1. Recall Niko Tinbergen’s studies of communication in sticklebacks (shown in the film Signs and Signals).
   a. Explain briefly (i) how male sticklebacks recognize their rivals (i.e., other males) and (ii) how they recognize breeding females. (6 pts.)
      i. Red belly
      ii. Swollen non-red belly
   b. What was the advantage of using models of fish (instead of real fish) to study these questions? (4 pts.)
      One can isolate key stimuli involved in recognition, controlling for other stimuli

2. Define the following parts or properties of neurons and receptors
   a. Dendrites (4 pts.) Extensions from neuron that receive input from other neurons or receptors
   b. Axons (4 pts.) The elongated extension of cell that carries signal (action potential) toward other parts of nervous system
   c. Excitability (4 pts.) The ability of cell to undergo electrochemical change in response to input
   d. Synapse (4 pts.) Junction between neurons, across which signal passes (chemically or electrically)

3. There are many lines of evidence that establish the role of genes in the development of behavior. Briefly state two of these lines of evidence, and give examples of each from the lecture or book.
   a. (5pts.) Five were listed in class; you needed to list two, each with an appropriate example:
      Compare relatives
      Isolation experiment
      Hybridization
   b. (5pts.) Artificial selection
      Single gene mutation

4. What are "looking time" experiments (described in the film "Animal Einsteins") and how are they useful in studies of animal cognition? (5 pts.) Observe how long animal gazes at interesting objects or events; measures animals “surprise,” hence what it expected to be true about the world. Probes knowledge without language
5. Methods in behavioral research. You observe a group of large birds (Canada geese) heading south in a flock shaped like the letter V. List two distinct questions about this behavioral trait (the V shape of the flock). Then pick one of the questions and state at least two different hypotheses to answer it. Note: I’ll be grading you not on whether the questions and hypotheses are correct, but on whether you understand the difference between a question and a hypothesis, and on being able to generate multiple questions and hypotheses.

a. Your questions (6 pts.):
   (i) **In general, I was looking for people to generate two different types of question. The most common mistakes were for people to give two different wordings for the same question, or to state a hypothesis in the form of a question.**
   (ii)

b. Your hypotheses about one of these questions (tell me which question) (6 pts.):
   (i)
   (ii) **Here, I was looking for people to generate two alternative hypotheses that pertained to the same question (not one hypothesis for each of the questions).**

6. Imprinting in ducks: duckling follows quacking object and then comes to recognize that object (visually) as its parent. This was presented as an example of experience-dependent behavioral development (in which the duckling is developing ability to recognize parent), one might also describe it as a case of learning (in which duckling is learning to recognize parent). In particular, imprinting could be viewed as an example of associative learning.

   a. Explain how imprinting fits into the associative learning framework, being sure to specify which “events” are being associated, and what behavior changes as a consequence of the learning. (5 pts.)

   
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<thead>
<tr>
<th>E1</th>
<th>E2</th>
<th>Response</th>
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<tbody>
<tr>
<td>Shape</td>
<td>Quack</td>
<td>Follow</td>
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<tr>
<td>Shape</td>
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   b. Which type of associative learning (classical conditioning or trial-and-error learning) does imprinting most resemble, and why? (5 pts.)

   Classical conditioning, because the behavior (following) is changing as a result of an association between two stimuli.

7. The development of song in songbirds was presented as an illustration of the interaction of genes and environment in behavioral development. Briefly describe two specific aspects of song development that illustrate this point.

   a. (5 pts.) **Examples of correct answers:**
      a. birds need exposure to song, but only certain songs can be learned
      b. Different species learn with different degrees of flexibility, implying evolved genetic differences in learning ability.

   b. (5 pts.) **The wording on this question confused people. I meant for you to give two examples of an interaction between genes and environment in song development, but many people gave me one example of genetic influence and one of environmental influence. I gave credit for this as well as for the ‘correct’ answer.**
8. Questions about the dance language of honey bees

a. Using a diagram, describe the direction code of the honey bee dance language. (5 pts.)

![Diagram of hive and food source]

Flight direction relative to sun is given by Dance angle relative to gravity

b. Briefly state the two opposing arguments in the “dance language controversy”. (6 pts.)

- Recruits find food using odors only
- Recruits use spatial info in dance to get to general vicinity of food, then use odors to pinpoint the location

Recruits use spatial info in dance to get to general vicinity of food, then use odors to pinpoint the location

8. The figure to the right, which was shown in class and in the text, illustrates the auditory tuning curves of a parasitic fly that orients to the chirps of crickets. The tuning curve of the female fly closely matches the frequencies in the crickets’ chirps. That of the male fly is not closely matched to crickets, but is tuned to higher frequencies).

a. Explain why neither a male nor a female fly, with only a single tuning curve, should be able to discriminate different sound frequencies (6 pts.)

Different sound frequencies would be detected with the same threshold response, hence animal wouldn’t be able to tell them apart (see red lines for the female curve). Only by comparing across multiple tuning curve would animal be capable of true frequency discrimination

b. Given that a male doesn’t need to lay eggs on crickets, propose a functional hypothesis to explain why he should be able to hear at all, and why his hearing does not exact match the female’s. (This calls for speculation, and there is more than one acceptable answer.) (5 pts.)

H1: Needs to hear predators (e.g., bats)
H2: Needs to hear crickets, so as to find females, but need not be so fine-tuned as females

(I accepted almost any reasonable hypothesis so long as it was on the functional level.)