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# K-12 Partnership Lesson Plan

# Sara Garnett, Michael Kuczynski, Anne Royer

# *Seeds on the Run: A Model of Seed Dispersal*

# *Using a game to demonstrate the challenges of dispersal*

## Overview

In the 1970’s, an influential ecological hypothesis was developed by two tropical biologists trying to explain the distribution of trees in the hyper-diverse rainforests of planet Earth. We use a deceptively simple board game as a model for students to explore how two basic concepts (dispersing far is hard, and living at high density is dangerous) can be combined to explain this baffling natural pattern. We show you how to interactively lead students through the predictions of the hypothesis, give you the tools to collect data from the game itself, and finish by graphing and discussing our board-game data.

**Objectives**

At the conclusion of the lesson, students will be able to:

* Explain dispersal in an ecological context including why dispersal is important and the challenges of dispersal
* Make predictions based on ecological concepts
* Understand the principles of the Janzen-Connell hypothesis
* Graph data generated from a game/model

**Length of Lesson**

50 minutes (10 min for background presentation, 30 min for game 10 min for graphing)

**Grade Levels**

Grades 6-12

**Standards covered**

Disciplinary Core Ideas:

*Middle School*

* **MS-LS2-1**: analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem

*High School*

* **HS-LS2-1:** use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales
* **HS-LS2-2**: use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales

Cross Cutting Concepts:

* Patterns
* Systems and system models

Science and Engineering Practices

* Developing and using models
* Analyzing and interpreting data

***Previous Michigan Standards Met:***

* **S.IP.06.15**: construct charts and graphs from data and observations
* **S.IP.06.16**: identify patterns in data
* **S.IA.06.11**: analyze information from data tables and graphs to answer scientific questions
* **S.IA.06.14**: draw conclusions form sets of data from multiple trials of a scientific investigation
* **B1.1B**: evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.
* **B1.1D**: identify patterns in data and relate them to theoretical models.
* **L3.P3A**:identify the factors in an ecocystem that influence fluctuations in population size
* **B3.5E**: recognize that and describe how the physical or chemical environment may influence the rate, extent, and nature of population dynamics within ecosystems

**Materials**

* Presentation powerpoint
* Seeds on the Run game board
* Dice
* Fate card decks (3 decks per game board)
* Assorted color tiddlywinks
* Seeds on the Run worksheet

**Background**

One of the most important aspects of plant and animal life is dispersal. Biological dispersal refers to the movement away from an existent population or parent organism. Dispersal has many benefits including avoiding competition, inbreeding and disease. For animals capable of moving themselves dispersal is relatively easy; plants however cannot simply walk away and must therefore rely on seed dispersal to spread. Seed dispersal can shape community structure and competition dynamics. In the 1970s, two ecologists developed a hypothesis that addressed how dispersal and community structure relate to each other. The hypothesis is based on two relatively simple concepts. This first concept is that dispersing very far is hard and therefore most seeds will fall near the parent plant. The second concept is that areas of higher population density (such as the area close to a parent plant) face more intense competition and are at greater risk of disease (particularly in the tropics, where specialist predators and diseases are common). Put together, these two concepts predict that the farther away from the parent plant you go, the fewer individuals you find, but those individuals should be larger and healthier due to reduced competition. The game presented in this lesson will allow students to generate their own dispersal data that they can graph and compare to these predictions.

### Activities of the session

1. Go over the Seeds on the Run powerpoint discussing dispersal and having students graph predictions of how dispersal influences community structure.
2. Play the Seeds on the Run game (see attached rule sheet).
3. Have the students graph the data collected during the game.
4. Compare the graphs to the predictions.

**Resources**

* Game board, rule sheet, fate cards, and intro powerpoint located on the “Seeds on the Run” lesson page on the GK-12 website.
* Janzen, Daniel H. “Herbivores and the Number of Tree Species in Tropical Forests.” The American Naturalist. 104.940 (1970).
* Connell, J.H. “On the role of natural enemies in preventing competitive exclusion in some marine animals and in rain forest trees.” In: Dynamics of Population. Ed. P.J. Den Boer and G.R. Gradwell. Wageningen: Pudoc, 1970.
* <http://en.wikipedia.org/wiki/Biological_dispersal>

**Extensions and Modifications**

1. Change the frequency of negative fate cards in the different zones to demonstrate the influence on plant distribution.
2. Make each player a different species of tree and modify dispersal abilities (how far they can disperse with each dice roll) to investigate how these differences shape ecosystems.
3. Individual groups often do not get the exact same patterns as the predictions when playing the game, but the pattern will emerge when all the groups pool their data. This can be used as an opportunity to discuss some statistical concepts, such as the importance of replication and natural variation in populations.
4. Students can also record how many times one of their seeds lands in each zone and compare those numbers to how many plants survive in each zone at the end of the game, which helps capture the trade-off between dispersal ability and survival.

**Assessment**

Students will be assessed through producing and interpreting graphs based on data generated in the game.