This model explores Charnov's (1976) 'marginal value theorem' which predicts how long an animal should forage in a given area before moving on to another.

The model opens to a virtual field with two hives (Fig. 1), each with three flowers to the east. There are a set of parameters (Table 1) that affect the properties of the flowers including: the distance between flowers the total amount of nectar in each flower and the rate in which bees can extract the nectar from the flower. For each bee, the amount of time it spends on each flower can be adjusted. When "Go!" is clicked a bee leaves each hive and flies to the first flower and forages on it for its set amount of time, and then it moves on to the second flower. Each bee continues on until it has finished with the third flower, then it flies back to the hive. The model reports the total amount of nectar collected by each bee, their times spent foraging, and rates of nectar collection (Table 2).

Figure 1.
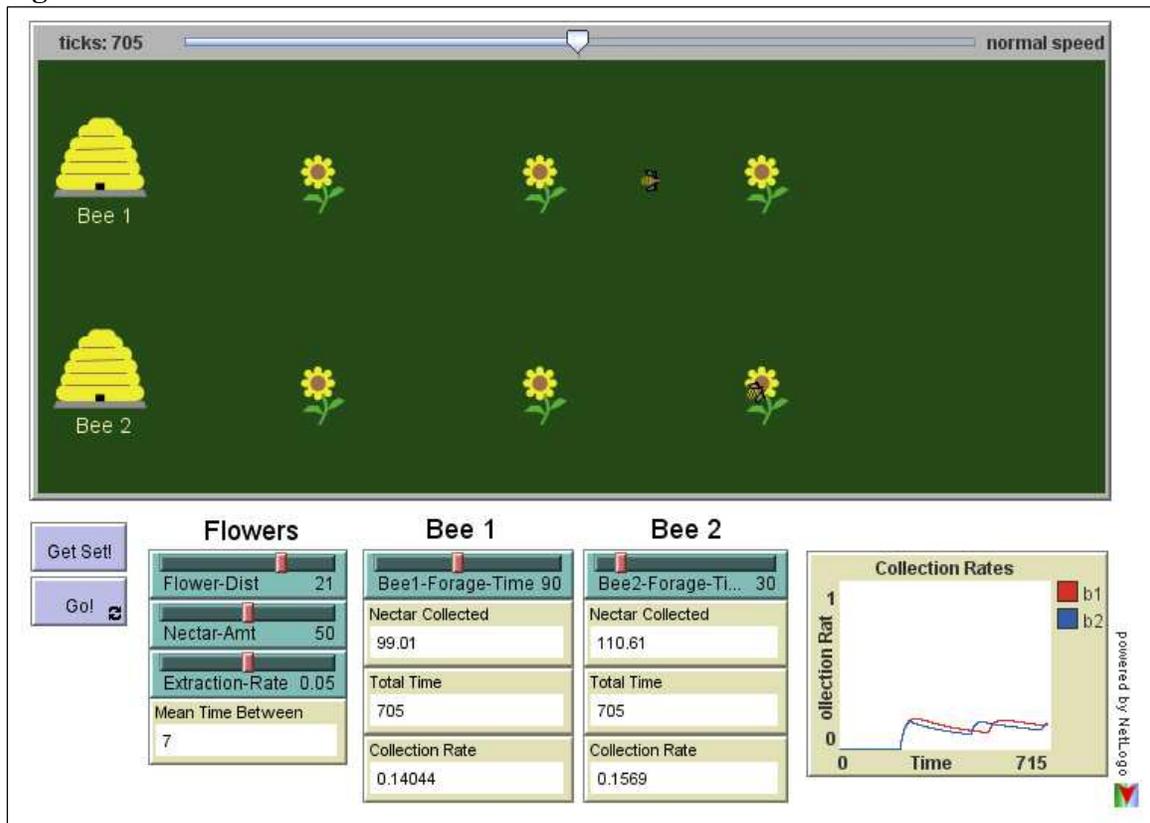
The general procedure for working with this model is to choose a set of flower parameters, and then to run the model repeatedly, while manipulating the foraging times of the two bees to find the foraging time that yields the maximum collection rate. This model is deterministic (rather than probabilistic), meaning that multiple runs with the same parameters will yield identical results. Because of this, it is possible to strategically adjust forage times between the bees narrowing in on the optimal time.

Table 1: Controls for the Bee Foraging model

Control	Action
Get Set!	Clears all values, resets model to set parameters
Go!	Sets the model in motion
Flower-Dist	The distance between each of the flowers (1-30 meters)
Nectar-Amt	The total amount of nectar in each flower (0-100 µl)
Extraction-Rate	The proportion of remaining nectar taken in each time step (0-0.1)
Bee-1-Forage-Time	The number of time steps bee 1 spends on each flower
Bee-2-Forage-Time	The number of time steps bee 2 spends on each flower

Table 2: Reporters for the Bee Foraging model

Reporter	Description
Mean Time Between	The travel time between flowers
Nectar Collected (Bees 1 & 2)	The total amount of nectar collected by the bee
Total Time (Bees 1 & 2)	The time of the foraging trip for each bee
Collection Rate (Bees 1 & 2)	The amount of nectar per time unit collected for each bee
Collection Rates (Graph)	Plot of each bee's collection rate over time

References

Charnov, EL. 1976. Optimal foraging: the marginal value theorem. *Theor. Pop. Biol.* 9:129-136.