INTEGRATED PEST MANAGEMENT

Unit 2 Section 1 Lesson 2 There's No Such Thing as a Free Lunch

Focus Areas: Pest Control Methods - Biological; Science

Focus Skills: Following directions, recording data, interpreting data

Level of Involvement: AVERAGE

University of Connecticut
College of Agriculture and Natural Resources
Cooperative Extension System

IZZY PRAYING MANTIS

Dedicated to Reducing Pesticides

Unit 2 Section 1 Lesson 2: There's No Such Thing as a Free Lunch

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Objectives

* To demonstrate through simulation the interactive relationship between predators and prey

* To demonstrate the impact of density-independent factors on predator and prey populations

Essential Question

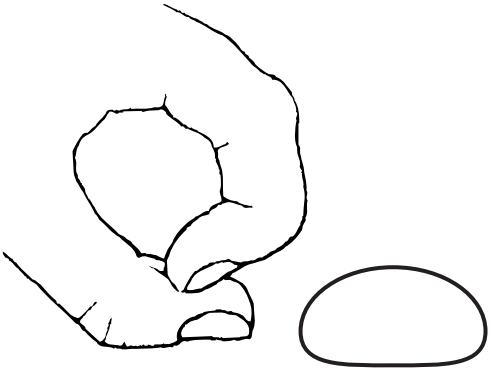
Why do pest populations vary from year to year and place to place?

Essential Understanding

Both density-dependent and density-independent factors impact pest populations.

Background

Based on the rule of survival of the fittest, predators and potential prey either increase or decrease in number. Added to this are environmental factors that impact predators or prey or both.



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Vocabulary

density - dependent — changes based on the respective prey and predator populations in a given location

density - independent — events that impact an area s population regardless of their numbers

population dynamics — the changes in plant and animal populations over time

Challenge

Simulate the interaction of predators and prey in order to understand causal impact on populations

Logistics

Time: 45 minutes
Group size: 6 to 30 (**Note:** 1 game board per 12 players is optimum)
Space: floor space to accommodate students around the game board

Materials

game board *
set of playing pieces: large/predator, small/prey, 1 color for male, 1 color for female in each set
push pins (12 per game board)
Handout 1 "Population Dynamics Data Sheet" *
Handout 2 "Density—independent Cards" *
Handout 3 H ow to Play *
Overhead 1 Population Dynamics *
Overhead 2 G raph Diagra m *
Assessment for a Game *

* single copy provided

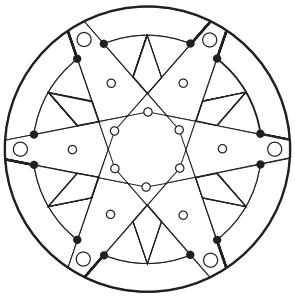
Preparations

1. Prepare copies of Handout 1 Population Dynamics Data Sheet and Handout 2 Density-independent Cards according to group size.

2. Set up game board, inserting push pins to left and right of predator pieces on inner circle boundary.

3. Use two different sizes and colors of round objects for playing pieces.

4. Set up a bumper around game board. **Note:** Upholstery ticking is inexpensive and works well. Consider using rolled newspaper, styrofoam, or a border of text books.



Activity

Introduction

1. Exhibit the game board and explain that the game they will be playing mirrors the natural order in the real world. The game board represents an ecosystem occupied by pests (prey; smaller pieces) and natural enemies (predators / natural enemies; larger pieces). Each of the three predator teams (red, blue, and yellow) has a male and a female member. Conversely, the prey has both male and female members (Male and Female are designated by the color of the playing pieces).

   Optional: You may wish to mention that the primary colors represent the range of each pest and that secondary colors represent areas in which the two pests cohabit.

2. Explain and demonstrate the game's procedure per the directions given in Handout 3 How to Play . **Note:** it is recommended that the participants do a walk through of round #1 rather than merely read the rules and directions.

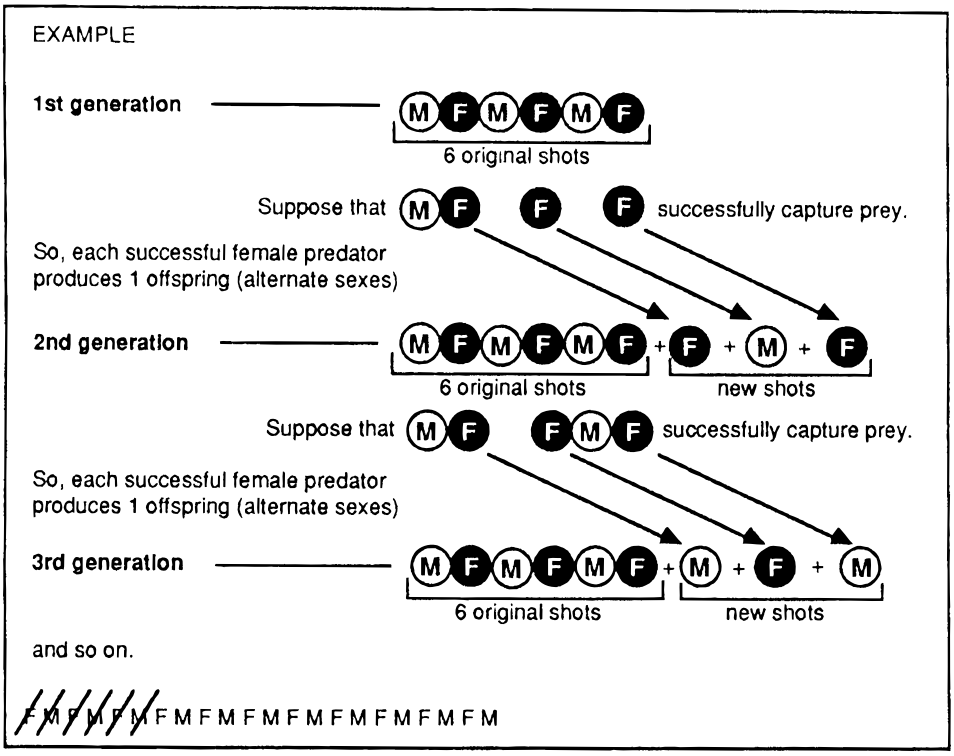
3. Following round 1, distribute and complete the population data sheets as a group, noting this play represents one generation of predator and play interactions.

Activity

Introduction (continued)

4. Using Overhead 1 "Population Dynamics" and Handout 3 How To Play , determine addition of predators and prey for the next round of play.

   Note: While both male and female may capture, only prey captured by female players results in additional playing pieces being added for the next round. Predator offspring should be distributed evenly between male and female predators.



Involvement

Continue playing generational rounds according to Handout 3 How to Play. A minimum of six rounds should be completed.

Follow Up

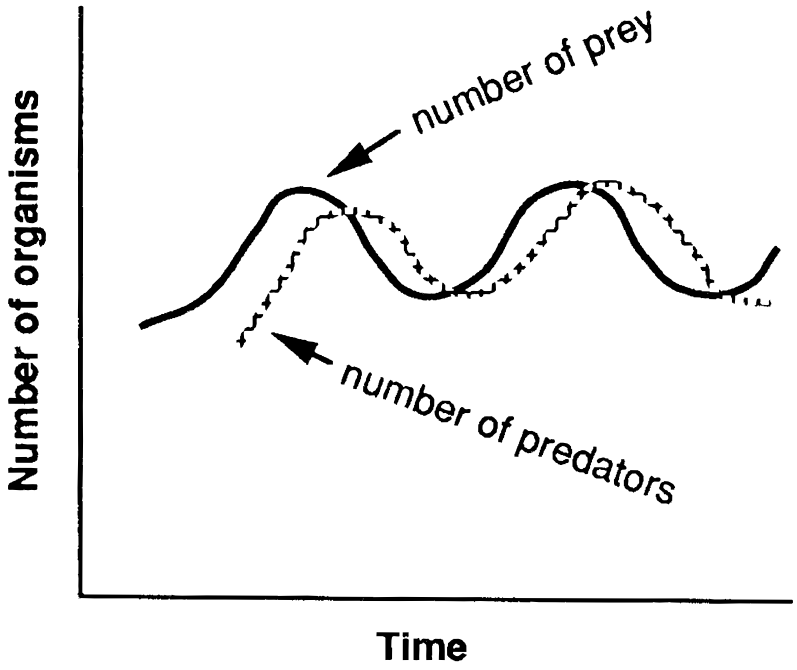
Using the data recorded, players create a graph illustrating the results of each round.

1. Display Overhead 2 Graph Diagram.

2. After at least six generations, students graph the results on *x-y* axes like those shown on Overhead 2.

3. A solid line is used to represent prey numbers and a dashed line to represent predator numbers. The completed graph reflects density-dependent and density-independent changes in prey and predator populations over time. Students may want to indicate on the graph when and what type of density - independent factors occurred. Use arrows and text to accomplish this.

4. After the graphs are drawn, discuss what occurred during the game. Emphasize two basic ecological concepts: (a) numbers of organisms change with time (for a variety of reasons), and (b) numbers of prey affect numbers of predators and vice versa.



Answer Key

Discussion occurs at the end of each round and is dependent on the outcome of that round. Guidelines are given within the directions for play. Note particularly #2 **Follow Up**.

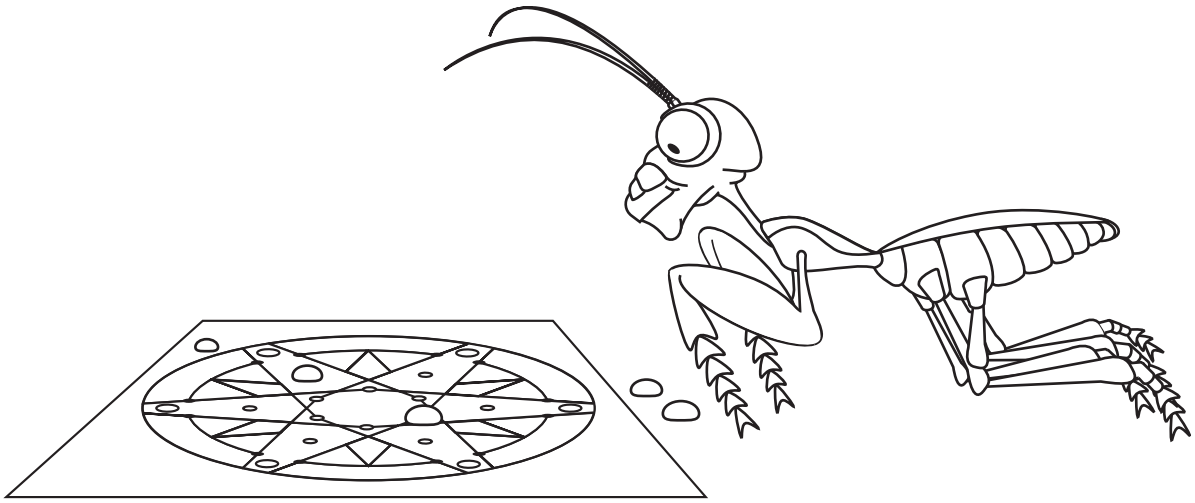
Assessment

Option #1 Evaluate graphs produced in **Follow Up** portion.

Option #2 Have individuals write a summary of what they learned by answering the **Essential Question**.

Option #3 Write numbers of prey affect numbers of predators and vice versa on a large piece of chart paper or black/white board and have individuals give evidence from the simulation to support the generalization.

Option #4 If the **Follow Through** portion was completed, the produced games may be evaluated.



Follow Through

Designer Game (strongly suggested)

Focus Area: Cooperative project design
Focus Skills: Graphic design, writing directions, application of new learning

Objective

To understand how population dynamics can be manipulated to produce successful biological control efforts

Additional Vocabulary

inoculative release	a small number of natural enemies released in an area of infestation in the hope that they will become part of the ecosystem for long range biological control
inundative release	a large number of natural predators released in an area of infestation to provide immediate reduction of pest populations

Task

Teams choose a scenario of either inoculative or inundative release and develop a game illustrating their choice. **Note:** Numbers of offspring should reflect their choice. Each team plays the game and records results. Based on results, they compare and contrast the scenarios developed.

Resources

Pests Have Enemies Too
Jeffords, M.R. and A.S. Hodgins, Illinois Natural History Survey Special Publication 18. July 1995.

Notes

Handout 1

Population Dynamics Data Sheet

A	B	C	D	E	F	G	H
Generation **round**	Number of prey alive at end of round **Small playing pieces**	Number of female prey alive at end of round **Small Fem. pieces**	Number of female predators that caught prey **Large Fem. pieces**	Number of prey offspring in next generation **2 x column C**	Number of predator offspring in next generation **1 x column D***	Number of prey in next generation **columns B + E**	Number of predator shots in next generation **6 + column F**

* Keep track of the sex of predator offspring by crossing out an M (male) or F (female) as each is used.

M F M F M F M F M F M F M F M F M F M F M F M F M F M F M F M F M F M F M F

Handout 2

Density-independent Cards

Predators are fed by supplemental diet to keep them in the area. Increase predator population by **25%**	**Pesticide sprayed to kill a different pest inadvertently wiped out predators.** Reduce predator population by **75%**
Cold Spring Reduce prey population by **20%** **natural enemies are not yet active**	**Heavy Rain** Reduce Prey By **50 %** Reduce Natural Enemies By **10 %**
Insecticide Sprayed Reduce pests by **50%** Reduce natural enemies by **8 shots**	**Severe Winter !!!** Reduce prey population by **40%** Reduce natural enemy shots by **3**
Prey Disease Epidemic **Predators get 3 extra shots at slow-moving sick prey**	**Perfect Spring Weather!** Increase pests population by **35%**
Summer Drought Decrease prey population by **25%**	**Natural Enemies Fooled by Early Warm Days and Emerge Too Early** No natural enemy reproduction this generation

Handout 3

How To Play:

1. Predator pieces are placed on the designated circles at the outside edge of the range : 6 in all; 3 each of male and female; 1 male and 1 female per color, red, blue and yellow ranges .

2. All other circles are filled with prey pieces, males and females equally distributed.

3. To begin play, one predator chip is flicked one at a time at the prey. To successfully capture a meal, the prey chip must be moved to the inner edge of the light blue circle or beyond, but not off the board. **Note:** On the line counts. Captured pieces are placed by the predator s game piece immediately; others are left where they come to rest. Play proceeds clockwise until each predator has flicked .

4. When all predators have had a turn to capture prey, a tally is taken and recorded on Handout 1 Population Dynamics Data Sheet . Offspring for the next round of play (a generation) are distributed based on the tally.

5. Both prey and predators now reproduce before the next round of play. Prey reproduction **(column E)** is based on the success of female predators (a density-dependent response). For each surviving female prey, place two more offspring on the board (one male and one female playing piece because the likelihood of offspring being male or female is 1:1). Predator reproduction **(column F)** is based on the success of female predators. For each female predator that successfully captured at least one prey, add one predator offspring to the board at the same location as its mother. Alternate the sex of these offspring, following the pattern shown on the bottom of Handout 1 Population Dynamics Data Sheet . In other words, during the next round of play, in addition to the regular six shots, one extra shot will be taken from the location of each female predator that was successful in the previous round. All female predators that were successful in capturing prey reproduce. You will need to keep track of how many female predators feed during each round (and thus how many shots they will get during the next round, and the sex of the predators). The original six predators remain on the board for the duration of the simulation game.

   Note: To involve more players actively, you may opt to allow the males to flick the male offspring, but the offspring should be flicked from the mother s niche.

6. Discuss results of preceeding round and speculate on effects these will have on the next round.

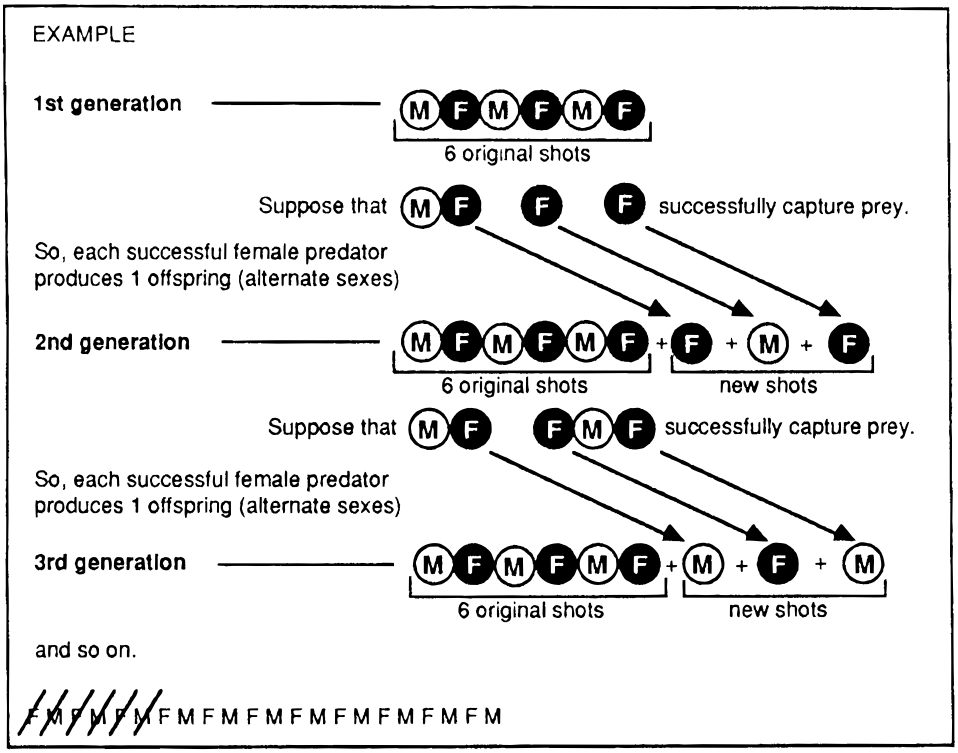
7. Following round 1, explain that outside factors influence population. Draw a density-independent card and follow the instructions given.

8. Make a note of the effect that this environmental influence exerted on the population.

9. Play further rounds following steps 3 through 8.

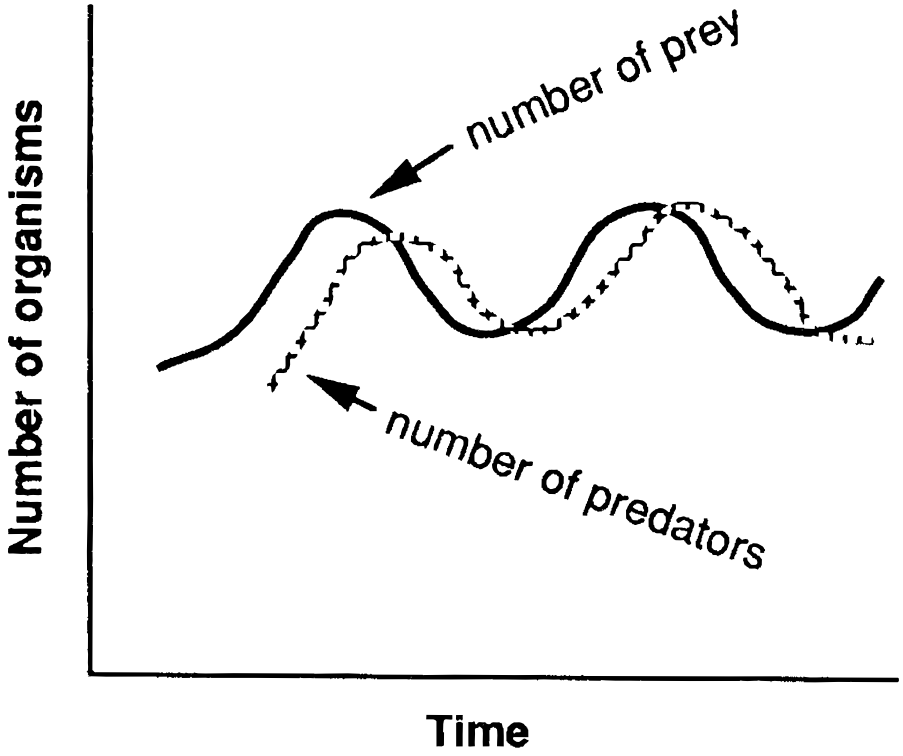
Overhead 1

Population Dynamics



Overhead 2

Graph Diagram



Assessment for a Game

Names Of Designers: _____

1. Game is accompanied by adequate background.	10 points	_____
2. Game includes clear instructions.	10 points	_____
3. Game is playable.	10 points	_____
4. Game pieces and parts are complete.	10 points	_____
5. Game demonstrates an understanding of Predator/Prey interaction.	20 points	_____
6. Game incorporates density-independent factors.	20 points	_____
7. Game is neatly done.	10 points	_____
8. Game exhibits creativity.	5 points	_____
9. Game is turned in on time.	5 points	_____
	Total Points	_____

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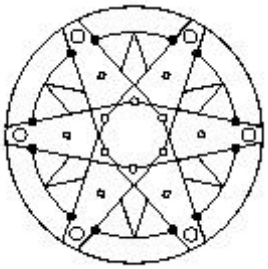
University of Connecticut
Department of Plant Science
Integrated Pest Management

Instructions for preparation of gameboard in Unit 2 Section 1 Lesson 2

"There's No Such Thing As A Free Lunch"



The original gameboard which was provided in the IPM curriculum kit is approximately 36" x 36". Usually, creating this size printout requires a professional printing service.

A full-size copy is provided on this CD in two different file formats:

- Adobe Acrobat Reader (.pdf) file - 118kb
- Portable Network Graphics (.png) compressed graphic file

If a professional printing service is not an option, the instructions below may be helpful in creating a smaller, but usable gameboard using whatever printing equipment you have available. Laminating the finished gameboard would be beneficial for ease of play.

How to Use the Adobe Acrobat Reader (.pdf) File
From Acrobat Reader, the gameboard can be printed by setting up the printer to whatever paper size you have available in your printer. In the print options, be sure to click in the block to select the print option, "shrink oversized pages to paper size."

How to Use the Portable Network Graphics (.png) File
You must have a graphics program that will open a .png file. Using your graphics program, you can resize the file to whatever size you are capable of printing. Be sure when you resize, that you select the option to "retain the ratio of the image."

A smaller gameboard, 20" x 20", is provided as a "print/cut/paste" project. The gameboard has been cut into six pages. Each page contains a portion of the gameboard image. The files are CompuServe Graphics Interchange (.gif) files that can be opened with any graphics program or web browser. The files can then be printed on any printer and taped together.

How to Use the CompuServe Graphics Interchange (.gif) Files
There are six CompuServe Graphics Interchange (.gif) files, each containing a portion of the gameboard.

Print all six images and arrange them as shown in the table below:

Image 1	**Image 2**	**Image 3**
Image 4	**Image 5**	**Image 6**

With scissors, trim the right side of the printouts for images 1, 2, 4, and 5 to eliminate the white on the right margin. On images 4 and 5 also trim the top to eliminate the top margin. Align the pages so that all gameboard lines are straight and all gameboard circles are complete. Tape all seams, front and back, with transparent tape.

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