1. Multiple-choice (1 point)

Which of the following is true of the gray crescent region of frog eggs?

- It contains mainly yolk.
- It may be seen in an unfertilized egg.
- Its content is usually distributed unequally during the first cleavage.
- It contains cytoplasmic factors that are required for gastrulation to occur.
- It has little significance in development of the frog embryo.

2. Multiple-choice (1 point)

If transcription is inhibited during the cleavage period of frog eggs, development is normal until the late gastrula stage. This indicates that

- Stored proteins control development until late gastrulation.
- mRNA from the embryonic DNA is needed at late gastrulation.
- Cytoplasmic factors are not important in early development of the frog embryo.
- Proteins are not synthesized by the embryo until late gastrulation.
- Both mRNA and protein synthesis are required during the cleavage period.

3. True/False (1 point-0.5 each)

Regarding the experiments of Briggs and King, indicate whether each of the following statements is true or false.

_____ If the nuclei had been transplanted into an isolated skin cell instead of an egg, the results of the experiment would have been about the same.

_____ Nuclei obtained from frog embryos at the neurula stage were less successful in supporting development than blastula nuclei because expression of embryonic genes has begun by the neurula stage.
4. Multiple-choice (1 point)

In the videos of Medaka that show a beating heart, what is the purpose of the blood vessels on the yolk surface?

- to transport nutrients from the yolk into the embryonic body
- to transport stored mRNAs into the embryonic body
- to transport proteins from the embryo into the yolk
- to regulate the heart beat
- to stimulate development of the yolk into other embryonic structures

5. Image upload (2 points)

Download this image of a fish embryo and label the yolk, eye, brain, and somites. Submit your labeled image to WebAssign in .jpg or .png format.

6. Matching (1.5 points)

Study these images of frog development. Place the images in order from youngest to oldest using the letters as identifiers.

<table>
<thead>
<tr>
<th>Stage of Development</th>
<th>Letter of Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>earliest</td>
<td></td>
</tr>
<tr>
<td>2nd earliest</td>
<td></td>
</tr>
<tr>
<td>3rd earliest</td>
<td></td>
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<tr>
<td>4th earliest</td>
<td></td>
</tr>
<tr>
<td>5th earliest</td>
<td></td>
</tr>
<tr>
<td>latest</td>
<td></td>
</tr>
</tbody>
</table>

7. Matching (1.5 points)

Use the same images as in question 6 for the following matching. Use the letters as identifiers of the late embryonic or larval stages.

<table>
<thead>
<tr>
<th>Letter of Image</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>embryo / larva in which external gills are most apparent</td>
<td></td>
</tr>
<tr>
<td>embryo / larva which has the most stored yolk</td>
<td></td>
</tr>
<tr>
<td>embryo / larva which has the most fully developed eyes</td>
<td></td>
</tr>
</tbody>
</table>
8. Multiple-choice (1 point)

Which of the following changes in tadpole metamorphosis is crucial in order for the frog to survive on land?

- The intestine becomes much shorter.
- The liver enlarges.
- The tail disappears.
- The hind legs grow longer than the front legs.
- The lungs become functional.

9. Fill-in-the blank (1 point-0.5 for each blank)

Fill in the blanks using words from this “word bank”:
- brain, optic cup, optic vesicle, lens, retina, cornea

In development of the vertebrate eye, the prospective lens ectoderm is induced to invaginate by the _________________. The optic cup will continue developing to form the ________________ of the eye.

10. Essay (2 points)

Study the tadpole-thyroxine and axolotl experiments, then write a short essay that answers the following questions:

What is the main difference after 7½ months of thyroxine treatment if the thyroidless tadpoles are 6 months, 18 months, or 30 months old when treatment is begun?

What might be a reason that axolotls in the wild do not undergo metamorphosis?

11. True/false (1.5 points-0.5 for each blank)

Indicate true or false for each statement by writing true or false in the blanks.

- Certain plants contain compounds similar to ecdysone which serve as a defense against insects.
- Juvenile hormone levels are high in insect larvae, but must decrease in order for metamorphosis to occur.
- Chemicals similar to ecdysone and juvenile hormone are widely used commercially to control insect pests.
12. Multiple-choice (1 point)

Which of the following best describes the insect life cycle shown in this diagram?

- It is an example of gradual metamorphosis.
- It is an example of complete metamorphosis.
- It is an example of neoteny.
- It is a life cycle in which metamorphosis does not occur.
- It is a life cycle in which hormones are not present.

13. Essay (1 point)

Study the graph showing effects of auxin concentration and observe the results of this simple experiment. Then write one or two sentences that explain the results of the experiment in terms of hormone action.

14. Essay (1 point)

Study the plant culture experiment. Then write a sentence or two that indicate which organs (roots or leaves) were stimulated by each hormone. Give sufficient details to justify your answer.

15. Matching (1 point-0.25 each)

The next two questions are based on the Yanofsky lecture using Arabidopsis plants. Predict what would happen if the activity of gene “A” is mutated and cannot function to regulate flowering. Write the flower part that would develop in each “ring”.

To aid you, a picture of the mutated flower is provided.

<table>
<thead>
<tr>
<th>Ring</th>
<th>Part of flower that will develop in the ring</th>
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<tbody>
<tr>
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<tr>
<td>4</td>
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</tbody>
</table>
16. Matching (1 point-0.25 each))

Predict what would happen if the activity of gene "B" is mutated and cannot function to regulate flowering. Write the flower part that would develop in each “ring”.

To aid you, a picture of the mutated flower is provided.

<table>
<thead>
<tr>
<th>Ring</th>
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17. Essay (2 points)

A researcher obtains the results below with a different flower. Do his results agree with those for Arabidopsis?
Write a short essay that states your answer and explains your reasoning. (Hint: explain the results with the C and BC mutants.)

18. True/false (1.5 points-0.5 for each blank)

Indicate true or false for each statement by writing the words true or false in the blanks. (Do not use T or F.)

_____ In PAGE, proteins are separated primarily on the basis of size (mass).

_____ During an electrophoretic “run” proteins move toward the negative electrode.

_____ Standards are not required to identify the proteins in PAGE analysis.

19. Multiple-choice (1 point)

Which of the following series of steps best describe the preparation of leaf samples for PAGE?

- cutting, grinding, straining, centrifuging, and pipeting the supernatant
- cutting, heating, grinding, straining, and pipeting the supernatant
- grinding, centrifuging, heating, straining, and pipeting the supernatant
- cutting, grinding, centrifuging, grinding again, and straining
- grinding, centrifuging, cutting, straining, and grinding again

20. Multiple-choice (1 point)

The role of the buffer added to the apparatus during the electrophoresis “run” is to

- denature the proteins
- allow proteins within the gel to be visualized
- prevent proteins from dissolving out of the gel
- allow current to flow through the apparatus and move proteins into the gel
- provide an easy way to remove the gel at the end of the electrophoretic “run”
The last two questions refer to the **electrophoretic runs** that are simulated on the assignment 11 website (see links at bottom of the page).

21. Image upload (2 points)

Run the begonia gel and capture an image that shows optimal resolution of proteins. Examine the gel and label as follows:

- Indicate a protein in **flowers** that has the same molecular weight as bovine serum albumen. (Use the letter F to indicate the band.)
- Indicate a protein in **leaves** that is not present in flowers. (Use the letter L to indicate the band.)

Submit your labeled image to WebAssign in .jpg or .png format.

22. Multiple-choice (1 point)

Run the *Drosophila* gel and observe the banding pattern. Which of the following best describes gene expression during development of *Drosophila*?

- The same genes are expressed at all stages of development.
- Gene expression is identical in larvae and pupae, but differs in adults.
- Gene expression is identical in larvae and adults, but differs in pupae.
- Gene expression is identical in pupae and adults, but differs in larvae.
- The pattern of gene expression is different at each stage of development.