Name _____ Period _____

Chapter 47: Animal Development

Overview

1. An organism's development is controlled by the genome of the zygote as well as by molecules from the mother that are in the cytoplasm of the egg. What are these proteins and RNAs called?

2. What is *cell differentiation*?

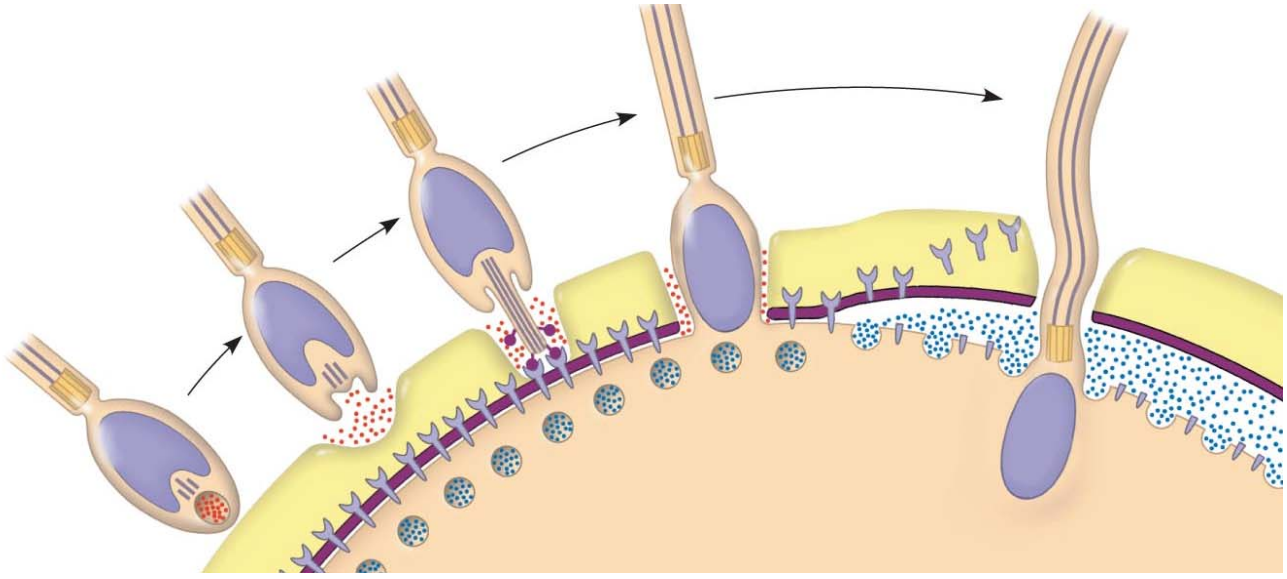
3. How do *cytoplasmic determinants* affect cell differentiation?

4. What is *morphogenesis*?

Concept 47.1 After fertilization, embryonic development proceeds through cleavage, gastrulation, and organogenesis

5. What is the *acrosome* of a sperm? What does it contain?

6. The figure below shows sea urchin fertilization. Label the following: *sperm acrosome, sperm nucleus, jelly coat of egg, sperm-binding receptors, cortical granules, vitelline layer, egg plasma membrane,* and *fertilization envelope*.



7. Describe what happens in the *acrosomal reaction*.

8. The fusion of the egg and sperm plasma membranes allows sodium ions to flow into the egg. How does this result in a *fast block to polyspermy*?

9. Describe the *cortical reaction*.

10. How is the *fertilization envelope* formed?

11. Why is the fertilization envelope considered a *slow block to polyspermy*?

12. Sperm binding activates a signal transduction pathway in which calcium ions are released from the endoplasmic reticulum. What are two outcomes of the elevated calcium ion level?

13. Now that you have studied sea urchin fertilization in some detail, study the section *Fertilization in Mammals* and make a list of what you consider the essential differences. You should have at least three differences.

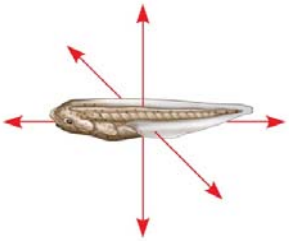
14. The early mitotic divisions of the zygote to form a ball of cells are called *cleavages*. What is unique about *cleavage*?

15. How do the early cleavages set the stage for subsequent developmental events?

16. On the figure below, label and describe each of the following: *fertilization envelope, zygote, blastomere, blastula,* and *blastocoel*.

17. Distinguish between the *animal* and *vegetal pole*.

18. This concept uses some anatomical terms that you need to know. Label the following parts on this diagram: *anterior, posterior, dorsal,* and *ventral*.



19. The point of the sperm nucleus entry will result in the formation of a *gray crescent*. How does this *gray crescent* serve as a marker?

20. The first cleavage will bisect the gray crescent. What axes are now established? Label the axes on the figure. Also label the *animal pole, vegetal pole, first cleavage,* and *gray crescent.*

21. The amount of yolk found in an egg will affect cleavages. What is *holoblastic cleavage*?

22. What animals show *holoblastic cleavage*?

23. What is *meroblastic cleavage*? What animals show this type of cleavage?

24. The early cleavages are followed by *gastrulation*. Visualize punching in a partially inflated ball with your fist. This would result in a layer of the ball being pushed to the inside. In essence, this is what occurs in *gastrulation*. These layers establish the future embryonic *germ layers*. So remember this: *gastrulation* establishes the *germ layers*. What are the three *germ layers* of the embryo?

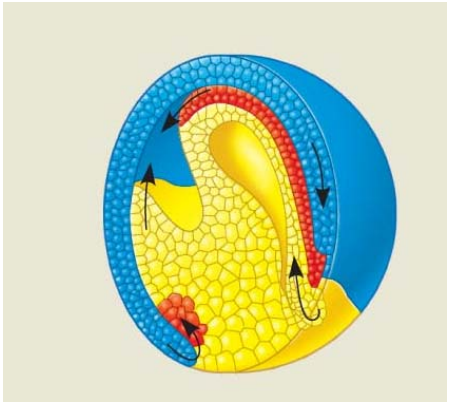
25. You should know at least two derivatives of each germ layer. Refer to Figure 47.14 in your text, and select three tissues to learn from each layer. Use this chart to help organize your learning.

Ectoderm	Mesoderm	Endoderm

26. Going back to the pushed-in ball analogy, the area that is pushed in (*invaginates*, to the embryologist) will form a tube called the *archenteron*. The *archenteron* forms the digestive tube, with an opening at each end, the *mouth* and the *anus*. Since the hollow ball that was pushed in was the *blastula*, the opening where the invagination occurs is called the *blastopore*. We want you to make a series of simple sketches below. Show a hollow ball (the blastula), then show it punched in as the archenteron forms, and then show the embryo with a completed digestive tube.

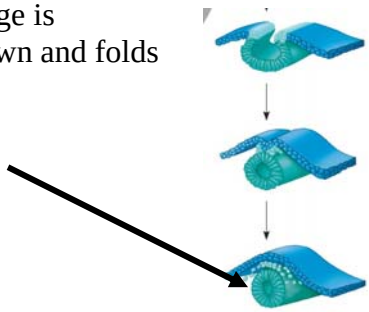
27. On the figures you drew above, label the *blastula, gastrula, archenteron, blastopore, ectoderm, endoderm, blastocoel, digestive tube, mouth,* and *anus*.

28. Let's look back at the frog embryo. The figure on the left shows the gray crescent, which forms opposite the point of sperm entry. Now look at the figure on the right. You will see that invagination occurs at the gray crescent. A crease forms where invagination occurs. The upper part of the crease is called the *dorsal lip of the blastopore*.



29. On the sketches above, label the *gray crescent, dorsal lip of blastopore, blastocoel, archenteron, blastopore, ectoderm, endoderm,* and *mesoderm*. The sketch on the right shows gastrulation. Note that this process establishes the three germ layers. **** This is important to know! ****

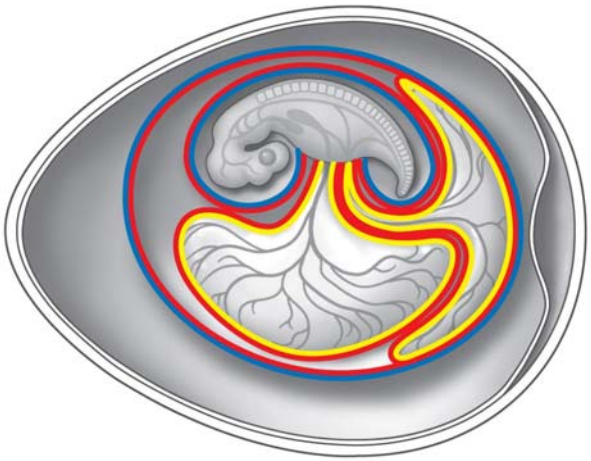
30. So now, the embryo has three germ layers. Gastrulation is followed by *organogenesis*. Let's look at the formation of the *neural tube* in the sketch at right. The process by which this dorsal hollow nerve chord is formed is called *neurulation,* and the embryo stage is sometimes referred to as a *neurula*. Which germ layer drops down and folds to form the *neural tube*?



31. An important chordate characteristic is the *notochord*. What is a *notochord*? From which germ layer does it develop?

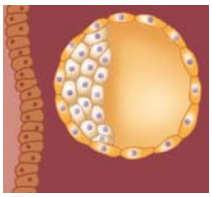
32. The development of the shelled egg was an important adaptation to allow the movement of animals onto dry land. Which animal groups have shelled eggs?

33. Use this sketch of a chicken egg to name and give the function of the four *extraembryonic membranes* seen in *amniotes*.



34. Let us return to development in mammals. What is the mammalian version of a blastula?

35. Label the *blastocyst* below to show the *blastocoel, inner cell mass,* and *trophoblast*.



36. The cells of the *inner cell mass* will form the embryo. What is the role of the cells of the *trophoblast*?

37. What is the function of the *amnion*?

38. Which extraembryonic membrane

    a. cushions the embryo?

    b. is involved in gas exchange?

    c. serves as a disposal sac for embryonic wastes?

Concept 47.2 Morphogenesis in animals involves specific changes in cell shape, position, and adhesion

39. What is *morphogenesis*? (Reread the overview if you have forgotten.)

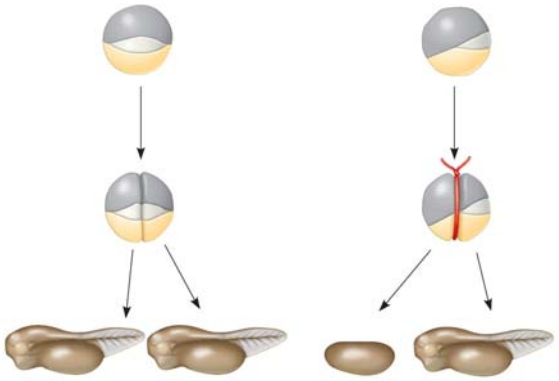
40. As stated in the concept heading, what are three things involved in morphogenesis?

Concept 47.3 The developmental fate of cells depends on their history and on inductive signals

41. Although all cells in an organism have the same genome, explain two ways in which gene expression is altered during development.

42. What does it mean to say that a cell is *totipotent*?

43. Explain why two normal embryos result when the two blastomeres on the left are separated, but not when the two blastomeres on the right are separated.



44. *Induction* is an interaction among cells that influences their fate, usually by causing changes in gene expression. What did Speman and Mangold find to be the *organizer* that induced a series of events that result in the formation of a notochord and neural tube?

Testing Your Knowledge: Self-Quiz Answers
Now you should be ready to test your knowledge. Place your answers here:

1._____ 2._____ 3._____ 4._____ 5._____ 6._____ 7._____