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Fall 2021 - **Week 6**

Fall 2021 - EE BIOL184-1 - SEARS

**Started on** Friday, 29 October 2021, 5:01 PM PDT**State** Finished**Completed on** Friday, 29 October 2021, 5:54 PM PDT**Time taken** 53 mins 20 secs**Grade** 27.00 out of 30.00 (90%)**Question 1**

Correct

1.50 points out of 1.50

Which of the following evolutionary events fits the definition of a heterotopic change in development?

- a. The bat wing (forelimb) is larger than the bat hind limb. Increases in the levels of *Shh* and *Fgf8* are thought to contribute to this size difference among bat limbs.
- b. In duck hind limbs, death of the interdigital tissues is blocked by expression of *Gremlin* in the interdigital tissues. *Gremlin* was not expressed in the interdigital tissues of the duck ancestor. ✓
- c. The forelimbs of marsupial mammals grow out from the body very early relative to the forelimbs of placental mammals. This early outgrowth is associated with *Fgf8* expression turning on earlier in marsupial than placental mammals.
- d. The AER does not form in snake hind limbs. AERs were present in the ancestors of snakes.

The correct answer is:

In duck hind limbs, death of the interdigital tissues is blocked by expression of *Gremlin* in the interdigital tissues. *Gremlin* was not expressed in the interdigital tissues of the duck ancestor.

**Question 2**

Correct

1.50 points out of 1.50

Which of the following is a correct order of events for limb development, from earliest occurring event to latest occurring event (for the three events in any given choice)?

- a. Limb placement, Interdigital tissue regression, Limb initiation/induction
- b. ZPA formation, Limb initiation/induction, Limb bud formation
- c. Interdigital tissue regression, *Fgf8* expression, Limb bud formation
- d. Limb placement, *Fgf8* expression, ZPA formation ✓

The correct answer is:

Limb placement, *Fgf8* expression, ZPA formation

**Question 3**

Correct

1.50 points out of 1.50

Mice exposed to ammonium chloride while developing *in utero* display limb malformations at birth. While doing research on the impact of ammonium chloride on development, you discover that ammonium chloride disrupts maintenance of some sections of the AER and thereby AER function after the initial formation of the AER. Based on this finding, which of the following limb malformations are you most likely to have observed in the mice exposed to ammonium chloride while developing *in utero*?

- a. syndactyly
- b. brachydactyly
- c. ectrodactyly
- d. polydactyly



The correct answer is:  
ectrodactyly

**Question 4**

Correct

1.50 points out of 1.50

The limb forms three major axes during its development. Which of these three axes goes from the shoulder (e.g., where the limb connects to the body) to the ends of the digits?

- a. Proximal-Distal
- b. Dorsal-Ventral
- c. Anterior-Posterior



The correct answer is:  
Proximal-Distal

## Question 5

Correct

1.50 points out of 1.50

You are a scientist exploring the rainforests of Brazil. You discover a mammal previously unknown to science. Most excitingly, the mammal is the first to ever be discovered in which the wild-type (i.e., typical) condition for the autopod is polydactyly. Your next step is to figure out what the molecular basis of this polydactyly is in your new species. Based on what you learned in this class, which of the following is most likely to be behind the evolution of polydactyly in this new species?

- a. A disruption of *Hox* gene signaling in the limb
- b. Early shut-down of AER activity
- c. A mutation in the ZRS that increases expression of the target gene
- d. Expansion of *Pitx1* expression to the developing fore limbs



The correct answer is:

A mutation in the ZRS that increases expression of the target gene

## Question 6

Correct

1.50 points out of 1.50

You are doing an experiment on chick limb development. You have been given a chicken limb in which the AER has been surgically removed soon after AER formation, and have been tasked with rescuing the limb's outgrowth (i.e., helping the limb continue to grow out and form a proper limb). Which of the procedures below would be most likely to rescue limb outgrowth?

- a. Apply a bead soaked in *Tbx5* protein to the AER's former location
- b. Apply a bead soaked in *Bmp* protein to the AER's former location
- c. Apply a bead soaked in *Fgf8* protein to the AER's former location
- d. Apply a bead soaked in *Shh* protein to the AER's former location



The correct answer is:

Apply a bead soaked in *Fgf8* protein to the AER's former location

**Question 7**

Incorrect

0.00 points out of 1.50

The forelimb the flightless emu bird is a vestigial structure, with greatly reduced wing elements and digit loss. Researchers have found that, while all expected limb genes are present and expressed in emu forelimbs, the onset of expression of *Shh* is delayed relative to that of other limb genes. Based on what we learned in class, what type of evodevo mechanism does this change in *Shh* expression represent?

- a. Heterochronic
- b. Heterotypic
- c. Heterometric
- d. Heterotopic



The correct answer is:  
Heterochronic

**Question 8**

Correct

1.50 points out of 1.50

The most common type of congenital limb malformation in humans is:

- a. oligodactyly
- b. syndactyly
- c. ectodactyly
- d. polydactyly



The correct answer is:  
polydactyly

**Question 9**

Correct

1.50 points out of 1.50

Dolphin forelimbs are highly derived for the aquatic environment. Two key morphological modifications in the dolphin forelimb, relative to the ancestral condition, are hyperphalangy and forelimb webbing. Based on what we discussed in class, which evodevo mechanisms were involved in the evolution of these key morphological modifications?

- a. Heterotopy and Heterotypy
- b. Heterochrony and Heterometry
- c. Heterotopy and Heterochrony
- d. Heterotypy and Heterometry



The correct answer is:

Heterotopy and Heterochrony

**Question 10**

Correct

1.50 points out of 1.50

Which of the following is a way in which development of the limbs of tetrapods and of the fins of fish are similar?

- a. Both fins and limbs produce dermal bones when *hox* expression is disrupted
- b. Both fins and limbs are patterned by extensive cell migration
- c. Both fins and limbs have an early and late phase of *hox* expression
- d. Both fins and limbs are exclusively composed of endochondral elements



The correct answer is:

Both fins and limbs have an early and late phase of *hox* expression

**Question 11**

Correct

1.50 points out of 1.50

You identify a new familial case of syndactyly. Based on your documentation, you confirm that this case of syndactyly is associated with a mutation that impacts the expression of the gene *XYZ*. Based on what you have learned in class, which of the following developmental processes is gene *XYZ* most likely to be regulating?

- a. ZPA signaling
- b. Digit condensation
- c. Interdigital tissue regression
- d. AER formation



The correct answer is:

Interdigital tissue regression

**Question 12**

Correct

1.50 points out of 1.50

Evolution of which of the following structures best fits the Müller and Wagner (1991) definition of evolutionary novelty that we discussed in class?

- a. evolution of the wings of birds, with the wings having evolved through modifications in the forelimbs of ancestral dinosaurs
- b. evolutionary appearance of antennae in insects, with the antennae being serial homologues of insect mouthparts
- c. evolution of eyespots on the wings of butterflies, with the eyespots having no developmental or structural homologues
- d. evolutionary loss of hind limbs in snakes, with the limbs initially forming as in other tetrapods and then regressing



The correct answer is:

evolution of eyespots on the wings of butterflies, with the eyespots having no developmental or structural homologues

## Question 13

Correct

1.50 points out of 1.50

The turtle carapace forms as a result of the action of a new developmental structure, the carapacial ridge. How does the carapacial ridge change the basics of tetrapod development to help generate the turtle carapace?

- a. The carapacial ridge increases the rate of cellular proliferation in the ribs, making them fuse together and form a carapace.
- b. The carapacial ridge changes the degree of cellular adhesion in the developing ribs that causes the ribs to fuse together and form a carapace.
- c. The carapacial ridge produces a signal that diverts the growth of ribs laterally, outside of the scapula. ✓
- d. The carapacial ridge drives a new pattern of apoptotic cell death that results in the ribs developing in a novel location, outside of the scapula.

The correct answer is:

The carapacial ridge produces a signal that diverts the growth of ribs laterally, outside of the scapula.

## Question 14

Correct

1.50 points out of 1.50

Which of the following findings would most support the hypothesis that the avian syrinx is an evolutionary novelty?

- a. A fossil bird that has both a larynx and syrinx ✓
- b. Developmental data showing that the mammalian larynx and avian syrinx develop at the same time during development
- c. A sequence of fossils that demonstrate that the avian syrinx and mammalian larynx exhibit historical continuity
- d. Developmental data showing that the mammalian larynx and avian syrinx develop from the same tissues

The correct answer is:

A fossil bird that has both a larynx and syrinx

## Question 15

Correct

1.50 points out of 1.50

According to the online lecture, loss of what gene in mice transforms the mouse's knuckles into duplicated foot pad on the presumptive dorsal side?

- a. Gli3
- b. Lmx1b
- c. Grem1
- d. Fgf10



The correct answer is:

Lmx1b

## Question 16

Incorrect

0.00 points out of 1.50

According to the inhibitory cascade model of tooth development described in the Kavanagh et al (2007) paper you read in discussion, what would be reasonably expected to occur if you *increased* the inhibition signaling from molar M1?

- a. The posterior molar M2 would develop more cusps than normal
- b. The posterior molars M2 and M3 would initiate later and result in progressively smaller tooth size
- c. The posterior molars M2 and M3 would initiate earlier and result in progressively larger tooth size
- d. The posterior molars M2 and M3 would develop normally



The correct answer is:

The posterior molars M2 and M3 would initiate later and result in progressively smaller tooth size



**Question 17**

Correct

1.50 points out of 1.50

According to the online lecture you watched for class, why do the beetles that Moczek studies bother growing a thoracic horn if it is not maintained into adulthood?

- a. pre-pupal horns are required for sexual selection and mating success in adults
- b. without pre-pupal horns, the embryo dies
- c. pre-pupal horns may facilitate shedding of larval head capsule ✓
- d. formation of pre-pupal horns is critical to the formation of other structures that are essential to adult success

The correct answer is:

pre-pupal horns may facilitate shedding of larval head capsule

**Question 18**

Correct

1.50 points out of 1.50

Moczek studied the impact of the microbiome on beetle development. According to the online lecture you watched for class, larvae inoculated with which of the following substances were the most resistant to death by fungus?

- a. Laboratory-generated microbiome
- b. Maternal microbiome ✓
- c. Environmental microbiome
- d. Sibling microbiome

The correct answer is:

Maternal microbiome

## Question 19

Correct

1.50 points out of 1.50

According to the online lecture, the hind feet of ducks retain their interdigital webbing into adulthood. This retention has been shown to be due to a change in the expression of the gene \_\_\_\_\_.

- a. Gli3
- b. Gremlin
- c. Fgf8
- d. Shh



The correct answer is:

Gremlin

## Question 20

Correct

1.50 points out of 1.50

What is the name of the distinct region of the limb bud that is restricted to a small portion of the posterior most bud and that, when transplanted, can cause the mirror image duplication of digits?

- a. Zone of polarizing activity (ZPA)
- b. Progress zone
- c. Apical ectodermal ridge (AER)
- d. Limb flank



The correct answer is:

Zone of polarizing activity (ZPA)

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