Reproductive Advantage Simulation

Rock Pocket Mice as an Example

Abstract

In this simulation, a population of orbs represents rock pocket mice with light and dark coat colors, and larger orbs represent predators. As you change the background color, "mice" with different coat colors gain or lose reproductive advantage.

Learning Objectives

- If an individual has an advantageous trait, then it is more likely to reproduce.
- Since traits pass from parents to offspring, then offspring are likely to inherit advantageous traits.
- Over time, advantageous traits become more common in a population.

Estimated time

- 10 minutes

Materials

- Computer connected to the Internet and a projector

Features of the simulation

- At the beginning of the simulation, the population should already have one mouse with a dark coat color variation.
- The ratio of light and dark colored offspring is based on real-life inheritance patterns. Consequently, some but not all of the offspring of the dark mice inherit a dark coat allele.
- Using the slider on the bottom, you can change the background in ways that reflect the natural habitats of the rock pocket mouse: from light, to mixed light and dark, to dark.
- Predators are more likely to take mice whose fur color does not match their habitat, but they will also take mice whose color does match.
- The frequencies of the fur color alleles in the population change over time because mice with fur that matches their habitat are more likely to survive and reproduce.

Ideas for implementation

Project the simulation while carrying out the following actions and posing questions to call attention to key concepts:

1. With the slider all the way to the left (light background), watch the simulation and discuss:

   - What do the small clusters of dots that grow larger represent? (Mouse offspring being born and growing up)
   - Are dark mice automatically preyed upon? (No, sometimes they survive, even on the light background.)
   - How many dark mice survive and reproduce compared to the light mice? (Few dark mice survive and reproduce.)
   - Point out that individual mice that are not taken by predators eventually die naturally.

   Notes: Refresh your browser if you need to reset the simulation. Since this is a simulation, there is randomness built in. Sometimes the dark mouse will die quickly, sometimes it will reproduce.

2. Ask your students to predict what will happen if the background changes to mixed dark and light.

3. Drag the slider half way to the right to represent a mixed background of light rocks and dark lava flows. (If there are no longer any dark mice, first refresh your browser.) Watch the simulation and discuss:

   - Do more dark mice survive in a mixed background? (Some do initially, but then the numbers of dark and light mice reach a balance.)
   - How are the population dynamics different than they were on the light background?
   - Is there an immediate increase in the number of dark mice in the population? (No, it takes many generations for the number of dark mice to increase.)

   Notes: Because the simulation incorporates randomness, single reproduction and predation events have a big impact on the number of dark mice when their numbers are still very small. Once the number of dark mice reaches a critical mass, it increases quickly. Events in nature also unfold this way.

4. Ask your students to predict what would happen if the background were instead made completely of dark lava.

5. Refresh the browser. Drag the slider all the way to the right (dark background). Watch the simulation and discuss:

   - Why does the population of dark mice increase? (More of them are surviving predation and reproducing.)
   - How are the population dynamics different than they were on the light and mixed backgrounds? (In most cases, the dark mice will increase in number more quickly than they did on the other backgrounds.)

6. Continue to move the slider back and forth, pausing to watch the simulation.

- Ask the class to make observations about the relative numbers of light and dark mice and the relationship to background color.
- Help your students understand that the reason the frequency of the coat color changes to match the background is because individuals that match their habitat are more likely—but not guaranteed—to survive and reproduce.

7. Discuss how this simulation could also represent other populations of organisms in other types of habitats.

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