

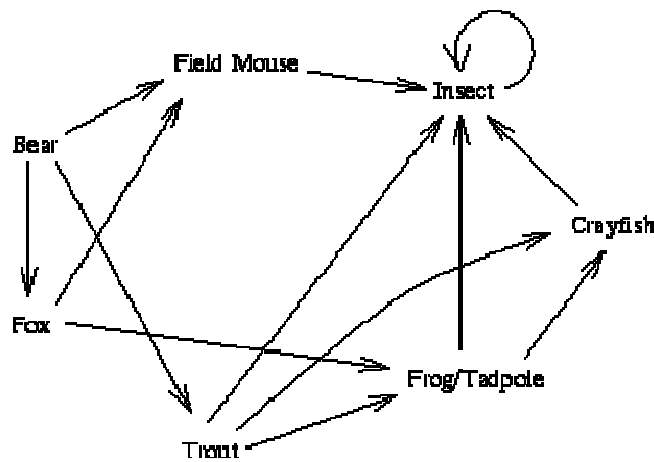
Name: \_\_\_\_\_ Band: \_\_\_\_\_

**Directions:** Do your work and write up solutions to the following questions on a separate, blank sheet of paper. You will be turning this in at the end of class.

### A Food Web<sup>1</sup>

Recent rains have caused a dramatic increase in the insect population of a mountain park. The insects are annoying to people and animals and health officials are concerned there will be an increase in disease. Health authorities want to use an insecticide that would literally wipe out the entire insect population of the park. You, as an employee of the Environmental Protection Agency, must determine how detrimental this would be to the environment. Specifically, you are concerned on the effects on the food web of the six animals known to populate park.

Consider the following digraph of a food web for the six animals and the insects that are causing the problem:



1. Construct the associated matrix  $F$  to represent this web. What does a row containing a single one indicate? What does a column of zeros indicate?
2. Which animals have the most direct sources of food? How can this be determined from the matrix? Find the number of direct food sources for each animal.
3. Which column has the most 1's? What does this suggest about the food web?
4. The matrix  $F^2$  (to be clear, that is  $F \cdot F$ , computed through normal matrix multiplication) denotes *indirect* (through one intermediary) sources of food. For example, the field mouse relies on insects for food, and the fox relies on the field mouse for food, so the insect is an *indirect* source of food for the fox. Find  $F^2$ . Notice that one of the columns contains all nonzero numbers. What does this indicate?
5. Compute a matrix to represent the total number of direct and indirect sources of food for each animal. Which animal has the most food sources?

<sup>1</sup> <http://www.colorado.edu/education/DMP/activities/matrices/jaehnd05.html>

If an insecticide is introduced into the food web, killing the entire insect population, several animals will lose a source of food.

6. Construct a new matrix  $G$  to represent the food web with no insects. What effect does this have on the overall animal population? What has happened to the row sums? Compare these with those of the original matrix. What does a row sum of zero indicate?

7. Will all the animals be affected by the insecticide? Which animal(s) will be least affected?

**Organize and summarize your findings in a brief report to the health officials. Take and support a position on whether using an insecticide to destroy the insect population is harmful to the environment.**

Once you finish, go to [images.google.com](https://images.google.com), and search for “food web.” You will get a lot of images of food webs. Find one that interests you and create a matrix to represent it. Then perform a basic analysis of the food web similar to what you did above.