. If a single presynaptic terminal releases gluatmate that acts on glutamate receptors in the alpha motor neuron that are selectively permeable to Na, the alpha motor neuron will:
A. Transiently depolarize.
B. Transiently hyperpolarize.
C. Fire an action potential.
D. Remain at -75 mV.
E. Depolarize until an IPSP occurs.

88. Which of the following statements is NOT TRUE about synaptic facilitation?
A. Facilitation involves an increase in the number of vesicles released per presynaptic action potential.
B. Facilitation probably involves residual calcium that remains in the nerve terminal after the preceding stimulus.
C. Facilitation occurs at stimulation frequencies of 20 Hz or higher.
D. Facilitation requires protein phosphorylation and protein synthesis.
E. Facilitation is normally not observed at stimulation frequencies of 3 Hz.

89. GABA-mediated presynaptic inhibition involves:
A. Activation of Cl-selective channels and a decrease in membrane resistance.
B. Activation of a G-protein.
C. Inhibition of voltage-gated Na channels.
D. Synapses on the cell body.
E. Decreases in the amount of transmitter per vesicle.

90. Which of the following is NOT TRUE about myasthenia gravis?
A. It is an auto-immune disease.
B. The number of nicotinic Ach receptors at the postsynaptic membrane is less than normal.
C. The number of vesicles released per presynaptic action potential is less than normal.
D. A diagnostic feature of myasthenia gravis is a decrease in amplitude of the EMG during stimulation at 3 Hz.
E. Mestinon, a drug that is used to treat myasthenia gravis, blocks the enzyme acetylcholinesterase and increases the concentration of ACh at the postsynaptic membrane.

121. The third ventricle is immediately surrounded by the
A. telencephalon
B. diencephalon
C. mesencephalon
D. metencephalon
E. myelencephalon

124. Which of the following is characteristic of the protein, tau, in Alzheimer's disease?
A. no longer binds to MAP2
B. decreased phosphorylation
C. increased phosphorylation

D. binds tightly to microtubules and increases their stability
E. none of the above

(repeat) 125. Which of the following hinders nerve regeneration in the CNS?
A. Damaged microglia can no longer remyelinate axons.
B. The Schwann cell dies.
C. Astrocytes move away from the site of injury and atrophy.
D. The oligodendroglia is physically separated from the axon it myelinates.

126. Which of these likely involves the basic protein of myelin?
A. Alzheimer's disease
B. Pick's disease
C. AIDS
D. experimental allergic encephalomyelitis

127. Multiple sclerosis and Guillan-Barre Syndrome are examples of
A. CNS and PNS ion channel defects, respectively.
B. PNS and CNS ion channel defects, respectively.
C. CNS and PNS demyelinating diseases, respectively.
D. PNS and CNS demyelinating diseases, respectively.
E. diseases with both CNS and PNS involvement.

129. During an action potential, how does depolarization affect the average open times of sodium and potassium channels?
A. Sodium channels open faster and stay open longer than potassium channels.
B. Potassium channels open faster and stay open longer than sodium channels.
C. Sodium channels open faster and close faster than potassium channels.
D. Potassium channels open faster and close faster than sodium channels.
E. Sodium and potassium channels open and close at the same time.

130. Assume that a hypothetical neuron contains the following in its terminal: Ach in clear rounded vesicles near the plasma membrane and a peptide neurotransmitter in dense core vesicles that are distant from the plasma membrane.
A. Low spike frequency would release the peptide, and high spike frequency would release ACh.
B. Low spike frequency would release ACh, and high spike frequency would also release the peptide.
C. The peptide and the ACh would be released in proportional amounts with any activity.
D. ACh would be released at all activity levels, but the peptide would only be released by non-physiological stimuli.
E. None of the above.

131. Which of the following serum ion concentrations in humans is seriously abnormal?
A. Na=145 mM
B. Cl=105 mM
C. K=20 mM
D. Ca=2.0 mM
E. H=10'-7.4 M

132. Which statement is FALSE about ion channels?
A. Ion channels have hydrophobic domains to interact with the lipid bilayer.
B. Ion channels have a gate that is opened by voltage, ligands, or other stimuli.
C. Ion channels are usually selective for one ion species or ions of like charge.
D. Ion channels can be modeled as an electrical resistor or conductor.
E. Ion channels are seldom composed of multiple subunits.

133. The pore of inwardly-rectifying K channels can be thought of as the “active site” of an enzyme which

A. catalyzes the dehydration of K ions as they pass through the membrane.
B. confers voltage sensitivity to the channel.
C. catalyzes the ionization of cations such as Na.
D. catalyzes interaction of the K ions with lipids in the membrane.

134. Funnel web spider venom contains a toxin which blocks a voltage-gated Ca channel located in active zones of presynaptic nerve terminals. Which of the following statements is (are) true for a synapse poisoned with this toxin?
A. The postsynaptic cell would respond to transmitter squirted onto the cell from a pipette.
B. The presynaptic axon would conduct action potentials.
C. Miniature postsynaptic potentials, although possibly reduced in frequency, would have a normal amplitude.
D. Excitatory postsynaptic potentials would be absent or greatly reduced in amplitude.
E. All of the above are true.

136. Presynaptic inhibition could involve which of the following mechanisms?

A. Inhibition of voltage-gated Ca channels by beta-gamma subunits of G proteins.
B. Reduced Na-K pump activity.
C. Increased VAMP synthesis.
D. Opening Cl channels in the presynatic nerve terminal.
E. Both A and D are true.

137. Acetylcholine (ACh) released from parasympathetic nerves causes a reduction in the frequency of cardiac contraction. Which of the following is TRUE about the mechanisms of this process?
A. ACh reduces frequency of contraction by activating G-protein-gated K channels in the pacemaker region of the heart.
B. ACh activates cyclic nucleotide-gated channels via phospholipase C pathway in the heart.
C. ACh decreases frequency via nicotine ACh receptors in the heart.
D. ACh opens Na channels in the sinoatrial node.

138. Which statement about synapses is FALSE?

A. Whether a synapse is excitatory or inhibitory depends on the nature of the receptor in the postsynaptic cell rather than on the nature of the neurotransmitter.

B. A synapse is defined as inhibitory if its activation decrease the likelihood that the postsynaptic cell will fire an action potential.

C. Synaptic inhibition usually works mechanistically by causing inactivation of voltage-gated sodium channels in the postsynaptic cell.

D. Some excitatory synapses involve neurotransmitter binding to ligand-gated channels
E. Some inhibitory synapses involve neurotransmitter binding to ligand-gated channels.

146. Which of these organelles is most critical for fast axonal transport?

A. actin filaments
B. Intermediate filaments
C. microtubules
D. neurofilaments

(repeat) 148. An early stage in the formation of paired helical filaments in Alzheimer’s disease is likely to be:
A. phosphorylation of MAP 2
B. phosphorylation of tubulin
C. phosphorylation of actin
D. phosphorylation of tau
E. all of the above

151. Which of the following is an aid to regeneration in the CNS?
A. secreted glycosaminoglycans (GAGS)
B. the endoneurium
C. activated astrocytes
D. activated oligodendrocytes
E. all of the above

152. Membrane conductance:
A. is degreased when an ion channel opens
B. is the square root of resistance
C. is the ratio of transmembrane current to voltage.
D. is measured in amperes.
E. is equivalent to driving force.

153. In the Nernst equation, V=1/z 60 mV log(ion) out/(ion)in, z is:
A. the Nernst constant
B. the Faraday constant
C. irrelevant
D. the valence of the permeant ion.
E. equal to RT/F

154. Which cell property would be most important in determining how two stimuli applied at different locations on the cell at the same time would sum together?
A. the space constant of the cell
B. the membrane capacitance
C. the distribution of Nissl substance
D. the type of channels opened by the stimuli

155. Cyclic nucleotide-gated ion channels are distantly related in structure to voltage-gated cation channels and are opened by the binding of cGMP or cAMP to the cytoslic face of the channel. The channel lacks the basic (lysine, arginine) residues typically found in the S4 domain of voltage-gated cation channels. This suggests that cyclic nucleotide channels are:
A. not gated by voltage.
B. are also gated by Ach released from photoreceptors
C. Na-selective channels
D. inwardly rectifying.

156. The pore of inwardly-rectifying K channels can be thought of as the "active site" of an enzyme which:
A. catalyzes the dehydration of K ions as they pass through the membrane
B. confers voltage-sensitivity on the channel
C. catalyzes the ionization of cations such as Na
D. catalyzes interaction of the K ions with lipids in the membrane

157. Acetylcholinesterase is inhibited by many common insecticides, like malathion and Sevin. A person poisoned with these insecticides might be expected to exhibit symptoms caused by which of the following conditions?
A. Increased concentration of GABA at inhibitory synapses in the spinal cord.
B. Increased responsiveness of NMDA receptors.
C. Increased concentration of Ach at the neuromuscular junction.
D. Increased voltage-sensitivity of Ca channels.

158. Exocytotic transmitter release occurs in response to:
A. an increase in cytosolic free Ca from 0.1 uM to > 10 uM.

B. hyperpolarization.
C. opening of voltage-gated K channels in the presynaptic membrane.
D. activation of neurotransmitter transporters.
E. overfilling of synaptic vesicles.

159. The presynaptic membrane protein syntaxin is thought to play an important role in transmitter release. Botulinum toxin Cl is a bacterial toxin that cleaves syntaxin and produces blockade of exocytosis at the neuromuscular junction. One would expect that botulinum toxin Cl would produce:

A. larger than normal endplate potentials.
B. IPSPs in the muscle.
C. paralysis of the muscle.
D. hyperexcitability.
E. none of the above.

160. Which of the following cranial nerves does not exit the brain stem close to the corticospinal tract?

A. II
B. III
C. IV
D. VI
E. XII

75. Which of the following would NOT interrupt pain and temperature input from the right hand?

A. Extensive damage to the dorsal roots or dorsal horn of upper thoracic and lower cervical cord on the right side.
B. Bilateral damage confined to the base of the pons.
C. Damage to the ventral lateral spinal cord on the left side at C2.
D. Damage to the lateral tegmental region of the rostral medulla on the left.
E. Damage to the left side of the ventral lateral complex of the thalamus.

76. Which one of the following nerves DOES NOT contain a significant autonomic component?

A. oculomotor
B. trigeminal
C. glossopharyngeal
D. hypoglossal

77. Which one of the following nerves IS NOT associated with a nucleus lying in the lateral part of the pons or medulla?

A. facial
B. trigeminal
C. glossopharyngeal
D. hypoglossal

78. The primary olfactory cortex is found:

A. near the face area of somatosensory cortex
B. in the insula

C. at the base of the temporal lobe, near the amygdala
D. in the anterior cingulate gyrus
E. in the hippocampus

79. Which of the following cranial nuclei sends axons to a muscle on the opposite side of the head?
A. facial
B. trigeminal
C. abducens
D. trochlear
E. glossopharyngeal

80. The central pathway for cutaneous innervation of the face involves
A. the facial nucleus
B. the solitary nucleus
C. the spinothalamic nucleus
D. the descending (spinal) trigeminal nucleus
E. the trigeminal mesencephalic nucleus

81. The axons of olfactory receptor cells in the nasal cavity
A. synapse directly in piriform cortex of the temporal lobe
B. synapse in the olfactory bulb, which projects second order neurons to the thalamus
C. are more able to discriminate between odorants than are the trigeminal axons that innervate the nasal cavity
D. ultimately influence the contralateral piriform cortex than the ipsilateral cortex
E. None of the above statements is correct

82. Which one of the following statements is CORRECT?
A. Primary afferent fibers have a narrow range of diameters and conduction velocities
B. Aδ and unmyelinated C sensory fibers are important in 2-point discrimination.
C. Aβ afferent fibers have sensory receptors that respond to temperature.
D. Pain sensation from visceral tissue is often fast, sharp and highly localizable.
E. Nocioceptors are activated by stimuli that cause or would cause tissue damage.

83. With regard to sensory receptors:
A. Adaptation refers to an increase in receptor responsiveness over time.
B. Adaptation occurs at a uniform rate for all types of mechanoreceptrors.
C. Localization of sensory information is accomplished in part by an anatomic mapping (somatotopic map in the brain) of a receptor's receptive field.
D. Mechanoreceptors, thermoreceptors, and chemoreceptors are all types of hair follicle receptors.

62. Which of the following systems respond most rapidly to sudden movement of the body and head?
A. The visual system
B. The vestibular system

C. The proprioceptive component of the somatosensory system

63. Which of the following statement is/are true regarding motor unit recruitment?
A. Slow motor units are used for maintaining posture.
B. A population of many, small units provides for fine control of force generation.
C. Fast motor units can be used for ballistic, forceful movements.
D. All of the above

64. Type S motor units:
A. are generally recruited first during reflex and voluntary muscle activity
B. maintain force output during prolonged activity
C. feature slow conducting motor axons
D. all of the above are correct

65. The properties of type S motor units include all those shown below EXCEPT:
A. long duration after hyperpolarizations
B. rapid fatigability
C. oxidative muscle fiber metabolism
D. axons that conduct action potentials with the slowest velocity

66. Muscles that are optimized for achieving fine control exhibit which of the following features:
A. large numbers of large-force motor units
B. large numbers of motor units that fatigue rapidly
C. many low-force motor units
D. all of the above

67. During head rotation to the left, which of the following muscle pairs contract to move the eyes in a compensatory direction?
A. Left lateral rectus and right medial rectus
B. Right lateral rectus and left medial rectus
C. Right superior oblique and left superior rectus

78. The hair cells of the utricle respond predominantly to accelerations in which of the following directions?
A. left-to-right or right-to-left
B. up or down
C. around a vertical axis
D. around a horizontal axis

82. Hair cells
A. Use GABA as their neurotransmitter.
B. Receive no afferent connections.
C. Can be regenerated by using cochlear implants.
D. Release some neurotransmitter at rest.

88. All the stereocilia on mature cochlear inner hair cells are:

A. Enlarged microvilli with actin cytoskeletal support
B. True cilia with a 9+2 arrangement of microtubules
C. All the same length in the organ or corti
D. Anchored to the tectorial membrane

Week Two

Neuro Week 2 Questions

1. Which of the following statements about the retinal pigment epithelium (RPE) is INCORRECT?
A. The RPE is important in the breakdown and reprocessing of sloughed segments of cones and rods.
B. The RPE reflects light not absorbed by photoreceptors back onto other regions of the eye.
C. All-trans retinal is converted to vitamin A, the precursor of 11-cis retinal, by the RPE.
D. Night blindness may result from damage to the RPE.

2. Which of the following statements about light signal transduction is INCORRECT?
A. 11-cis retinal is the light absorbing molecule of rhodopsin.
B. Activation of cGMP phosphodiesterase lowers cytoplasmic cGMP, leading to depolarization of the rod photoreceptor.
C. Light adaptation occurs within photoreceptors because cGMP-gated channels close, reducing calcium entry to the cell, which then leads to more rapid photopigment inactivation and increased synthesis of cGMP.
D. The dark current in rods and cones is a predominantly inward sodium current that leads to depolarization and glutamate release.

3. The retina and LGN topographically map the visual world onto the cortex. Which of the following statements is FALSE concerning this topographic representation?
A. The superior part of the visual field is represented on the inferior bank of the calcarine fissure.
B. Adjacent parts of the visual world are represented in adjacent parts of the visual cortex.
C. The left visual field is processed in the right visual cortex.
D. The fovea contains a high density of cones but occupies a small surface of the retina and a small portion of the visual cortex.

4. Choose the INCORRECT statement concerning processing within the visual cortex.
A. Hypercolumns process orientation and color information of a small part of the visual field from both eyes.
B. Cells in the visual cortex that respond to a particular orientation lie within a column, while cells in an adjacent column respond to a slightly different orientation.
C. Within the striate cortex, each LGN axon terminates primarily in layer 1.
D. Separation of inputs from each eye is maintained in layer 4 of the primary visual cortex.

5. Choose the INCORRECT statement.
A. From the lateral geniculate nucleus (LGN) of the thalamus, fibers of optic radiation project to the primary visual cortex.

B. All retinal ganglion cells project to the LGN.
C. Neurons in the superior colliculus are important for directing body movements towards tactile, auditory, and/or visual stimuli.
D. The pretectum is involved in reflex constriction of the pupils.

6. Choose the INCORRECT statement that relates to the visual information pathways from the primary visual cortex (V1).
A. Fibers project from V1 to other areas within the occipital lobe.
B. A dorsal pathway from V1 is associated with location and movement.
C. A ventral pathway from V1 is associated with recognition of fine detail and color.
D. All visual pathways from V1 "bind together" in the preoptic area.

7. All of the following would be characteristic of an optic (CN II) neuropathy EXCEPT:
A. ipsilateral enlarged pupil.
B. a pale optic nerve head.
C. abnormal visual field.
D. ipsilateral relative afferent pupillary defect.
E. loss of central vision.

8. A patient complains of sudden loss of visual field and is found on examination to have a complete left homonymous hemianopia. The lesion could be in the:
A. chiasm.
B. left optic nerve.
C. right optic tract.
D. right pons.
E. left occipital lobe.

9. A patient has a lesion of sympathetic pathways on the right controlling pupil size. Which of the following is most likely to be true?
A. The pupils will be equal in size.
B. There will be a right relative afferent pupillary defect.
C. There will be a left relative afferent pupillary defect.
D. The right pupil will be larger than the left.
E. The left pupil will be larger than the right.

10. Which of the following statements is most accurate about association cortex?
A. Unlike primary sensory cortex, association cortex has only three layers.
B. Unlike primary motor cortex, association cortex is found only in the temporal lobe.
C. Unlike primary sensory and motor cortices, association cortex is found only on the left side in about 90% of people, regardless of handedness.
D. Unlike primary sensory cortex, association cortex has no connections with the thalamus.
E. Unlike primary sensory cortex, all sensory inputs to association cortex come from other cortical regions.

11. Which of the following is true of signal processing in the retina:
A. Glutamate depolarizes both on-center and off-center bipolar cells.
B. Light hyperpolarizes the cone cell in the center of the receptive field, leading to a depolarization of the on-center bipolar cell.
C. Horizontal cells hyperpolarized by cones in the surround receptive field result in hyperpolarization of cones in the center of their receptive field.
D. On-center and off-center bipolar cells contain identical receptors for glutamate.

12. Regarding the organization of the primary visual cortex:
A. A hypercolumn contains a ~1x1 mm piece of primary visual cortex that analyzes only one orientation.
B. A cluster of highly active cells called blobs are sensitive to the orientation of moving bars of light.
C. A hypercolumn includes a series of adjacent orientation selective columns, representing all possible orientations.
D. A simple cell receptive field results from the inputs of many different complex cells.

13. Which of the following is NOT true:
A. An L cone pigment absorbing a longer wavelength photon generates a lower concentration of cytoplasmic cGMP than an L cone absorbing a shorter wavelength photon.
B. A reflectance function of an observed object describes the proportion of light of all wavelengths that is reflected off the object.
C. S cones optimally absorb light of shorter wavelengths.
D. We see color as represented by the combined wavelengths of light reflected off objects.

14. Choose the correct statement(s) concerning the “M” and “P” pathways of the primate visual system.
A. “M” and “P” pathways remain separate through the lateral geniculate nucleus of the thalamus and through projections to the primary visual cortex.
B. From the primary visual cortex, the “M” pathway projects strongly to parietal-occipital-temporal or middle temporal regions of the cortex while the “P” pathway projects to the inferior temporal regions.
C. The “P” pathway contains information about fine detail and color, while the “M” pathway contains information about position and motion.
D. All of the above are correct

15. All of the following could be characteristic of an optic (CN II) neuropathy EXCEPT:
A. Loss of central vision
B. A pale optic nerve head
C. Anisocoria, ipsilateral pupil larger
D. Abnormal visual field
E. Ipsilateral relative afferent pupillary defect

16. The dorsal pathway from V1 is thought to be primarily concerned with the perception of:

A. depth and form.
B. form and color.
C. color and motion.
D. the space map.
E. motion and depth.

17. Which of the following applies to cones compared to rod photoreceptors (or their neural system)? Cones:
A. are more sensitive to scattered light
B. have less total photopigment
C. exhibit high amplification, single photon sensitivity
D. are monochromatic (one type of pigment)
E. have low temporal resolution (slow response, long integration time)

18. Retinal ganglion cells are silent (not secreting a transmitter):
A. never (during life)
B. in absolute dark.
C. when they are illuminated and lie in the surround portion of the receptive field of an "on-center" retinal ganglion cell.
D. when they are illuminated and lie in the central portion of the receptive field of an "off-center" retinal ganglion cell.
E. when inhibited by a horizontal cell.

19. Color vision depends on:
A. three forms of retinal with different spectral sensitivities.
B. three forms of opsin which use the same retinal co-factor.
C. the color of the pigment in the retinal pigment epithelium.
D. the color of the iris.
E. the shift from rhodopsin to meta-rhodopsin.

20. Which is NOT true?
A. Rod/cone dystrophy is synonymous with rod/cone degeneration
B. Usher's syndrome includes hearing loss
C. Retinitis pigmentosa often precedes achromatopsia
D. Geographic dystrophy can precede "wet" Age Related Macular Degeneration (ARMD)
E. Smoking is a risk factor for ARMD

21. The "dorsal" (visual movement) pathway includes the
A. Parvocellular Layers of LGN
B. V1 blobs
C. Magnocellular Layers of LGN
D. V2 thin stripes

22. The fovea
A. Is in the periphery of the retina.
B. Is in the central retina and contains only cones.
C. Contains only rods.

D. Is in the region where the optic nerve exits the retina.

23. “Off center” retinal ganglion cells
A. Are maximally stimulated by illumination of their entire field.
B. Are found only outside the fovea.
C. Are the same cells as the M ganglion cells.
D. Are maximally stimulated by illumination of their “surround” field.

24. Cone cells
A. Contain rhodopsin
B. Contain either L, M or S-opsin.
C. Do not exist in protanopes.
D. Are the last cells lost during retinitis pigmentosa.

25. A patient complains of a sudden loss of visual field and is found on examination to have a complete left homonymous hemianopia. The lesion could be in the:
A. Chiasm
B. Left optic nerve
C. Right optic tract
D. Right pons
E. Left occipital lobe

26. When light hits the photoreceptors, all of the following occur in transduction EXCEPT:
A. Light induces a conformational change in the retinal pigment rhodopsin
B. Rhodopsin activates a G-protein linked to a cGMP Phosphodiesterase
C. cGMP generation is decreased, which leads to a closure of Na channels
D. The photoreceptor depolarizes and sends action potentials to bipolar and adjacent horizontal cells.

27. Horizontal cells play an essential role in generating which receptive field property of retinal ganglion cells?
A. Antagonistic center surround organization
B. Color sensitivity
C. Transient response dynamics
D. Luminance sensitivity

28. Damage to the fovea of each eye would result in
A. Loss of night vision
B. Poor visual acuity and difficulty reading
C. Loss of motion perception
D. Absence of a direct papillary light reflex
E. Loss of form vision

29. A lesion that destroys the magnocellular layers of the right LGN but spares the parvocellular layers would be associated with which of the following deficits?
A. Disorders of circadian rhythms
B. Loss of visual orienting responses to novel visual stimuli in the left hemifield
C. Absent direct papillary light reflex for the right eye
D. Loss of form vision
E. Defective motion perception in the left visual field

30. Which one of the following statements about the primary visual cortex is CORRECT?
A. An electrode penetration perpendicular to the pial surface from layer 1 to 6 will encounter cells that have similar orientation patterns
B. Cells in layer 6 provide inhibitory connection to the contralateral visual cortex
C. In the normal adult brain, geniculate afferents from each eye completely overlap in layer 4
D. Magnocellular input from the lateral geniculate terminates in layer 2 and 3

32. Retinal visual processing is characterized by which of the following?
A. Cones hyperpolarize in response to photon absorption.
B. Amacrine cells are connected to horizontal cells in the inner plexiform layer.
C. Bipolar cell receptive fields lack antagonistic center-surround organization.
D. Rods are most densely packed in the fovea.
E. Color coding ganglion cells project to the magnocellular layers of the lateral geniculate.

33. In age related macular degeneration (loss of foveal representation), what deficit would be found?
A. Loss of night vision.
B. Loss of motion perception.
C. Poor visual acuity and difficulty reading.
D. Retinal blood vessels invading the foveal area.
E. Absence of a papillary light reflex.

34. During accommodation:
A. The lens zonules are relaxed.
B. The curvature of the anterior lens surface increases.
C. The ciliary muscle contracts.
D. Pupillary constriction occurs.
E. All of the above are correct.

35. Which statement is CORRECT regarding retinal bipolar cell physiology?
A. Center-surround organization is not a feature of the bipolar cell.
B. Off-center bipolar cells hyperpolarize in response to light in the center of their receptive fields.
C. Bipolar cells use action potentials to transmit visual signals.
D. There is only one type of bipolar cell found in the outer retina.

36. The direct retinal projection to the superior colliculus plays a crucial role in which one of the following?
B. Visual orienting responses to novel visual stimuli.

C. Color perception.
D. Entrainment of circadian rhythms by light.
E. Depth perception.

37. Inability to recognize familiar colors is most likely due to damage in which brain region?
A. Magnocellular layers of the lateral geniculate nucleus.
B. Middle temporal visual area (MT).
C. Pretectum.
D. Superior colliculus.
E. Infero-temporal cortex.

38. Which one of the following statements about the primary visual cortex is CORRECT?
A. An electrode penetration that runs parallel to the pial surface for several millimeters will encounter cells that all have the same orientation preference.
B. Cells in layer-6 provide an inhibitory connection to the superior colliculus.
C. In the normal adult brain, lateral geniculate afferents from each eye are segregated in layer 4.
D. Input from the lateral geniculate nucleus terminates in layer 3.

39. In presbyopia:
A. Accommodation increases.
B. The pupil will become dilated.
C. Accommodation decreases.
D. Radius of curvature of the cornea increases.
E. All of the above are correct.

40. The fovea:
A. Is located in the peripheral retina.
B. Contains cones.
C. Is found in the center of the optic nerve.
D. Responds best in low light.

41. Glaucoma can be associated with:
A. A visual field defect in the retina.
B. An increase in intraocular pressure.
C. Optic nerve damage.
D. All of the above are correct.

42. Normal color vision is best characterized by which one of the following?
A. Normal perception of color can only occur if each cone contains three different types of pigments.
B. Intact magnocellular layers of the LGN are required.
C. Three different cone pigments in three different populations of cones lead to normal color vision.
D. Photon absorption does not depend on wavelength for cones.

43. Binocular interaction is essential for which one of the following properties?

A. Orientation preference.
B. Color perception.
C. Face recognition.
D. Disparity-based depth perception.
E. Movement detection.

44. Following a motorcycle accident where a bilateral temporal lobe lesion was sustained, which visually based deficit might be encountered?
A. Inability to recognize familiar faces.
B. Inability to maintain posture with the eye closed.
C. Loss of motion perception.
D. Loss of depth perception.
E. Complete blindness.

45. The only place in the list below where damage confined to the right side of the nervous system could cause loss of joint position sense from the right leg and loss of pain sensation from the left leg would be

A. in the anterior (ventral) lateral column of cervical cord
B. in the posterior (dorsal) column of cervical cord.
C. in the spinal cord at segment T1
D. in the rostral medulla
E. in the primary somatosensory cortex

46. Which of the following regions contains axons with cell bodies in the right dorsal root ganglion?

A. The left dorsal column
B. The right dorsal column
C. The left anteriorlateral (spinothalamic) column
D. The right anteriorlateral (spinothalamic) column
E. Both B and C

47. Damage to which of the following regions would most likely produce a loss of motor coordination on the right without affecting strength?

A. The right precentral gyrus
B. The left precentral gyrus
C. The right cerebellum
D. The left cerebellum
E. The right spinothalamic tract

57. Which statement is TRUE:
A. Transcutaneous electrical nerve stimulation (TENS) is a therapeutic technique to control pain sensation that is accomplished by selectively activating temperature receptors.
B. Diffuse noxious inhibitory controls (DNIC) recruit descending pain control mechanisms via activation of the periaqueductal gray (PAG).
C. Activation of Mu (μ) opiate receptors in somatosensory cortex contributes to the analgesic properties of opiates like codeine.
D. Sympathetic-sensory coupling is responsible for signaling damage to visceral tissue.

E. Pain signaling due to visceral tissue damage is perceived as arising from the body surface.

58. Which of the following is FALSE:
A. Carpel tunnel syndrome can produce phantom pain.
B. Reflex sympathetic dystrophy is a pain disorder caused by hyperreflexia.
C. Allodynia and hyperalgesia are commonly associated with neuropathic pain.
D. Paresthesias are abnormal sensations that are not unpleasant.
E. Allodynia is defined as pain sensation due to non-noxious stimuli.

59. Neuropathic pain is defined as pain initiated or caused by a primary lesion or dysfunction in the nervous system. Which event below would be associated with the occurrence of neuropathic pain that follows a peripheral nerve lesion:
A. Pain sensation is very intense but very short-lasting
B. Accumulation of excess voltage sensitive K+ channels in terminal swelling (neuroma).
C. Sprouting of sympathetic fibers resulting in cholinergic sensitivity.
D. Spontaneous action potentials generated in neuronal cell bodies of dorsal root ganglia.
E. Afferent fibers become hypoexcitable.

60. Regarding two-point discrimination:
A. 2 point discrimination is enhanced by a neural process called lateral inhibition
B. 2 point discrimination is a form of temporal discrimination
C. the ability to resolve 2 points as distinct occurs equally in all body regions
D. 2 point discrimination is lost following damage to the spinal anterolateral projection system
E. all of the above are correct

61. Sensory information from the muscle spindle receptor contributes to all the following EXCEPT:
A. The stretch reflex
B. Reciprocal inhibition
C. Kinesthesia
D. The flexion-withdrawal reflex

68. Ataxia includes the following symptoms EXCEPT:
A. Normal multijoint movements
B. Delays in initiating movement
C. Errors in the metrics of movement
D. Dysmetria
E. Inability to sustain rhytmic movements

69. Deficits in motor planning result from lesions to which region of the cerebellum?
A. Vestibulocerebellum
B. Vermis
C. Spinocerebellum
D. Cerbrocerebellum
E. Fastigial nuclei

70. Which one of the following statements about the basal ganglia is TRUE?
A. The basal ganglia influence only motor behavior.
B. The basal ganglia receives input only from the primary motor cortex.
C. The basal ganglia project through the thalamus to the frontal lobe of cerebral cortex.
D. Neurons within the basal ganglia make direct synaptic connections with spinal motoneurons.
E. Neurons within the basal ganglia are all inhibitory.

71. Regarding the basal ganglia (BG) direct pathway:
A. The direct pathway projects directly from striatum to BG output neurons.
B. The direct pathway acts to decrease BG inhibition of thalamus.
C. Straitum inhibits BG output neurons in the direct pathway.
D. All of the above.

72. All of the following are associated with cerebellar damage except:
A. action tremor
B. profound sensory deficits
C. delays in initiating movements
D. asynergia
E. ataxia

73. Damage to the interposed nuclei in the right side of the cerebellum will cause:
A. movement disorders restricted to the left side of the body
B. complete inability to maintain balance
C. movement disorders restricted to trunk muscles
D. postural instability only
E. ataxia expressed when using distal muscles on the right side of the body

74. All of the following features are associated with cerebellar ataxia EXCEPT:
A. abnormal execution of voluntary movement
B. absolute inability to initiate movement
C. dysmetria
D. decomposition of movement
E. postural instability

75. Which of the following cerebellar structures and functions are paired INCORRECTLY?
A. dentate nucleus—motor planning
B. cerebrocerebellum—motor planning
C. interposed nuclei—proximal muscle activity
D. vermis—posture
E. vestibulocerebellum—balance

76. Activation of the basal ganglia indirect pathway
A. strongly inhibits the subthalamic nucleus
B. increases firing rates of neurons in the internal globus pallidus
C. is not influenced by dopamine
D. increases excitation from thalamus to cerebral cortex

E. facilitates cortically driven movements

77. Inhibition of the thalamus by the basal ganglia is decreased:
A. by activation of substantia nigra
B. by activation of the indirect pathway alone
C. exclusively during movement
D. never under normal conditions, but only after pallidotomy
E. never in the skeletomotor basal ganglia-thalamo-cortical loop

80. Which of the following statements is INCORRECT?
A. the corticospinal tract arises in part from motor and premotor cortical areas
B. the posterior parietal cortex projects to premotor and supplementary motor areas
C. cells in the primary motor cortex discharge only during the preparation for movement
D. the supplementary motor area is involved in coordinating the sequential movements

81. Tip links
A. Are stiff rods that protrude vertically from the tips of ion channels.
B. Act as mechanical gating springs for ion channels.
C. Are positioned between the top of stereocilia and Reissner's membrane.
D. Are made of myosin.

83. In planar view the basilar membrane is wider at the tip (Apex) than the base (Basal end). As a consequence, the basilar membrane:
A. Resonates maximally for low notes at the tip.
B. Resonates maximally for high notes at the tip.
C. Resonates equally at every position across its length irrespective of pitch.
D. None of the above is correct.

84. The ____ and _____ connect at the _____ .
A. Scala vestibuli / scala tympani / helicotrema.
B. Round window / scala vestibuli / malleus.
C. Scala media / incus / oval window.
D. Modiolus / spiral ganglion / organ of Corti.

85. When a sound wave reaches the ear and the air is initially compressed, the stapes moves in raising pressure in the perilymph in the:
A. Scala vestibuli first, then the basilar membrane drops, then pressure in the scala tympani rises and the round window bows outwards
B. Scala tympani first, then the basilar membrane drops, then pressure in the scala vestibuli rises and the round window bows outwards
C. Scala vestibuli first, then the basilar membrane rises, then pressure in the scala tympani rises and the round window bows inwards.
D. None of the above is correct.

86. Which of the following is true about auditory transduction in the inner ear?

A. It is primarily carried out by the semicircular canals.
B. The base of the basilar membrane is more sensitive to lower frequency sounds.
C. The organ of Corti contains three rows of inner hair cells and one row of outer hair cells.
D. The outer hair cells are primarily involved in the amplification of sounds detected by the inner hair cells.
E. Firing from CN8 will eventually project to the lateral geniculate nucleus of the thalamus.

87. The tectorial membrane is in contact with
A. The stereocilia of the outer hair cells
B. The stereocilia of the inner hair cells
C. The phalangeal cells
D. Reisner's membrane

89. Which of the following is NOT in the inner ear?
A. Cochlea
B. Spiral Ganglion
C. Organ of Corti
D. Tonotopic Map
E. Incus

90. Which of the following statements is correct for the mechanically gated channels in the stereocilia of the cochlear hair cells?
A. When they OPEN calcium ions flow OUT.
B. When they OPEN potassium ions flow OUT.
C. More of them OPEN when the hair bundle is displaced towards the SHORT side.
D. They are active ion pumps.
E. Whey they OPEN calcium ions flow IN.

91. Which of the following statements is NOT true concerning LTP and the hippocampus?
A. The Schaeffer collateral path projects axons from CA3 to CA1.
B. Postsynaptically-induced LTP can be inhibited by NMDA receptor antagonists.
C. Homosynaptic LTP induction is dependent upon Ca2+ influx.
D. Brain association cortex sends axons directly to the dentate gyrus.
E. Late LTP is dependent on protein synthesis.

92. Which of the following statements would NOT be true concerning long-term memory?
A. It may be acquired via processes involving parieto-occipital-temporal association cortex.
B. Formation may be dependent upon afferent hippocampal pathways.
C. Consolidation may involve a single brain region specific for each memory.
D. Storage may involve premotor association cortex.

93. Loss of input to the thalamus in the transition from the awake state to NREM sleep is marked by changes in thalamocortical neuronal activity from _____ to _____.
A. desynchronized and tonic … synchronized and oscillatory
B. synchronized and oscillatory … desynchronized and tonic

C. ictal … interictal
D. none of the above

94. Choose the INCORRECT statement concerning sleep.
A. As a neurological process, sleep is passive.
B. Sleep is characterized by a reduced responsiveness to stimuli.
C. As opposed to coma, sleep mechanisms are reversible.
D. During NREM sleep the body temperature, heart rate and blood pressure decline.

95. Which of the following statements is (are) correct?
A. Each sensory system (somatic, visual, auditory) has a unimodal cortical association area in close proximity to its primary cortical receiving area.
B. A major function of the unimodal association areas is to extract the general, invariant features of a sensory stimulus (e.g., "squareness", regardless of a "square's" size or orientation).
C. The unimodal association areas in the Right and the Left hemispheres differ only in terms of the sides of the body from which they process information.
D. A and B only are true.
E. All of the above are true.

96. We have our most detailed sense of touch in those parts of the body:
A. Where the cutaneous receptive fields are few in number but very large.
B. Where there are many neurons in the cortex to represent its somatosensory input.
C. Where sensory input from skin and viscera have the greatest convergence in the brain.
D. Where the body part map within the occipital lobe is largest.

97. Which of the following statements is INCORRECT?
A. Postural responses to rapid horizontal displacements of the supporting surface are initially mediated mainly by the somatosensory system.
B. Postural responses to sudden vertical translation of the supporting surface are mediated mainly by the vestibular system.
C. Movements of the limbs during a step cycle continue during periods of no electrical activity of leg muscle because force generation may occur without electrical activity.
D. Following severe damage to the vestibular system, movements of the head may cause changes in the tone of antigravity muscles.

98. The motor symptoms of Parkinson's disease:
A. Appear when the striatal dopamine content is reduced by more than 70%
B. Are due entirely to a genetic defect in less than 15% of cases
C. Can be produced by injection of 1-Methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP)
D. All of the above are correct.

99. Dystonia is characterized by:
A. Rapid jerking movements
B. Slow and sustained muscular contractions
C. Abnormal relaxation of antagonist muscles
D. Movements that are worst at rest and dissipate with voluntary movements

Questions from last year's Week 1 Testbank that are more applicable to the Week 2 cirriculum:

25. Which of the following statements about the retinal pigment epithelium (RPE) is INCORRECT?
A. The RPE is important in the breakdown and reprocessing of sloughed segments of cones and rods.
B. The RPE reflects light not absorbed by photoreceptors back onto other regions of the eye.
C. All-trans retinal is converted to vitamin A, the precursor of 11-cis retinal, by the RPE.
D. Night blindness may result from damage to the RPE.

26. Which of the following statements about light signal transduction is INCORRECT?
A. 11-cis retinal is the light absorbing molecule of rhodopsin.
B. Activation of cGMP phosphodiesterase lowers cytoplasmic cGMP, leading to depolarization of the rod photoreceptor.
C. Light adaptation occurs within photoreceptors because cGMP-gated channels close, reducing calcium entry to the cell, which then leads to more rapid photopigment inactivation and increased synthesis of cGMP.
D. The dark current in rods and cones is a predominantly inward sodium current that leads to depolarization and glutamate release.

27. The retina and LGN topographically map the visual world onto the cortex. Which of the following statements is FALSE concerning this topographic representation?
A. The superior part of the visual field is represented on the inferior bank of the calcarine fissure.
B. Adjacent parts of the visual world are represented in adjacent parts of the visual cortex.
C. The left visual field is processed in the right visual cortex.
D. The fovea contains a high density of cones but occupies a small surface of the retina and a small portion of the visual cortex.

28. Choose the INCORRECT statement concerning processing within the visual cortex.
A. Hypercolumns process orientation and color information of a small part of the visual field from both eyes.
B. Cells in the visual cortex that respond to a particular orientation lie within a column, while cells in an adjacent column respond to a slightly different orientation.
C. Within the striate cortex, each LGN axon terminates primarily in layer 1.
D. Separation of inputs from each eye is maintained in layer 4 of the primary visual cortex.

29. Choose the INCORRECT statement.
A. From the lateral geniculate nucleus (LGN) of the thalamus, fibers of optic radiation project to the primary visual cortex.
B. All retinal ganglion cells project to the LGN.
C. Neurons in the superior colliculus are important for directing body movements towards tactile, auditory, and/or visual stimuli.
D. The pretectum is involved in reflex constriction of the pupils.

30. Choose the INCORRECT statement that relates to the visual information pathways from the primary visual cortex (V1).
A. Fibers project from V1 to other areas within the occipital lobe.
B. A dorsal pathway from V1 is associated with location and movement.
C. A ventral pathway from V1 is associated with recognition of fine detail and color.
D. All visual pathways from V1 "bind together" in the preoptic area.

48. Rods signal bipolar cells by changing the amount of released glutamate following:
A. absorption of a photon by the 11-cis retinal component of rhodopsin.
B. the opening of cGMP gated channels that are potassium permeable.

C. the conversion of all-trans retinal to vitamin A.
D. changes in the frequency of action potentials induced in the rod cell by currents associated with the cGMP gated channels.

49. Which of the following is true of signal processing in the retina:
A. Glutamate depolarizes both on-center and off-center bipolar cells.
B. Light hyperpolarizes the cone cell in the center of the receptive field, leading to a depolarization of the on-center bipolar cell.
C. Horizontal cells hyperpolarized by cones in the surround receptive field result in hyperpolarization of cones in the center of their receptive field.
D. On-center and off-center bipolar cells contain identical receptors for glutamate.

50. Regarding the organization of the primary visual cortex:
A. A hypercolumn contains a ~1x1 mm piece of primary visual cortex that analyzes only one orientation.
B. A cluster of highly active cells called blobs are sensitive to the orientation of moving bars of light.
C. A hypercolumn includes a series of adjacent orientation selective columns, representing all possible orientations.
D. A simple cell receptive field results from the inputs of many different complex cells.

51. Which of the following is NOT true:
A. An L cone pigment absorbing a longer wavelength photon generates a lower concentration of cytoplasmic cGMP than an L cone absorbing a shorter wavelength photon.
B. A reflectance function of an observed object describes the proportion of light of all wavelengths that is reflected off the object.
C. S cones optimally absorb light of shorter wavelengths.
D. We see color as represented by the combined wavelengths of light reflected off objects.

52. Choose the correct statement(s) concerning the “M” and “P” pathways of the primate visual system.
A. “M” and “P” pathways remain separate through the lateral geniculate nucleus of the thalamus and through projections to the primary visual cortex.
B. From the primary visual cortex, the “M” pathway projects strongly to parietal-occipital-temporal or middle temporal regions of the cortex while the “P” pathway projects to the inferior temporal regions.
C. The “P” pathway contains information about fine detail and color, while the “M” pathway contains information about position and motion.
D. All of the above are correct

70. Which of the following applies to cones compared to rod photoreceptors (or their neural system)? Cones:
A. are more sensitive to scattered light
B. have less total photopigment
C. exhibit high amplification, single photon sensitivity
D. are monochromatic (one type of pigment)
E. have low temporal resolution (slow response, long integration time)

71. Retinal ganglion cells are silent (not secreting a transmitter):
A. never (during life)
B. in absolute dark.
C. when they are illuminated and lie in the surround portion of the receptive field of an “on-center” retinal ganglion cell.
D. when they are illuminated and lie in the central portion of the receptive field of an “off-center” retinal ganglion cell.
E. when inhibited by a horizontal cell.

72. Color vision depends on:
A. three forms of retinal with different spectral sensitivities.
B. three forms of opsin which use the same retinal co-factor.
C. the color of the pigment in the retinal pigment epithelium.
D. the color of the iris.
E. the shift from rhodopsin to meta-rhodopsin.

73. Most color blindness is caused by:
A. point mutations in the opsin genes in the male germ-line.
B. recombination between the S and M opsins.
C. evolutionary changes in new-world monkeys.
D. untreatable viral infections of the conjunctiva.
E. unequal crossing-over between the L and M opsin genes.

91. The "dorsal" (visual movement) pathway includes the
A. Parvocellular Layers of LGN
B. V1 blobs
C. Magnocellular Layers of LGN
D. V2 thin stripes

92. The fovea
A. Is in the periphery of the retina.
B. Is in the central retina and contains only cones.
C. Contains only rods.
D. Is in the region where the optic nerve exits the retina.

93. Off center retinal ganglion cells
A. Are maximally stimulated by illumination of their entire field.
B. Are found only outside the fovea.
C. Are the same cells as the M ganglion cells.
D. Are maximally stimulated by illumination of their "surround" field.

94. M-type retinal ganglion cells have
A. Larger receptive fields than P-type cells.
B. Are color selective.
C. Chiefly detect form.
D. Connect directly to V1 and bypass the LGN.

95. Cone cells
A. Contain rhodopsin
B. Contain either L, M or S-opsin.
C. Do not exist in protanopes.
D. Are the last cells lost during retinitis pigmentosa.

112. During normal aging of the human lens:
A. The lens fibers increase in number and the size of the lens increases in thickness.
B. More insoluble lens proteins accumulate.
C. There is an increase in light scatter by the lens.
D. There is a loss of near vision, a condition called presbyopia.
E. All of the above are correct.

113. Which one of the following statements about the primary visual cortex is CORRECT?
A. In the normal adult brain, geniculate afferents from each eye completely overlap in layer 4 of the primary visual cortex.

B. An electrode traveling parallel to the pial surface in layer 4 for several millimeters will encounter cells that have the same ocular dominance preference.
C. An electrode traveling perpendicular to the pial surface from layer 1 to layer 6 will encounter successive cells that have similar orientation preference.
D. An electrode traveling parallel to the pial surface in layer 3 will never encounter color sensitive neurons.

115. Binocular interaction is essential for which of the following properties:
A. Orientation preference.
B. Color perception.
C. Disparity based depth perception.
D. Face recognition.
E. Movement detection.

116. You examine a patient who had a congenital cataract in the left eye that was not corrected until adulthood. Following cataract removal and treatment with corrective optics, visual acuity through the treated eye is still poor because:
A. The pupillary light reflex is inadequate.
B. The ability to accommodate has been lost.
C. The left eye failed to develop sufficient representation in primary visual cortex.
D. Degeneration of the optic nerve.
E. Disconjugate eye movements.

139. When light hits the photoreceptors, all of the following occur in transduction EXCEPT:
A. Light induces a conformational change in the retinal pigment rhodopsin
B. Rhodopsin activates a G-protein linked to a cGMP Phosphodiesterase
C. cGMP generation is decreased, which leads to a closure of Na channels
D. The photoreceptor depolarizes and sends action potentials to bipolar and adjacent horizontal cells.

140. Horizontal cells play an essential role in generating which receptive field property of retinal ganglion cells?
A. Antagonistic center surround organization
B. Color sensitivity
C. Transient response dynamics
D. Luminance sensitivity

141. Damage to the fovea of each eye would result in
A. Loss of night vision
B. Poor visual acuity and difficulty reading
C. Loss of motion perception
D. Absence of a direct papillary light reflex
E. Loss of form vision

142. A lesion that destroys the magnocellular layers of the right LGN but spares the parvocellular layers would be associated with which of the following deficits?
A. Disorders of circadian rhythms
B. Loss of visual orienting responses to novel visual stimuli in the left hemifield
C. Absent direct papillary light reflex for the right eye
D. Loss of form vision
E. Defective motion perception in the left visual field

143. Which one of the following statements about the primary visual cortex is CORRECT?
A. An electrode penetration perpendicular to the pial surface from layer 1 to 6 will encounter cells that have similar orientation patterns
B. Cells in layer 6 provide inhibitory connection to the contralateral visual cortex

C. In the normal adult brain, geniculate afferents from each eye completely overlap in layer 4
D. Magnocellular input from the lateral geniculate terminates in layer 2 and 3

144. Which deficit would most likely follow a head injury that damages the temporal lobes bilaterally?
A. Loss of stereoscopic depth perception
B. Bitemporal hemianopsia
C. Loss of motion perception
D. Inability to recognize familiar colors

145. Binocular interaction is essential for which of the following properties?
A. Orientation preference
B. Color perception
C. Disparity-based perception
D. Face recognition
E. Movement detection

160. Cocaine and tricyclic antidepressants produce their effects by:
A. enhancing catecholamine reuptake into the postsynaptic cell.
B. blocking postsynaptic 5-HT receptors.
C. blocking catecholamine re-uptake into the presynaptic nerve terminal.
D. stimulating catecholamine reuptake into mitochondria.
E. inhibiting monamine oxidase.

161. Which of the following transmitters is synthesized in the neuronal soma and transported to the nerve terminal by axonal transport in large dense core vesicles?
A. acetylcholine
B. GABA
C. glutamate
D. vasopressin
E. norepinephrine.

167. Retinal visual processing is characterized by which of the following?
motion.
A. Cones hyperpolarize in response to photon absorption.
B. Amacrine cells are connected to horizontal cells in the inner plexiform layer.
C. Bipolar cell receptive fields lack antagonistic center-surround organization.
D. Rods are most densely packed in the fovea.
E. Color coding ganglion cells project to the magnocellular layers of the lateral geniculate.

168. In age related macular degeneration (loss of foveal representation), what deficit would be found?
A. Loss of night vision.
B. Loss of motion perception.
C. Poor visual acuity and difficulty reading.
D. Retinal blood vessels invading the foveal area.
E. Absence of a papillary light reflex.

169. During accommodation:
A. The lens zonules are relaxed.
B. The curvature of the anterior lens surface increases.
C. The ciliary muscle contracts.
D. Pupillary constriction occurs.
E. All of the above are correct.

170. Which statement is CORRECT regarding retinal bipolar cell physiology?
A. Center-surround organization is not a feature of the bipolar cell.
B. Off-center bipolar cells hyperpolarize in response to light in the center of their receptive fields.
C. Bipolar cells use action potentials to transmit visual signals.
D. There is only one type of bipolar cell found in the outer retina.

Answers

Week One

Neuro Week 1 Answers

1. D

MS is "is an inflammatory disease in which the fatty myelin sheaths around the axons of the brain and spinal cord are damaged, leading to demyelination" (from Wikipedia, but also mentioned in lecture)

2. C

I don't think this was addressed directly in out readings, but the answer makes intuitive sense. The rough ER is continuous with the nuclear membrane should be found in the cell body of a neuron as opposed to the axon.

3. C
4. -
5. A (slide 54-55 of Synaptic Transmission)
6. C (discussion of EPSPs begins slide 36 of Synaptic Transmission)
7. B (slide 15 of Synaptic Transmission)
8. C Metabotropic receptors (such as the beta-adrenergic receptor) are coupled to some (slide 41-44 of Synaptic Transmission) are coupled to adenylyl cyclase activation.
9. A (slide 64 of Synaptic Transmission)
10. D
11. E (slide 53 of Synaptic Transmission)
12. B

@ Tau is a Microtubule Associated Protein (MAP) that stabilizes the axonal microtubules of a neuron. In Alzheimer's, Tau has an one extra phosphorylation. This modified Tau is only 50% competent in stabilizing tubulin assembly

13. D

@ Myelin is about 75% lipid and 25% protein. If you isolate the proteins in myelin, they have a high pKa and are very basic. The are called myelin basic proteins (MBP). IF MBPs are injected or exposed in the brain, our immune systems attack them, causing Experimental Allergic Encephalomyelitis (EAE). EAE is similar to multiple sclerosis, characterized by immune response and demyelination.

14. -
15. C

@ Regeneration in the CNS: If a neuron in the CNS is severed, the proximal and distal ends seal up. In 1-2 days, the distal axon degenerates but the myelin and cell body remain. Eventually the myelin degenerates. The microglia cells respond quickly to trauma and secrete a factor causing the astrocytes to grow. The astrocyte processes create a physical barrier called a glial scar, which would inhibit neuron regeneration. The astrocytes also secrete GAGS, or glycosaminoglycans, which further inhibit neural regeneration. Once the myelin degenerates in the CNS, it is very hard to regenerate since the oligodendroglia are separated from the neurons.

16. D

@ Microglia cells are small stellate cells. In the resting state they are called ramified microglia and if there is trauma to the brain, they retract their processes and become motile. In response to trauma, they are the first cells to respond and secrete a factor causing astrocytes to hypertrophy. Once in a motile state, the microglia cells are macrophages and phagocyte debris. Microglia cells are also the antigen presenting cells in brain. Finally, microglial cells have membrane CD4 and CD8 receptors. CD4 receptor binds to the HIV virus, which suggests the pathway the HIV virus uses leading to dementia in late stage AIDS.

17. A

@ A motor neuron innervates many muscle fibers. If you activate a motor neuron with different voltages, you can start by just activating one axon, then two, and so on. A compound action potential is the sum of action potentials for a skeletal muscle. An EMG measures these

18. A

19. C

@ An EPSP is an Excitatory Postsynaptic Potential and is a local signal produced by a neurotransmitter. It is graded in amplitude as opposed to action potentials which are all or nothing. If an EPSP amplitude is big enough or if the sum of several EPSPs are big enough, it can reach threshold and activate a voltage gated channel, generating an action potential. EPSPs are usually depolarizing; IPSPs are usually hyperpolarizing(however both can exhibit depolarizing and hyperpolarizing effects on the postsynaptic neuron

20. D

@ Electrical synapses are gap junctions with continuity between the cytoplasms of the presynaptic and postsynaptic neurons, which allows ions to flow between them. Due to this anatomy, ion transmission is very fast and can be bidirectional. The gap junctions are made up for connexons and allow ion and molecules up to 10,000 D

21. B

@ An example of this is norepinephrine. The synthesis of NE starts with tyrosine in the cytoplasm. Tyrosine is converted into DOPA and then dopamine, which is transported from the cytoplasm into the vesicle by DAT (dopamine transporter) which uses energy from the proton gradient established by the proton pump to bring dopamine into the vesicle, where it is converted into NE by dopamine beta hydroxylase

22. E

~ Synaptic vesicles have an alkaline pH in their lumen This is false because synaptic vesicles have an acidic pH of approximately 5- 5.5 due to the proton pump. The cytoplasm's pH is around 7.2 in contrast. Reminder: the proton pump creates a proton gradient which can be used to move neurotransmitters into the vesicles

@ A. Docking involves the interaction of SNARE proteins on the vesicle and presynaptic membrane- True, docking of vesicles to the presynaptic membrane involves interactions between SNARE proteins, most notably VAMP(vesicular SNARE), and SNAP-25 and syntaxin (two membrane SNAREs). There are coil-coil interactions pulling the vesicle down, and when there is a calcium influx, this energy is released allowing the vesicle to exocytose. B. Release is triggered by Ca influx through voltage-gated CA channels- True: Calcium influx triggers synaptic transmission. C. Synaptic

vesicle release can be blocked by botulism toxins which cleave certain SNARE proteins- True: botulism toxins proteolyze VAMP-1 SNARE proteins which are involved in alpha motor neurons, creating a situation where the postsynaptic neuron cannot be activated and the muscles are flaccidly paralyzed. D. Synaptic vesicle proteins are recovered and recycled by formation of coated pits and vesicles- True: synaptic vesicles are often recovered and recycled

23. C If the cell is only permeable to K, its will have a RMP equal to the Nernst Equation potential for K (which is ~ -90mV); if NA channels open, Na will flow down its concentration and electrostatic gradient and enter the cell, resulting in a more positive (depolarized) voltage inside the cell.
24. D

@ Quantal content is greatly increased- The presynaptic membrane and vesicular release are NORMAL in Myasthenia Gravis; the problem is in the postsynaptic membrane. Because of this, quantal content (the number of synaptic vesicles released) remains the same as in a healthy neural synapse

31. E

@ Sympathetic innervation dilates the pupil. Sympathetic neurons originate in the hypothalamus. The firs order neuron passes through the brain stem to the spinal cord to synapse on the intermediolateral cell column (C8-T1). The second order neuron travels to and synapses at the superior cervical ganglion. The third order neuron rides along blood vessels of the internal carotid, through the cavernous sinus to join the parasympathetic fibers traveling to the ciliary ganglion (remember, the sympathetic fibers do not synapse in the ciliary ganglion).

32. C

@ Seizures as: “uncontrolled synchronous firing of a large population of neurons in the brain.” So, seeing how the temporal lobe is the only brain structure listed, it is most likely the correct answer choice. the cerebellum is the least likely to be affected in seizures because there has only been one recorded case in history

33. C

@ The key here is that PROLONGED and SEVERE neonatal hypoxia predisposes individuals to epileptic episodes later in life. Pregnancy is a traumatic event for the neonate and there are BRIEF periods of hypoxia during partum. So, neonatal hypoxia by itself (i.e. not prolonged or severe) is not a risk factor for developing hypoxia

34. B

~ Presynaptic dense projections guide the vesicles in fusing with the presynaptic membrane.
@ A is incorrect- Is there a sole determinant of synaptic physiology? B is correct- Presynaptic dense projections guide the vesicles in fusing with the presynaptic membrane. C is incorrect- Retrograde transport is driven by a microtubule-associated protein (MAP). D is incorrect- Neurotransmitters are synthesized in the cytoplasm and vesicles and then packaged into vesicles

35. C

@ The phosphorylation of tau at one site leads to dimerization and further phosyphorylations. This results in the formation of an insoluble helical filament and decreases the free tau available for the stabilization of axonal microtubules

37. A

~ The autoimmune breakdown of the myelin sheath by myelin basic proteins causes MS.

@ A is correct- The autoimmune breakdown of the myelin sheath by myelin basic proteins causes MS. B is incorrect- In the PNS, the pathology is somewhat different and results in Guillain Barré syndrome. C is incorrect- MS is not due to the degeneration of peripheral neurons. D is incorrect- Neither MS nor Guillain Barré stem from problems with the Schwann cells; the problem lies in the myelin sheath itself

38. E

@ Sensory information is routed through the thalamus (usually) to the primary sensory cortices. These then project to the sensory association areas, which then project to the motor association areas

39. A

@ Contraction occurs in response to an EPSP that reaches threshold and generates an action potential. Muscle membrane potential amplitude depends not only on the presence of transmitter, but the quantity released, the quantity that reaches the receptors and the number of activated receptors. However, at the neuromuscular junction, EPSPs almost always reach threshold.

40. E

@ Electrical synapses are composed of transmembrane proteins forming channels between the membranes of the presynaptic and postsynaptic terminals (A) through which ions can pass bi-directionally (C). No synaptic delay is seen (B), because there is no synaptic cleft (D).

41. E

@ Depolarization of the presynaptic terminal by a propagating action potential (C) causes the opening of calcium channels and an influx of calcium (B) from the synaptic cleft (A). This influx causes the transmitter-filled vesicles docked next to the calcium channels to fuse and exocytose (D).

42. E

@ Ionotropic receptors are postsynaptic ion channels that open in response to neurotransmitter binding to one or both subunits (A). In metabotropic receptors, neurotransmitter binds and initiates a signaling cascade involving G-proteins. The G-protein subunits themselves can bind to and open the channels (B), or they can activate second messengers to do the job (C). And finally, the second messengers can activate a kinase, which causes the channels to open in response to phosphorylation (D).

43. C

@ A is incorrect- Open ion channels determine resting membrane potential by pulling it proportionally towards their equilibrium potentials. Because the resting potential in this case is –95 mV, that suggests a strong influence by K channels (Ek=-93mV) and little influence from Na (Ena=+66), Ca (Eca=+135mV), or Cl (Ecl=-42mV). B is incorrect- With the resting membrane potential so close to the value of Ek, K channels must be present. C is correct- Due to the aforementioned reasons. D is incorrect- The Nernst potential for Na isn't anywhere close to –95mV (it's +66mV).

44. D

~ Desensitization is essentially a closing of the inactivation gates in a ligand-gated channel, which prevents ion flow. Neurotransmitter amounts are irrelevant in this situation

@ Presynaptic inhibition occurs when GABA binds to its receptor causing an increase in chloride conductance and hyperpolarization of the membrane. This results in fewer open voltage-gated calcium channels and the subsequent decrease in transmitter released. B is incorrect- When a second stimulus occurs shortly after the first in paired pulse facilitation, some calcium remains sequestered in the presynaptic terminal, and this intracellular calcium store mobilizes vesicles and results in an increased neurotransmitter release. C is incorrect- Frequently applied stimulation (post-tetanic potentiation) may either cause an extra-large store of residual Ca or a change in syntaxin (SNARE protein) function that makes vesicle fusion more efficient. D is correct-

45. E

~ Acetylcholinesterase is responsible for the hydrolysis (and inactivation) of acetylcholine. It is a postsynaptic modulation

@ A is incorrect- Inhibition of Ca channels would certainly result in presynaptic inhibition, given its pivotal role in vesicle fusion and exocytosis. B is incorrect- K channels are key in the depolarization and hyperpolarization of the presynaptic membrane. C is incorrect- GABA-A receptors on the presynaptic membrane respond to GABA by increasing Cl conduction, causing the presynaptic membrane to hyperpolarize. D is incorrect- Inhibition of V-SNARES (on the vesicle) and t-SNARES (on the target membrane) prevent the docking and exocytosis of the transmitter-filled vesicles.

46. C

@ Cocaine and tricyclic antidepressants block the reuptake of dopamine (a catecholamine). 5-HT is serotonin, on which cocaine and antidepressants have no effect

47. A

@ MG is an autoimmune disease caused by antibodies against nicotinic ACh receptors, not acetylcholinesterase

54. A

@ CSF does not normally contain RBCs. White blood cell counts higher than 4 /mm^3 are pathological. CSF is secreted by the choroid plexus, not the arachnoid membrane (D). It contains 35 mg/dL of protein, not I microgram per liter (c). CSF is secreted a a rate of 0.35 mL/min or 500 mL/ day.

55. E

56. B

@ tau is hyperphosphorylated at praline residues and thus can no longer stabilize (C is incorrect) tubulin as much as normal tau, because it no longer binds tubulin (A is incorrect) with the same affinity

57. D

@ The MBP, myelin basic protein, is a low molecular weight protein that fits in between fused membranes of the oligodendrocytes. If demyelination occurs, the MBP is exposed and an immune response occurs, which is the pathology of Multiple Sclerosis. In Guillain-Barre (B) a similar process occurs in the PNS. A is incorrect because the pathology for AD includes

tau, neurofibrilary tangles, and beta-amyloid plaques. AIDS dementia (C) involves CD4 and CD8 viral receptors.

58. C

@ Nissl bodies or substance are ribosomes that are only found in the soma of neurons. The axons of neurons contain microtubule tracks and vesicles for transport, mitochondria for ATP production to maintain the excitable membrane potential, and synaptic vesicles for communication.

59. C

@ In the CNS, the oligodendroglia myelinates the axon, while its soma remains separated from the axon, which contrasts with the Schwann cell in the PNS. A is incorrect because astrocytes are not responsible for myelinating axons. B is incorrect because Schwann cells are found in the PNS.

60. D

~ Microglia are quiescent cells that function as phagocytes in pathology. Their characteristics include expressing a range of antigens, harboring CD4 and CD8 viral receptors, and co-activation with astrocytes

61. B

@ The endoneurium is connective tissue that creates a sheath around PNS neurons that provides a tunnel-like pathway through which the axon travels when regenerating. (C) activated astrocytes are associated with neuron damage in the CNS, where a lack of endoneurium hampers the regeneration process. (A) secretion of GAGS was never mentioned and (D) the existence of degenerative resistant pools of neurons would not aid in regeneration

62. D
63. E

@ Small molecule NTs, as opposed to neuroactive peptides, are not synthesized in the RER, as they are not protein. They are synthesized in the cytosol of the nerve terminal via catalytic reactions. The uptake of NTs into the vesicles is energy dependent

64. A
65. E

@ The amplitude of the EPSPis equal to the unit potential times the quanta of NT released. The letter S in the A chart represents the MEPPs, thus the max peak in trace A1 is considered to be 4x the S peak. Trace A2 represnts a failure in which no quanta were released upon stimulation or at random. The inset shows the amplitude of the MEPP and thus answer C. 2 out of 8 nerve stimulations were failure, producing no postsynaptic response. (D). Answer E is incorrect because, as aforementioned the S peaks represent MEPPs, not compound APs

66. C
67. E

@ Metabotropic receptors are often G protein coupled, not ionotropic receptors.

68. A

@ AchEase inhibitors decrease the breakdown of Ach in the synaptic cleft, thus prolonging the effects of Ach, which is the method of treatment for MG

69. A

75. B

@ The MLF is involved in coordinated movements between the eyes, versions. The VI nerve controls the lateral rectus, which is mediated ipsilaterally to the nucleus. You will recall that CN VI also mediates the contralateral medial rectus via interneurons. The tract from the VI nucleus splits with some fibers ascending to control the ipsilateral lateral rectus and some fibers decussate to form the MLF that then ascends to centers such as the RIMLF and the INC. These centers allow for interneuronal control of the contralateral (to the VI nucleus) medial rectus. A left MLF lesion would lose the innervation from the contralateral VI nucleus to the left medial rectus, thus the left eye would not follow the right eye in looking towards the right. The right eye may show horizontal nystagmus, in this case, as an attempt to maintain the coordination between eyes. In class, Dr. Newman gave the example of a right MLF lesion producing the opposite effects.

76. E

@ A and D express the fact that trauma predisposes a patient to seizures, but a genetic component may be underlying for which trauma patients develop seizure. B and C reflect the fact that epilepsy is caused by asynchronous hyperactivity of neurons and circuitry.

77. C

@ The CSF has an ionic composition that is similar to that of the blood and ECF, but it contains little protein (eliminates choice D) and very few blood cells (choice C) The CSF is secreted by the choroid plexus and by ependymal cells that line the ventricles – it is resorbed, NOT generated, into the superior saggital sinus at the arachnoid granulations (eliminates choice A). CSF circulates in the subarachnoid, NOT the subdural, space (eliminates choice B). About 500 cc of CSF is secreted per day in the adult human (eliminates choice E).

78. C

@ The key here is to think about how far a neuron can travel without synapsing. A neuron of the dorsal column/medial lemniscus tract can travel from the specialized sensory receptors of skin or muscle (Golgi tendon organs…we'll learn about these later) from the furthest extremity (leg), through the dorsal horn, and up the dorsal column to the medulla before synapsing (choice C). This neuronal cell would ultimately span from the leg to the dorsal column nuclei of the medulla, a distance greater than 30 cm (eliminates choice A). The cells of the spinothalamic tract (pain and temperature sensory neurons) are small axons (eliminates choice E) that are either thinly myelinated or unmyelinated. Because myelination enables an action potential to move quickly, long cells require myelination to propagate a signal over a long distance. Hence, the longest cells of the nervous system would not be unmyelinated (choice D). Although a cell extending from the precentral gyrus to a muscle in the foot would be longer than the cell described in choice C, such a cell does not exist. Cells of the corticospinal tract leaving the precentral gyrus SYNAPSE onto another motor neuron in the ventral horn of the spinal cord before sending a signal to a muscle (eliminates choice B).

79. B

@ Fast transport (at a rate of 400 mm/day) involves the movement of large membrane-bound organelles (secretory vesicles, mitochondria, smooth ER elements, etc.) to and from the cell body. Anterograde transport (what they are most likely referring to in this question) involves a track of microtubules and kinesin molecular motors, so it is doubtful that neurofilaments (choice A), intermediate filaments (choice C), or actin filaments (choice D), all alternative types of cytoskeletal filaments, is the answer. "Anterograde transport depends critically on ATP," so choice B is correct

80. C

@ Tau is a protein that associates with microtubules to make them stable tracts. Tau is a linear protein, and it is normally post-translationally modified by the addition of a phosphate group. However, if Tau undergoes only one or two additional phosphorylating events, Tau is 50% less competent at associating with and promoting stability of microtubules. This demarcates early-onset Alzheimer's Disease. Now unable to associate with microtubules, Tau becomes "soluble Tau" and tends to dimerize. Once dimerized it undergoes additional modifications, wraps around itself, and becomes increasingly phosphorylated. It becomes to accumulate in the cell body (not the axon) and becomes known as a paired helical filament (PHF).

81. B

@ Following chromatolysis (the making of soluble proteins in an attempt to regenerate a destroyed axon), the CNS axon attempts to extend collateral sprouts and find its way back to the original site of synapse. However, the growing axon encounters a physical barrier (hypertrophied astrocytes) and a chemical barrier (GAGs) to growth. This makes it very difficult for the growing axon to find the original dendrite and reconnect the previous neural circuit (choice B). Oligodendrocytes are NOT in close apposition to the axons they myelinate (that is a property of Schwann cells in the PNS); hence, their distance from the axon means that the oligodendrocyte must navigate its way back to the appropriate regenerated axon in order to myelinate it, which is made even more difficult because the regenerated axon is now very densely packed with material (eliminates choice A). Schwann cells are in the PNS, and their death has no effect on CNS neuron regeneration (eliminates choice C). It would be ideal for microglia to move away from the site of injury so that they would not cause the astrocytes to hypertrophy and secrete GAGs, but this does not usually happen (eliminates choice D).

82. A

@ Multiple sclerosis is an autoimmune disease that causes demyelination of the CNS (not the PNS, eliminating choices B and D). It is thought that a slow virus causes myelin fragments to be released from the myelin sheath of CNS neurons, exposing myelin basic protein (MBP), which is detected by the immune system as foreign and leads to the mounting of an immune response against one's own myelin (choice A). The additional fragments cause additional immune response and more demyelination – a vicious cycle of exacerbations and remissions. It is a dymelinating disease, not a disease directly causing the degeneration of neurons (eliminates choice C).

83. C

84. E

@ Small molecule transmitters are synthesized in the nerve terminal, where the RER and Golgi apparatus are absent (choice E). Choice E actually describes peptide and polypeptide

transmitters, which are synthesized in the soma on the RER, packaged into vesicles in the Golgi, and travel to the axon via axonal transport

85. C

@ Transmitter release does require calcium to enter the active zone of the presynaptic nerve terminal from the extracellular space via voltage-gated calcium channels (choices A, D, and E). Calcium causes transmitter release by changing the conformation of the SNARE complex, which stimulates vesicle fusion; this is thought to be the main mechanism behind post-tetanic potentiation, whereby repetitive stimulation of Ca channels may alter syntaxin (part of the SNARE complex) function to make vesicle fusion more efficient (choice B). We are left with the fact that choice C is false – transmitter release does NOT require that calcium stimulate a protein kinase.

86. -

87. A

~ Opening sodium channels on a cell at a resting membrane potential of -75 mV will cause the cell to depolarize. The Nerst potential for Na is +66 mV, so if Na channels are open to a cell at any potential below this value, Na will rush into the cell, and the entrance of this positive charge will depolarize the cell. Also, this increased Na permeability will tend to bring the cell's potential toward that of sodium, in this case increasing the potential from -75 mV toward +66 mV. The depolarization is transient because Na channels will quickly inactivate, and the flux of K out of the cell will tend to hyperpolarize the cell back to resting potential

@ Choices B and D are clearly wrong as a result of this explanation – the cell does not initially hyperpolarize or remain constant. Choice C is wrong because you cannot assume that an action potential will be fired by the opening of some Na channels; this requires meeting a threshold of open Na channels that we cannot verify has been achieved. Sodium inactivation takes care of the repolarization of the cell, so it is not necessary to await an IPSP before hyperpolarizing back to resting potential (choice E).

88. D

@ Facilitation is a process that involves the mobilization of vesicles already in the presynaptic terminal due to residual calcium from a previous firing and release of transmitter. It occurs on a timescale of 10-40 milliseconds (25-1000 Hz – convert to seconds and take the inverse), so there is no time in this mechanism for protein phosphorylation and especially not for protein synthesis and subsequent axonal transport

89. A

@ We were given two examples of presynaptic inhibition, one with alpha-adrenergic receptors involving G-protein activation, and the other (discussed here) involving GABA-A receptors that when activated increase flux of Cl into the cell. Increased chloride conductance leads to hyperpolarization of the membrane, preventing voltage-gated Ca channels from opening and thus blocking the release of transmitter from the presynaptic cell. The increased conductance to chloride can also be viewed as decreased membrane resistance to chloride because conductance and resistance have an inverse relationship.

90. C

@ Myasthenia gravis is an autoimmune disorder in which one's antibodies target acetylcholine receptors and block neuromuscular transmission (eliminates choice A). Antibodies bind near ACh binding sites and reduce ACh binding. They also cross-link receptors and cause receptor clustering and internalization, and they stimulate a complement cascade that degrades the endplate membrane. As a result, the number of nicotinic ACh receptors in the postsynaptic membrane is less than normal (eliminates choice B). Mestinon is a drug which goes to the neuromuscular junction and inhibits acetylcholinesterase; this prolongs the life of ACh in the synapse, increasing the likelihood that it will bind to one of the still-functioning ACh receptors (eliminates choice E). As we have seen over and over in Dr. Hartzell's packets, EMGs of MG patients decrease is amplitude during repetitive stimulation at 3 Hz. When depression occurs (less release of transmitters or vesicles from the presynaptic neuron), MG patients cannot reach threshold as often and their muscles do not fire as readily (eliminates choice D). The problem in MG is not presynaptic vesicle release of ACh, but rather loss of postsynaptic receptors (choice C).

119. -
120. -
121. B

@ Diencephalon lies lateral to the third ventricle

122. -
123. -
124. C
125. D

@ When a neuron is damaged, the connections between it and its support cells are broken. If by some chance the oligodendrocyte (responsible for myelination in the CNS) were not damaged it would still have difficulty reestablishing a connection with its particular neurons

126. D

@ Experimental allergic encephalomyelitis causes demyelination in animals injected with MBP

127. C

@ Oligodendroglia are located in the CNS and they make the MBP protein we know that this is the protein that the immune system goes after in MS. Guillain-Barre' Sydrome is a demyelination of peripheral nerves

129. C

@ sodium channels open faster and close faster than potassium channels.

130. B

@ The vesicles near the plasma membrane will always be exocytosed first. Further stimulus would be necessary to bring the vesicles that are farther away close to the membrane so that they can be exocytosed.

131. C

@ extracellular levels of K are 3.5 – 5.0 mM. A serum level of 20 mM is not good for the patient.

132. E
133. A
134. E

@ In this case, the postsynaptic cell would still function normally – it would react to neurotransmitter released from any source. The presynaptic cell would not be able to release neurotransmitter without an influx of Ca. This would cause fewer, if any, EPSP's

136. E

@ Presynaptic inhibition, GABA-A receptor is a ligand gated Cl channel when the channel opens Cl is allowed in to the terminal and the terminal hyperpolarizes, 2) Alpha-adrenergic receptor, a G-protein is activated and the beta-gamma subunit dissociates and inhibits the Ca channel.

137. A

@ The ACh receptor in the heart that is responsible for reduction of contraction frequency is the muscarinic. It is coupled to a Gi system, which opens an inward rectifying K channel that keeps the membrane potential down and slows down the spontaneous depolarization of the SA node

138. C

~ C is incorrect because the inhibition of voltage-gated sodium channels on the postsynaptic cell will not affect anything that is going on in the synapse – as far as release and reception of neurotransmitter go – the synapse would still be functional.

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146. C

@ Microtubules provide a stationary track along which specific organelles can move using various molecular motors. Microtubules: very long length and key player in support and axonal transport

148. D

The principle components of senile plaques are neurofibrillary tangles. These tangles are the result of a conglomeration of hyperphosphorylated tau proteins, which dimerize and then form the typical paired helical filaments. When Tau becomes hyperphosphorylated in AD it no longer can bind Tubulin it then will dimerize this is called paired helical filaments

Microglia membranes harbor CD4 and CD8 that are part of the complex of the receptor for the HIV virus-A is true. Microglia can take foreign material, process it, and present antigen on the cell surface to be seen by immune cells-B is true. Upon CNS damage microglia become activated and secrete a factor that causes astrocyes to hypertrophy-C is true.

149. -

150. -

151. D

@ The astrocytes secrete GAGS that are laid down and are frequently inhibitory to outgrowth of an axon-A is wrong. The endoneurium is located in the PNS-B is wrong. The astrocytes hypertrophy in response to signals released from the microglia, the hypertrophied processes form the glial scar-C is wrong

152. C

@ Conductance measures the ability of the membrane (or channel) to carry electrical current and depends on the properties of the membrane and the concentration of the ions in solution. It is measured in units of 1/ohms. The conductance of the membrane is equal to the inverse (reciprocal) of the resistance (1/R). Remember V= IR so, 1/R = I/V so, conductance =

current/voltage. The driving force in this case is the electrochemical gradient across the membrane.

153. D

154. A

@ Out of all the properties listed, the space (length) constant would be the most important. The space/length constant of the cell determines the degree to which a depolarizing current decreases as it spreads. Neurons with a large length constant are more likely to be brought to threshold by two different inputs arising from different sites than are neurons with a short length constant. The Nissl substance (ribosomes on the rer) and capacitance do not have anything to do with spatial summation. The type of stimulus will not determine whether they will sum together or not. The type of channel opened by a particular stimulus will affect the reaction of the cell membrane (depolarize or not) but not the distance the stimulus will spread.

155. A

@ The important point here is that voltage gated channels have voltage sensors (S4 domain) which consist of a segment of the protein that is rich in positively charged amino acids.

156. A

@ The pore of the channel can be thought of as the active site of an enzyme because it is rich in carbonyl groups that strip the water from the ion, stabilize its positive charge and allow it to pass through the membrane where it can be hydrated on the other side. This prevents the ion from having to come in contact with the lipid bilayer (which would not be favorable). The channels are specific for one ion and will usually not allow other species to pass through. Voltage sensitivity was discussed on the previous question.

157. C

@ ACh is the neurotransmitter used in neuromuscular junctions. If AChE is inhibited then the concentration of ACh in the neuromuscular junction would be increased

158. A

@ For neurotransmitter to be released, the presynaptic cell must be depolarized, the vesicles must fuse to the terminal membrane and Ca must be allowed into the cell. Neither Na nor K is required for neurotransmitter release. Hyperpolarization prevents opening of voltage-gated Ca channels. Neurotransmitter transporters help move the vesicles to the membrane, not release the neurotransmitter from them.

159. C

@ The botulinum toxin will affect syntaxin, which will prevent neurotransmitter release. The lack of neurotransmitter will not affect A, B or D, but it will result in the inability of the muscle cell to contract

160. C

75. B

@ The spinothalamic tract carrying pain and temperature information enters the spinal cord at the dorsal root, synapses in the dorsal horn, and almost immediately crosses under the central canal to ascend in the ventral lateral portion of the spinal cord on the contralateral side of the affected area of the body. Therefore, damage to the dorsal roots or dorsal horn or the lower cervical/upper thoracic regions of the spinal cord (area communicating with the upper extremities) on the RIGHT side

would interrupt the spinothalamic tract projecting from the RIGHT hand (eliminates choice A); we are still in the spinal cord and have not crossed over yet.
Damage to the ventral lateral spinal cord on the LEFT side at C2, once the spinothalamic tract has already crossed over and ascended, would also interrupt pain and temperature sensation in the RIGHT hand (eliminates choice C). The spinothalamic tract enters the lateral medulla, passes through the lateral brain stem, and terminates in the ventral posterior lateral nucleus of the thalamus. Therefore, damage to the LEFT side of the ventral lateral thalamus will affect the spinothalamic system of the RIGHT hand (eliminates choice E). the spinothalamic tract lies in the tegmental region and not in the base region of the brain stem. Damage to the lateral tegmental region of the LEFT rostral medulla would therefore affect the right hand (eliminates choice D), while bilateral damage to the base of the pons will have no affect on the spinothalamic tract (choice B).

76. B

    @ Oculomotor gets its component from the Edinger-Westphal nucleus. Glossopharyngeal gets its component from the nucleus ambiguus and inferior salivatory nucleus. Vagus gets its component from the nucleus ambiguus and the dorsal motor nucleus of the vagus

77. D
78. C
79. D
80. D
81. C
82. E

    @ Nocioceptors are silent or wekaly active at rest and become strongly activated following extreme termpatures, mechanical damage, or chemical damage..they are activated by an intensity of stimulus that causes tissue damage or would if applied long enough." Primary afferents can be types Aα, Aβ, Aδ, or C, all with a variety of diameters and conduction velocities (Aα have the largest diameters and fastest conduction/lowest thresholds, and so on) (eliminates choice A). Aδ and C fibers are predominantly present in the anterolateral system, while it is the dorsal-lateral/medial lemniscus system that controls 2-point discrimination (eliminates choice B). Aβ fibers are predominantly present in the dorsal-lateral/medial lemniscus system, while temperature is primarily conveyed via the anterolateral system (eliminates choice C). Visceral pain is conveyed via C-polymodal fibers, which signal late, dull pain (eliminates choice D); myelinated Aδ fibers are responsible for the early , sharpt pain felt immediately following injury.

83. C

    @ Receptor location on body surface has corresponding anatomic [somatotopic] representation in the CNS. Each receptor will only be excited if the appropriate physical stimulus occurs at the appropriate locations," making choice C the correct answer.
    Adaptation refers to a DECREASE in receptor responsiveness over time and occurs at DIFFERENT rates with different receptors (eliminates choices A and B). Mechanoreceptors, thermoreceptors, and chemoreceptors are all types of cutaneous

(skin) receptors, but my guess would be that hair follicle receptors probably are just a type of mechanoreceptor (eliminates choice D).

62. C
63. D

    @ Type S slow motor units are the most excitable, recruited first and used the most. They are used in standing (maintaining posture; choice A), walking, reflex, and most voluntary behavior. Motor units are recruited in order of increasing force output and increasing susceptibility to fatigue (in small units) to produce the whole muscle force as smoothly as possible (choice B). Fast-fatigable units are poorly equipped to sustain force output and so tend to be used for ballistic movements (choice C) and large, quickly generated forceful movements that are only sustained for a brief period of time

64. D
65. B

    S motor units can sustain contraction for very long periods of time.

66. C

    @ Muscles specialized for fine control need to be able to precisely regulate their contraction over a range of forces. These muscles do not require a lot of brute strength, however. These properties imply having many low-force motor units.

67. B

    @ In translational motion, signals travel from the vestibular nucleus to the appropriate extra-ocular muscle nuclei that will cause the eyes to move in the opposite direction of the movement of the head. If the head turns left, the eyes move right by stimulating the nuclei for the medial rectus of the left eye and the lateral rectus of the right eye. Simultaneously, the medial rectus of the right eye and the lateral rectus of the left eye (antagonist muscles) will be inhibited.

78. A

    @ The utricle detects linear accelerations in the horizontal plane (saccules are sensitive mainly to vertical accelerations)

82. D

    Hair cells have a basal level of neurotransmitter release. When they are bent in the direction of the kinocilium they increase the amount of neurotransmitter released, when bent the opposite direction, the level of neurotransmitter

88. A

    ~ Each stereocilium is a rigid cylinder whose cytoskeleton consists of a fascicle of actin filaments cross-linked by protein fibrin
    @ ‘B’ is false because the only true cilia made of microtubules is the kinocilium, which typically degenerates in the adult cochlea. ‘C’ is false because the hair bundles range from short to long, otherwise they would not be able to function by mechanical transduction. ‘D’ is false because only the outer hair cells are anchored to the tectorial membrane.

Week Two

1. B

@ The RPE is important in absorbing stray light. Some light will pass through the retina and may bounce off hitting other parts of the retina reducing the resolution of an image. The RPE counters this by refocusing light back onto the fovea. The RPE is also important in maintaining the outer segments of cones and rods. New discs are generated in the inner segment of cones and rods, and the segments nearest the RPE slough off and are phagocytosed by the RPE. Finally, the RPE is important in the photoreception and conduction in rod photopigment (rhodopsin). When light hits 11-cis retinal, 11-cis retinal converts to the all-trans conformation. All-trans retinal is sent to the RPE where it is converted to vitamin A and then sent back to rods and recycled into 11-cis retinal.

2. B

Lowering the levels of cytoplasmic cGMP actually closes Na channels and results in hyperpolarization of the rod cell.

3. D

@ The fovea does contain a high density of cones and occupies a small surface on the retina. However, the fovea is represented by a LARGE area on the visual cortex.

4. C

@ LGN axons terminate primarily in layer 4C

5. B

@ Only 90% of RGCs project to the LGN.

6. D

@ There are two visual pathways that begin in the retina that project to the LGN: the dorsal parietal pathway and the ventral inferior temporal pathway. The dorsal pathway: M (RGCs) project to the magnocellular layers (LGN) à layer 4C (V1) à thick stripes (V2) à middle temporal area (MT) à posterior parietal cortex. The dorsal pathway is concerned with depth perception and motion. The ventral pathway: P RGCs project to the parvocellular layers (LGN) à layer 4C of the primary visual cortex (V1) à thin stripes and interstripes (V2) à V4 à the inferior temporal cortex. The ventral pathway also receives projections from M RGCs. The ventral pathway is concerned with color and fine detail. The brain “binds” all of the information coming from the dorsal and ventral pathways through attention and focus. It is now thought that feature maps of the visual field are bound by synchronized activity during focus. That is, the most synchronously active regions of a feature map are bound together to create a single image. This is opposed to another less accepted theory that proposes that information from feature maps are bound together on a single master map to create an image.

7. A

@ CN II damage to an eye disrupts ipsilateral and contralateral PLR projections from that eye. HOWEVER, remember that efferent PLR projections follow CN III to the ciliary ganglion to constrict the pupil. In this question, only CN II is damaged, so the efferent PLR pathway of

the affected eye is still intact. Therefore, the eye with CN II damage can still receive contralateral PLR projections from the contralateral undamaged eye. So, the ipsilateral (CN II damaged) eye does not necessarily have to be enlarged. Remember: unequal pupil size is an EFFERENT problem

8. C

@ This is a definition question. Homonymous hemianopia is the loss of one side of the visual field. This results from damage to the optic tract contralateral to the visual field deficit. So, in this question left visual field deficit is a result of right optic tract damage

9. E

@ sympathetic innervation dilates the pupil. Sympathetic neurons originate in the hypothalamus. The firs order neuron passes through the brain stem to the spinal cord to synapse on the intermediolateral cell column (C8-T1). The second order neuron travels to and synapses at the superior cervical ganglion. The third order neuron rides along blood vessels of the internal carotid, through the cavernous sinus to join the parasympathetic fibers traveling to the ciliary ganglion (remember, the sympathetic fibers do not synapse in the ciliary ganglion). Damage to the sympathetic tract would result in ipsilateral pupillary defects. In this case, loss of sympathetic tone to the right eye results in unopposed parasympathetic innervation of the right pupil. Thus, the right pupil will be more constricted than the left pupil

10. E

~ Sensory information is routed through the thalamus (usually) to the primary sensory cortices. These then project to the sensory association areas, which then project to the motor association areas

11. B

~ Light hyperpolarizes cones which causes a decreased release of glutamate; “on-center bipolar cells are hyperpolarized by glutamate and therefore are depolarized following illumination.”
@ A: on-center bipolar cells are hyperpolarized by glutamate. C: horizontal cells hyperpolarized by cones depolarize cones in the center of the receptive field. D: on-center bipolar cells are hyperpolarized by glutamate while off-center are depolarized by glutamate. The receptors must be different.

12. C

@ A: hypercolumns analyze all orientations. B: blobs are not orientation selective but respond to different color stimuli. D: simple cells respond to bars of light at a particular orientation. They receive multiple inputs from LGN neurons, not complex cells.

13. A

~ an L cone pigment absorbing a longer wavelength photon generates a higher concentration of cytoplasmic cGMP
@ C: S cones are most sensitive to wavelengths under 420nm. D: objects will absorb certain wavelengths according to their color, but we see light as a combination of all the non-absorbed, reflected wavelengths

14. D

@ A: the pathways remain separate but they do ‘cross’ in a sense after synapsing in the LGN. B: this is the ‘cross’ discussed in the response for A. Before the LGN, the P pathway was superior to the M pathway; after the LGN, the P pathway projects to the inferior temporal regions.

15. C

~ this must be a brain stem or lesion along the ciliary ganglion.
@ A: loss of central vision can occur with an optic nerve neurofibromatosis. B: this describes pallor, a condition in which optic nerve neurons have ‘died’ because of trauma or other conditions. D: many conditions of CN II neuropathy will cause abnormal visual fields. E: with a lesion of CN II, signals from the optic nerve cannot conduct to the pretectile nucleus. For the pretectile nucleus, a bilateral signal is sent to both Eddinger Westphal nuclei and onto the ciliary ganglion to innervate the ciliary muscles.

16. E
17. B

@ Cones detect color by having three different pigment types each one maximally stimulated by a particular wavelength. The cones are called, blue/ S, green/ M, and red/ L although each responds to a range of wavelength and there is much overlap. Cones have high acuity and resolution and are not convergent, thus not involved in amplification. Cones are in a one to one relationship with RGCs. The cones are less heavily pigmented than rods. B is correct of cones, the other answers are characteristic of rods.

18. A

@ The dark and light currents show that RGCs are never silent. The constitutive activity is due to release of glutamate at the synapse that is only reduced in amount in response to light and the ensuing hyperpolarization.

19. B

@ 11 cis- retinal is a vit A derived light absorbing molecule. The pigment that is responsive to various wavelengths is the opsin molecule. Cones express three different forms of opsin. Meta- rhodopsin is the activated molecule that then activates transducin. The shift from rhodopsin to meta-rhodopsin occurs in rod cells and is involved in light detection, not color.

20. C

has deficits in the S cones first then other cones before rods, reflecting the degree of sensitivity/ vulnerability in these pigments. But achromatopsia is a congenital lack of one or more of the cone types. Usher's syndrome is retinitis pigmentosa associated with a hearing loss. B is a true statement. The neovascular "wet" form of macular degeneration is characterized by the invasion of new, poorly formed blood vessels beneath the retina (from the choroid). Since these new blood vessels are poorly formed, they leak their contents into the retina and subretinal space. This causes geographic scarring and macular degeneration or dsytrophy. A and D are true statements.

21. C

@ The dorsal pathway, which is thought to be involved in processing motion, depth, and special information, involves the M retinal ganglion cells à magnocellular layer of the LGN (choice C), à V1 à thick stripes of V2 à middle temporal area (MT or V5) à posterior parietal cortex. Choice A, B, and D all describe facets of the parvocellular pathway.

22. B

@ The fovea is defined as the center of the retina (eliminates choice A, the periphery of the retina), and it is evident that “rods [are]…not in the fovea (eliminates choice C),” while cones are concentrated in the fovea and there are few in the peripheral retina (choice B). The region where the optic nerve exits the retina is somewhat adjacent to the fovea, and this is sometimes referred to as the blind spot (eliminates choice D).

23. D

@ Off center retinal ganglion cells are maximally stimulated by full illumination of their surround (choice D) and maximally inhibited by full illumination of their centers. From the same slide, it is evident that diffuse illumination has no net effect on the basal firing rate of the retinal ganglion cell – the stimulation of the surround cancels out the inhibition of the center (eliminates choice A). From my understanding (though I could not find this written explicitly), on- and off-center retinal ganglion cells can be found both inside and outside the fovea (eliminates choice B). it is evident that M-type retinal ganglion cells can be either on-center or off-center (eliminates choice C); P cells are not only on-center and off-center but are also classified by red/green and blue/yellow opponent systems.

24. B

@ Cone cells contain one of three color opsins: L-opsin (red cones), M-opsin (green cones), or S-opsin (blue cones) (choice B). Rod cells, not cone cells, contain rhodopsin (eliminates choice A). Protonopes have an L-opsin defect (missing red cones), and they only have dichromatic color vision provided by the remaining green and blue cones (eliminates choice C). Cones are the first cells to degenerate in retinitis pigmentosa, and as a result, patients often receive an initial diagnosis of achromatopsia (eliminates choice D).

25. C

@ The patient has a left homonymous hemianopia, meaning that the left visual field is compromised in both eyes. Because the retina has an inverse image of the visual field, visual information from a field ends up on the contralateral side of the optic pathway. Hence, a left hemianopia results from damage on the right (eliminates choice B and E). If damage was in the optic nerve proper, vision in both fields of the ipsilateral eye would be compromised (eliminates choice B again). Damage to the optic chiasm would lead to loss of bitemporal fields in both eyes (eliminates choice A). Occipital lobe damage would likely lead to partial contralateral field deficits with macular sparing (eliminates choice E again). The right pons, though involved in extraocular muscle innervation, is not a key player in the optic nerve transmission pathway (eliminates choice D). We are left with choice C, right optic tract damage.

26. D

@ Normally in the dark, photoreceptor cells are depolarized. The process described in A-C occurs in the presence of light and causes the photoreceptor to close its Na channels and consequently hyperpolarize.

27. A

@ Horizontal cells play a role in center-surround antagonism. Horizontal cells feedback onto the cones in the center of bipolar cells’ receptive field. Both horizontal and bipolar cells lack voltage gated Na channels and thus transmit signals passively. When light is present in

photoreceptors in the center of the bipolar's receptive field, the on-center bipolar cells depolarize while off-center bipolar cells hyperpolarize. (In the dark, photoreceptor cells cause on-center bipolar cells to hyperpolarize and off-center bipolar cells to depolarize.) Horizontal cells connect the cones from the surround region to the center region. In the dark, the horizontal cells maintain the center cone in a slightly hyperpolarized state. In the presence of light on the surround cone, the horizontal cell is hyperpolarized. This leads the center cone to become depolarized. This causes hyperpolarization of the on-center bipolar cell and depolarization of the off-center bipolar cell. The reverse happens when light is shown on the cone in the center of the receptive field.

28. B
29. E
30. A
31. -
32. A

~ Cones fire in the dark, but when exposed to photons of light the levels of phosphodiesterase increase which causes reduction in cGMP and thus causes the cell to close its channels and hyperpolarize
@ . 'B' is false because amacrine cells in the inner plexiform layer form connections among the proximal process of bipolar cells and the dendrites of retinal ganglion cells. Horizontal cells are in the outer plexiform layer. 'C' is false because bipolar cells have center-surround receptive fields similar to ganglion cells. 'D' Rods are not present in the fovea. It is entirely cones. 'E' color coding cells project to the parvocellular layer of the LGN. Recall that the parvocellular layer projects to LGN layers 3,4,5,6, which carry on to the blobs and thin stripes then the Temporal pathway. This information includes color. In contrast the magnocellular pathway is more involved in 'where' and carries information about depth and motion.

33. C

~ although depending of severity of the degeneration other deficits are possible. In macular degeneration the retinal-pigmented epithelium degenerates and collects both lipids and neovascularization. Severe macular degeneration produces poor visual acuity in the center of the visual, which especially impairs tasks such as reading
@ 'A' night vision is not lost since much of this information is mediated by rods, which exist outside of the fovea. Therefore they are not as affected by macular degeneration. 'B' loss of motion would not be extremely significant because the larger field pathways would still be functioning. Activity of the magnocellular pathway would still receive information from the retina outside of the fovea. 'D' Choroidal neovascularization would occur in macular degeneration, however this is not until the 'wet' stage. Also this is technically not a 'deficit'. 'E' the papillary light reflex would be spared as long as areas outside the macula could still detect photons.

34. E

@ Accommodation is changing the curvature of the lens to focus the world onto the retina. In accommodation the ciliary muscles contract to adjust the curvature of the lens. When the ciliary body contracts tension in the lens zonules (aka suspensory ligament) is reduced/relaxed. As the ciliary body contracts and lens zonules relax, the eye is allowed to form more of a convex shape, thus the anterior curvature of the anterior lens surface

increases. During accommodation the pupils transiently constrict to increase the depth of field. Thus ‘E’ is correct because all of the above happen.

35. B

~ cone cells excite (depolarize) off-center cells in the dark. In the presence of light on-center cells depolarize and off-center cells hyperpolarize
@ ‘A’ is false. Center-surround is a specific feature of bipolar cells. ‘C’ The photoreceptor cells fire in a graded process to light, not in a dichotomous AP fashion. Similarly, bipolar cells appear to fire in a graded fashion. In the ganglion cells we begin to get signal transduction in the form of AP trains. ‘D’ is false because there are both off-center and on-center bipolar cells in the outer retina.

36. B

direct projections from the retina to the superior colliculus. These projections contribute to visually guided movement. Saccades for example are coordinated in the superior colliculus

Recall that we have two general pathways. The dorsal pathway, which passes through the middle temporal visual area, carries information on depth and motion. The ventral pathway, which terminates in the inferotemporal cortex, carries information on color and form. Therefore loss of color recognition (achromatopsia) is likely to be in the ventral pathway including infero-temporal cortex.

37. E

@ Recall that we have two general pathways. The dorsal pathway, which passes through the middle temporal visual area, carries information on depth and motion. The ventral pathway, which terminates in the inferotemporal cortex, carries information on color and form. Therefore loss of color recognition (achromatopsia) is likely to be in the ventral pathway including infero-temporal cortex.

38. C

@ correct each eye has separate termination in the striate cortex. ‘A’ is incorrect because cells with the same orientation are arranged perpendicular to the pial surface. ‘B’ is incorrect because layer 5 projects to the superior colliculus. ‘D’ is incorrect because LGN input to the striate cortex ends at layer 4.

39. C

40. B

@ The fovea contains only cones. The fovea is in the center of the retina. The optic nerve is displaced away from the fovea. The fovea contains only cones so it responds best in well-illuminated conditions.

41. D

@ Like retinitis pigmentosa, glaucoma is associated with visual field defects in the retina. It includes an increase in intraocular pressure and optic nerve damage

42. C

@ L, M, and S opsin are found in different cones and allow us to see the world in color. ‘A’ is FALSE: because different cones contain different types of opsin pigment. ‘B’ is FALSE because color is carried along the Parvocellular, not magnocellular pathway. ‘D’ is FALSE because the wavelength of the photon determines which type of cone is affected (long wavelengths for red, medium wavelengths for green, and short wavelengths for blue).

43. D

@ One of the ways that we are able to register depth is the disparity of an object in our visual field when compared between the two eyes (stereoscopic cues). Since each eye is separated by about 6cm, objects in the visual field will appear slightly different when registered in cortex. The position of an object is registered in relation to disparity between the right and left eyes in relation to the fixation point. Thus we interpret depth of an object by the amount binocular disparity it produces. There are specific cells, which register this disparity.

44. A

@ The most simplistic breakdown of visual processing is that the dorsal pathway registers ‘where’ an object is, while the ventral pathway registers ‘what’ an object is. The ability to recognize faces falls into the what category and is thus localized somewhere in the infero-temporal region. Prosopagnosia is the inability to recognize faces. This comes about by bilateral lesions in Brodmann’s areas 20 and 21 (temporal lobe). ‘B’ posture regulation when the eyes are closed has nothing to do with the visual system it is purely the vestibular and proprioceptive system. ‘C’ motion perception and ‘D’ depth perception are processed in the dorsal pathway. The one catch here is that this includes the middle temporal lobe (MT), however, this region is very close to the parietal lobe and can be spared in some temporal lobe lesions, whereas Brodmann’s 20 and 21 are more susceptible to temporal lobe lesioning. ‘E’ complete blindness would result from lesioning of the striate cortex.

45. C

@ the question is asking for a region of the spinal cord that would inhibit ipsilateral joint position and contralateral pain sensation. Joint position is controlled by the dorsal spinal tract, which controls things ipsilateral in the spinal cord and contralateral after it crosses the midline before entering the internal capsule. Pain sensation is controlled by the spinothalamic tract, and damage to the spinothalamic tract in the spinal cord would cause contralateral loss.

46. B

@ In the dorsal root ganglion, there are cell bodies for the dorsal column and 1st spinothalamic axon. The question is worded to trick you. It asks which regions have AXONS WITH CELL BODIES in the right dorsal root ganglion. Yes, the right dorsal column’s first axon has its cell body in the ganglion, then it continues up the column. It is tempting to say C is correct, however, the axon in the dorsal root ganglion synapses before entering the spinothalamic tract.

47. C

~ The cerebellum is responsible for the coordination of movements and it receives information from limbs and coordinates them with what the brain tells the body to do. Damage to the cerebellum impairs spatial awareness and muscle tone. Damage to the

cerebellum would cause loss of motor coordination. Damage on the right side of the cerebellum would affect the right side of the body because information coming through the spinal column into the cerebellum is ipsilateral

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48. -
49. -
50. -
51. -
52. -
53. -
54. -
55. -
56. -
57. E

@ Sensations arising from viscera are generally only perceived as painful and are poorly localizable. Visceral sensory input converges onto the pathways used by somatic pain sensation. Because visceral and somatic sensations share the same transmission paths, visceral pain is perceived as arising from the body surface." Transcutaneous electrical neural stimulation (TENS) makes use of the "gate control theory" to treat chronic pain by providing electrical shocks to skin regions, preferentially activating large diameter axons that have the lowest threshold to stimulation. Therefore, the SMALLER diameter, HIGH threshold axons of temperature receptors are not selectively activated during this procedure (eliminates choice A). Diffuse noxious inhibitory controls work via the nucleus reticularis dorsalis at the level of the caudal medulla (recall that the periaqueductal gray referred to in the answer choice is in the MIDBRAIN) to cause widespread depression of wide dynamic range neurons (but not nociceptive-specific neurons, which are acted on by the mechanism used in the periaqueductal gray) in the spinal cord (eliminates choice B). Activation of the mu opiate receptors by opiates like codeine occurs not in the somatosensory cortex, but rather in the periaqueductal gray matter of the midbrain (eliminates choice C). From my understanding, sympathetic-sensory coupling is a phenomena that results in the case of nerve injury, when sympathetic fibers that normally only innervate blood vessels in the DRG sprout to contact the sensory neuronal cell bodies. This coupling occurs following nerve damage, and is NOT the main signal for damage to visceral tissue (which involves the whole referred pain scenario described above) (elminites choice D).

58. B

@ Reflex sympathetic dystrophy is a pain disorder, but it is caused by trauma affecting the limbs, CNS lesions, or after visceral diseases, with or without nerve damage (see Pain II packet for more on this disorder). Hyperreflexia is a condition in which the deep tendon reflexes are exaggerated, and this is not a CAUSE of the RSD. Carpal tunnel syndrome is an example of referred pain where pain in perceived not only in the hand where the median nerve is injured, but also in the entire arm, far beyond the injured nerve territory (choice A). it is clearly stated that allodynia (pain due to non-noxious stimuli) and hyperalgesia (decreased sensitivity to pain) are commonly associated with neuropathic pain (choices C

and E). Paresthesia are abnormal sensations that are not unpleasant, as opposed to dysesthesias which are unpleasant abnormal sensations (choice D).

59. D ~ After peripheral nerve lesion, the receptor ending of the afferent axon is either physically or functionally severed from the cell body. While this should silence the afferent, many injured afferents actually develop HYPEREXCITABILITY hours to days following nerve injury (eliminates choice E). This hyperexcitation results from ongoing discharge and stimulus-evoked activity from ectopic midnerve sites, occuring mostly in the region of injury and/or in the axotomized parent neuron in the dorsal root ganglion. Thus, dorsal root ganglia cell bodies reorganize and fire spontaneously, resulting in excitatory signals for ongoing pain (choice D). Because of the abnormal spontaneous discharges from the site of injury and the dorsal root ganglia, the sprouting of sympathetic fibers from blood vessels to DRG neurons, and often ensuing central sensitization, pain sensation is NOT short-lasting but rather is often chronic (eliminates choice A
60. A
61. D

@ Muscle spindle receptors are discussed on p. 3 of the Motor Functions of the Spinal Cord (MFSC) packet. They are activated by stretch, and their most rapid actions are to excite motoneurons monosynaptically, in what is commonly known as the stretch reflex (choice A). Branches of the afferents from the primary receptors of muscle spindles also project to interneurons that inhibit muscles with antagonistic actions, known as reciprocal inhibition (choice B). Kinesthesia is the proprioceptive sense of limb movement. Muscle spindle receptors, gogli tendon organs, and receptors located in joint capsules that sense flexion or extension of the joint all contribute to kinesthesia (choice C). The remaining choice, the flexion-withdrawal reflex, a flexed posture in response to painful stimuli, is thought to arise from actions of the spinal circuitry and is apparently unrelated to muscle spindle receptors (choice D).

62. -
63. -
64. -
65. -
66. -
67. -
68. A

~ Ataxia includes asynergia, decomposition of movement across multiple joints. The patient may be competent at moving one joint but not at coordinating several
@ Ataxia includes asynergia, decomposition of movement across multiple joints. The patient may be competent at moving one joint but not at coordinating several (choice A). Delays in initiating or terminating movement (choice B), dysmetria (choices C and D) and dysdiadochokinesia (choice E) are all symptoms of ataxia.

69. D

~ The cerebrocerebellum (lateral hemispheres of the cerebellum) project via the dentate nucleus to the red nucleus and motor (and other) cortices to control movement initiation, planning, and timing

@ The cerebrocerebellum (lateral hemispheres of the cerebellum) project via the dentate nucleus to the red nucleus and motor (and other) cortices to control movement initiation, planning, and timing (choice D). The vestibulocerebellum is involved in vestibular reflexes and the control of axial muscles (choice A), the vermis controls axial and proximal muscles by sending output through the fastigial nucleus (choices B and E), and the spinocerebellum controls distal muscles (choice C).

70. C
71. D
72. B

The cerebellum plays the largest role in motor, not sensory, function.

73. E

@ The interposed nuclei in the right half of the cerebellum project to neurons in the left motor cortex that control the distal muscles on the right side of the body

74. B
75. C

The interposed nuclei modulates muscle stretch reflexes of distal muscle groups.

76. B

@ The indirect pathway is composed of the following sequence: striatum --> external pallidal segment --> subthalamic nucleus --> internal pallidal segment. The first two connections are inhibitory (GABA-ergic) but the last is excitatory (glutaminergic). Activation of this pathway increases firing rates of neurons in the internal pallidal segment

77. A

@ The substantia nigra pars reticulata tonically inhibits nuclei in the thalamus. Activation of the substantia nigra pars reticulata would be expected to increase inhibition of the thalamus instead of decrease inhibition

78. -
79. -
80. C
81. B

@ Hair cell ion channels are mechanically gated, and an elastic protein element that senses hair-bundle displacement, known as the gating spring or tip link, controls the opening and closing of the gate (choice B). Tip links are elastic coiled protein structures, and are therefore only stiff when moved from short to long side to provide a “springiness” which resists pull. They span from the tip of a shorter stereocilium to the side of the adjacent longer stereocilium (eliminates choice A and C), and the ion channel that opens and closes is located on the longer stereocilium. Reissner’s membrane, also known as the vestibular membrane, separates the scala media from the scala vestibuli and is not an important player in tip link function (further eliminates choice C). Tips links are coiled protein structures that are associated with myosin, not made of myosin (eliminates choice D). myosin is thought to actin an ATP-dependent manner with actin to power the movement of the tip link’s attachment point up or down the surface of the stereocilium; this is the molecular mechanism that is thought to underlie hair cell adaptation.

82. -

83. A

@ the apex of the basilar membrane is broad and thin and has its maximum vibration for low frequency tones. High note have their maxima at the base of the basilar membrane, thus ‘B’ is wrong. The tonotopic map occurs because each portion of the basilar membrane resonates differently based on the pitch, thus ‘C’ is wrong.

84. A

@ Both the scala vestibuli and tympani contain perilymph, which can move between chambers only at the helicotrema

85. A

@ Recall that sound causes pressure changes in the external acoutic meatus. This cause the tympanum to be pushed inward toward the middle ear. This causes movement of the ossicles. The base of the stapes is displaced and presses inward on the oval window. Since perilymph is virtually incompressible the pressure rise in the scala vestibuli causes the basilar membrane to deflect downward. This cause a pressure rise in this scala tympani which also contains virtually incompressible perilymph. Thus, the increased pressure of the scala tympani causes the round window to bow outwards into the middle ear.

86. D

~ The outer hair cells primarily work to amplify the sounds received by the inner hair cells.
@ The outer hair cells primarily work to amplify the sounds received by the inner hair cells. ‘A’ is FALSE because vestibular information is gathered in the semicircular canals while auditory information is gathered in the cochlea. ‘B’ is false because the thick base of the basilar membrane is more sensitive to high frequencies while the apex, which is broad and flat, responds more to low frequencies. ‘C’ is false because it is reversed. There is one row of inner hair cells and 3-4 rows of outer hair cells. ‘E’ is false. Auditory signals on CN8 project to the medial geniculate nucleus.

87. A

@ The tectorial membrane is in contact with the stereocilia of the outer hair cells ‘A’. “The longest stereocilia of outer hair cells are tightly attached to the tectorial membranes lower surface.”

88. -

89. E

@ the Incus is NOT in the inner ear. Recall that the “Outer Ear” consists of the auricle (pinna) and external acoustic meatus; and it ends at the tympanic membrane. The “middle ear” runs from the tympanic membrane to the oval window. It includes the malleus, incus, stapes, and the eustachean tube. The “inner ear” includes the semicircular canals, cochlea, organ of Corti, and spiral ganglion. The tonotopic map is found on the basilar membrane which is structured differently across its length based on the frequency to which it responds.

90. E

@ When bundles displace to the tall end, tip links pull on adjacent channels causing them to open and allow K and Ca to enter the hair cell. ‘A’ is FALSE because vibration of the basilar membrane combined with each hair cells specific response frequency cause the channels to OPEN and allow Ca and K to flow IN. ‘B’ is FALSE for the same reason. ‘C’ is false. ‘Tip

links' attach the tips of each hair cell to the next. When the bundle moves toward the TALL edge the tip links pull on the adjacent hair cell's channels causing them to open. When the bundle moves toward the SHORT edge, the tension in the tip links is reduced so there channels close. 'D' is false because the hair cells operate based on mechanical transduction rather than active ion pumps.

91. D

@ A: Incorrect because it is a true statement. The short term memory pathway: first a person perceives something in the environment and this information proceeds down its processing pathways to become a short term memory in the association cortices. If this short-term memory is utilized, it is then transferred from the higher processing centers to the hippocampus (information first enters the entorhinal cortex), where the memory is formed and consolidated. The circuit is as follows: entorhinal cortex à dentate gyrus (perforant path); dentate gyrus à CA3 (mossy fiber path); CA3 à CA1 (Schaffer collateral path). If the information from the hippocampus continues to be used, it is transferred back to the association cortices for long-term storage which can last for hours, days, or years. B. Incorrect because it is a true statement. NMDA inhibition is an important differentiating feature between presynaptic LTP and postsynaptic LTP. NMDA antagonists disrupt the ability of NMDA receptors to be activated to allow Na+ and Ca2+ entry and mediate the sensitization of AMPA to glutamate stimulation. C. Incorrect because it is a true statement. Homosynaptic LTP is mediated by tetanus induced presynaptic Ca2+ influx which ultimately increases neurotransmitter release from the presynaptic cell. E. Incorrect because it is a true statement. Early LTP alters the activity of preexisting proteins in the synapse. Late LTP involves the production of new proteins and as a result can be blocked by protein synthesis inhibitors. Some of the protein synthesis is involved in structural change, specifically the formation of new synapses.

92. C

~ COnsolidation occurs in the hippocampus which then sends projections to single brain regions responsible for individual memories.
@ The short term memory pathway: first a person perceives something in the environment and this information proceeds down its processing pathways to become a short term memory in the association cortex. If this short-term memory is utilized, it is then transferred from higher processing centers to the hippocampus (information first enters the entorhinal cortex), where the memory is formed and consolidated. The circuit is as follows: entorhinal cortex à dentate gyrus (perforant path); dentate gyrus à CA3 (mossy fiber path); CA3 à CA1 (Schaffer collateral path). If the information from the hippocampus continues to be used, it is transferred back to the association cortex for long-term storage, which can last for hours, days, or years.

93. A

~ thalamocortical neurons have two firing modes. During slow wave sleep (NREM) thalamocortical activity is synchronized (firing at once) , slow, oscillatory, and burst firing. EEG shows high amplitude and low frequency. During the awake state thalamocortical activity is desynchronized, fast, tonic, and single spike. EEG shows low amplitude and high frequency. REM sleep shows similar thalamocortical activity as the awake state. The main difference between REM and awake is that there is atonia in REM sleep.

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94. A

~ Until the first human EEG done during sleep in 1929 it was thought that sleep was a relatively passive process. Two other discoveries/innovations were pivotal to establishing sleep as an active process. The first was the discovery of REM sleep in 1953. The second was the 1972 development of polysomnography which allows simultaneous interpretation of EEG, EOG (eye movements), EMG, and EKG.

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95. D

@ Each sensory system has a unimodal cortical association area in close proximity to its primary receiving area. There are three main features of unimodal sensory areas. The first is to extract the invariant features of a stimulus specific to that modality (primary receiving area): somatosensory, visual, or auditory. Disturbances in this function lead to agnosia. The second feature is to relay extracted invariant information to multimodal association areas where the convergent input from unimodal association, memory, and motivational areas of the brain are unified. The third feature is to elicit goal-directed behaviors on the basis of this processed sensory information. The unimodal association areas perform different functions. This is demonstrated by the flashing screen experiment with commisurotomized subjects that are asked to identify objects such as the hybridized man/woman face.

96. B

~ The cutaneous areas that have the greatest cortical representation have the greatest density of neurons, which implies they have a very detailed sense of touch

@ The areas of the body with the greatest density of receptors with small receptive fields have the most detailed sense of touch. In addition, those areas of the body with the greatest density of neurons in the periphery also have the greatest cortical representation areas.

97. C

~ Movements of the limbs during the step cycle continue without electrical activity due to influences such as inertia, elasticity of the muscles, and gravity, but these movements are passive. Actual force generation from the muscles requires activation of motor units, which requires electrical activity in the motor neurons of those units

@ A: demonstrated by experiments where a cat was placed on a horizontal platform and the platform was moved. The cats were trained to maintain stability by making a corrective response. These responses were mediated by proprioceptive somatosensory information from the golgi tendon organ, muscle spindle receptors, and cutaneous feedback. When we move, shear forces on the skin provide us with information about our body orientation, which

allows us to respond to changes in that orientation. B: these responses are known as tonic labyrinthine reflexes. These reflexes monitor the head position relative to gravity, and invoke a muscle response in order to maintain stability. This reflex is demonstrated by the maintenance of stability in cats walking on upward or downward slopes. For example, when the head is down with respect to gravity, the cat extends its fore limbs and flexes its hind limbs to stabilize itself. D: Severe damage to the vestibular system would interfere with the tonic labyrinthine reflex and prevent it from functioning correctly. However, the tonic neck reflex, which responds to activity in spindle afferents in the muscles of the neck, would still be intact. It would sense movements of the head relative to the rest of the body, and if you moved the head in that manner, this reflex would induce appropriate changes in muscle tone to maintain balance.

98. D

~ A: the basal ganglia have a lot of tolerance in terms of dopamine signaling, so symptoms will not start to appear until dopamine levels are reduced by about 80%. B: for the disease to be entirely genetic is rare, representing only about 15% or less of total cases. The majority of people have sporadic Parkinson's disease, which is through to be due to undetermined genetic susceptibility to the disease. C: research in Parkinson's disease was revitalized with a discovery that drug addicts exposed to MPTP develop a profound Parkinsonian state. MPTP was found to be selectively toxic to dopaminergic neurons. This toxicity reduces activation of D1 and D2 receptors, which leads to increased activity in the indirect pathway and decreased activity in the receptors which leads to increased inhibition of thalamus and hypokinetic features of the disease

99. B

~ Dystonia patients may have the inability of open their eyes, or they may grimace without wanting to, all due to uncontrollable facial muscle contractions.
@ dystonia is a hyperkinetic neurological disorder. It's characterized by abnormal tonicity thought to arise from deficits in motor learning. These patients do not have shaky movements as seen in Parkinson's, instead they have slow sustained muscular contractions. These contractions are usually brought on by other movements, so if patients are still and relaxed, muscle tone tends to stay normal.

Last Year's Week 1 Testbank

25. Which of the following statements about the retinal pigment epithelium (RPE) is INCORRECT?

A. The RPE is important in the breakdown and reprocessing of sloughed segments of cones and rods.

*B. The RPE reflects light not absorbed by photoreceptors back onto other regions of the eye.

C. All-trans retinal is converted to vitamin A, the precursor of 11-cis retinal, by the RPE.

D. Night blindness may result from damage to the RPE.

@ The RPE is important in absorbing stray light. Some light will pass through the retina and may bounce off hitting other parts of the retina reducing the resolution of an image. The RPE counters this by refocusing light back onto the fovea. The RPE is also important in maintaining the outer segments of cones and rods. New discs are generated in the inner segment of cones and rods, and the segments nearest the RPE slough off and are phagocytosed by the RPE. Finally, the RPE is important in the photoreception and conduction in rod photopigment (rhodopsin). When light hits 11-cis retinal, 11-cis retinal converts to the all-trans conformation. All-trans retinal is sent to the RPE where it is converted to vitamin A and then sent back to rods and recycled into 11-cis retinal.

26. Which of the following statements about light signal transduction is INCORRECT?

A. 11-cis retinal is the light absorbing molecule of rhodopsin.

*B. Activation of cGMP phosphodiesterase lowers cytoplasmic cGMP, leading to depolarization of the rod photoreceptor.

C. Light adaptation occurs within photoreceptors because cGMP-gated channels close, reducing calcium entry to the cell, which then leads to more rapid photopigment inactivation and increased synthesis of cGMP.

D. The dark current in rods and cones is a predominantly inward sodium current that leads to depolarization and glutamate release.

@ This question pertains to signal transduction in rod cells. The sequence is as follows (1) 11-cis retinal is the light absorbing component of the rhodopsin molecule. Light hits 11-cis retinal causing a conformational change to all-trans retinal. (2) This conformational change induces a conformational change in the entire rhodopsin molecule into metarhodopsin: the active form of rhodopsin. (3) Metarhodopsin activates the G-protein transducin which then activates a cGMP phosphodiesterase which breaks down cGMP. In the absence of light (i.e. darkness) intracellular cGMP levels are relatively high. In addition, rod cells possess cGMP-dependent Na^+ channels. So, in dark environments there is perpetual opening of the Na^+ channels and thus depolarization. Light activation of rhodopsin results in the decrease of intracellular cGMP levels à closing of the Na^+ channels à hyperpolarization of the rod cells. Another feature of importance of rod cell signal transduction is adaptation. Light hitting rhodopsin initially causes a total loss of Na^+ current. However, after a period of time the current slowly returns. Some of this adaptation is due to pupillary constriction. A larger part occurs at the photoreceptors. This is because the Na^+ channels also allow some Ca^{2+} influx. Closing of Na^+ channels à reduces Ca^{2+} influx à faster photopigment inactivation à activates the synthesis of cGMP à opening of Na^+ channels.

27. The retina and LGN topographically map the visual world onto the cortex. Which of the following statements is FALSE concerning this topographic representation?

A. The superior part of the visual field is represented on the inferior bank of the calcarine fissure.

B. Adjacent parts of the visual world are represented in adjacent parts of the visual cortex.

C. The left visual field is processed in the right visual cortex.

*D. The fovea contains a high density of cones but occupies a small surface of the retina and a small portion of the visual cortex.

@ The fovea does contain a high density of cones and occupies a small surface on the retina. However, the fovea is represented by a LARGE area on the visual cortex.

28. Choose the INCORRECT statement concerning processing within the visual cortex.

A. Hypercolumns process orientation and color information of a small part of the visual field from both eyes.

B. Cells in the visual cortex that respond to a particular orientation lie within a column, while cells in an adjacent column respond to a slightly different orientation.

*C. Within the striate cortex, each LGN axon terminates primarily in layer 1.

D. Separation of inputs from each eye is maintained in layer 4 of the primary visual cortex.

Most axons terminate in layer 4c.

29. Choose the INCORRECT statement.

A. From the lateral geniculate nucleus (LGN) of the thalamus, fibers of optic radiation project to the primary visual cortex.

*B. All retinal ganglion cells project to the LGN.

C. Neurons in the superior colliculus are important for directing body movements towards tactile, auditory, and/or visual stimuli.

D. The pretectum is involved in reflex constriction of the pupils.

@ Only 90% of RGCs project to the LGN.

30. Choose the INCORRECT statement that relates to the visual information pathways from the primary visual cortex (V1).

A. Fibers project from V1 to other areas within the occipital lobe.

B. A dorsal pathway from V1 is associated with location and movement.

C. A ventral pathway from V1 is associated with recognition of fine detail and color.

*D. All visual pathways from V1 “bind together” in the preoptic area.

@ The “master map” theory proposes that all visual pathways from V1 are bound together in the preoptic area. This is a less accepted theory. This is opposed to the “synchronous activity” theory that proposed that visual pathways are bound by synchronous activity in feature maps. This is a more accepted theory.

48. Rods signal bipolar cells by changing the amount of released glutamate following:

*A. absorption of a photon by the 11-cis retinal component of rhodopsin.

B. the opening of cGMP gated channels that are potassium permeable.

C. the conversion of all-trans retinal to vitamin A.

D. changes in the frequency of action potentials induced in the rod cell by currents associated with the cGMP gated channels.

~ Captured light converts 11-cis retinal to the all-trans conformation which changes the rhodopsin conformation to its active state, metarhodopsin II. Metarhodopsin activates transducin and hyperpolarizes the rod cell by closing cGMP-gated Na channel. The hyperpolarization reduces the amount of glutamate released by the rod]

@ B. the opening of cGMP gated channels that are potassium permeable. INCORRECT; the cGMP-gated channels are Na permeable. C. the conversion of all-trans retinal to vitamin A. INCORRECT; vitamin A is not involved in the signal transduction pathway. D. changes in the frequency of action potentials induced in the rod cell by currents associated with the cGMP gated channels. INCORRECT; the frequency of the action potentials is not in question here. The amount of glutamate released by the rod cells is directly determined by the hyperpolarization of the rod, not the frequency that it occurs.

49. Which of the following is true of signal processing in the retina:

A. Glutamate depolarizes both on-center and off-center bipolar cells.

*B. Light hyperpolarizes the cone cell in the center of the receptive field, leading to a depolarization of the on-center bipolar cell.

C. Horizontal cells hyperpolarized by cones in the surround receptive field result in hyperpolarization of cones in the center of their receptive field.

D. On-center and off-center bipolar cells contain identical receptors for glutamate.

~ Light hyperpolarizes cones which causes a decreased release of glutamate; “on-center bipolar cells are hyperpolarized by glutamate and therefore are depolarized following illumination.”

@ A: on-center bipolar cells are hyperpolarized by glutamate. C: horizontal cells hyperpolarized by cones depolarize cones in the center of the receptive field. D: on-cent bipolar cells are hyperpolarized by glutamate while off-center are depolarized by glutamate. The receptors must be different.

50. Regarding the organization of the primary visual cortex:

A. A hypercolumn contains a ~1x1 mm piece of primary visual cortex that analyzes only one orientation.

B. A cluster of highly active cells called blobs are sensitive to the orientation of moving bars of light.

*C. A hypercolumn includes a series of adjacent orientation selective columns, representing all possible orientations.

D. A simple cell receptive field results from the inputs of many different complex cells.

~ hypercolumns only look at one specific part of the visiual field but they maintain a complete representation of all orientations.

@ A: hypercolumns analyze all orientations. B: blobs are not orientation selective but respond to different color stimuli. D: simple cells respond to bars of light at a particular orientation. They receive multiple inputs from LGN neurons, not complex cells.

51. Which of the following is NOT true:

*A. An L cone pigment absorbing a longer wavelength photon generates a lower concentration of cytoplasmic cGMP than an L cone absorbing a shorter wavelength photon.

B. A reflectance function of an observed object describes the proportion of light of all wavelengths that is reflected off the object.

C. S cones optimally absorb light of shorter wavelengths.

D. We see color as represented by the combined wavelengths of light reflected off objects.

~ an L cone pigment absorbing a long wavelength photon generates a higher concentration of cytoplasmic cGMP

@ C: S cones are most sensitive to wavelengths under 420nm. D: objects will absorb certain wavelengths according to their color, but we see light as a combination of all the non-absorbed, reflected wavelengths

52. Choose the correct statement(s) concerning the “M” and “P” pathways of the primate visual system.

A. “M” and “P” pathways remain separate through the lateral geniculate nucleus of the thalamus and through projections to the primary visual cortex.

B. From the primary visual cortex, the “M” pathway projects strongly to parietal-occipital-temporal or middle temporal regions of the cortex while the “P” pathway projects to the inferior temporal regions.

C. The “P” pathway contains information about fine detail and color, while the “M” pathway contains information about position and motion.

*D. All of the above are correct

@ A: the pathways remain separate but they do ‘cross’ in a sense after synapsing in the LGN. B: this is the ‘cross’ discussed in the response for answer A. Before the LGN, the P pathway was superior to the M pthway; after the LGN, the P pathway projects to the inferior temporal regions.

70. Which of the following applies to cones compared to rod photoreceptors (or their neural system)? Cones:

A. are more sensitive to scattered light

*B. have less total photopigment

C. exhibit high amplification, single photon sensitivity

D. are monochromatic (one type of pigment)

E. have low temporal resolution (slow response, long integration time)

@ Cones detect color by having three different pigment types each one maximally stimulated by a particular wavelength. The cones are called, blue/ S, green/ M, and red/ L although each responds to a range of wavelength and there is much overlap. Cones have high acuity and resolution and are not convergent, thus not involved in amplification. Cones are in a one to one relationship with RGCs. The cones are less heavily pigmented than rods. B is correct of cones, the other answers are characteristic of rods.

71. Retinal ganglion cells are silent (not secreting a transmitter):

*A. never (during life)

B. in absolute dark.

C. when they are illuminated and lie in the surround portion of the receptive field of an "on-center" retinal ganglion cell.

D. when they are illuminated and lie in the central portion of the receptive field of an "off-center" retinal ganglion cell.

E. when inhibited by a horizontal cell.

@ The dark and light currents show that RGCs are never silent. The constitutive activity is due to release of glutamate at the synapse that is only reduced in amount in response to light and the ensuing hyperpolarization

72. Color vision depends on:

A. three forms of retinal with different spectral sensitivities.

*B. three forms of opsin which use the same retinal co-factor.

C. the color of the pigment in the retinal pigment epithelium.

D. the color of the iris.

E. the shift from rhodopsin to meta-rhodopsin.

@ 11 cis- retinal is a vit A derived light absorbing molecule. The pigment that is responsive to various wavelengths is the opsin molecule. Cones express three different forms of opsin. Meta- rhodopsin is the activated molecule that then activates transducin. The shift from rhodopsin to meta-rhodopsin occurs in rod cells and is involved in light detection, not color.

73. Most color blindness is caused by:

A. point mutations in the opsin genes in the male germ-line.

B. recombination between the S and M opsins.

C. evolutionary changes in new-world monkeys.

D. untreatable viral infections of the conjunctiva.

*E. unequal crossing-over between the L and M opsin genes.

@ The most common form of color blindness occurs is 7-8% of males called anomalous trichromacy. Replacement of an M or L cone with an M/L hybrid that results from nondisjunction is the M and L genes.

91. The “dorsal” (visual movement) pathway includes the

A. Parvocellular Layers of LGN

B. V1 blobs

*C. Magnocellular Layers of LGN

D. V2 thin stripes

~ The dorsal pathway, which is thought to be involved in processing motion, depth, and special information, involves the M retinal ganglion cells à magnocellular layer of the LGN (choice C), à V1 à thick stripes of V2 à middle temporal area (MT or V5) à posterior parietal cortex.

92. The fovea

A. Is in the periphery of the retina.

*B. Is in the central retina and contains only cones.

C. Contains only rods.

D. Is in the region where the optic nerve exits the retina.

~ The fovea is defined as the center of the retina (eliminates choice A, the periphery of the retina), while cones are concentrated in the fovea and there are few in the peripheral retina (choice B). The region where the optic nerve exits the retina is somewhat adjacent to the fovea (, and this is sometimes referred to as the blind spot (eliminates choice D).

93. “Off center” retinal ganglion cells

A. Are maximally stimulated by illumination of their entire field.

B. Are found only outside the fovea.

C. Are the same cells as the M ganglion cells.

*D. Are maximally stimulated by illumination of their “surround” field.

@ Off center retinal ganglion cells are maximally stimulated by full illumination of their surround (choice D) and maximally inhibited by full illumination of their centers. From the same slide, it is evident that diffuse illumination has no net effect on the basal firing rate of the retinal ganglion cell – the stimulation of the surround cancels out the inhibition of the center (eliminates choice A). From my understanding (though I could not find this written explicitly), on- and off-center retinal ganglion cells can be found both inside and outside the fovea (eliminates choice B). it is evident that M-type retinal ganglion cells can be either on-center or off-center (eliminates choice C); P cells are not only on-center and off-center but are also classified by red/green and blue/yellow opponent systems.

94. M-type retinal ganglion cells have

*A. Larger receptive fields than P-type cells.

B. Are color selective.

C. Chiefly detect form.

D. Connect directly to V1 and bypass the LGN.

~ Even the smallest center of M cells receives inputs from several cones, whereas P cells receive input from only one cone in or near the fovea or from several cones in the periphery of the retina. As a result, M cells have larger receptive fields (more inputs per M cell) than do P cells

@ Even the smallest center of M cells receives inputs from several cones, whereas P cells receive input from only one cone in or near the fovea or from several cones in the periphery of the retina. As a result, M cells have larger receptive fields (more inputs per M cell) than do P cells (choice A). P-cells, not M-cells, are color selective and detect both color and form (eliminates choices B and C). M cells travel through the magnocellular layer of the LGN before synapsing on V1 (eliminates choice D).

95. Cone cells

A. Contain rhodopsin

*B. Contain either L, M or S-opsin.

C. Do not exist in protanopes.

D. Are the last cells lost during retinitis pigmentosa.

@ Cone cells contain one of three color opsins: L-opsin (red cones), M-opsin (green cones), or S-opsin (blue cones) (choice B). Rod cells, not cone cells, contain rhodopsin (eliminates choice A). Protonopes have an L-opsin defect (missing red cones), and they only have dichromatic color vision provided by the remaining green and blue cones (eliminates choice C). Cones are the first cells to degenerate in retinitis pigmentosa, and as a result, patients often receive an initial diagnosis of achromatopsia (eliminates choice D).

112. During normal aging of the human lens:

A. The lens fibers increase in number and the size of the lens increases in thickness.

B. More insoluble lens proteins accumulate.

C. There is an increase in light scatter by the lens.

D. There is a loss of near vision, a condition called presbyopia.

*E. All of the above are correct.

113. Which one of the following statements about the primary visual cortex is CORRECT?

A. In the normal adult brain, geniculate afferents from each eye completely overlap in layer 4 of the primary visual cortex.

B. An electrode traveling parallel to the pial surface in layer 4 for several millimeters will encounter cells that have the same ocular dominance preference.

*C. An electrode traveling perpendicular to the pial surface from layer 1 to layer 6 will encounter successive cells that have similar orientation preference.

D. An electrode traveling parallel to the pial surface in layer 3 will never encounter color sensitive neurons.

~ orientation preference is organized in columns perpendicular to the pial surface

@ . ‘A’ is incorrect because each eye maintains separate processing from the LGN in layer 4. ‘B’ is incorrect because the organization of ocular dominance in perpendicular not parallel. ‘D’ is incorrect because parvocellular fibers carrying color information will enter layer 3 then proceeds on to blobs and thin stripes.

115. Binocular interaction is essential for which of the following properties:

A. Orientation preference.

B. Color perception.

*C. Disparity based depth perception.

D. Face recognition.

E. Movement detection.

@ One of the ways that we are able to register depth is the disparity of an object in our visual field when compared between the two eyes (stereoscopic cues). Since each eye is separated by about 6cm, objects in the visual field will appear slightly different when registered in cortex. The position of an object is registered in relation to disparity between the right and left eyes in relation to the fixation point. Thus we interpret depth of an object by the amount binocular disparity it produces. There are specific cells, which register this disparity

116. You examine a patient who had a congenital cataract in the left eye that was not corrected until adulthood. Following cataract removal and treatment with corrective optics, visual acuity through the treated eye is still poor because:

A. The pupillary light reflex is inadequate.

B. The ability to accommodate has been lost.

*C. The left eye failed to develop sufficient representation in primary visual cortex.

D. Degeneration of the optic nerve.

E. Disconjugate eye movements.

~ Hubel and Wiesel, they found that early deprivation in one produces cortical blindness when vision is restored. Thus a cataract at birth would prevent the necessary environmental stimulation to produce normal vision in the left eye; the primary visual cortex for that region would fail to develop

@ ‘A’ since the papillary light reflex is bilateral, this would not be affected. ‘B’ accommodation would also be functional due to regions maintained ‘D’ the optic nerve itself would still be inplace, but portions of the visual cortex would atrophy. ‘E’ would be spared because the MLF circuits would still be intact, so visual information into the right would coordinated conjugated movement of the left eye

139. When light hits the photoreceptors, all of the following occur in transduction EXCEPT:

A. Light induces a conformational change in the retinal pigment rhodopsin

B. Rhodopsin activates a G-protein linked to a cGMP Phosphodiesterase

C. cGMP generation is decreased, which leads to a closure of Na channels

*D. The photoreceptor depolarizes and sends action potentials to bipolar and adjacent horizontal cells.

@ Normally in the dark, photoreceptor cells are depolarized. The process described in A-C occurs in the presence of light and causes the photoreceptor to close its Na channels and consequently hyperpolarize.

140. Horizontal cells play an essential role in generating which receptive field property of retinal ganglion cells?

*A. Antagonistic center surround organization

B. Color sensitivity

C. Transient response dynamics

D. Luminance sensitivity

@ Horizontal cells play a role in center-surround antagonism. Horizontal cells feedback onto the cones in the center of bipolar cells' receptive field. Both horizontal and bipolar cells lack voltage gated Na channels and thus transmit signals passively. When light is present in photoreceptors in the center of the bipolar's receptive field, the on-center bipolar cells depolarize while off-center bipolar cells hyperpolarize. (In the dark, photoreceptor cells cause on-center bipolar cells to hyperpolarize and off-center bipolar cells to depolarize.) Horizontal cells connect the cones from the surround region to the center region. In the dark, the horizontal cells maintain the center cone in a slightly hyperpolarized state. In the presence of light on the surround cone, the horizontal cell is hyperpolarized. This leads the center cone to become depolarized. This causes hyperpolarization of the on-center bipolar cell and depolarization of the off-center bipolar cell. The reverse happens when light is shown on the cone in the center of the receptive field.

141. Damage to the fovea of each eye would result in

A. Loss of night vision

*B. Poor visual acuity and difficulty reading

C. Loss of motion perception

D. Absence of a direct papillary light reflex

E. Loss of form vision

142. A lesion that destroys the magnocellular layers of the right LGN but spares the parvocellular layers would be associated with which of the following deficits?

A. Disorders of circadian rhythms

B. Loss of visual orienting responses to novel visual stimuli in the left hemifield

C. Absent direct papillary light reflex for the right eye

D. Loss of form vision

*E. Defective motion perception in the left visual field

@ Recall that the magnocellular pathway contributes significantly to the dorsal visual pathway, which handles motion and depth. ‘B’ is wrong because the visual orienting response is coordinated by a separate pathway through the superior colliculus. ‘D’ form vision is mediated by the ventral visual pathway.

143. Which one of the following statements about the primary visual cortex is CORRECT?

*A. An electrode penetration perpendicular to the pial surface from layer 1 to 6 will encounter cells that have similar orientation patterns

B. Cells in layer 6 provide inhibitory connection to the contralateral visual cortex

C. In the normal adult brain, geniculate afferents from each eye completely overlap in layer 4

D. Magnocellular input from the lateral geniculate terminates in layer 2 and 3

@ ‘A’ orientations are arranged in perpendicular columns to the pial surface. ‘B’ is wrong because layer 6 feeds back to the LGN and the claustrum. ‘C’ is wrong because the LGN afferents from each are processed separately. ‘D’ is wrong because magnocellular afferents terminate in layer 4Ca.

144. Which deficit would most likely follow a head injury that damages the temporal lobes bilaterally?

A. Loss of stereoscopic depth perception

B. Bitemporal hemianopsia

C. Loss of motion perception

*D. Inability to recognize familiar colors

@ The ventral pathway to the infero-temporal lobe carries color information. ‘A’ and ‘C’ are wrong because depth and motion are mediated by the dorsal pathway. ‘B’ bitemporal hemianopsia is caused by severing the optic chiasm

145. Binocular interaction is essential for which of the following properties?

A. Orientation preference

B. Color perception

*C. Disparity-based perception

D. Face recognition

E. Movement detection

167. Retinal visual processing is characterized by which of the following?

motion.

*A. Cones hyperpolarize in response to photon absorption.

B. Amacrine cells are connected to horizontal cells in the inner plexiform layer.

C. Bipolar cell receptive fields lack antagonistic center-surround organization.

D. Rods are most densely packed in the fovea.

E. Color coding ganglion cells project to the magnocellular layers of the lateral geniculate.

@ Cones fire in the dark, but when exposed to photons of light the levels of phosphodiesterase increase which causes reduction in cGMP and thus causes the cell to close its channels and hyperpolarize. ‘B’ is false because amacrine cells in the inner plexiform layer form connections among the proximal process of bipolar cells and the dendrites of retinal ganglion. Horizontal cells are in the outer plexiform layer. ‘C’ is false because bipolar cells have center-surround receptive fields similar to ganglion cells. ‘D’ Rods are not present in the fovea. It is entirely cones. ‘E’ color coding cells project to the parvocellular layer of the LGN. Recall that the parvocellular layer projects to LGN layers 3,4,5,6, which carry on to the blobs and thin stripes then the Temporal pathway. This information includes color. In contrast the magnocellular pathway is more involved in ‘where’ and carries information about depth and

168. In age related macular degeneration (loss of foveal representation), what deficit would be found?

A. Loss of night vision.

B. Loss of motion perception.

*C. Poor visual acuity and difficulty reading.

D. Retinal blood vessels invading the foveal area.

E. Absence of a papillary light reflex.

@ although depending of severity of the degeneration other deficits are possible. In macular degeneration the retinal-pigmented epithelium degenerates and collects both lipids and neovascularization. Severe macular degeneration produces poor visual acuity in the center of the visual, which especially impairs tasks such as reading. ‘A’ night vision is not lost since much of this information is mediated by rods, which exist outside of the fovea. Therefore they are not as affected by macular degeneration. ‘B’ loss of motion would not be extremely significant because the larger field pathways would still be functioning. Activity of the magnocellular pathway would still receive information from the retina outside of the fovea. ‘D’ Choroidal neovascularization would occur in macular degeneration, however this is not until the ‘wet’ stage. Also this is technically not a ‘deficit’. ‘E’ the papillary light reflex would be spared as long as areas outside the macula could still detect photons.

169. During accommodation:

A. The lens zonules are relaxed.

B. The curvature of the anterior lens surface increases.

C. The ciliary muscle contracts.

D. Pupillary constriction occurs.

*E. All of the above are correct.

@ Accommodation is changing the curvature of the lens to focus the world onto the retina. In accommodation the ciliary muscles contract to adjust the curvature of the lens. When the ciliary body contracts tension in the lens zonules (aka suspensory ligament) is reduced/relaxed. As the ciliary body contracts and lens zonules relax, the eye is allowed to form more of a convex shape, thus the anterior curvature of the anterior lens surface increases. During accommodation the pupils transiently constrict to increase the depth of field

170. Which statement is CORRECT regarding retinal bipolar cell physiology?

A. Center-surround organization is not a feature of the bipolar cell.

*B. Off-center bipolar cells hyperpolarize in response to light in the center of their receptive fields.

C. Bipolar cells use action potentials to transmit visual signals.

D. There is only one type of bipolar cell found in the outer retina.

@ cone cells excite (depolarize) off-center cells in the dark. In the presence of light on-center cells depolarize and off-center cells hyperpolarize. ‘A’ is false. Center-surround is a specific feature of bipolar cells. ‘C’ The photoreceptor cells fire in a graded process to light, not in a dichotomous AP fashion. Similarly, bipolar cells appear to fire in a graded fashion. In the ganglion cells we begin to get signal transduction in the form of AP trains. ‘D’ is false because there are both off-center and on-center bipolar cells in the outer retina.

Exercise

Questions

Answers

Nutrition and Metabolism

Questions

Answers

Endocrine

Questions

Answers

Genetics and Evolution

Questions

Answers

Aging and Dying

Questions

Answers