Vocabulary: adaptation, fitness, evolution, natural selection

Essential Questions: Are some organisms more likely to survive and reproduce than others? How do populations change over time?

Background
How long could a parrot survive in Antarctica? It would probably not survive long. Parrots do not have adaptations—helpful characteristics—to survive icy cold weather. Because of this, we say a parrot is not fit for Antarctica. Fitness describes how well an organism can survive and reproduce in an environment.

In this gizmo, you will see how a species’ fitness can change over time as it becomes better adapted to its environment.

Activity: Survival of the Fittest
Before beginning, click Reset, then set Red to 255, Green to 0, Blue to 130, and the Mutation rate to 1.0

1. Move the Sim. speed slider all the way to the left. Click Play. After the parents mate, click Pause.
   a. How many offspring are there? __________.
   b. Click Play. After the birds eat, Click Pause. How many offspring are left? __________.

In nature (and the Gizmo), more offspring are born than can survive long enough to reproduce. Because of this, the offspring must compete with one another for survival. In this Gizmo, the insect offspring compete to avoid being eaten by birds.

2. Move the Sim. speed slider one notch to the right. Click Play and wait for about 20 generations to pass. You should see a variety of insect phenotypes.
   a. What different colors of insects do you see?

   b. How do you think these different colors affect the competition between the offspring (to survive)?

3. Click on several of the insects and note their fitness. (Shown under Phenotype). The fitness of an organism reflects how likely it is to survive and produce offspring. Each insect is given a percentage (%) that reflects its likelihood of surviving to reproduce.
   a. Compare the fitness (%) of several insects of different colors. How does fitness appear to relate to the color of the insects?

   b. How do you think an insect’s fitness will affect its chance of being eaten?

4. Move the Sim. speed slider all the way to the left. Click Play, and then click Pause when all the offspring are visible. Write the generation number and the average fitness of all the offspring in the table below.

Next, click Play, and then click Pause immediately after the birds have fed and only the 10 survivors are visible. Mouse over each survivor and look at their individual fitness values. Record the average fitness value of the survivors.

Repeat this entire process two more times, recording your results in the data table.
a. Are the fittest or least fit insects most likely to survive? Use evidence from your data table to support your claim.

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b. The principle of natural selection states that the best adapted (fittest) organisms are most likely to survive and reproduce. Was this demonstrated in your experiment? Explain.

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Activity: Evolution
Before beginning, click Reset, set Red to 100, Green to 255, and Blue to 50.

1. Record the Avg. Fitness of Generation 1 in the table below. Click on the insects and find the one with the greatest fitness. (In the first Generation, they will all have the same fitness). Record that individual’s phenotype in the table below.

Move the Sim. Speed slider a quarter of the way to the right. Run the Gizmo, and complete the table for each of the generations listed below. (The generation #'s don't have to be perfectly exact).

<table>
<thead>
<tr>
<th>Generation #</th>
<th>Avg. Fitness</th>
<th>Fitness of Fittest Individual</th>
<th>Phenotype of Fittest Individual</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>300</td>
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</tr>
</tbody>
</table>

Examine your data.

a. How did the phenotype of the fittest individual change over time? ____________________________________________

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b. How did the population’s fitness change over time? _________________________________________________

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The process by which populations change over time is called evolution.

2. How do you think the population of bugs would evolve over time if you made the background color purple?

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3. Set Red to 120, Green to 0, and Blue to 160 to make a purple background. Click Play and watch as 300 more generations go by. Click Pause. Was your prediction correct? Explain.

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