Retinoic Acid/Embryo Laboratory Exam

1. What is the difference between a qualitative and a quantitative observation?

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2. Chronologically order the following research activities: (1 - first → 9 - last step)

   ____ acquire test equipment and specimens
   ____ review the scholarly literature on the research problem
   ____ confirm or revise hypothesis, and plan future experiment
   ____ analyze data by creating plots, comparing between experiment conditions
   ____ define the problem or research question
   ____ collect data from experimental system
   ____ interpret mean/significance of data
   ____ form an initial hypothesis
   ____ revise initial hypothesis in light of literature findings

3. A congenital defect is a health problem or physical abnormality that arises during

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4. What does “regulation of gene expression” mean?

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5. Retinoic acid is a metabolite of what vitamin?
   a) vitamin A
   b) vitamin B
   c) vitamin C
   d) vitamin D
   e) vitamin E
6. How did retinoic acid affect the developing chick embryo? (Name at least 3 effects)

Effect #1 –

Effect #2 –

Effect #3 –

7. In the context of causing birth defects, is elevated retinoic acid an environmental or a genetic factor? Explain.

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Match the following vocabulary words with the correct definition:

____ teratogen

A. formation and differential growth of an organism during development

____ birth defects

B. lack of a particular quantity; often used in the context of nutrition

____ morphogenesis

C. any substance produced during the process of metabolism

____ metabolite

D. structural or functional abnormalities present at birth resulting in physical or mental disability

____ deficiency

E. a logical incompatibility between two ideas, statements, or propositions

____ gestation

F. natural to or characteristic of a specific people or place

____ endemic

G. the proportion of sickness in a particular geographical location

____ contradiction

H. the carrying of developing embryos in the womb; feature of mammalian reproduction

____ morbidity

I. any agent that can disturb the development of an embryo or fetus

8. In our experiment, we examined only 1 embryo for each condition. Is this a sufficient number of specimens to draw conclusions from? Why or why not.

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9. The table below contains the cross-sectional area of the embryos we used earlier. Use the data to make a plot of the control and 1mg/ml RA treatment data in the graph provided. Be sure to appropriately label each data curve.

<table>
<thead>
<tr>
<th>Embryo Area (mm²)</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Day 6</th>
<th>Day 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.35</td>
<td>0.51</td>
<td>0.90</td>
<td>1.50</td>
</tr>
<tr>
<td>Retinoic Acid (1mg/ml)</td>
<td>0.25</td>
<td>0.48</td>
<td>0.74</td>
<td>1.01</td>
</tr>
</tbody>
</table>

10. How would you describe the data?
   a) the control curve is linear, but the 1mg/ml RA curve is exponential
   b) the control curve is exponential, but the 1mg/ml RA curve is linear
   c) both are linear
   d) both are exponential

11. How would you describe the relative growth the RA treatment vs control?
   a) RA treatment grew more than control, but at a slower rate
   b) RA grew less than control, but at a faster rate
   c) RA and control grew at the same rate
   d) RA grew less than the control, and at a slower rate
12. Select the best order for collecting data from images files.
   a) open image, measure feature, save measurement, calibrate image
   b) save measurement, calibrate image, open image, measure feature
   c) measure feature, open image, save measurement, calibrate image
   d) open image, calibrate image, measure feature, save measurement

13. What does “calibrate image” mean? Why is it important?
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14. In the context of our ex-ovo chick experiment, which of the following statements are true about global and local defects?
   a) local defects are those in our community, which are competing against worldwide defects
   b) a local defects is one that occurs at the location of treatment, while global defects are ones that affect the entire organism
   c) local defects can induce global defects
   d) local defects cannot induce global defects
   e) both b and c

Use the figure from excerpt #3 below and your knowledge of the retinoic acid metabolic pathway to answer the following questions. Remember, words in line with the arrows are retinoids (or metabolites), while words above the lines are retinoid converting enzymes.

![Fig. 1. Very simplified schematic of the many molecules involved in retinoid biosynthesis and handling, and of the transcriptional processes influenced by binding of RA to its nuclear receptors. These include the various retinoids, the enzymes implicated in their biosynthesis, the retinoid-binding proteins that help regulate their location and activity, and the nuclear receptors and cofactors through which the retinoids act to regulate transcription.](image)

-Drager, U. Retinoic acid signaling in the functioning brain. Science STKE. 2006 (324) pg10, Figure 1
15. Retinoic acid binds to nuclear receptors to regulate (note nuclear receptors are attached to DNA)
   a) the expression of specific genes
   b) the spatial expression of growth factors
   c) the synthesis of specific proteins
   d) all of the above
   e) none of the above

16. Carrots are a great source of beta-carotene, but what converting enzyme is needed to input it into the retinoic acid pathway? ___________________________

17. Retinoic acid activates gene transcription when it
   a) is not bound to the RAR/RXR receptors
   b) is bound to the RAR/RXR receptors
   c) has time
   d) none of the above – retinoic acid doesn’t regulate gene transcription

18. In the reading, we learned that removal of retinaldehyde dehydrogenase (RALDH) causes the most severe form of retinoic acid deficient symptoms. From the figure, why do you think RALDH is so critical compared to the other retinoid converting enzymes?

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19. Vitamin deficiency is a serious problem in developing countries among mothers and newborn infants. What are two treatment techniques currently used to help with this deficiency?
   a) clinical and subclinical
   b) supplementing the vitamin diet of the fathers and grandfathers
   c) oral vitamin supplements to pregnant mothers, and supplements to newborns
   d) there are currently no treatments for this vitamin deficiency

20. How could our data assist with this vitamin deficiency problem?

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**Reflection:** The following questions will not be graded, but will be used to improve future versions of this curriculum. Please select your level of agreement with the questions according to this scale.

1 – strongly disagree    2 – disagree    3 – indifferent    4 – agree    5 – strongly agree

**R1.** I found this curriculum experience too challenging.  
1 2 3 4 5

**R2.** I found this curriculum experience challenging, but enjoyed being pushed to learn new, difficult things.  
1 2 3 4 5

**R3.** The journal excerpts were difficult and I did not understand them.  
1 2 3 4 5

**R4.** The journal excerpts were difficult, but I did understand them by the end.  
1 2 3 4 5

**R5.** I liked acquiring science information from technical journal excerpts.  
1 2 3 4 5

**R6.** I liked acquiring science information from the experimental data.  
1 2 3 4 5

**R7.** This curriculum changed my view of how science is done.  
1 2 3 4 5

(if you agree with this statement, please state how your view changed)

**R8.** Because of this curriculum, I am better informed about what it takes to be a scientist.  
1 2 3 4 5

**R9.** This curriculum experience increased my interest in a science career.  
1 2 3 4 5

**R10.** If there was one thing you would change about the curriculum, what would it be?  
  a) More background literature reading  
  b) More data collection and analysis  
  c) More time spent defining the scientific problem  
  d) Other, please specify below  

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